

# GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR LIMESTONE IN KIRANAGI-1 BLOCK

**DISTRICT: KALABURAGI, KARNATAKA**

**TEXT, ANNEXURES, AND PLATES**



**MINERAL EXPLORATION AND CONSULTANCY LIMITED**  
*(Formerly known as Mineral Exploration Corporation Limited)*

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LIMESTONE IN KIRANAGI -1 BLOCK, DISTRICT- KALABURAGI, KARNATAKA**

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**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR  
LIMESTONE IN KIRANAGI 1 BLOCK, DISTRICT- KALABURAGI, KARNATAKA.**

**SALIENT FEATURES**

|     |  |   |                    |                    |                                |
|-----|--|---|--------------------|--------------------|--------------------------------|
| 1.  | Name of the block                                  | Kiranagi -1<br>Tehsil – Gulbarga, District – Kalaburagi<br>State - Karnataka  |                    |                    |                                |
| 2.  | Mineral  | Limestone   |                    |                    |                                |
| 3.  | Total Area   | 5.5734 Sq. Km   |                    |                    |                                |
| 4.  | Area covered under present scheme                  | 5.5734 Sq. Km   |                    |                    |                                |
| 5.  | Period of Exploration                              | May-2023 to June-2023   |                    |                    |                                |
| 6.  | Meterage drilled by MECL                           | Total 225.00 m at G3 level  |                    |                    |                                |
| 7.  | No. of Boreholes drilled by MEC                    | Total 05 Nos. at G3 Leve  |                    |                    |                                |
| 8.  | Thickness(Cumulative) of Different Grade Limestone | Min: 13.00m (MKG-09 Zone I). Max 34.00m (MKG-10-Zone I)<br>Cement (Portland) Grade.<br>Min: 2.00m (MKG-06 Zone II) & Max: 5.00m (MKG-10 Zone I) Blendable Gr.<br>Min: 3.00m (MKG-09 Zone I) One borehole only Blendable/Threshold Grade.<br>Min: 3.00m (MKG-10 Zone I) & Max: 21.00m (MKG-08 Zone I) Threshold Gr.. |                    |                    |                                |
| 9.  | Cut-off grade                                      | <b>Grade</b>  | <b>CaO % (Min)</b> | <b>MgO % (Max)</b> | <b>SiO<sub>2</sub> % (Max)</b> |
|     |  | Cement (Portland)   | ≥ 44.00            | 3.50               | 16.00                          |
|     |  | Blendable   | ≥ 38.00            | <5.00              | <18.00                         |
|     |  | Threshold   | ≥ 34.00            | < 6.00             |                                |
| 10. | Resources  | 281.43 million tonnes (net in-situ) Cement (Portland) Grade<br>50.78 million tonnes (net in-situ) BlendableGrade<br>3.27 million tonnes (net in-situ) Blendable/Threshold Grade<br><u>97.27 million tonnes (net in-situ) Threshold Grade</u><br>432.85 million tonnes (net in-situ) All Grades                      |                    |                    |                                |
| 11. | Grade  | Cement, Blendable, Blendable/Threshold and Threshold  |                    |                    |                                |
| 12. | Average Grades                                     | <b>Grade</b>  | <b>CaO %</b>       | <b>MgO %</b>       | <b>SiO<sub>2</sub> %</b>       |
|     |  | <b>Cement</b>   | <b>49.13</b>       | <b>0.54</b>        | <b>9.96</b>                    |
|     |  | <b>Blendable</b>  | <b>43.88</b>       | <b>0.67</b>        | <b>17.11</b>                   |
|     |  | <b>Blendable/Threshold</b>  | <b>42.28</b>       | <b>0.45</b>        | <b>20.26</b>                   |
|     |  | <b>Threshold</b>  | <b>40.60</b>       | <b>0.58</b>        | <b>23.45</b>                   |
|     |  | <b>Average Grade</b>  | <b>46.55</b>       | <b>0.56</b>        | <b>13.91</b>                   |
| 13. | UNFC Category                                      | Inferred Category (333) & Reconnaissance (334)  |                    |                    |                                |
| 14. | Report Submission                                  | February 2024   |                    |                    |                                |

# किरानागी 1 ब्लॉक जिला- कालाबुरागी, कर्नाटक में चूनापत्थर के लिए प्रारंभिक गवेषण (जी 3) पर भूवैज्ञानिक रिपोर्ट

## अध्याय 1

### कार्यकारी सारांश

#### 1.1.0 परिचय

1.1.1 चूनापत्थर, एक अवसादीय चट्टान है, जो मुख्य रूप से समुद्री से लेकर स्थलीय तक विभिन्न निक्षेपण वातावरणों में कार्बोनेट खनिजों की रासायनिक/जैव रासायनिक अवक्षेपण से उत्पन्न होती है। समुद्री प्रणाली या तो नेरिटिक (शैल्फ) या पेलजिक (खुला महासागर) है (जेम्स और जोन्स, 2016)। भूवैज्ञानिक इतिहास में अधिकांश चूनापत्थर नेरिटिक प्रणाली में जमा है। दूसरी ओर, प्रमाण बताते हैं कि पेलजिक चूनापत्थर जुरासिक काल से ही प्रचलन में हैं। इनमें से प्रत्येक निक्षेपण वातावरण को तापमान, लवणता, फोटोनिक क्षेत्र की गहराई, सिलिक्लास्टिक इनपुट और तलछट आपूर्ति में अंतर द्वारा नियंत्रित किया जाता है। सामान्य लवणता और कम सिलिक्लास्टिक इनपुट के साथ गर्म पानी ( $20^{\circ}$  सी) फोटिक ज़ोन के उत्तेजित हिस्से (पानी की गहराई जिसमें प्रकाश प्रवेश करता है) के भीतर चूनापत्थर के निर्माण में योगदान देता है (जेम्स और जोन्स, 2016)। यह इंगित करता है कि अधिकांश चूनापत्थर उष्णकटिबंधीय-उपोष्णकटिबंधीय बेल्ट में, भूमध्य रेखा के 30 डिग्री उत्तर और दक्षिण में जमा हैं (टकर, 2001)। स्थलीय सेटिंग में कार्बोनेट आमतौर पर पानी के तापमान और स्थानीय जलवायु के आधार पर झीलों, झरनों, गुफाओं में बनते हैं।

1.1.2 कैल्साइट के रूप में कैल्शियम कार्बोनेट ( $\text{CaCO}_3$ ), चूनापत्थर का प्रमुख खनिज घटक है। इसमें कुछ मात्रा में मैग्नीशियम कार्बोनेट ( $\text{MgCO}_3$ ) और/या डोलोमाइट ( $\text{CaMg}(\text{CO}_3)_2$ ) भी होता है। गैर-कार्बोनेट खनिजों के रूप में मौजूद टेरिजेनस कार्टेज, मिट्टी, पाइराइट, हेमेटाइट, चर्ट आदि की विभिन्न मात्रा चूनापत्थर की गुणवत्ता/ग्रेड को नियंत्रित करती है।

1.1.3 चूनापत्थर एक महत्वपूर्ण और बहुमुखी खनिज वस्तु है। इस बात के प्रमाण हैं कि मानव सभ्यता के शुरुआती दिनों से ही इसका उपयोग निर्माण सामग्री के रूप में किया जाता रहा है। गीज़ा के महान पिरामिडों से लेकर जैसलमेर के स्वर्ण किले तक, दुनिया की कई सबसे खूबसूरत और ऐतिहासिक इमारतें चूनापत्थर से बनी हैं। आधुनिक समय में, चूनापत्थर का उपयोग मुख्य रूप से सीमेंट बनाने के लिए किया जाता है। हालाँकि, आजकल चूनापत्थर का उपयोग केवल निर्माण सामग्री तक ही सीमित नहीं रह गया है; बल्कि विभिन्न उद्योगों में इसके उपयोग की बहुमुखी प्रतिभा ने इसे एक मूल्यवान खनिज बना दिया है। लौह और इस्पात उद्योग में, चूनापत्थर का उपयोग ब्लास्ट फर्नेस और स्टील पिघलने की दुकान दोनों में फ्लक्स के रूप में किया जाता है। रासायनिक उद्योग में, चूनापत्थर का उपयोग ब्लीचिंग पाउडर, ट्रूथपेस्ट, कैल्शियम कार्बाइड

आदि के उत्पादन में किया जाता है। इसका उपयोग चीनी उद्योग में शोधक के रूप में किया जाता है। चूनापत्थर की खपत कागज, उर्वरक और फाउंड्री आदि उद्योगों में भी की जाती है।

- 1.1.4 1.4.2015 (खनिज वर्ष पुस्तक 2020) तक यूएनएफसी (संयुक्त राष्ट्र फ्रेमवर्क वर्गीकरण) प्रणाली पर आधारित एनएमआई (राष्ट्रीय खनिज सूची) डेटा के अनुसार सभी श्रेणियों और ग्रेडों के चूनापत्थर के कुल भंडार/संसाधन 203,224 मिलियन टन, अनुमानित किए गए हैं जिसमें से 16,336 मिलियन टन (8%) को आरक्षित श्रेणी के अंतर्गत रखा गया है और 1,86,889 मिलियन टन (92%) को संसाधन श्रेणी के अंतर्गत रखा गया है। कर्नाटक कुल संसाधनों का 27% हिस्सा रखने वाला अग्रणी राज्य है, इसके बाद आंध्र प्रदेश और राजस्थान (12% प्रत्येक), गुजरात (10%), मेघालय (9%), तेलंगाना (8%), छत्तीसगढ़ और मध्य प्रदेश (5% प्रत्येक) हैं और शेष 12% अन्य राज्यों द्वारा। ग्रेड के अनुसार, सीमेंट ग्रेड (पोर्टलैंड) की अग्रणी हिस्सेदारी लगभग 70% है, इसके बाद अवर्गीकृत ग्रेड (12%) और बीएफ ग्रेड (7%) हैं। शेष (11%) अलग-अलग ग्रेड हैं।
- 1.1.5 2019-20 में चूनापत्थर का उत्पादन 359 मिलियन टन था, जो पिछले वर्ष की तुलना में लगभग 5.43% कम है। पिछले वर्ष के दौरान 725 की तुलना में 2019-20 में 659 रिपोर्टिंग खदानें थीं। प्रति वर्ष 3 मिलियन टन से अधिक उत्पादन करने वाली तीस खदानों ने 2019-20 में चूनापत्थर के कुल उत्पादन में 42% का योगदान दिया। 2 से 3 मिलियन टन की उत्पादन सीमा वाली 26 खदानों की हिस्सेदारी कुल उत्पादन का 17% थी। कुल उत्पादन का लगभग 19% योगदान 51 खदानों का था, जिनमें से प्रत्येक का उत्पादन 1 से 2 मिलियन टन सालाना था। वर्ष के दौरान कुल उत्पादन का शेष 22% 552 खदानों और तीन संबद्ध खदानों द्वारा दर्ज किया गया। दस प्रमुख उत्पादकों ने कुल उत्पादन में लगभग 54% का योगदान दिया। पिछले वर्ष के 2.88% की तुलना में सार्वजनिक क्षेत्र की खदानों द्वारा लगभग 2.82% उत्पादन दर्ज किया गया। 2019-20 के दौरान चूनापत्थर के कुल उत्पादन का लगभग 97% सीमेंट ग्रेड का, 2% लोहा और स्टील ग्रेड का और शेष 1% रासायनिक ग्रेड का था (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)।
- 1.1.6 राजस्थान चूनापत्थर के कुल उत्पादन (20%) का अग्रणी उत्पादक राज्य था, इसके बाद मध्य प्रदेश (13%), आंध्र प्रदेश और छत्तीसगढ़ (12% प्रत्येक), और कर्नाटक (10%), तमिलनाडु और तेलंगाना (प्रत्येक 7%), गुजरात (6%) और शेष 13% का योगदान असम, बिहार, हिमाचल प्रदेश, केंद्र शासित प्रदेश जम्मू और कश्मीर, झारखंड, केरल, महाराष्ट्र, मेघालय, ओडिशा और उत्तर प्रदेश द्वारा किया गया। (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)

1.1.7 भारत चीन के बाद दुनिया का दूसरा सबसे बड़ा सीमेंट उत्पादक देश था। 2019-20 में, विभिन्न उद्योगों द्वारा बताई गई चूनापत्थर की कुल खपत 328.62 मिलियन टन थी, जो पिछले वर्ष की तुलना में 0.87% की नकारात्मक वृद्धि दर्ज करती है। सीमेंट 308.66 मिलियन टन (94%) खपत वाला प्रमुख उपभोक्ता उद्योग था, इसके बाद लोहा और इस्पात 12.68 मिलियन टन (4%) और रासायनिक 5.29 मिलियन टन (2%) था। शेष खपत एल्यूमीनियम, मिश्र धातु इस्पात, चीनी, कागज, उर्वरक, कांच, धातु विज्ञान, फाउंड्री, आदि द्वारा बताई गई थी। (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)।

1.1.8 चूनापत्थर का निर्यात 3% की मामूली कमी के साथ 2019-20 में 3.76 मिलियन टन हो गया, जो पिछले वर्ष 3.88 मिलियन टन था। चूनापत्थर मुख्य रूप से बांग्लादेश (97.00%) और यूके (1.00%) को निर्यात किया गया था। 2019-20 में चूनापत्थर का आयात 5% की मामूली वृद्धि के साथ 25.64 मिलियन टन हो गया। चूनापत्थर मुख्य रूप से संयुक्त अरब अमीरात (80.00%), ओमान (12.00%), वियतनाम (4.00%), मलेशिया (3.00%), और अन्य देशों (1.00%) से आयात किया जाता था। (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)

## 1.2.0 परियोजना और जांच एजेंसी का विवरण

1.2.1 गवेषित किरानागी-1 ब्लॉक टोपोशीट संख्या 56सी/16, किरानागी, गांव, तालुका: कालाबुरागी, जिला: कालाबुर्गी, कर्नाटक में पड़ता है।

1.2.2. ब्लॉक हेतु जांच एजेंसी मिनरल एक्सप्लोरेशन एंड कंसल्टेंसी लिमिटेड (एमईसीएल), नागपुर है।

## 1.3.0 जांच के उद्देश्य

गवेषण निम्नलिखित उद्देश्यों के साथ प्रस्तावित किया गया था:

- i) गवेषण के जी-3 स्तर पर 5 बोरहोल की ड्रिलिंग द्वारा ब्लॉक क्षेत्र के भीतर चूनापत्थर की उपस्थिति का सीमांकन करना।
- ii) गवेषण के जी-3 स्तर के यूएनएफसी मानदंडों के अनुसार ब्लॉक क्षेत्र में ग्रेड-वार चूनापत्थर के अनुमानित संसाधनों का आकलन करना।
- iii) राज्य सरकार (कर्नाटक) को सुविधा प्रदान करने के लिए खनिज (साक्ष्य और खनिज सामग्री) संशोधन नियम 2021, खनिज नीलामी नियम 2015, 2021 तक संशोधित, एमएमडीआर संशोधन अधिनियम 2015 के अनुसार प्रारंभिक गवेषण (जी-3) करने के लिए खनन पट्टा/ब्लॉक के अंतर्गत ब्लॉक की नीलामी।

## 1.4.0 जांच करने हेतु आधार

- 1.4.1 किरानागी 1 ब्लॉक भीमा बेसिन में पड़ता है और यह एमईसीएल द्वारा हाल ही में खोजे गए डिगागांव और उडगी ब्लॉक के निकट है। निकटवर्ती क्षेत्र (दिगागांव और उडगी ब्लॉक) में हाल में किए गए गवेषण के आधार पर, यह देखा गया है कि शाहाबाद चूनापत्थर में एक क्षेत्र (जोन), नामतः पोर्टलैंड ग्रेड जोन-1 हैं। पोर्टलैंड ग्रेड जोन; औसत ग्रेड 48.89% CaO के साथ जोन I की अधिकतम मोटाई 34.00 मीटर (एमकेजी-10) है। जोन-1 में किरानागी 1 ब्लॉक में औसत 48.71% CaO, औसत 0.55% MgO और औसत 10.37% SiO<sub>2</sub> है। गवेषित किरानागी 1 ब्लॉक एमईसीएल द्वारा गवेषित किए गए डिगागांव और उडगी चूना पत्थर ब्लॉक के उत्तर में पड़ता है।
- 1.4.2 किरानागी 1 और 2 ब्लॉक कर्नाटक सरकार के भूविज्ञान निदेशालय द्वारा पहचाने गए संभावित चूनापत्थर ब्लॉक हैं, जिसके लिए एमईसीएल ने किरानागी गांव, तालुका : कालाबुर्गी जिला: कालाबुर्गी में गवेषण के जी-3 स्तर पर 10 बोरहोल में 600 मीटर ड्रिलिंग सहित गवेषण प्रस्ताव तैयार किया है और एनएमईटी की तकनीकी सह लागत समिति (टीसीसी) के अनुमोदन के लिए रखा गया। 16 मार्च, 2023 को आयोजित टीसीसी, एनएमईटी की 28 वीं बैठक के दौरान, उक्त प्रस्ताव का तकनीकी रूप से मूल्यांकन किया गया और फाईल सं. 23/325/2023-एनएमईटी/409 दिनांक 27 मार्च, 2023 के माध्यम से अनुमोदित किया गया।
- 1.4.3 16 मार्च, 2023 को आयोजित एनएमईटी की 28 वीं टीसीसी की सिफारिश पर एमईसीएल द्वारा किरानागी गांव, तालुका: कालाबुर्गी, जिला: कालाबुर्गी में किरानागी 1 और 2 चूनापत्थर ब्लॉकों के लिए अनुमानित 1,27,57,798/- रुपये की लागत के साथ किरानागी 1 और 2 दोनों ब्लॉकों के लिए 10 महीने की समय-सीमा में एक साथ खनिज गवेषण परियोजना को मंजूरी दी गई। 450 मीटर के संचयी मीटर के लिए 10 बोरहोल के लिए एक साथ मंजूरी दी गई थी। हालाँकि गवेषण को अलग से निष्पादित किया गया था और किरानागी 1 और किरानागी 2 के लिए भूवैज्ञानिक रिपोर्ट अलग से तैयार की गई थी। किरानागी 1 ब्लॉक का गवेषण 225 मीटर की संचयी मीटरेज के साथ 5 बोरहोल द्वारा की गई थी।
- 1.4.4 सभी संरचनाओं की सामान्य प्रवृत्ति उत्तर-दक्षिण है। सीधी रेखीय पूर्व-पश्चिम (ईडब्ल्यू) से उत्तर पश्चिम (एनडब्ल्यू)-दक्षिण पूर्व (एसई) प्रवृत्ति सीमाएँ भ्रंशात्मक हैं जबकि एन-एस और एनएनई-एसएसडब्ल्यू रेखिक प्रवृत्ति अंतर्निहित निसिक के साथ असंगत संबंध दिखाते हैं।
- 1.4.5 भीमा समूह के अवसादीय संरचनात्मक रूप से कम से कम अव्यवस्थित होते हैं और निक्षेपण के समय मूल रूप से प्रभावित अपने क्षैतिज बेडेड वाले रचना को संरक्षित करते हैं। ब्लॉक की चट्टानें क्षैतिज रूप से फैली हुई हैं और ज्यादातर ऊपरी मिट्टी के नीचे ढकी हुई हैं। कुछ स्थानों पर चूनापत्थर की बेड्स उत्तर-पश्चिम की ओर 1° से 3° तक नति हैं।

- 1.4.6 ब्लॉकों का लगभग पूरा क्षेत्र चतुर्धातुक अवसाद यानी मिट्टी के आवरण के नीचे ढका हुआ है। जगह-जगह चूनापत्थर के बिखरे हुए टुकड़े दिखाई देते हैं। जैसा कि आस-पास के क्षेत्रों में देखा गया है, बेड्स क्षैतिज रूप से व्यवस्थित हुआ है। चूंकि अधिकांश क्षेत्र मिट्टी के आवरण के नीचे ढका हुआ है, इसलिए ब्लॉकों में चूनापत्थर के बेड्स की नतिलंब और नति नहीं देखी गई है। वर्तमान में आसपास के क्षेत्रों में खनन गतिविधियाँ चल रही हैं और सीमेंट के निर्माण के लिए चूनापत्थर की खुदाई की जा रही है।
- 1.4.7 ऊपरी मिट्टी की अधिभार का रंग काला , महीन से लेकर गादयुक्त , सूखने पर भुरभुरी और गीली होने पर चिपचिपी होती है। अधिभार मिट्टी लगभग पूरे ब्लॉक क्षेत्र को कवर करती है। कुछ स्थानों पर मिट्टी की मोटाई 2.00 मीटर (MKG-09) से लेकर लगभग 4.00 मीटर (MKG-08) तक होती है । मिट्टी के अधिभार के तुरंत बाद चूना पत्थर जो शाहाबाद संरचना से संबंधित है, जिसमे एमईसीएल द्वारा वेधन किया गया है । गवेषित किरानागी-1 ब्लॉक में चूना पत्थर के ऊपर ब्लेंडेबल ग्रेड ज़ोन II मौजूद है। चूनापत्थर में सिलिसियस/फ्लैगी चूनापत्थर, विशाल ग्रे चूनापत्थर, शैली चूनापत्थर शामिल है। इस ब्लॉक के चूनापत्थर के बैंड चूने की मात्रा से समृद्ध हैं जो सीमेंट के निर्माण के लिए उपयुक्त है।

### 1.5.0 कार्य का विवरण

- 1.5.1 यह प्रस्ताव किरानागी 1 और 2 ब्लॉक के लिए एक साथ बनाया गया था। किरानागी 1 (225 मीटर -5 बोरहोल) और 2 (225 मीटर -5 बोरहोल) में एक साथ स्वीकृत मीटरेज 450 मीटर (10 बोरहोल) है। किरानागी 1 ब्लॉक में कुल मीटरेज 225 मीटर (5 बोरहोल) और किरानागी 2 ब्लॉक में 225 मीटर (5 बोरहोल) की ड्रिलिंग की गई थी। सभी बोरहोल चूनापत्थर युक्त हैं। चूनापत्थर क्षेत्र ऊपरी मिट्टी के आवरण के 2 से 4 मीटर के बाद प्रतिच्छेदित हो जाता है। इसलिए प्राथमिक नमूनों की मात्रा 415 तक बढ़ा दी गई है, जिसके परिणामस्वरूप स्वीकृत 400 नमूनों की तुलना में 15 अतिरिक्त नमूने तैयार किए गए हैं। किरानागी ब्लॉक 1 में, प्राथमिक नमूनों की कुल मात्रा 204 है, जबकि किरानागी ब्लॉक 2 में 211 है। 57वीं टीसीसी बैठक में मालखेड 1 और 2 और किरानागी 1 और 2 ब्लॉक में नमूनाकरण और विश्लेषण लागत को मंजूरी देने का प्रस्ताव किया गया था। 26 और 27 सितंबर 2023 को नई दिल्ली में आयोजित किया गया। समिति ने अतिरिक्त नमूनों और 1.49 लाख रुपये की अतिरिक्त लागत को मंजूरी दे दी (कार्यवृत्त एजेंडा 57.2.13 के अनुसार) और अनुमोदन की प्रति अनुबंध संख्या XI के रूप में संलग्न है।

एनएमईटी से मंजूरी मिलने के बाद, एमईसीएल द्वारा किरानागी 1 और 2 ब्लॉक में गवेषण गतिविधियां शुरू की गई हैं । प्रस्तावित कार्य बनाम उपलब्धि का विवरण, प्रकृति और मात्रा नीचे दी गई है:

**तालिका सं. 1.1**  
**किरानागी 1 और 2 ब्लॉक के लिए प्रस्तावित कार्य की मात्रा वनाम लक्षित**

| क्र.सं.   | कार्य का विवरण एवं प्रकृति   | इकाई       | अनुमोदित        | लक्षित  | लक्षित     | लक्षित  |
|-----------|--|------------|-----------------|---|------------|---------|
|           |  |            | किरानागी 1 और 2 | किरानागी 1  | किरानागी 2 | 1 और 2  |
| <b>ए</b>  | <b>भूवैज्ञानिक कार्य और सर्वेक्षण</b>  |            |                 |   |            |         |
| 1         | भूवैज्ञानिक मानचित्रण (1:4000 पैमाना)  | वर्ग. किमी | 11.41           | 5.5734  | 5.8022     | 11.3756 |
| 2         | सर्वेक्षण कार्य  |            |                 |   |            |         |
|           | i) स्थलाकृतिक सर्वेक्षण (1:4000 पैमाना)  | वर्ग. किमी | 11.41           | 5.5734  | 5.8022     | 11.3756 |
|           | ii) बोर होल निर्धारण   | नग         | 10              | 5   | 5          | 10      |
|           | iii) डीजीपीएस द्वारा आरएल और निर्देशांक निर्धारण   | नग         | 10              | 5   | 5          | 10      |
| <b>बी</b> | <b>गवेषणात्मक ड्रिलिंग</b>   |            |                 |   |            |         |
| 1         | 300 मीटर तक ड्रिलिंग (सॉफ्ट रॉक)   | मी         | 450             | 225   | 225        | 450     |
| 2         | ड्रिल कोर संरक्षण  | प्रति मी   | 405             | 200   | 205        | 405     |
| <b>सी</b> | <b>प्रयोगशाला अध्ययन</b>   |            |                 |   |            |         |
| 1         | <b>रासायनिक विश्लेषण</b>   |            |                 |   |            |         |
|           | i) XRF द्वारा प्राथमिक नमूनाकरण (9 मूलकों CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O और LOI)            | नग         | 400             | 204*  | 211*       | 415*    |
|           | ii) XRF द्वारा आंतरिक 5% (9 मूलकों CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O और LOI) सैंपलिंग की जाँच। | नग         | 20              | 10  | 10         | 20      |
|           | iii) बाहरी सैंपलिंग की जाँच 10% (9 मूलकों CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O और LOI)            | नग         | 40              | 20  | 19         | 39      |
| 2         | <b>पेट्रोलॉजिकल नमूने (सतही और बोरहोल कोर नमूने)</b>   |            |                 |   |            |         |
|           | i) थीन सेक्शन की तैयारी  | नग         | 10              | 5   | 5          | 10      |
|           | ii) थीन सेक्शन का अध्ययन   | नग         | 10              | 5   | 5          | 10      |
| 3         | <b>थोक घनत्व निर्धारण</b>  |            |                 |   |            |         |
|           | i) थोक घनत्व   | नग         | 2               | किरानागी 1 और 2 दोनों ब्लॉकों के लिए 2 संयुक्त नग |            | 2       |
| <b>डी</b> | <b>रिपोर्ट तैयार करना (सॉफ्ट कॉपी के साथ 5 हार्ड कॉपी)</b>   | नग         | 2               | 1   | 1          | 2       |
| <b>इ</b>  | <b>गवेषण प्रस्ताव की तैयारी (सॉफ्ट कॉपी के साथ 5 हार्ड कॉपी)</b>   | नग         | 1               | 1   | 1          | 1       |

\*The additional sampling and analysis cost was approved by the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023.

### 1.6.0 ब्लॉक का स्थान

- 1.6.1 प्रस्तावित किरानागी-1 ब्लॉक टोपोशीट संख्या 56सी/16 में आता है और यह कालाबुरागी तालुक और जिले में स्थित है, जिसका कुल ब्लॉक क्षेत्रफल 5.5734 वर्ग किलोमीटर है। ब्लॉक तक निकटतम सेदम तालुक मुख्यालय से पश्चिम की ओर सिंगल लेन डामरीकृत ग्रामीण सड़कों द्वारा लगभग 24 किमी की दूरी पर पहुंचा जा सकता है। गवेषित किए गए ब्लॉक किरानागी गांव, कालाबुरागी तालुक और जिला के अधिकार क्षेत्र में आते हैं। जिला मुख्यालय कालाबुरागी ब्लॉक से उत्तर की ओर 24 किमी की दूरी पर है।
- 1.6.2 किरानागी 1 ब्लॉक 5.5734 वर्ग किमी के क्षेत्र को कवर करता है और यह एनएमईटी फंडिंग के तहत गवेषण के लिए कर्नाटक सरकार के खान और भूविज्ञान विभाग द्वारा एमईसीएल को प्रदान किया गया है।

**तालिका संख्या 1.2**  
**ब्लॉक सीमा के कार्डिनल बिंदुओं का निर्देशांक**  
**(जैसा कि डीएमजी, कर्नाटक द्वारा प्रदान किया गया)**

| सीमा बिंदु | डब्ल्यूजीएस 1984 डीएमएस |                  | यूटीएम (एम) |             |
|------------|-------------------------|------------------|-------------|-------------|
|            | देशान्तर                | अक्षांश          | X (E)       | Y (N)       |
| KE1        | 76° 53' 1.247"E         | 17° 09' 46.653"N | 730933.538  | 1902026.461 |
| KE2        | 76° 52' 41.266"E        | 17° 08' 20.961"N | 733372.913  | 1901673.966 |
| KW-1       | 76° 51' 37.148"E        | 17° 09' 47.298"N | 731540.207  | 1898450.414 |
| KW-4       | 76° 51' 42.426"E        | 17° 08' 21.481"N | 728906.867  | 1899950.505 |

- 1.6.3 अधिकांश बुनियादी ढांचा (पुलिस स्टेशन, बैंक सुविधा, अस्पताल, कार्यशाला सुविधा, बस स्टैंड आदि) शाहाबाद में उपलब्ध है जो ब्लॉक से लगभग 11 किमी की दूरी पर कालाबुरागी तालुका में उपलब्ध है।

### 1.7.0 क्षेत्र की क्षेत्रीय भूवैज्ञानिक संरचना

- 1.7.1 भीमा बेसिन भारत के सभी प्रोटेरोज़ोइक बेसिनों में सबसे छोटा है। भीमा बेसिन कलादगी समूह के संपर्क में नहीं है और यह युवा माना जाता है और वे कडप्पा सुपर ग्रुप के कुरनूल समूह से काफी मिलते जुलते हैं। भीमा बेसिन अक्षांश N 16°20' से 17°35' और देशांतर N 76°15' से 77°40'E तक फैला हुआ है। भीमा बेसिन अवसाद एन-एस में अलग-अलग चौड़ाई के साथ लगभग 160 किमी तक रेखिक रूप से फैली हुई है और अधिकतम 40 किमी है। यह 5200 वर्ग किमी के क्षेत्र में फैला हुआ है। और कडप्पा बेसिन के उत्तर-पश्चिम में और कलादगी बेसिन के उत्तर पूर्व में स्थित है।
- 1.7.2 कैप्टन न्यू बोल्ड (1842-1845) सबसे पहले तालीकोट प्रलैंगी चूनापत्थर और मुद्देबिहाल लाल बलुआ पत्थर को रिकॉर्ड करने वाले थे। आर. ब्रूस फूटे (1876) ने भीमा समूह (मुख्य रूप से

चूनापत्थर) को बलुआ पत्थर और शेल द्वारा दर्शाए गए निचले क्लैस्टिक और ऊपरी मुख्य रूप से चूनापत्थर और शैल्स में विभाजित किया था । इसके अलावा, महादेवन (1947), जनार्दन राव इत्यादी (1973), माथुर (1977), मुधोलकर और काले (1982) और मिश्रा इत्यादी (1987) भीमा समूह को वर्गीकृत करते हैं। हालाँकि, विवेक एस काले, वीजी फणसलकर और अन्य (1991) ने भीमा समूह को रबनपल्ली (क्लैस्टिक) संरचना और शाहाबाद (चूनापत्थर) संरचनाओं में वर्गीकृत किया है।

1.7.3 भीमा समूह का स्ट्रेटिग्राफिक कॉलम (जीएसआई के बाद) नीचे दिया गया है:

**तालिका संख्या 1.3**  
**भीमा समूह का स्ट्रेटिग्राफिक कॉलम (जीएसआई के बाद)**

| समूह  | उप-समूह   | गठन               | सदस्य   | मोटाई(एम)  |             |
|---|---|-------------------|---|--|-------------|
| डेक्कन ट्रैप  | -   |                   | मूल प्रवाह  |  |             |
| भीमा समूह<br>(ऊपरी प्रोटेरोज़ोइक)<br>(93-273 एम.वाई ) | अंडोला उप-समूह<br>(31-68 मेरी )                               | हरवाल-गोगी        | जीवाश्म शेल सदस्य ऑर्थो -<br>कार्टजाइट चर्ट + कंकड़<br>समूह | 5-10   |             |
|   |   | कटमदेवर-<br>हल्ली |   | 10-40<br>16-18   |             |
|   |   | हलकल              |   |  |             |
|   | ----- पैराकॉम्फॉर्मिटी -----                                  |                   |   |  |             |
|   | शांत बेसिन क्षेत्र के<br>साथ सेदम उप-समूह<br>(62-2.5 एम.वाई ) |                   | शाहाबाद   | फ्लैगी गहरे भूरे और<br>आर्गिलैसियस चूनापत्थर<br>मैसिव गहरे भूरे और नीले<br>भूरे रंग का चूनापत्थर | 4-6<br>8-20 |
|   |   |                   |   | विभिन्न प्रकार का और<br>सिलिसियस/चेरी चूनापत्थर  | 20-80       |
|   |   |                   |   | काला, हल्का भूरा से नीला<br>भूरा चूनापत्थर   | 10-15       |
|   |   | रबनपल्ली          |   | मैला और झण्डादार<br>एलएसटी   | 4-8         |
|   |   |                   |   | बैंगनी शेल   | 2-40        |
|   |   |                   |   | हरा/पीला शेल   | 5-15        |
|   |   |                   |   | सिल्टस्टोन   | 3-4         |
|   |   |                   |   | कार्टजाइट/इंटर-<br>कैलेटेड बलुआ पत्थर<br>समूह/धैर्य  | 5-15<br>1-2 |
|   | ----- अन कॉम्फॉर्मिटी -----                                   |                   |   |  |             |
|   | निम्नतल क्रिस्टलीय  |                   |   | युवा ग्रेनाइट प्रायद्वीपीय<br>गनीस   | -           |

1.7.4 भीमा समूह की संशोधित लिथो स्ट्रेटिग्राफी का हालिया वर्गीकरण (1991) नीचे दिया गया है:

**तालिका संख्या 1.4**  
**भीमा समूह की संशोधित लिथो स्ट्रेटिग्राफी**  
**( विवेक एस काले, वीजी फणसलकर और अन्य 1991 के बाद)**

| गठन                                       | अधिकतम मोटाई(एम) | सदस्य                                | मुख्य लिथोलॉजिकल घटक   |
|---|------------------|--------------------------------------|--|
| 2. शाहाबाद चूनापत्थर                      | <75              |                                      | <ul style="list-style-type: none"> <li>• धूसर, आर्गिलैसियस माइक्रोक्रीक्लाइमस्टोन ।</li> <li>• गहरा, नीला भूरा, विशाल चूनापत्थर ।</li> <li>• विविध, सिलिसियस और चेरी चूनापत्थर ।</li> <li>• नीला-ग्रे, काला- माइक्रोक्रीक्लाइमस्टोन ।</li> <li>• फ़्लैगी (आंशिक रूप से अशुद्ध आर्गिलैसियस और चर्टी) चूनापत्थर ।</li> </ul> |
| ----- क्रमिक और संक्रमणकालीन संपर्क ----- |                  |                                      |  |
| 1. रबनपल्लीवलै स्टिक्स                    | <70              | एकमाई शेल सदस्य                      | लौहयुक्त शैल्स, शीर्ष पर कैलकेरियस शैल्स के साथ।   |
|   |                  | कस्तूरपल्ली - ग्लौकोनितिक सदस्य      | हरा, ग्लौकोनाइट , महीन दाने वाले बलुआ पत्थर और सिल्टस्टोन।   |
|   |                  | कुंद्रापल्ली क्वार्ट्ज एरेनाइट सदस्य | क्वार्ट्जिटिक बलुआ पत्थर ( मध्यम से बारीक दाने वाला)।  |
|   |                  | अदकी हिल समूह के सदस्य               | पॉलिमिक्टिक समूह और आर्कोसिक , किरकिरा बलुआ पत्थर।   |

1.7.5 जीवाश्मों की पूर्ण अनुपस्थिति भीमा समूह की अवसादों को कैम्ब्रियन में स्थानांतरित होने से रोकती है। इस प्रकार परिकल्पित ऊपरी आयु सीमा 600 मिलियन वर्ष से कम नहीं है।

**1.8.0 ब्लॉक भूविज्ञान**

ब्लॉकों में उजागर चट्टानें भीमा समूह के सेदम उप समूह की शाहाबाद संरचना से संबंधित हैं। एमईसीएल ने एमईसीएल द्वारा पहले गवेषित गए डिगगांव ब्लॉक के पश्चिम में लगभग 15 किलोमीटर की दूरी पर मालखेड 2 ब्लॉक की गवेषण की थी। क्षेत्र अवलोकनों और निकटवर्ती खदान/क्षेत्रों से उपलब्ध डेटा/साहित्य के आधार पर किरानागी-1 ब्लॉक का सामान्य स्ट्रेटिग्राफिक अनुक्रमण नीचे तालिका संख्या 1.5 में दिया गया है।

तालिका-1.5

**ब्लॉक में और उसके आसपास उजागर लिथो-इकाइयों का स्ट्रेटिग्राफिक अनुक्रम**

| युग                                       | समूह | उप समूह | संरचना             | लिथो इकाइयाँ  |
|---|------|---------|--------------------|---|
| क्वार्टनरी                                | -    | -       | वर्तमान            | उपरी मिट्टी   |
| उपरी प्रोटोजोइक                           | भीमा | सेदाम   | शाहाबाद चूना पत्थर | सिलिसियस/फ्लैगी चूनापत्थर<br>मैसिव भूरे चूनापत्थर<br>शैली चूनापत्थर                           |
| ----- क्रमिक और संक्रमणकालीन संपर्क ----- |      |         |                    |   |
| -   | -    | -       | रबनपल्ली क्लैस्टिक | लौहमय शैल्स,<br>कैलकेरियस शैल्स,<br>हरा, ग्लूकोनाइट, बारीक दाने वाले बलुआ पत्थर और सिल्टस्टोन |

**1.9.0 क्षेत्रीय संरचना**

सभी संरचनाओं की सामान्य प्रवृत्ति उत्तर-दक्षिण है। सीधी रेखीय पूर्व-पश्चिम (ईडब्ल्यू) से उत्तर पश्चिम (एनडब्ल्यू)-दक्षिण पूर्व (एसई) प्रवृत्ति सीमाएँ भ्रंशात्मक हैं जबकि एन-एस और एनएनई-एसएसडब्ल्यू रेखिक प्रवृत्ति अंतर्निहित नीस के साथ असंगत संबंध दिखाते हैं।

भीमा समूह के अवसाद संरचनात्मक रूप से कम से कम अव्यवस्थित होते हैं और अपने क्षेत्रीय बेड्स वाले रचना को मूल रूप से निक्षेपण के समय प्रभावित करते हैं। विकृति केवल भ्रंशों के आसपास ही देखी जाती है। सामने आई खामियाँ बेसमेंट में जारी हैं जिसने बेसिन विन्यास पर नियंत्रण स्थापित कर लिया है।

यह बेसिन गोगी के पास हाल ही में खोजी गई यूरेनियम की उपस्थिति के लिए जाना जाता है। गवेषित किए गए किरानागी 1 ब्लॉक का क्षेत्रीय भूवैज्ञानिक मानचित्र भीमा बेसिन (भाग) प्लेट-II के रूप में दिखाया गया है।

**1.10.0 व्यवस्थित ड्रिलिंग द्वारा गवेषण**

1.10.1 एमईसीएल ने मई, 2023 को किरानागी 1 चूनापत्थर ब्लॉक में प्रारंभिक गवेषण (जी-3 स्तर) शुरू किया और जून, 2023 को 05 बोरहोल में 225.00 संचयी मीटरज की भूवैज्ञानिक मानचित्रण और ड्रिलिंग पूरी की।

1.10.2 संपूर्ण कोर ड्रिलिंग हीरे के बिट्स का उपयोग करके एनक्यू बोरहोल आकार के साथ वायर लाइन विधि द्वारा की गई है। कटिंग को बाहर निकालने और गवेषणात्मक बोरहोल की दीवार को स्थिर करने के लिए पॉलिमर का उपयोग ड्रिलिंग तरल पदार्थ के रूप में किया गया था। ड्रिलिंग तरल पदार्थ ड्रिल बिट्स को जलने से बचाने के लिए शीतलक के रूप में भी काम करता है, कोर की

अधिकतम कोर रिकवरी प्राप्त करने के लिए उचित देखभाल की गई थी। चूनापत्थर का निर्माण कठोर और विशाल है, जिसके परिणामस्वरूप अधिकतम 90-95% कोर रिकवरी होती है।

1.10.3 लिथोलॉजिकल रूप से चूनापत्थर बहुत कठोर और विशाल है, कुछ स्थानों पर कभी-कभी मिट्टी के पतले मिश्रण का सामना करना पड़ता है, जिसके परिणामस्वरूप 90-95% कोर रिकवरी होती है। संसाधन आकलन में इन कारकों पर विचार किया जाता है।

1.11.0 नमूनाकरण और विश्लेषण

1.11.1 प्राथमिक और जांच नमूने

सभी बोरहोलों में काफी मोटाई में चूनापत्थर की एक समान प्रकृति को ध्यान में रखते हुए और जी-3 गवेषण के दौरान उत्पन्न लिथोलॉजिकल डेटा के अध्ययन के बाद, चूनापत्थर के ग्रेड का मूल्यांकन करने के लिए 1 मीटर की इष्टतम नमूना लंबाई उचित है। लिथोलॉजी, जीवाश्म सामग्री पर विचार करते हुए प्राथमिक नमूना लंबाई 1 मीटर रखने का निर्णय लिया गया; हालाँकि, जहाँ भी आवश्यक लगा, लिथोलॉजी और जीवाश्म सामग्री में भिन्नता के आधार पर छोटी और बड़ी लंबाई के नमूने भी तैयार किए गए।

**1.11.2 समग्र नमूना विश्लेषण**

किरानागी-1 और 2 ब्लॉकों के समग्र नमूनों का विश्लेषण अनुमोदित मात्रा में नहीं है। इसलिए, मिश्रित नमूने विश्लेषण के लिए तैयार नहीं किए गए।

1.12.0 चूनापत्थर क्षितिज का मूल्यांकन

1.12.1 संबंधित भूवैज्ञानिक और प्रयोगशाला अध्ययनों के साथ गवेषात्मक ड्रिलिंग के माध्यम से की गई जांच ने चूनापत्थर क्षितिज के आकार, आकार और ज्यामिति को स्थापित करने के लिए गवेषण डेटा उत्पन्न किया है। इसने ब्लॉक के विभिन्न जमा मापदंडों के मूल्यांकन का आधार बनाया। सभी ग्रेडों के लिए न्यूनतम 1.0 मीटर नमूना लंबाई के आधार पर जोनों का सीमांकन किया गया, आसन्न बोरहोल के साथ कटऑफ और सहसंबंध के आधार पर, आसन्न खोजे गए/खदान ब्लॉक के बोरहोल डेटा पर भी विचार किया गया। मूल्यांकन की मुख्य विशेषताओं पर नीचे चर्चा की गई है।

1.12.2 सीमेंट ग्रेड चूनापत्थर क्षितिज ( $\text{CaO}\% \geq 44$ ,  $\text{MgO}\%$  अधिकतम 3.50,  $\text{SiO}_2\%$  अधिकतम 16)

1.12.3 मिश्रण योग्य ग्रेड चूनापत्थर क्षितिज

आईबीएम दिशानिर्देशों के अनुसार, मिश्रण योग्य ग्रेड चूनापत्थर क्षेत्र को  $\text{CaO}\%$  रेंज पर  $\geq 38$  से  $\leq 44\%$  के बीच सीमांकित किया गया था और  $\text{MgO}\%$  6% से अधिक नहीं होना चाहिए।

1.12.4 थ्रेसहोल्ड ग्रेड चूनापत्थर क्षितिज

आईबीएम दिशानिर्देशों के अनुसार. थ्रेसहोल्ड ग्रेड चूनापत्थर क्षेत्र को CaO% रेंज पर  $\geq 34$  से  $\leq 38\%$  के बीच सीमांकित किया गया था और MgO 6% से अधिक नहीं होना चाहिए।

1.12.5 गवेषण किए गए ब्लॉक में पोर्टलैंड ग्रेड चूना पत्थर के अलावा अन्य चूना पत्थर क्षेत्रों में मिश्रण योग्य और थ्रेसहोल्ड दोनों श्रेणियों में उच्च CaO और उच्च SiO<sub>2</sub> का विश्लेषण किया गया। इसलिए मिश्रण योग्य ग्रेड को SiO<sub>2</sub> मूल्यों के आधार पर दो में वर्गीकृत किया गया है, पहला मिश्रण योग्य ग्रेड (-18% SiO<sub>2</sub>) और दूसरा उच्च SiO<sub>2</sub> (+18% SiO<sub>2</sub>) के साथ। दूसरे प्रकार के ब्लेंडेबल ग्रेड (+ 18% SiO<sub>2</sub>) को थ्रेसहोल्ड ग्रेड चूना पत्थर के साथ जोड़ा गया है और ब्लेंडेबल/थ्रेसहोल्ड ग्रेड वर्ग के रूप में वर्गीकृत किया गया है और इसे MKG -09 बोरहोल में प्रतिच्छेदित किया गया है।

1.13.0 संसाधन आकलन के लिए अपनाई गई पद्धति

1.13.1 चूनापत्थर के संसाधनों का अनुमान मुख्य विधि के रूप में भूवैज्ञानिक क्रॉस सेक्शन विधि और चेक विधि के रूप में बहुभुज विधि द्वारा किया गया है। संसाधन आकलन के लिए उपरोक्त मान्यताओं को ध्यान में रखते हुए अपनाई गई पद्धति इस प्रकार है :

संसाधनों का वर्गीकरण

यूएनएफसी के अनुसार संसाधनों को चूनापत्थर संसाधनों (333 और 334) की अनुमानित और आवीक्षण श्रेणी के अंतर्गत वर्गीकृत किया गया है । संसाधनों के आकलन के लिए मापदंडों और मान्यताओं को अध्याय XIX के तहत पहले ही परिभाषित किया जा चुका है।

भारतीय खान ब्यूरो, भारत सरकार द्वारा निर्धारित **अंतिम उपयोग ग्रेड** विनिर्देशों के आधार पर चूनापत्थर जोन का गणना और वर्गीकृत किया जाता है।

1.14.0 संसाधन

1.14.1 सीमेंट (पोर्टलैंड), ब्लेंडेबल और ब्लेंडेबल/थ्रेसहोल्ड ग्रेड चूना पत्थर के कुल शुद्ध इन-सीटू संसाधन को मोटे तौर पर अनुमानित और टोही (333 और 334) संसाधनों के तहत वर्गीकृत किया गया है, जिसका विवरण निम्नलिखित तालिका में प्रस्तुत किया गया है। क्रॉस सेक्शनल विधि द्वारा कुल अनुमानित श्रेणी संसाधन 237.34 मिलियन टन और टोही श्रेणी 195.51 मिलियन टन है।

### तालिका सं. 1.6

#### श्रेणीवार संसाधन का सारांश

इकाई: मिलियन टन

| श्रेणी और यूएनएफसी कोड | सीमेंट (पोर्टलैंड) ग्रेड | ब्लेंडेबल ग्रेड | ब्लेंडेबल/थ्रेसहोल्ड ग्रेड | थ्रेसहोल्ड ग्रेड | कुल    | प्रतिशत |
|------------------------|--------------------------|-----------------|----------------------------|------------------|--------|---------|
| 333                    | 156.55                   | 22.88           | 2.66                       | 55.24            | 237.34 | 54.83%  |
| 334                    | 124.98                   | 27.90           | 0.61                       | 42.03            | 195.51 | 45.17%  |
| कुल                    | 281.43                   | 50.78           | 3.27                       | 97.27            | 432.85 | 100.00% |

कुल शुद्ध अनुमानित श्रेणी संसाधन 237.34 (432.85 के कुल शुद्ध भूवैज्ञानिक संसाधन का 54.83%) मिलियन टन है। कुल शुद्ध टोही श्रेणी संसाधन 195.51 (कुल शुद्ध भूवैज्ञानिक संसाधन 432.85 का 45.17%) मिलियन टन है।

विभिन्न ग्रेडों के लिए चूना पत्थर के संसाधनों का अनुमान बोरहोल-वार, अनुभाग-वार, बहुभुज-वार और क्षेत्र-वार लगाया गया है।

#### 1.15.0 सिफ़ारिशें

- 1.15.1 सीमेंट (पोर्टलैंड) ग्रेड संसाधन का कुल शुद्ध इन-सीटू संसाधन 281.43 मिलियन टन है, जिसका औसत ग्रेड CaO 49.13%, MgO 0.54% और SiO<sub>2</sub> 9.96% है। ब्लेंडेबल ग्रेड का कुल शुद्ध इन-सीटू संसाधन 50.78 मिलियन टन CaO 43.88%, MgO 0.67% और SiO<sub>2</sub> 17.11% है, ब्लेंडेबल/थ्रेसहोल्ड ग्रेड संसाधन 3.27 मिलियन टन है जिसमें औसत ग्रेड CaO 42.28%, MgO 0.45% और SiO<sub>2</sub> 20.26% है। और थ्रेसहोल्ड ग्रेड संसाधन 97.27 मिलियन टन है, औसत ग्रेड CaO 40.60%, MgO% 0.58 और SiO<sub>2</sub> 23.45% भी स्थापित किया गया है।
- 1.15.2 गवेषण खनिज (खनिज सामग्री का साक्ष्य) नियम-2015, खनिज नीलामी नियम-2015, एमएमडीआर संशोधन अधिनियम - 2015 और खनिज (खनिज सामग्री का साक्ष्य) संशोधन नियम 2021 के अनुसार किया जाता है।
- 1.15.3 गवेषण के इस स्तर से कर्नाटक राज्य सरकार को खनन पट्टे के तहत ब्लॉक की नीलामी में सुविधा होगी।
- 1.15.4 अध्ययन क्षेत्र सुझाव देता है कि भविष्य की कोई भी खनन परियोजना स्थानीय लोगों के लिए रोजगार पैदा कर सकती है और आसपास के क्षेत्रों में रहने वाले लोगों की सामाजिक-आर्थिक स्थिति में वृद्धि करेगी।
- 1.15.5 अनुमोदन के अनुसार, 5 बोरहोल ड्रिल किए गए; और संसाधनों का अनुमान यूएनएफसी के अनुसार अनुमानित श्रेणी (333) और आवीक्षण (334) में लगाया गया है। हालाँकि, उच्च विश्वास स्तर पर संसाधनों की पुष्टि के लिए, निकट अंतराल पर कुछ और बोरहोल ड्रिल किए जाने चाहिए।

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR  
LIMESTONE IN KIRANAGI - 1 BLOCK, DISTRICT- KALABURAGI, KARNATAKA**

**CHAPTER-1**

**1.0.0 EXECUTIVE SUMMARY**

**1.1.0 INTRODUCTION**

- 1.1.1 Limestone, a sedimentary rock, originated mainly by chemical/biochemical precipitation of carbonate minerals in a variety of depositional environments, ranging from marine to terrestrial. The marine system is either neritic (shelf) or pelagic (open-ocean) (James and Jones, 2016). Most of the limestone in geological history is deposited in neritic system. On the other hand, evidences show that pelagic limestones are in the operation since Jurassic time. Each of these depositional environments is controlled by differences in temperature, salinity, depth of photic zone, siliciclastic input and sediment supply. Warm water with normal salinity and low siliciclastic input favours the formation of limestone within the agitated part of the photic zone (the depth of water to which light penetrates) (James and Jones, 2016). This indicates that most of the limestones are deposited in tropical-subtropical belt, within 30° north and south of Equator (Tucker, 2001). In terrestrial setting carbonates are usually formed in lakes, springs, caves depending upon water temperature and local climate.
- 1.1.2 Calcium carbonate ( $\text{CaCO}_3$ ) in the form of calcite is the predominant mineral constituent of limestone. It also contains some amount of magnesium carbonate ( $\text{MgCO}_3$ ) and/or dolomite ( $\text{CaMg}(\text{CO}_3)_2$ ). Variable amount of terrigenous quartz, clay, pyrite, haematite, chert etc., present as non-carbonate minerals, control the quality/grade of limestone.
- 1.1.3 Limestone is a crucial and versatile mineral commodity. There are evidences that it has been in use as construction material from the early days of human civilization. From the Great Pyramids of Giza to the Golden fort of Jaisalmer, many of the world's most beautiful and historical buildings are made up of limestone. In the modern time, limestone is primarily used to manufacture cement. However, the uses of limestone, now a day, have not been confined only to construction material; rather the versatility in its uses in different industries made it a valuable mineral. In Iron & Steel Industry, limestone is used both in blast furnace and steel melting shop as a flux. In chemical industry, limestone is consumed to produce bleaching powder, toothpaste, calcium carbide etc. It is used as a purifier in the sugar industry. Limestone is also consumed by industries like paper, fertilizer and foundry etc.

- 1.1.4 The total reserves/resources of limestone of all categories and grades as per NMI (National Mineral Inventory) data based on UNFC (United Nations Framework Classification) system as on 1.4.2015 (Mineral Year Book 2020) have been estimated at 203,224 million tonnes, of which 16,336 million tonnes (8%) are placed under reserves category and 1,86,889 million tonnes (92%) are under resources category. Karnataka is the leading state having 27% of the total resources followed by Andhra Pradesh and Rajasthan (12% each), Gujarat (10%), Meghalaya (9%), Telangana (8%), Chhattisgarh and Madhya Pradesh (5% each) and remaining 12% by other states. Grade wise, Cement Grade (Portland) has leading share of about 70% followed by Unclassified Grades (12%) and BF Grade (7%). Remaining (11%) are different Grades.
- 1.1.5 The production of limestone in 2019-20 was 359 million tonnes, decreased marginally by about 5.43% as compared to that of the previous year. There were 659 reporting mines in 2019-20 as against 725 during the previous year. Thirty mines each producing more than 3 million tonnes per annum contributed 42% of the total production of limestone in 2019-20. The share of 26 mines each in the production range of 2 to 3 million tonnes was 17% of the total production. About 19% of the total production was contributed by 51 mines each producing 1 to 2 million tonnes annually. The remaining 22% of the total production was reported by 552 mines and three associated mines during the year. Ten principal producers contributed about 54% of the total production. About 2.82% of the production was reported by public sector mines as against 2.88% in the previous year. About 97% of the total production of limestone during 2019-20 was of cement grade, 2% of iron & steel grade and the rest 1% consisted of chemical grade (As per Mineral Year Book 2020 by Indian Bureau of Mines).
- 1.1.6 Rajasthan was the leading producing state accounting for (20%) of the total production of limestone, followed by Madhya Pradesh (13%), Andhra Pradesh & Chhattisgarh (12% each), & Karnataka (10%), Tamil Nadu & Telangana (7% each), Gujarat (6%) and the remaining 13% was contributed by Assam, Bihar, Himachal Pradesh, UT of Jammu and Kashmir, Jharkhand, Kerala, Maharashtra, Meghalaya, Odisha and Uttar Pradesh. (As per Mineral Year Book 2020 by Indian Bureau of Mines)
- 1.1.7 India was the second largest cement producing country in the world after China. In 2019-20, the total consumption of limestone, as reported by different industries was 328.62 million tonnes registering negative growth of 0.87% over that of preceding year. Cement was the major consuming industry accounting for 308.66 million tonnes (94%) consumption, followed by iron & steel 12.68 million tonnes (4%) and chemical 5.29 million tonnes (2%). The remaining consumption was reported by aluminium, alloy

steel, sugar, paper, fertilizer, glass, metallurgy, foundry, etc. (As per Mineral Year Book 2020 by Indian Bureau of Mines)

- 1.1.8 Exports of limestone decreased marginally by 3%, to 3.76 million tonnes in 2019-20 from 3.88 million tonnes in the previous year. Limestone was mainly exported to Bangladesh (97.00%) & UK (1.00%). In 2019-20 the import of limestone increased marginally by 5% to 25.64 million tonnes. Limestone was mainly imported from UAE (80.00%), Oman (12.00%), Vietnam (4.00%), Malaysia (3.00%), & Other Countries (1.00%). (As per Mineral Year Book 2020 by Indian Bureau of Mines)

### **1.2.0 DETAILS OF PROJECT AND INVESTIGATING AGENCY**

- 1.2.1 The explored Kiranagi-1 Block falls in Toposheet No 56C/16, in Kiranagi, Village, Taluka: Kalaburagi, District: Kalaburgi. Karnataka.
- 1.2.2. The investigating agency for the block is Mineral Exploration and Consultancy Limited (MECL), Nagpur.

### **1.3.0 OBJECTIVES OF INVESTIGATION**

The exploration was proposed with following objectives:

- i) To demarcate the limestone occurrences within the block area by drilling of 5 boreholes at G-3 level of exploration.
- ii) To estimate the grade wise limestone inferred resources in the block area as per UNFC norms of G-3 level of exploration.
- iii) To carry out preliminary exploration (G-3) as per the Minerals (Evidence and Mineral Contents) Amendment Rules 2021, Mineral Auction Rule 2015 Amended up to 2021, MMDR Amendment Act 2015 in turn to facilitate the State Government (Karnataka) for auctioning of the block under Mining Lease/Block.

### **1.4.0 BASIS FOR TAKING UP INVESTIGATION**

- 1.4.1 The Kiranagi-1 Block falls in the Bhima Basin and it is adjacent to the recently explored Diggaon and Udagi Blocks by MECL. Based on the recent exploration in the nearby area (Diggaon and Udagi Blocks), it has been observed that there is one zone in Shahabad limestone, namely Portland grade Zone-I. Portland Grade Zones; Zone I having a maximum thickness of 34.00m (MKG-10), with average grade is 48.89% CaO. The zone-1 has average 48.71% CaO, average 0.55% MgO and average 10.37% SiO<sub>2</sub> in Kiranagi 1 Block. The explored Kiranagi 1 Block falls to the north of the Diggaon and Udgi limestone blocks explored by MECL.
- 1.4.2 Kiranagi-1& 2 Blocks are the prospective limestone blocks identified by Directorate of Geology, Government of Karnataka for which MECL has prepared the exploration

proposal involving 600m drilling in 10 boreholes at G-3 level of exploration in Kiranagi, Village, Taluka: Kalaburagi, District Kalaburgi and put up for approval of Technical cum cost Committee (TCC) of NMET. During the 28<sup>th</sup> meeting of TCC, NMET held on 16<sup>th</sup> March, 2023, the said proposal was technically evaluated and approved vide F.No.23/325/2023-NMET/409 dated 27<sup>th</sup> March 2023.

- 1.4.3 On the recommendation of 28<sup>th</sup> TCC of NMET held on 16<sup>th</sup> March, 2023 approved the mineral exploration project to be executed by MECL for Kiranagi 1 & 2 Limestone Blocks in Kiranagi Village, Taluka: Kalaburagi, District: Kalaburgi with an estimated cost of Rs.1,27,57,798/- in the time schedule of 10 months together for both Kiranagi 1 & 2 blocks. The approval was together for 10 boreholes for the cumulative meterage of 450m. The exploration was executed separately and geological reports are prepared for Kiranagi 1 and Kiranagi 2 separately. The Kiranagi 1 Block was explored by 5 boreholes with the cumulative meterage of 225m.
- 1.4.4 The general trend of all formations is North - South. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses.
- 1.4.5 Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. The rock formations of the Block are horizontally disposed and mostly concealed under top soil. At places, limestone beds dip 1° to 3° due North.
- 1.4.6 Almost entire area of the blocks is concealed under quaternary sediments i.e. soil cover. Scanty scattered limestone outcrops are seen at places. The beds are horizontally disposed as noticed in nearby areas. Since most of the area is concealed under soil cover the strike and dip of the limestone beds is not observed in the blocks. Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing of cement.
- 1.4.7 The overburden top soil is black in colour, fine to silty, friable when dry and sticky when wet. The overburden soil covers almost the entire Block area. The thickness of the soil varies from 2.00m (MKG-09) to about 4.00m (MKG-08) at places. The overburden of soil is immediately followed by Limestone belongs to Shahabad formation in boreholes drilled by MECL. The limestone is overlaying Blendable Grade Zone II in the explored Kiranagi – 1 Block. The limestone comprises of Siliceous/flaggy

limestone Massive grey limestone Shaly limestone. The bands of limestone of this block are enriched with lime content which is suitable for manufacture of cement.

### **1.5.0 DETAILS OF THE WORK**

1.5.1 The proposal was made as one together for Kiranagi 1 and 2 Blocks. The approved meterage is 450m (10 Boreholes) together in Kiranagi 1 (225m - 5 Bhs) Block and Kiranagi 2 (225m - 5 Bhs) Block. The total meterage was drilled is 225m in Kiranagi 1 Block and 225m in Kiranagi 2 Block. All the boreholes are limestone bearing. The limestone zone intersected after 2 to 4m of top soil cover. Hence the quantum of Primary Samples are increased up to 415 nos. which resulting the generation additional 15 nos. samples as against approved 400 nos. of samples. In Kiranagi Block 1, the total quantum of primary samples is 204, where as in Kiranagi Block 2 is 211 nos. It was proposed to approve the sampling and analysis cost in the Malkhed 1 & 2 and Kiranagi 1 & 2 Blocks in the 57<sup>th</sup> TCC meeting held on 26<sup>th</sup> & 27<sup>th</sup> September 2023 held at New Delhi. The Committee approved the additional samples and additional cost of Rs. 1.49 lakh (vide minutes agenda 57.2.13) and the copy of approval is enclosed as Annexure No XI.

After receipt of approval from NMET, MECL has carried out exploration activities in Kiranagi 1 & 2 Block. The details, nature and quantum of work proposed Vs achievement is given below:

**Table No. 1.1**  
**Quantum of Work for Proposed Vs Achieved Kiranagi-1 and 2 Blocks**

| Sl. No.  | Description and Nature of Work  | Unit   | Approved       | Achieved   | Achieved   | Achieved |
|----------|---|--------|----------------|--|------------|----------|
|          |   |        | Kiranagi 1 & 2 | Kiranagi 1                                       | Kiranagi 2 | 1 & 2    |
| <b>A</b> | <b>GEOLOGICAL WORK AND SURVEYING</b>  |        |                |  |            |          |
| 1        | Geological Mapping (1:4000 scale)   | Sq. km | 11.41          | 5.5734   | 5.8022     | 11.3756  |
| 2        | Survey Work   |        |                |  |            |          |
|          | i) Topographical Survey (1:4000 scale)  | Sq. km | 11.41          | 5.5734   | 5.8022     | 11.3756  |
|          | ii) Bore Hole Fixation  | Nos.   | 10             | 5  | 5          | 10       |
|          | iii) RL & Coordinate Determination by DGPS  | Nos.   | 10             | 5  | 5          | 10       |
| <b>B</b> | <b>EXPLORATORY DRILLING</b>   |        |                |  |            |          |
| 1        | Drilling up to 300m (Soft Rock)   | m      | 450            | 225  | 225        | 450      |
| 2        | Drill Core Preservation   | Per m  | 405            | 200  | 205        | 405      |
| <b>C</b> | <b>LABORATORY STUDIES</b>   |        |                |  |            |          |
| 1        | <b>Chemical Analysis</b>  |        |                |  |            |          |
|          | i) Primary Sampling (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF            | Nos.   | 400            | 204*   | 211*       | 415*     |
|          | ii) Check Sampling Internal 5% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF | Nos.   | 20             | 10   | 10         | 20       |
|          | iii) Check Sampling External 10% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.)      | Nos.   | 40             | 20   | 19         | 39       |
| 2        | <b>Petrological samples (Surface &amp; BH Core Samples)</b>   |        |                |  |            |          |
|          | i) Preparation of thin section  | Nos.   | 10             | 7  | 3          | 10       |
|          | ii) Study of Thin Section   | Nos.   | 10             | 7  | 3          | 10       |
|          | iii) Photomicrograph  | Nos.   | 10             | 4  | 2          | 6        |
| 3        | <b>Bulk Density Determination</b>   |        |                |  |            |          |
|          | i) Bulk Density   | Nos.   | 2              | 2 Nos. Combined for both Kiranagi 1 and 2 Blocks |            | 2        |
| <b>D</b> | <b>Report Preparation (5 Hard copies with a soft copy)</b>  | Nos.   | 2              | 1  | 1          | 2        |
| <b>E</b> | <b>Preparation of Exploration Proposal (5 Hard copies with a soft copy)</b>   | Nos.   | 1              | 1  | 1          | 1        |

*\*The additional sampling and analysis cost was approved by the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023.*

### 1.6.0 LOCATION OF THE BLOCK

- 1.6.1 The proposed Kiranagi-1 Block falls in Toposheet no 56C/16 and it is located in Kalaburagi Taluk and District having a total block area of 5.5734 Sq. Km. The block can be approached from the nearest Sedam Taluk head-quarters towards west at a distance of around 24 kms by single lane asphalted village roads. The explored blocks fall in the jurisdiction of Kiranagi Village, Kalaburagi Taluk and District. The district head quarter Kalaburagi is at a distance of 24 kms towards north from the block.
- 1.6.2 Kiranagi-1 Block covers an area of 5.5734 sq.km, as provided by Department of Mines and Geology, Government of Karnataka to MECL to explore under NMET funding.

**Table No. 1.2**  
**Co-ordinates of Cardinal Points of the Block Boundary**  
**(As provided by DMG, Karnataka)**

| Boundary Points | WGS 1984 DMS     |                  | UTM(m)     |             |
|-----------------|------------------|------------------|------------|-------------|
|                 | Longitude        | Latitude         | X (E)      | Y (N)       |
| KE1             | 76° 53' 1.247"E  | 17° 09' 46.653"N | 730933.538 | 1902026.461 |
| KE2             | 76° 52' 41.266"E | 17° 08' 20.961"N | 733372.913 | 1901673.966 |
| KW-1            | 76° 51' 37.148"E | 17° 09' 47.298"N | 731540.207 | 1898450.414 |
| KW-4            | 76° 51' 42.426"E | 17° 08' 21.481"N | 728906.867 | 1899950.505 |

- 1.6.3 Most of the infrastructure (Police station, Bank facility, Hospital, workshop facility, bus stand etc) are available in Shahabad which is located at Kalaburagi Taluk at a distance of around 11 kms from the block.

### 1.7.0 REGIONAL GEOLOGICAL SETUP OF THE AREA

- 1.7.1 Bhima basin is the smallest of all Proterozoic basins of India. Bhima Basin is not in contact with the Kaladgi group and it is believed to be younger and they are in close resemblance to the Kurnool group of the Cuddapah Super Group. The Bhima basin is covered by latitude N 16°20' to 17°35' and longitude N 76°15' to 77°40'E. The Bhima basin sediments stretch linearly in N-S for about 160 km with varying width and the maximum being 40 km. It extends over an area of 5200 Sq.km. and is situated to the North-west of Cuddapah basin and North east of Kaladgi basin.
- 1.7.2 Captain New Bold (1842 – 1845) was first to record the Talikote flaggy limestone and Muddebihal red sandstone. R. Bruce Foote (1876) had divided the Bhima Group (mainly of limestone) into lower clastic represented by sandstone and shale and upper mainly of limestone and shales. Further, Mahadevan (1947), Janardhana Rao et.al (1973), Mathur (1977), Mudholkar and Kale (1982) and Mishra et.al (1987) classified Bhima Group. However, Vivek S. Kale, V.G. Phansalkar et.al (1991) classified Bhima Group into Rabanapalli (clastic) formation and Shahabad (limestone) formations.

1.7.3 The Stratigraphic Column of the Bhima Group (after GSI) is furnished in below:

**Table No. 1.3**  
**The Stratigraphic Column of the Bhima Group (after GSI)**

| Group  | Sub-Group   | Formation                  | Member  | Thickness (m)                                 |       |
|--|---|----------------------------|---|---|-------|
| <b>Deccan Trap</b>   | -   |                            | Basic flows   |   |       |
| <b>Bhima Group</b><br>(Upper Proterozoic )<br>(93-273 m.y) |   | Harwal-Gogi                |   | 5-10  |       |
|  | Andola Sub-group in Pulsating basin environment (31-68 m.y) | Katamdevar-halli           | Fossil shale member ortho-quartzite chert + pebble conglomerate | 10-40   |       |
|  |   | Halkal                     |   | 16-18   |       |
|  |   | ----- Paraconformity ----- |   |   |       |
|  | Sedam Sub-group with quiescent basin regime (62-2.5 m.y)    |                            |   | Flaggy dark grey and argillaceous limestone   | 4-6   |
|  |   |                            |   | Massive dark grey and bluish grey Limestone   | 8-20  |
|  |   |                            | Shahabad  | Variegated and siliceous/cherty Limestone     | 20-80 |
|  |   |                            |   | Blackish, light grey to bluish grey limestone | 10-15 |
|  |   | Rabanapalli                |   | Slabby and flaggy Lst                         | 4-8   |
|  |   |                            |   | Purple shale                                  | 2-40  |
|  |   |                            |   | Green/yellow shale                            | 5-15  |
|  |   |                            |   | Siltstone                                     | 3-4   |
|  |   |                            |   | Quartzite/Inter-calated sandstone             | 5-15  |
|  |   |                            |   | Conglomerate / grit                           | 1-2   |
|  | ----- Un conformity -----                                   |                            |   |   |       |
| Basement Crystallines                                      |   |                            | Younger granite peninsular gneisses                             | -   |       |

1.7.4 Recent classification (1991) of revised litho stratigraphy of the Bhima Group is furnished below:

**Table No. 1.4**  
**Revised litho stratigraphy of the Bhima Group**  
**(after Vivek S. Kale, V.G. Phansalkar et.al 1991)**

| Formation  | Maximum Thickness(m) | Member                            | Main Lithological components   |
|--|----------------------|-----------------------------------|--|
| Shahabad Limestone                               | < 75                 |                                   | <ul style="list-style-type: none"> <li>• Grey, argillaceous micritic limestones.</li> <li>• Dark, bluish grey, massive limestones.</li> <li>• Variegated, siliceous and cherty limestones.</li> <li>• Blue- grey, black- micritic limestones.</li> <li>• Flaggy (Partly impure argillaceous and cherty) limestones.</li> </ul> |
| ----- Gradational and transitional contact ----- |                      |                                   |  |
| Rabanpalli Clastics                              | < 70                 | Ekmal shale member                | Ferruginous shales, with calcareous shales at top.   |
|  |                      | Kasturpalli-Glaucanitic member    | Green, glauconite, fine grained sandstones and siltstones.   |
|  |                      | Kundrapalli quartz arenite member | Quartzitic sandstones (medium to fine grained).  |
|  |                      | Adki Hill conglomerate member     | Polymictic conglomerates and arkosic, gritty sandstones.   |

1.7.5 The total absence of fossils rules out the sediments of Bhima Group transgresses into the Cambrian. Thus envisaged the upper age limit is not less than 600 million years.

### 1.8.0 BLOCK GEOLOGY

The rocks exposed in the blocks belong to the Shahabad formation of Sedam sub group of Bhima Group. MECL had explored Kiranagi-1 Block at a distance of around 15 kms west of previously explored Diggaon Block by MECL. The general stratigraphic succession of the Kiranagi-1 Block based on field observations and available data/literature from nearby mine/areas is given below in Table No. 1.5.

**Table-1.5**

**Stratigraphic Sequence of Litho-units exposed in and around the Block**

| Age  | Group | Sub Group | Formation              | Litho Units  |
|--|-------|-----------|------------------------|--|
| Quaternary                                       | -     | -         | Recent                 | Top soil   |
| Upper Proterozoic                                | Bhima | Sedam     | Shahabad Limestone     | Siliceous/flaggy limestone<br>Massive grey limestone<br>Shaly limestone                                      |
| ----- Gradational and transitional contact ----- |       |           |                        |  |
| -  | -     | -         | Rabanpalli<br>Clastics | Ferruginous Shales,<br>calcareous shales,<br>Green, Glauconite, fine<br>grained Sandstones and<br>Siltstones |

**1.9.0 REGIONAL STRUCTURE**

The general trend of all formations is North - South. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses. Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. Deformation is observed only in the vicinity of faults. The faults encountered have continued into the basement that has exercised control upon the basin configuration.

The basin is well known for its huge reserves of limestone and the newly discovered Uranium occurrence near Gogi. Regional Geological Map Bhima Basin (Part) of the explored Kiranagi-1 Block is shown as Plate – II.

**1.10.0 EXPLORATION BY SYTEMATIC DRILLING**

1.10.1 MECL commenced preliminary exploration (G-3 level) in Kiranagi-1 limestone block in May 2023 and completed in June 2023 (Geological mapping and drilling of 5 boreholes with the cumulative meterage of 225.00m).

1.10.2 The entire core drilling has been carried out by wire line method with NQ borehole size using diamond bits. The polymer was used as drilling fluid to flush out the cuttings and stabilize the wall of exploratory boreholes. The drilling fluid also works as a coolant to avoid burning of drill bits, due care was taken to obtain maximum core recovery of cores. The limestone formation is hard and massive, which resulting the maximum core recovery of 90-95%.

1.10.3 Lithologically the limestone is very hard and massive with occasional thin intercalation of clays encountered in few places, hence resulted 90-95% core recovery. These factors are considered in resource estimation.

## **1.11.0 SAMPLING AND ANALYSIS**

### **1.11.1 PRIMARY AND CHECK SAMPLES**

Considering the uniform nature of the limestone over considerable thickness in all the boreholes and after study of lithological data generated during G-3 exploration optimum sample length of 1m is justifiable in evaluating grade of limestone. It was decided to keep 1m primary sample length considering on lithology, fossil content; however, sample of shorter and larger lengths were also prepared wherever felt necessary depending on the variations in the lithology and fossil contents.

### **1.11.2 COMPOSITE SAMPLE ANALYSIS**

Composite samples analysis not in approved quantum of the Kiranagi-1 and 2 blocks. Hence, composite samples not prepared for analysis.

## **1.12.0 EVALUATION OF LIMESTONE HORIZONS**

1.12.1 The investigation carried out by way of exploratory drilling with associated geological and laboratory studies which have generated the exploration data to establish the shape, size and geometry of the limestone horizons. This formed the basis for evaluation of various deposit parameters of the block. Zones were demarcated based on min 1.0 m sample length for all grades, based on cutoff and correlation with adjacent boreholes, Borehole data of the adjacent explored/mine block were also considered. The salient features of the evaluation are discussed below.

1.12.2 CEMENT GRADE LIMESTONE HORIZON ( $\text{CaO}\% \geq 44$ ,  $\text{MgO}\%$  Max 3.50,  $\text{SiO}_2\%$  Max 16).

### **1.12.3 BLENDABLE GRADE LIMESTONE HORIZON**

As per IBM guidelines, Blendable grade limestone zone was demarcated on  $\text{CaO}\%$  range between  $\geq 38$  to  $\leq 44\%$  and  $\text{MgO}$  shall not be more than 6%.

### **1.12.4 THRESHOLD GRADE LIMESTONE HORIZON**

As per IBM guidelines. Threshold grade limestone zone was demarcated on  $\text{CaO}\%$  range between  $\geq 34$  to  $\leq 38\%$  and  $\text{MgO}$  shall not be more than 6%.

1.12.5 As the limestone zones other than Portland Grade limestone in the explored block analysed high  $\text{CaO}$  and high  $\text{SiO}_2$ . Hence the Blendable Grade is categorised into two based on  $\text{SiO}_2$  values, firstly as Blendable Grade ( $-18\% \text{SiO}_2$ ) and second with high  $\text{SiO}_2$  ( $+18\% \text{SiO}_2$ ). The second type Blendable grade ( $+18\% \text{SiO}_2$ ) is clubbed with Threshold Grade limestone and categorised as Blendable/Threshold grade class and the same has been intersected in MKG-09 borehole.

### 1.13.0 METHODOLOGY ADOPTED FOR RESOURCE ESTIMATION

1.13.1 The resources of limestone have been estimated by Geological Cross Section method as principal method and Polygon method as check method. The methodology adopted, keeping the above assumptions in view, for resource estimation is as follows:

#### CATEGORISATION OF RESOURCES

Resources have been categorized under inferred and reconnaissance category of limestone resources (333 and 334) as per UNFC. The parameters and assumptions for resources estimation have been defined under chapter XIX.

Limestone zones are computed and categorized based on **End Use Grade** specifications prescribed by Indian Bureau of Mines, Government of India.

### 1.14.0 RESOURCES

1.14.1 The total Net in-situ resource of Cement (Portland), Blendable and Blendable/Threshold grade limestone is broadly categorized under inferred and reconnaissance (333 & 334) resources the details of the same is furnished in the following table. The total inferred category resource is 237.34 million tonnes and reconnaissance category are 195.51 million tonnes by cross sectional method.

**Table No 1.6**  
**Summary of Category wise Net-Resource**

**Unit: million tonnes**

| Category and UNFC Code | Cement (Portland) Grade | Blendable Grade | Blendable/Threshold Grade | Threshold Grade | Total  | Percentage |
|------------------------|-------------------------|-----------------|---------------------------|-----------------|--------|------------|
| 333                    | 156.55                  | 22.88           | 2.66                      | 55.24           | 237.34 | 54.83%     |
| 334                    | 124.98                  | 27.90           | 0.61                      | 42.03           | 195.51 | 45.17%     |
| Total                  | 281.43                  | 50.78           | 3.27                      | 97.27           | 432.85 | 100.00%    |

The total net inferred category resource is 237.34 (54.83% of total Net Geological resource of 432.85) million tonnes. The total net reconnaissance category resource is 195.51 (45.17% of total Net Geological resource of 432.85) million tonnes.

The resources of limestone for different grades have been estimated borehole wise, section wise, polygon wise and zone wise.

### 1.15.0 RECOMMENDATIONS

1.15.1 Total Net In-situ Resources of Cement (Portland) Grade resource is 281.43 million tonnes with an average grade of CaO 49.13%, MgO 0.54% and SiO<sub>2</sub> 9.96%. Total Net In-situ Resources of Blendable grade is 50.78 million tonnes CaO 43.88%, MgO 0.67% and SiO<sub>2</sub> 17.11%, Blendable/Threshold grade resource is 3.27 million tonnes with an average grade of CaO 42.28%, MgO 0.45% and SiO<sub>2</sub> 20.26% and Threshold Grade resource is

97.27 million tonnes with an average grade of CaO 40.60%, MgO% 0.58 and SiO<sub>2</sub> 23.45% have also been established.

- 1.15.2 The exploration is carried out as per Mineral (Evidence of Mineral Contents) Rule-2015, Mineral Auction Rule-2015, MMDR Amendment Act - 2015 and in accordance with the Minerals (Evidence of Mineral Contents) Amendments Rules 2021.
- 1.15.3 This level of exploration will facilitate the State government of Karnataka for auctioning of block under Mining Lease.
- 1.15.4 The study suggests that any future mining project may generate employment for the local people and will increase socio-economic status of the people residing in the nearby areas.
- 1.15.5 As approved, 5 boreholes were drilled; and resources are estimated in Inferred Category (333) & Reconnaissance (334) Category as per UNFC. However, the confirmation of resources at higher confidence level, few more boreholes should be drilled at closer interval.

## **CHAPTER - 2**

### **2.0.0 DETAILS OF THE QUALIFIED PERSON(S) / EXPLORATION AGENCY**

#### **2.1.0 INVESTIGATING AGENCY**

MINERAL EXPLORATION & CONSULTANCY LIMITED

(A Govt. of India Enterprise Miniratna PSE)

Dr. Babasaheb Ambedkar Bhavan, High Land Drive Road,

Seminary Hills, Nagpur-440006

#### **2.2.0 PERSONAL INVOLVED WITH PRELIMINARY EXPLORATION (G-3) IN KIRANAGI – 1 BLOCK, DISTRICT-KALABURAGI, KARNATAKA.**

- A : OVERALL GUIDANCE  
: Shri P. Ravindran GM (Exploration)
- B : OVERALL PLANNING and CO-ORDINATION  
: Shri P. Ravindran GM (Exploration)  
: Shri. Pradeep P. Kulkarni, DGM (Exploration)
- C : OVERALL SUPERVISION  
: Shri. Pradeep P. Kulkarni, DGM (Exploration)  
: Dr. Kuppusamy E, Sr. Manager (Geology)
- D PROJECT MANAGEMENT  
: Shri. Anil Tiwari, Project Manager  
: Shri. J. MadhuBabu, AM (Geology)  
: Shri. Ashok Kumar Shankar ADO (Drilling Engineer)  
: Shri, Kamlesh Kumar ADO (Drilling Engineer)
- E : PHYSICAL EXECUTION OF WORK  
: Shri. J. Madhu Babu, AM (Geology)  
: Shri. Ashok Kumar Shankar ADO (Drilling Engineer)  
: Shri. Kamalesh Kumar, ADO  
: Shri. Ripun Paul, TA (S&D)  
: Shri. Nagaraju, Sampling (Tech.)
- F : SAMPLE PROCESSING, MECL, NAGPUR  
: Shri. Sathish Kumar Inaparathi Sr. Tech. Sampling  
: Mrs. Shika Sharam Sr. Tech. Sampling

- G : CHEMICAL LABORATORY, MECL, NAGPUR  
: Shri. Rohit Sharma, Manager (Chemical)  
: Dr. Dipti Rahangdale, Manager (Chemical)
- H : PETROLOGICAL LABORATORY, MECL, NAGPUR  
: Shri. Sayantan Pal, Assistant Manager (Geology)
- I : INFORMATION TECHNOLOGY CENTRE  
: Shri. Uday Patil Sr. Operator (Computer)  
: Shri. N.C.S. Reddy, Console Operator
- J : DATA PROCESSING and DOCUMENTATION  
: Shri. Pradeep P. Kulkarni, DGM (Exploration)  
: Dr. Kuppusamy E, Sr. Manager (Geology)  
: Shri. J. Madhu Babu, A.M (Geology)  
: Shri. Jagdish Thakaral, Sr. MSO  
: Shri. Durgesh Devarshi STA (Map)

### **CHAPTER - 3**

#### **3.0.0 TITLE OF THE REPORT & OWNERSHIP**

Title: Geological Report of Kiranagi-I Block (G-3), Kalaburagi District, Karnataka.

Ownership: Department of Geology and Mining, Government of Karnataka

#### **3.1.0 DETAILS ABOUT PERIOD OF PROSPECTING**

The exploratory work in the block commenced on 11.05.2023 with the surveying and geological mapping on 1:4,000 scale. Subsequently, the exploratory drilling commenced with borehole no. MKG-06 and was completed with the closure of borehole no. MPK-09 on 27.05.2023. The allied field-works including surveying, geological mapping, drilling and borehole core sampling etc. were completed simultaneously. The analytical / laboratory studies were also carried out simultaneously in laboratories of MECL and other NABL accredited laboratories.

#### **3.3.0 DETAILS OF EXPLORATION AGENCY, QUALIFICATION, AND EXPERIENCE OF ASSOCIATED TECHNICAL PERSONS ENGAGED IN EXPLORATION**

3.3.1 Exploration Agency: Mineral Exploration and Consultancy Limited

(Formerly Mineral Exploration Corporation Limited)

A Govt. of India Enterprise-A Miniratna-ICPSE

3.3.2 Qualification: M.Sc. / M. Sc. Tech. (Geology)

3.3.3 Experience: Experience: Since 1972 Exploration agency

: Mineral Exploration and Consultancy Limited

3.3.4 Address of the Prospector: Dr. Babasaheb Ambedkar Bhavan, High Land Drive Road,

Seminary Hills, Nagpur, Pin- 440006

3.3.5 Email: [cmd@gov.in](mailto:cmd@gov.in); [gm-exploration@mecl.gov.in](mailto:gm-exploration@mecl.gov.in)

3.3.6 Phone No: 0712-2510289; 0712-2511829

## CHAPTE - 4

### **4.0.0 DETAILS OF THE AREA**

#### **4.1.0 LOCATION OF THE BLOCK**

- 4.1.1 The explored Kiranagi-1 block is located in Kalaburagi Taluk, Kalaburagi District. The block can be approached from the nearest Kalaburagi Taluk headquarters towards west at a distance of around 24kms, by single lane asphalted village roads.
- 4.1.2 A village road from Kiranagi Village to Tonsahalli is passing outside the block in the south eastern side at about 300m distance from the Kiranagi-1 block.
- 4.1.3 Kiranagi-1 block covers an area of 5.5734sq.km as provided by DGM, Karnataka to NMET and MECL, the deposit falls within the Survey of India Toposheet No.56 C/16. The block limits with co-ordinates of cardinal points as given below. (As provided by DGM, Karnataka).

**Table-6.1  
CO-ORDINATES OF CARDINAL POINTS OF THE BLOCK BOUNDARY  
(UTM CONVERTED)**

| Boundary Points | WGS 1984 DMS     |                  | UTM(m)     |             |
|-----------------|------------------|------------------|------------|-------------|
|                 | Longitude        | Latitude         | X (E)      | Y (N)       |
| KE1             | 76° 53' 1.247"E  | 17° 09' 46.653"N | 730933.538 | 1902026.461 |
| KE2             | 76° 52' 41.266"E | 17° 08' 20.961"N | 733372.913 | 1901673.966 |
| KW-1            | 76° 51' 37.148"E | 17° 09' 47.298"N | 731540.207 | 1898450.414 |
| KW-4            | 76° 51' 42.426"E | 17° 08' 21.481"N | 728906.867 | 1899950.505 |

#### **4.2.0 DETAILS OF THE AREA WITH LAND USE**

- 4.2.1 Cadastral details of the area with land use, area under forest with type of forest. In case the cadastral details are not available an indicative data of breakup of government, private and forest land.

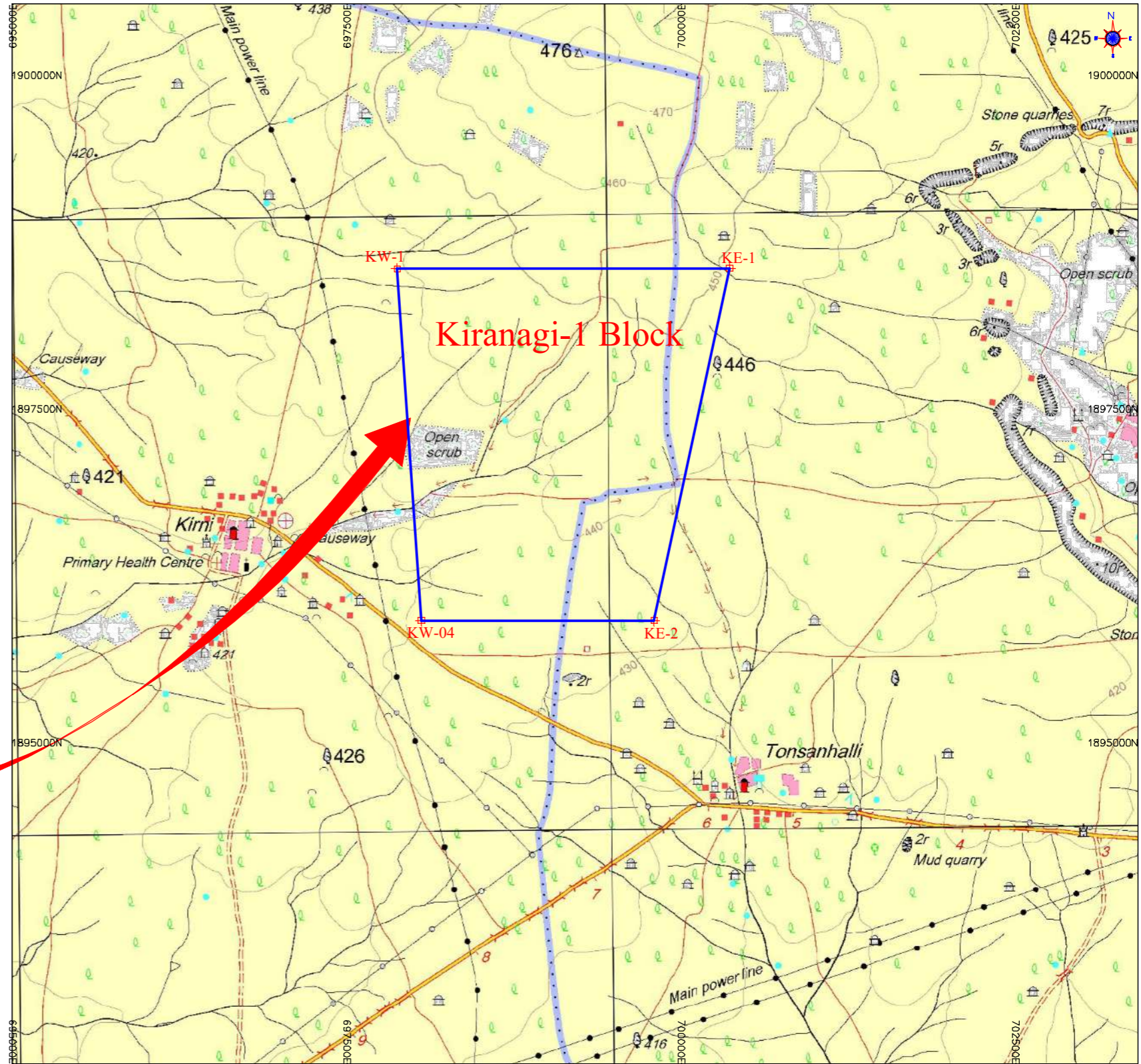
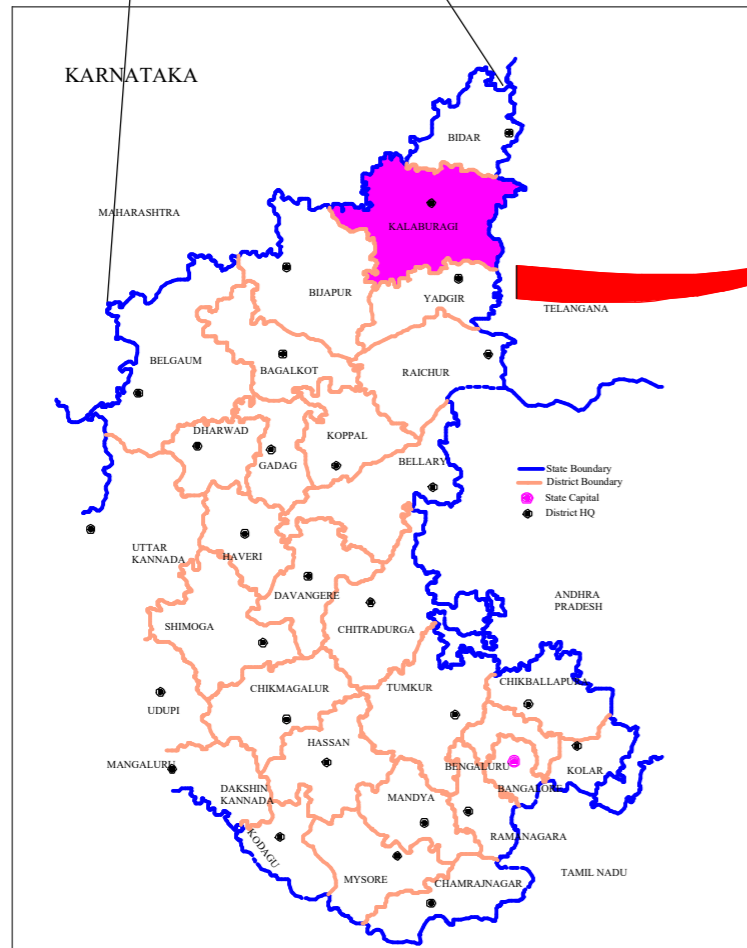
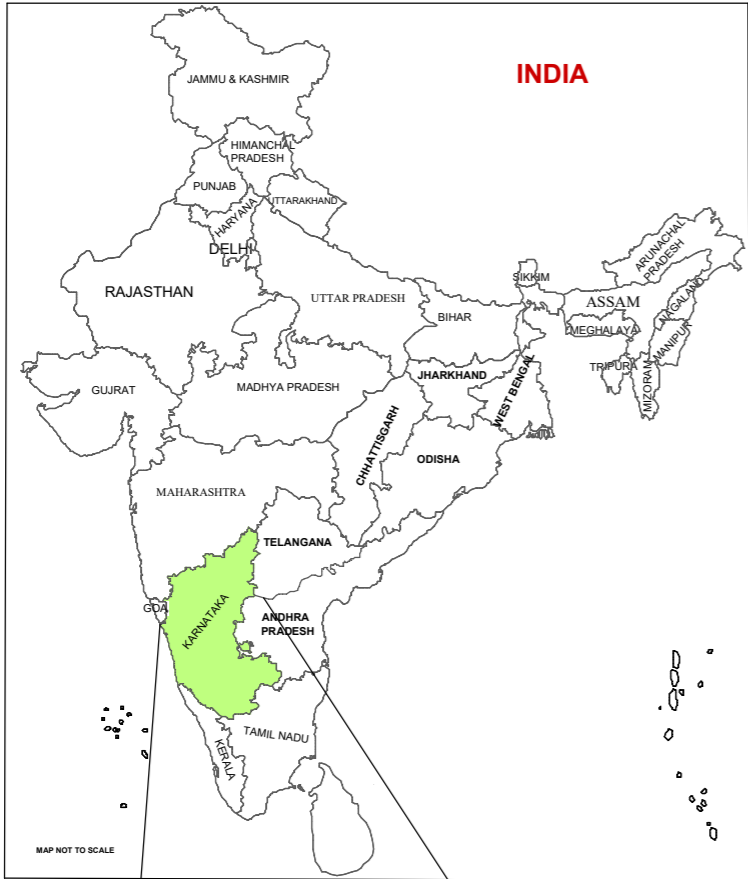
Data not available

#### **4.3.0 MINERAL(S) UNDER INVESTIGATION**

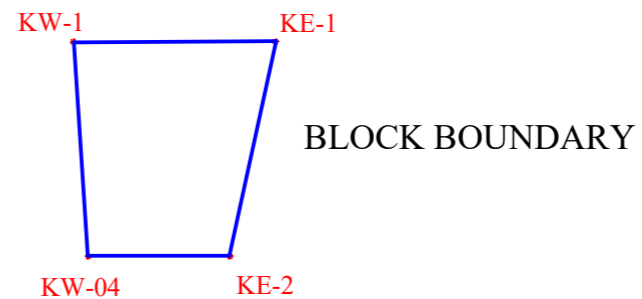
- 4.3.1 Mineral(s) under investigation or granted under license or lease.

Limestone

# LOCATION MAP OF KIRANAGI-1 BLOCK (PART OF TOPOSHEET NO:-56C/16)



| ID   | Easting (Meter) | Northing (Meter) | Elevation (Meter) | Feature Code |
|------|-----------------|------------------|-------------------|--------------|
| KE1  | 700360.893      | 1898554.680      | 450.803           | BP           |
| KE2  | 699795.811      | 1895914.501      | 434.849           | BP           |
| KW-1 | 697875.140      | 1898550.534      | 443.397           | BP           |
| KW-4 | 698056.442      | 1895913.773      | 434.186           | BP           |



TEXT FIGURE NO-1

NOT TO SCALE

## **CHAPTER - 5**

### **5.0.0 PHYSIOGRAPHY AND ENVIRONMENT**

#### **5.1.0 RELIEF OF THE AREA WITH MINIMUM AND MAXIMUM ELEVATION, DRAINAGE PATTERN, NATURAL WATER COURSES, RESERVOIRS ETC**

5.1.1 The area is generally flat and maximum area is covered by cultivated fields. The block area depicts plain with gentle slope towards North. The elevation of the area ranges from 434m to 454m above mean sea level. The general slope of the topography in the blocks is from Northeast to Southwest.



**Photo-1: A Panoramic view of Kiranagi-1 Block**

#### **5.2.0 ROADS, RAILWAY TRACK, ELECTRIC TRANSMISSION LINE, TELEPHONE LINE ETC**

5.2.1 The explored block fall in the jurisdiction of Kiranagi Village, Kalaburagi Taluk and District. The district head quarter Kalaburagi is at a distance 24kms towards north from the block.

5.2.2 Shahabad is the nearest railway station at a distance of around 11 kms from the explored block. Nearest airport is at Kalaburagi at a distance of 24km. The nearest port is Marmagoa, Goa situated at around 480km from the explored block.

5.3.3 No electrical Transmission lines are seen within the block. However the Kiranagi Village is having electric transmission for domestic purposes and also well connected by telecommunication net-works for fare communication.

#### **5.3.0 HOST POPULATION (LOCAL TRIBES), HUMAN SETTLEMENTS WITHIN AND NEARBY THE AREA**

5.3.1 The initial provisional data released by Census India 2011, shows the density of Kalaburagi District for 2011 had population of 25,66,326 of which male and female were 13,01,755 and 12,64,571 respectively.

5.3.2 Kiranagi -1 block falls in Kiranagi village, Kalaburagi Taluka of Kalaburagi District. Kiranagi village has a population of 5465 out of which 2743 are male and 2722 females. Literacy rate combined is 49.80% (Male 79.60% & Female 20.40), out of total population 668 (12.2%) belong to SC community and (7) 0.1% belong to ST community.

#### **5.4.0 SOCIO DEMOGRAPHIC PROFILE OF THE AREA AND NEARBY**

5.4.1 Kiranagi village has a population of 5465 out of which 2743 are male and 2722 females. Literacy rate combined is 49.80% (Male 79.60% & Female 20.40), out of total population 668 (12.2%) belong to SC community and (7) 0.1% belong to ST community.

5.4.2 Professionally there are workers, agricultural farmers and labourers in Kiranagi Village. Out of total population 5465, Female population 2722 and Male population is 2743. Out of these 44.80% are working population. engaged in work activities.

#### **5.5.0 HISTORICAL SITES AND ARCHAEOLOGICAL MONUMENTS, PLACES OF WORSHIP, PUBLIC UTILITIES ETC. WITHIN OR NEARBY**

5.5.1 Shree Basvaligeshwar, Magamma Devi, Sharvanabasaveshwara and Sanesavara Temples are within 2km radius from the block. In addition to this Jamiy masjid and Eid Gah Masjith are also approachable with-in 10 km radius from the block.

#### **5.6.0 FOREST, SANCTUARIES, NATIONAL PARK AND WILD LIFE SANCTUARY**

5.6.1 No Forest, Sanctuaries, National Park and Wild Life Sanctuaries exists within the 10kms from the explored block. Nearest wildlife sanctuary is Chincholi Wildlife Sanctuary and it is situated about 103 kms towards north-east from Kiranagi in Kalaburagi District

#### **5.7.0 FLORA AND FAUNA**

5.7.1 The area is characterised by scanty vegetation and dry crop cultivation. Chilli, maize, groundnut, gingili and pulses are the common dry crops cultivated by rotation. Study area is fertile. Mostly cashew, black gram is cultivated in the study area.

5.7.2 The area has no rare endangered species of fauna. The species of fauna found in the area are rat, squirrel, lizard and house crow and reptiles.

5.7.3 Total block area is under cultivation i.e., agricultural activities.

#### **5.8.0 WATER BODIES SUCH AS RIVER, NALA, STREA, RESERVOIR, ETC**

The block is drained by West flowing Kagina river and Mullamari river forms the main drainage in the area. There is no perennial river within the block area, however a seasonal nala flows across the central part of the block. The drainage pattern of the area is dendritic in nature.

#### **5.9.0 CLIMATE CONDITIONS**

5.9.1 The climate of the area is tropical monsoon type. The temperature during winter month seldom goes to 10<sup>0</sup> C, while in the peak summer it rises up to 45<sup>0</sup> C. The average rain fall is 770-880mm and the relative humidity varies from 26% in summer to 62% in winter.

#### **5.10.0 OTHER PHYSIOGRAPHIC, SOCIAL AND ENVIRONMENT FACTOR**

5.10.1 The block area is generally flat with moderately slopes terrain from northeast towards southwest. Entire area is covered by soil cover and main source of the income is agriculture. In addition, there are many Cement industries are in the Kalaburagi District.

5.10.2 No major environment factors such as Sanctuaries, Forest areas are with-in the buffer zone of 10kms.

## **CHAPTER - 6**

### **6.0.0 INFRASTRUCTURE AND ENVIRONMENT**

#### **6.1.0 LOCAL INFRASTRUCTURE DETAILS**

6.1.1 The block can be approached from the nearest Kalaburagi Taluk headquarters towards south at a distance of around 24kms. by single lane asphalted village roads. The explored block fall in the jurisdiction of Kiranagi Village, Kalaburagi Taluk and District. The district head quarter Kalaburagi is at a distance 24kms towards north from the block. The nearest airport (Kalaburagi Airport) is at about 30 km from the block.

6.1.2 Banking, Government medical facility, Postal, Police facilities are available at Kiranagi village, and as well as in Kalaburagi Taluka which is 24km from the explored block and educational and other major facilities are available at Kalaburagi Taluk.

6.1.3 Shahabad is the nearest railway station at a distance of around 11 kms from the explored block. Nearest airport is at Kalaburagi at a distance of 24km. The nearest port is Marmagoa, Goa situated at around 480km from the explored block.

6.1.4 The block area is surrounded by cement manufacturing industries and some them are as follows:

- Orient Cement Plant, Itgi, Chittapur
- Ultratech Cement Plant, Malkhed
- Vasavadatta Cement plant, Sedam
- Jaypee Cement Corporation Ltd. Plant, Shahabad
- ACC, Cement, Wadi
- Shree Cement, Kalaburagi

#### **6.2.0 HOST POULATION AND HISTORICAL SITES**

6.2.1 Kiranagi -1 block falls in Kiranagi village, Kalaburagi Taluka of Kalaburagi District. Kiranagi village has a population of 5465 out of which 2743 are male and 2722 females. Literacy rate combined is 49.80% (Male 79.60% & Female 20.40), out of total population 668 (12.2%) belong to SC community and (7) 0.1% belong to ST community.

6.2.2 Shree Basvaligeshwar, Magamma Devi, Sharvanabasaveshwara and Sanesavara Temples are within 2km radius from the block. In addition to this Jamiy masjid and Eid Gah Masjith are also approachable with-in 10 km radius from the block.

#### **6.3.0 FORESTS, SANCTUARIES, NATIONAL PARK AND ENVIRONMENT SETTING OF THE AREA**

6.2.1 No Forest, Sanctuaries, National Park and Wild Life Sanctuaries exists within the 10kms from the explored block. Nearest wildlife sanctuary is Chincholi Wildlife Sanctuary and it is situated about 103 kms towards north-east from Kiranagi in Kalaburagi District.

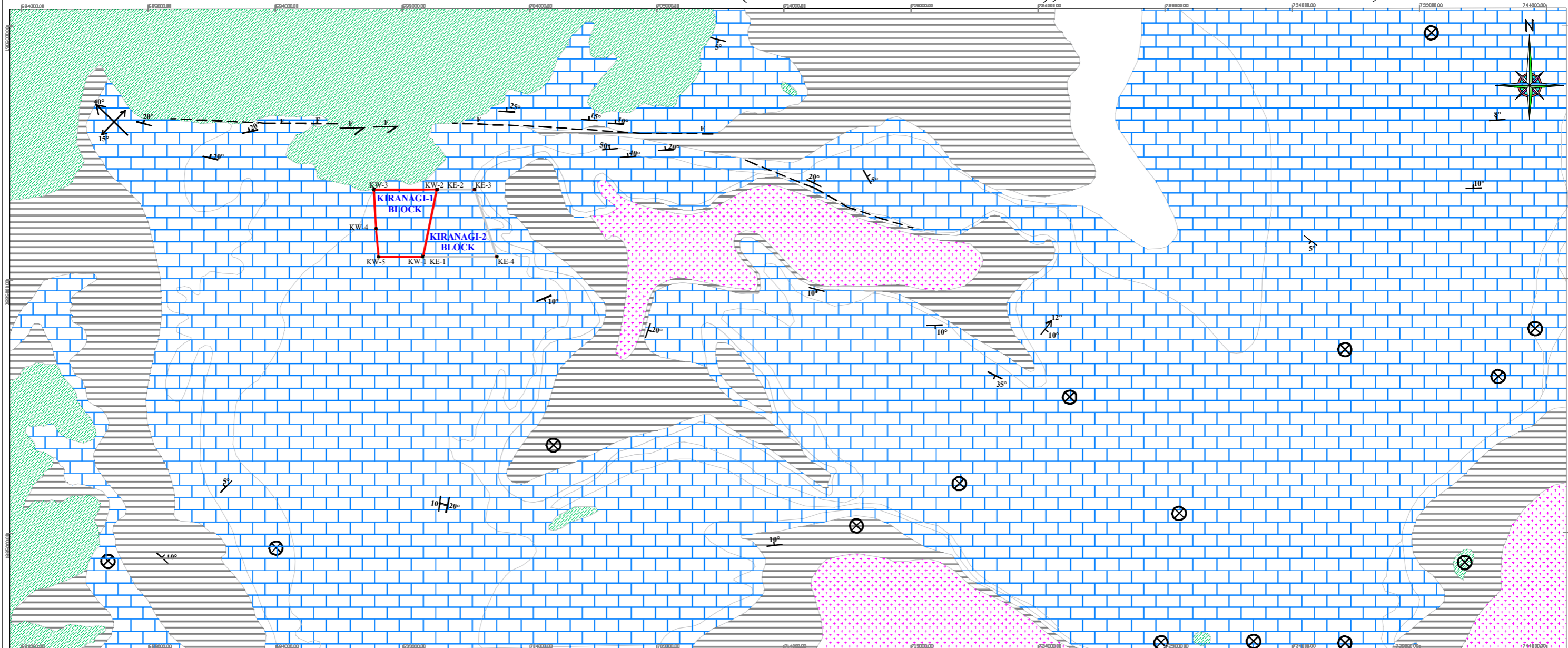
## CHAPTER - 7

### **7.0.0 GEOLOGY OF THE AREA**

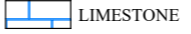



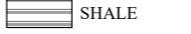





#### **7.1.0 REGIONAL GEOLOGY**

- 7.1.1 Bhima basin is the smallest of all Proterozoic basins of India. They do not actually come in contact with the Kaladgi Group and are believed to be younger. They are in close resemblance to the Kurnool Group of the Cuddapah Super group. The Bhima Basin is covered by latitude N 16°20' to 17°35' and longitude N 76°15' to 77°40'E. The Bhima Basin is trending N-S for about 160 km with varying width and the maximum being 40 km. The Northern and North-Western extensions are concealed under Deccan Traps. The Southern and Eastern margins of the basin mark the unconformity contact with granitic gneisses of Dharwar Craton. It extends over an area of 5200 sq.km. and is situated to the North-West of Cuddapah Basin and North-East of Kaladgi Basin.
- 7.1.2 Captain New Bold (1842 – 1845) was first to record the Talikote flaggy limestone and Muddebihal red sandstone. R. Bruce Foote (1876) had divided the Bhima Group (mainly of limestone) into lower clastic represented by sandstone and shale and upper mainly of limestone and shales. Further, Mahadevan (1947), Janardhana Rao et.al (1973), Mathur (1977), Mudholkar and Kale (1982) and Mishra et.al (1987) classified Bhima Group. However, Vivek S. Kale, V.G. Phansalkar et.al (1991) classified Bhima Group into Rabanapalli (clastic) formation and Shahabad (limestone) formations.
- 7.1.3 The Stratigraphic Column of the Bhima Group (after GSI) is furnished in below:

# REGIONAL GEOLOGICAL MAP OF KIRANAGI-1 BLOCK (PART OF BHIMA BASIN), KALABURAGI DISTRICT, KARNATAKA



Source: The Geological Map of Bhima Basin (Parts of Gulbarga and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G, and H) Scale 1:200000, 2007, Published, GSI

| INDEX   |                  |   |                    |
|---|------------------|---|--------------------|
|  | LIMESTONE        |  | GRANITE            |
|  | DECCAN TRAP      |  | HORIZONTAL BEDDING |
|  | SHALE            |  | PLUNGING ANTIFORM  |
|  | FAULT            |  | STRIKE SLIP FAULT  |
|  | KIRANAGI-1 BLOCK |  | BEDDING            |

NOT TO SCALE

TEXT FIGURE NO - 02

**Table No. 7.1**  
**The Stratigraphic Column of the Bhima Group (after GSI)**

| Group  | Sub-Group   | Formation  | Member  | Thickness(m)                                  |           |     |
|--|---|--|---|---|-----------|-----|
| <b>Deccan Trap</b>   | -   |  | Basic flows   |   |           |     |
| <b>Bhima Group</b><br>(upper Proterozoic )<br>(93-273 m.y) |   | Harwal-Gogi  |   | 5-10  |           |     |
|  | Andola Sub-group in Pulsating basin environment (31-68 m.y) | Katamdevarhalli  | Fossil shale member ortho-quartzite chert + pebble conglomerate | 10-40<br>16-18                                |           |     |
|  |   | Halkal   |   |   |           |     |
|  | ----- Paraconformity -----                                  |  |   |   |           |     |
|  |   |  |   | Flaggy dark grey and argillaceous limestone   | 4-6       |     |
|  |   |  |   | Massive dark grey and bluish grey Limestone   | 8-20      |     |
|  |   |  | Shahabad  | Variegated and siliceous/cherty Limestone     | 20-80     |     |
|  |   | Sedam Sub-group with quiescent basin regime (62-2.5 m.y) |   | Blackish, light grey to bluish grey limestone | 10-15     |     |
|  |   |  |   | Slabby and flaggy Lst                         | 4-8       |     |
|  |   |  |   | Purple shale                                  | 2-40      |     |
|  |   |  |   | Green/yellow shale                            | 5-15      |     |
|  |   |  |   | Rabanapalli                                   | Siltstone | 3-4 |
|  |   |  |   | Quartzite/Intercalated sandstone              | 5-15      |     |
|  |   |  |   | Conglomerate / grit                           | 1-2       |     |
| ----- Un conformity -----                                  |   |  |   |   |           |     |
| Basement Crystallines                                      |   |  | Younger granite peninsular gneisses                             | -   |           |     |

7.1.4 Recent classification (1991) of revised litho stratigraphy of the Bhima Group is furnished below:

**Table No. 7.2**  
**Revised litho stratigraphy of the Bhima Group**  
**(after Vivek S. Kale, V.G. Phansalkar et.al 1991)**

| Formation  | Maximum Thickness(m) | Member                            | Main Lithological components  |
|--|----------------------|-----------------------------------|---|
| 2. Shahabad Limestone                            | < 75                 |                                   | <ul style="list-style-type: none"> <li>• Grey, argillaceous micriticlimestones.</li> <li>• Dark, bluish grey, massive limestones.</li> <li>• Variegated, siliceous and cherty limestones.</li> <li>• Blue- grey, black-micriticlimestones.</li> <li>• Flaggy (Partly impure argillaceous and cherty) limestones.</li> </ul> |
| ----- Gradational and transitional contact ----- |                      |                                   |   |
| 2. Rabanpalli Clastics                           | < 70                 | Ekmai shale member                | Ferruginous shales, with calcareous shales at top.  |
|  |                      | Kasturpalli-Glauconitic member    | Green, glauconite, fine grained sandstones and siltstones.  |
|  |                      | Kundrapalli quartz arenite member | Quartzitic sandstones (medium to fine grained).   |
|  |                      | Adki Hill conglomerate member     | Polymictic conglomerates and arkosic, gritty sandstones.  |

7.1.5 The total absence of fossils rules out the sediments of Bhima Group transgresses into the Cambrian. Thus envisaged the upper age limit is not less than 600 million years.

7.1.6 Regional Geological map of Bhima Basin (Part) is enclosed as Plate No.II in 1: 150,000 Scale.

### 7.2.0 REGIONAL STRUCTURE

7.2.1 The general trend of all formations is NE–SW. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses.

7.2.2 Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. Deformation is observed only in the vicinity of faults. The faults encountered have continued into the basement that has exercised control upon the basin configuration.

### 7.3.0 REGIONAL MINERALISATION

7.5.1 The basin is well known for its huge resource of limestone and the newly discovered Uranium occurrences near Gogi (1998-2000) by AMD.

7.5.2 Stylolites are diagenetic structure usually follow the bedding plane and are filled by ferruginous clayey material. Within the Massive limestone, dolomitic limestone and shaly limestone as thin veins of re-crystallized calcite are present. Solution cavities and vugs filling are found well within the dolomitic limestone and shaly limestone. Sedimentary deformation structures are present at places in shaly limestone.

### 7.4.0 GEOLOGY AND STRUCTURE OF THE BLOCK

7.4.1 The rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima Group. The stratigraphic sequence of the litho units exposed in and around the block based on field observations and available data/literature from nearby mine/areas is given in Table-9.3. The Topographical & Geological Map of the Kiranagi-1 Block is enclosed as Plate No III in 1: 4000 Scale.

**Table No. 7.3**

**Stratigraphic Sequence of Litho-units exposed in and around the Block**

| Age  | Group | Sub Group | Formation           | Litho Units  |
|--|-------|-----------|---------------------|--|
| Quaternary                                       | -     | -         | Recent              | Top soil   |
| Upper Proterozoic                                | Bhima | Sedam     | Shahabad Limestone  | Siliceous/flaggy limestone<br>Massive grey limestone<br>Shaly limestone                          |
| ----- Gradational and transitional contact ----- |       |           |                     |  |
| -  | -     | -         | Rabanpalli Clastics | Ferruginous Shales, calcareous shales, Green, Glauconite, fine grained Sandstones and Siltstones |

### 7.5.0 STRUCTURAL FEATURES OBSERVED IN & AROUND THE BLOCK

#### 7.5.1 PRIMARY SEDIMENTARY AND SECONDARY/DIAGENETIC STRUCTURES

The preservation of primary sedimentary structure in this block are absent. The entire area is covered by soil cover with few out crops are exposed to limited extent in the west of the block.

7.5.2 As the area is fully covered by soil cover, the sedimentary deformations structures are not noticeable

7.5.3 The rock formations of the Block are horizontally disposed and mostly concealed under top soil. At places, limestone beds dip 1° to 3° due North.

## 7.6.0 DESCRIPTION OF ROCK TYPES

7.6.1 Almost entire area of the block is concealed under quaternary sediments i.e. soil cover. Scanty scattered limestone outcrops are seen at places along the seasonal water way in the south of the south-west of the block. Since most of the area is concealed under soil cover the strike and dip of the limestone beds are observed in two or three places within the block. Mining activities are currently ongoing in the eastern part of the Bhima Basin wherein limestones are being excavated for manufacturing of cement. The lithological description of litho units from top to bottom as obtained from drilled boreholes from Kirangi 1 and 2 blocks. The stratiform and tabular limestone deposit of Kiranagi – 1 block belongs to Bhima Basin formation of upper Proterozoic age. The details of stratigraphic lithounits encountered in MECL boreholes are discussed below.

### 7.6.2 Top Soil

The overburden top soil is black in colour, fine to silty, friable when dry and sticky when wet. The Over burden soil covers almost the entire Block. The thickness of the soil as intersected in boreholes varies from 2.00m (MKG-09) to about 4.00m (MKG-08).



**Photo 2: Soil cover with in the Kiranagi -1 Block**

### 7.6.3 Shahbad Limestone

Massive limestone is dark grey to light grey in colour, micritic, fine grained and compact. Stylolitic structures are often noticed. The massive grey limestone is of Cement Grade (Portland) to high grade encountered in one zone with intermittent partitions of blendable grade blendable/threshold grade limestone zones. Over all in all the five boreholes, the blendable and threshold limestone are + 38% Cao with +18.00 SiO<sub>2</sub> and limestone is dark grey to light grey in colour, micritic, fine grained and compact.



**Photo 3: Limestone Exposures in the Kiranagi-1 Block**

### 7.7.0 PETROGRAPHIC STUDIES

7.7.1 A total of 7 nos. of drill core specimens from limestone horizon were drawn during the phase of exploration and petrographic study was carried out in Petrology Laboratory, MECL Nagpur. The rock specimen is identified as micritic limestone. Major mineral is calcite and minor minerals are clay minerals, opaques, sericite, glauconite as accessory minerals The details of studies are furnished as Annexure-VI.

**Table No. 7.4**  
**Summary of the petrographic study done by Petrology Laboratory, MECL**

| SL. NO | SAMPLE NO. | BOREHOLE NO. | FROM (m) | TO (m) | ROCK TYPE CONFIRMED BY PETRO LAB |
|--------|------------|--------------|----------|--------|----------------------------------|
| 1      | MKG-06/P4  | MKG-06       | 15.00    | 15.05  | Micritic limestone               |
| 2      | MKG-06/P5  | MKG-06       | 25.00    | 25.06  | Micritic limestone               |
| 3      | MKG-07/P6  | MKG-07       | 17.00    | 17.06  | Micritic limestone               |
| 4      | MKG-07/P7  | MKG-07       | 22.00    | 22.06  | Micritic limestone               |
| 5      | MKG-08/P8  | MKG-08       | 13.00    | 13.06  | Micritic limestone               |
| 6      | MKG-08/P9  | MKG-08       | 42.00    | 42.06  | Micritic limestone               |
| 7      | MKG-08/P10 | MKG-08       | 44.00    | 44.06  | Micritic limestone               |

### 7.7.2 PHOTOMICROGRAPHIC STUDIES

A total of 4 nos. of drill core specimens from limestone horizon were drawn during the phase of exploration and petrographic study was carried out in Petrology Laboratory, MECL Nagpur.



**Photo 4:** Photomicrograph showing grain size coarsening, ferruginous dissemination and contraction cracks in micritic limestone as seen under cross nicols.

**Specimen No: MKG-06/ P5**

**Magnification : 100X**



**Photo 5:** Photomicrograph showing undulating stylolitic cracks and grain size coarsening in micritic limestone as seen under cross nicols.

**Specimen No: MKG-07/ P6**

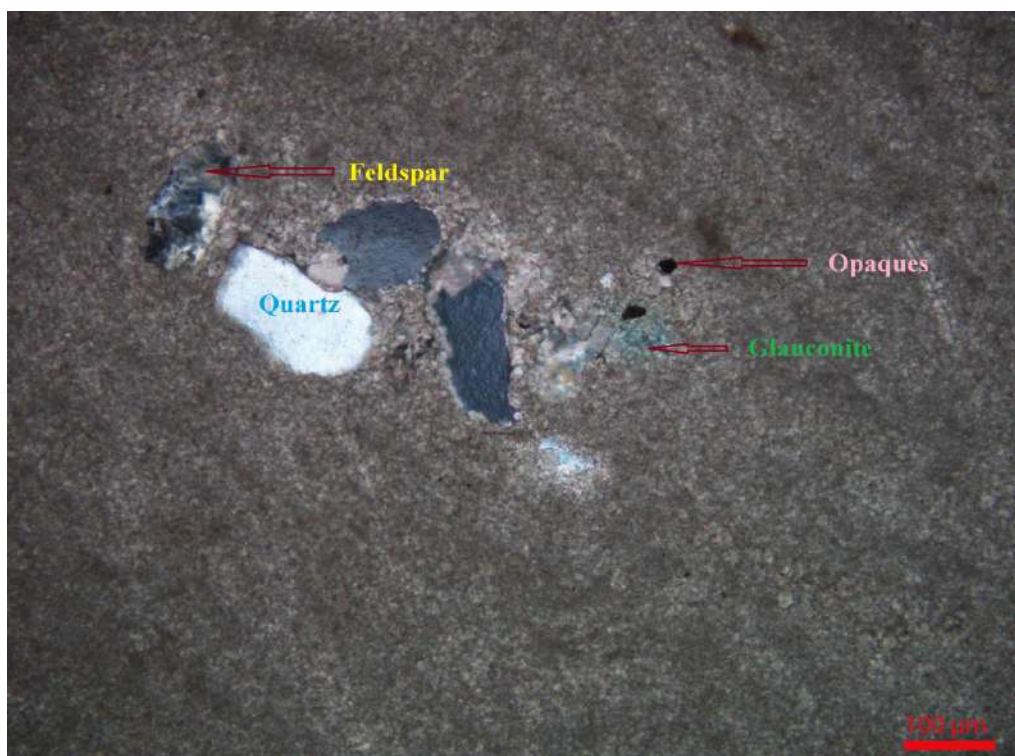
**Magnification : 40X**



**Photo 6:** Photomicrograph showing sparry replacement, stylolitic fillings and fine subhedral opaques in accessories in micritic limestone as seen under cross nicols.

**Specimen No: MKG-07/ P7**

**Magnification : 100X**



**Photo 7:** Photomicrograph showing quartz, feldspar, opaques and glauconite within micritic limestone as seen crossed nicols.

**Specimen No: MKG-08/ P10**

**Magnification : 100X**

### 7.8.0 MINERALISATION IN THE BLOCK

7.8.1 In the present exploration block, entire area is covered by soil cover with 3 out crops are seen in the western side of the block in throughout the block, however limestone intersected in all the drilled (05nos.) boreholes in the explored block.



**Photo 08 Limestone Exposures**



**Photo 9 Limestone Exposures**

## CHAPTER - 8

### **8.0.0 PREVIOUS WORK**

#### **8.1.0 DETAILS OF PREVIOUS EXPLORATION CARRIED OUT BY OTHER AGENCIES/PARTIES**

##### **8.1.1.0 PREVIOUS EXPLORATION BY DMG OF KARNATAKA**

8.1.1.1 Previously no detailed work has been carried out in the proposed Kiranagi-1 block. However, the entire Bhima basin was mapped by GSI and exploration at different stages was carried out in a scattered manner. The Geological Map of Bhima Basin (Part) of Kalaburagi and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G, and H Scale 1:150,000, 2007, Published by GSI is attached as **Plate No. II**.

8.1.1.2 Directorate of Mining & Geology (DMG), Karnataka explored the adjoining area in detail in the year 1976 with the purpose of proving cement grade limestone in the area. The exploration could establish the occurrence of large reserves of cement grade limestone in the area. The results of investigation are given in the report entitled "Limestone Deposits immediately to the East of Chittapur, Kalaburagi District of Karnataka." The said work was targeted for feasibility to setup cement industry.

##### **8.1.2.0 PREVIOUS EXPLORATION BY GEOLOGICAL SURVEY OF INDIA**

8.1.2.1 GSI carried out preliminary investigation for Flux grade Limestone around Wadi, Kalaburagi District Karnataka during the year 1974-75. The area is occupied by Shahabad limestone formation of Bhima Group, chip samples were collected from vertical faces of the quarries existing in the area. Chemical analysis shows that the MgO content is always very low. A few beds of grey to dark grey soft limestone are of blast furnace grade and the rest are of cement grade. Flaggy to slabby variegated limestones are always siliceous in composition with the insoluble around 15%.

8.1.2.2 During the field season 1976-77, GSI carried out preliminary investigation for Flux grade Limestone near Wadi, Kalaburagi District Karnataka. An area of about 16.75 sq. km. on 1:7,910 scale using the village maps as base map was covered by mapping. A total of 150 samples were collected and analysed. The formations met with here are Rabanapalli shale and flaggy limestone, stylolitic limestone and variegated limestone units of Shahabad Limestone Formation. All those formations are remarkably horizontal and undisturbed. Generally, stylolitic limestone contains CaO 48% and above and insoluble around 10%. Hence it is categorized as Blast Furnace Grade. The other two units can be utilized in cement manufacture if suitably blended with high grade limestone. An inferred reserve of 96 million tonnes of Blast Furnace grade limestone has been estimated over an area of 4.00 sq.km to a depth of 12 m. Drilling

can be taken up to explore the depth-wise persistence and lateral extension of the B.F. grade limestone.

- 8.1.2.3 During the F.S. 1977-78, GSI carried out preliminary investigation for Flux grade Cement grade Limestone in Bhima Basin, Kalaburagi District, Karnataka. Preliminary investigation for flux grade and cement grade limestone in parts of Bhima Basin, Kalaburagi District, Karnataka was taken up an area of 50.5 sq.km area was mapped on 1:10,000 scale using tape and compass and a total of 125 samples were collected, around Wadi and Chittapur. The limestone met with in this area has been classified as fissile limestone stylolitic limestone and variegated limestone. Stylolitic limestone is of Flux grade (Blast Furnace grade) and occupies over an area of 8.5sq.km. Total inferred reserve of B.F. grade limestone has been calculated as 153 million tonnes for the area under investigation.
- 8.1.2.4 GSI had carried out G-2 exploration in Bommanalli Limestone Block and estimated a resource of B.F Grade 244.27 MMT in Avg 49.83% CaO, 9.92%SiO<sub>2</sub>, 1.16%Al<sub>2</sub>O<sub>3</sub>, Portland Cement Grade 18.921 MMT in Avg 47.42% CaO, 14.41%SiO<sub>2</sub>, 0.91%Al<sub>2</sub>O<sub>3</sub>, 154.246 MMT in Avg 41.80% CaO, 23.37%SiO<sub>2</sub>, 2.12%Al<sub>2</sub>O<sub>3</sub> and 46.488 MMT in Avg 39.12% CaO, 27.17%SiO<sub>2</sub>, 1.65%Al<sub>2</sub>O<sub>3</sub>.
- 8.1.2.5 GSI had carried out G-2 exploration in Chittapur South Limestone Block and estimated a resource of Portland Cement Grade 89.04 MMT in Avg 46.39% CaO, 15.65%SiO<sub>2</sub>, 0.98%Al<sub>2</sub>O<sub>3</sub>, Beneficiable Cement Grade 228.16 MMT in Avg 39.08% CaO, 27.03%SiO<sub>2</sub>, 1.66%Al<sub>2</sub>O<sub>3</sub>.
- 8.1.2.6 GSI had carried out G-4 level exploration in Chitapura SW Block and Sulahalli Limestone Block, estimated a resource of 438.00 MMT of Cement Grade Limestone and 466.00 MMT of Cement Grade Limestone respectively.

### **8.1.3.0 PREVIOUS EXPLORATION BY MECL**

- 8.1.3.1 MECL has carried out G-3 level of exploration in Diggaon and Udagi blocks and recently carried G3 level exploration in Malkhed 1 and 2 blocks in the February-April 2023.
- 8.1.3.2 East of Chittapur and North Diggaon village, MECL has carried out exploration during 2018-19 at G3 level and established 530.80 MT with average grade 45.45% CaO, 1.00% MgO, 11.59% SiO<sub>2</sub> in Diggaon Block and 385.35 MT with average grade 45.66% CaO, 0.55% MgO, 12.98% SiO<sub>2</sub> in Udagi Block of net in-situ resource of Cement grade Limestone. Presently these blocks are on auction platform.

- 8.1.3.3 In the recent exploration carried out by MECL in Malkhed 1 block, MECL estimated a total Geological Net In-situ Resources of Cement (Portland) Grade resource estimate is 686.26 million tonnes with an average grade of CaO 49.09%, MgO 0.42% and SiO<sub>2</sub> 11.49%. Total Geological Net In-situ Resources of Blendable grade is 25.00 million tonnes CaO 45.87%, MgO 0.48% and SiO<sub>2</sub> 16.84%. However, the Blendable/Threshold grade resource are 346.89 million tonnes with an average grade of CaO 43.26%, MgO 0.52% and SiO<sub>2</sub> 20.68% have also been established. The occurrence of limestone is confirmed up to 130m by a Straigraphic borehole (KML-08) which was drilled up to 150m (Closed in Ekmai Shale at 150.00m)
- 8.1.3.4 In the recent exploration carried out by MECL in Malkhed 2 block, MECL estimated a total Geological Net In-situ Resources of Cement (Portland) Grade resource estimate is 264.02 million tonnes with an average grade of CaO 48.31%, MgO 0.38% and SiO<sub>2</sub> 13.17%. However, the Blendable/Threshold grade resource are 606.70 million tonnes with an average grade of CaO 43.51%, MgO 0.48% and SiO<sub>2</sub> 20.58% have also been established.

## **CHAPTER - 9**

### **9.0.0 GEO PHYSICAL EXPLORATION**

#### **9.1.0 GROUND GEO PHYSICAL EXPLORATION**

9.1.1 The present exploration has been carried out for limestone in Kiranagi – 1 Block G-3 stage for which geophysical survey has not been carried out.

## CHAPTER - 10

### 10.0.0 EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

#### **10.1.0 INTRODUCTION**

- 10.1.1 The Kiranagi - Block G-3 stage exploration block over an area of 11.41 sq. km. lies in the Kiranagi Village of the Kalaburagi District which falls in the part of Survey of India toposheet no. 56C/16. The Kiranagi-1 Block falls in the Bhima Basin and it is to the north of the Diggaon and Udgi limestone blocks explored by MECL.
- 10.1.2 Kiranagi-1& 2 Blocks are the prospective limestone blocks identified by Directorate of Geology, Government of Karnataka for which MECL has prepared the exploration proposal involving 600m drilling in 10 boreholes at G-3 level of exploration in Kiranagi, Village, Taluka: Kalaburagi, District Kalaburgi and put up for approval of Technical cum cost Committee (TCC) of NMET. During the 28<sup>th</sup> meeting of TCC, NMET held on 16<sup>th</sup> March, 2023, the said proposal was technically evaluated and approved vide F.No.23/325/2023-NMET/409 dated 27<sup>th</sup> March 2023.
- 10.1.3 On the recommendation of 28<sup>th</sup> TCC of NMET held on 16<sup>th</sup> March, 2023 approved the mineral exploration project to be executed by MECL for Kiranagi 1& 2 Limestone Blocks in Kiranagi Village, Taluka: Kalaburagi, District: Kalaburgi with an estimated cost of Rs.1,27,57,798/- in the time schedule of 10 months together for both Kiranagi 1 & 2 blocks. The approval was together for 10 boreholes for the cumulative meterage of 450m. The exploration was executed separately and geological reports are prepared for Kiranagi-1 and Kiranagi-2 separately. The Kiranagi-1 Block was explored by 5 boreholes with the cumulative meterage of 225m.
- 10.1.4 Totally 10 boreholes drilled both in Kiranagi 1 and 2 blocks.: All Boreholes drilled up to 45m and closed in Limestone. The limestone Occurrence from after soil cover from 2.75m and continued up to the bottom of the borehole at 45.00m. Lesser OB and the continuous occurrence of lime stone resulted more number of samples. During proposal, it was not expected the thickest and continuous band of limestone, hence it was proposed for 400 numbers of samples only. Approved Sample Quantity: 400; Actually sampled 415; Additional sample 15. The additional sample quantity was discussed in 57<sup>th</sup> meeting and Committee approved the additional samples and additional cost of R.S. 1.49 lakh. (vide minutes 57.2.13). Subsequently the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18th December 2023. The total cost

of the project was enhanced up-to Rs. 129,06,747/- (one crore twenty nine lakh six thousand seven hundred forty seven only).

### **10.2.0 OBJECTIVES OF INVESTIGATION**

10.2.1 One of the prime objectives of the Preliminary Exploration (G-3) is to demarcate the various grades of limestone and Estimation of resources under inferred category (333) & reconnaissance (334) in Kiranagi-1 Block, Kalaburagi Taluk and District, Karnataka. The exploration was proposed with following objectives:

- i) To demarcate the limestone occurrence within the area by drilling, 5 nos. of exploratory boreholes at G - 3 level of exploration.
- ii) To estimate the grade wise limestone inferred resources in the block area as per UNFC norms of G - 3 level of exploration.

To carry out preliminary exploration (G-3) as per Mineral (Evidence and Mineral contents) Rule-2015, Mineral Auction Rule-2015 and MMDR Amendment Act-2015 in turn to facilitate the State Government (Karnataka) for auctioning of the block under Mining Lease.

### **10.3.0 EXPLORATION ACTIVITIES TAKEN UP**

10.3.1 The exploratory work in the block was commenced on 11.05.2023 with survey work and Geological mapping on 1:4,000 scale. Subsequently, exploratory drilling commenced with borehole no. MKG-01 and was completed with the closure of borehole no. MKG-04 on 27.05.2023. The allied field-works including surveying, geological mapping, drilling and borehole core sampling etc. were completed simultaneously. The analytical / laboratory studies were also carried out simultaneously in laboratories of MECL and other NABL accredited laboratories, JNARDDC, Nagpur.

10.3.2 Geological mapping was carried out at 1:4,000 scale for the entire area of 11.3756 sq km depicting the lithology, structure, and surface mineralization signatures. Broad lithological units and litho-contacts have been mapped with the help of handheld GPS. Attitude and structural features of rocks like bedding, folds and joints has been recorded by Brunton Compass. General Strike of the litho-units is E-W dipping gently (1-3°) towards South direction. The readings recorded in the field were plotted and produced in the form of geological map given as Plate III.

10.3.3 The Kiranagi -1 block has moderate topography. Major lithologies which were encountered during geological mapping are soil cover with scanty outcrops of limestone. The entire block area is covered by soil cover only in 3 places the limestone exposures are seen in the western side of the block. Limestone is exposed almost in the entire block

area. The limestone have gentle dip of 1-3°, the general strike of the limestone beds being E-W.

- 10.3.4 Geological logging of borehole cores was properly done along-with all the structural, lithological and mineralogical observations. (Annexure IIA and IIB). Limestone has been encountered in all the five boreholes. Primary analysis of all the borehole core samples has been tabulated in Annexure-III.

**Table No. 10.1**  
**Details of Co-ordinates (in WGS-84), Reduced Levels of boreholes drilled by MECL,**  
**Kiranagi-1 Block, Kalaburagi District, Karnataka**

| Sl. No.          | Bh.No. | RL (m)  | Northing (m) | Easting (m) | Date of Commencement | Date of Closure | Total Depth (m) |
|------------------|--------|---------|--------------|-------------|----------------------|-----------------|-----------------|
| 1                | MKG-06 | 450.61  | 1898096.017  | 699671.634  | 11.05.2023           | 12.05.2023      | 45.00           |
| 2                | MKG-07 | 446.612 | 1898097.30   | 698503.476  | 12.05.2023           | 14.05.2023      | 45.00           |
| 3                | MKG-08 | 446.41  | 1897212.90   | 699549.208  | 15.05.2023           | 17.05.2023      | 45.00           |
| 4                | MKG-09 | 439.605 | 1896317.371  | 698949.865  | 17.05.2023           | 27.05.2023      | 45.00           |
| 5                | MKG-10 | 438.991 | 1897212.235  | 698497.563  | 18.05.2023           | 20.05.2023      | 45.00           |
| <b>Total (m)</b> |        |         |              |             |                      |                 | 225.00          |

- 10.3.5 Borehole co-ordinates along with RL have been determined for all the boreholes with the help of DGPS in WGS-84 Datum. The associated laboratory studies i.e., chemical analysis, petrographic studies and bulk density studies have been completed simultaneously and geological report has been submitted.

- 10.3.6 Based on this current exploration it has been observed that there is one zone in Shahabad limestone, namely Portland Grade Zone-I. Portland Grade Zones; Zone I having a maximum thickness of 34.00m (MKG-10), with average grade 48.71% CaO, average 0.55% MgO and average 10.37% SiO<sub>2</sub>. The overall Zone-1 ((MKG-01 to MKG-05) has an average grade of 49.14% CaO, average 0.54% MgO and average 9.95% SiO<sub>2</sub> in Kiranagi 1 Block.

**10.3.7 DETAILS OF THE WORK**

After receipt of approval from NMET, MECL has carried out exploration activities in Kiranagi-1 and 2 Block. The details, nature and quantum of work proposed Vs achievement is given below:

**Table No. 10.2**  
**Quantum of Work for Proposed Vs Achieved in Kiranagi-1 and 2 Blocks**

| Sl. No.  | Description and Nature of Work  | Unit   | Approved       | Achieved   | Achieved   | Achieved       |
|----------|---|--------|----------------|--|------------|----------------|
|          |   |        | Kiranagi 1 & 2 | Kiranagi 1                                       | Kiranagi 2 | Kiranagi 1 & 2 |
| <b>A</b> | <b>GEOLOGICAL WORK AND SURVEYING</b>  |        |                |  |            |                |
| 1        | Geological Mapping (1:4000 scale)   | Sq. km | 11.41          | 5.5734   | 5.8022     | 11.3756        |
| 2        | Survey Work   |        |                |  |            |                |
|          | i) Topographical Survey (1:4000 scale)  | Sq. km | 11.41          | 5.5734   | 5.8022     | 11.3756        |
|          | ii) Bore Hole Fixation  | Nos.   | 10             | 5  | 5          | 10             |
|          | iii) RL & Coordinate Determination by DGPS  | Nos.   | 10             | 5  | 5          | 10             |
| <b>B</b> | <b>EXPLORATORY DRILLING</b>   |        |                |  |            |                |
| 1        | Drilling up to 300m (Soft Rock)   | m      | 450            | 225  | 225        | 450            |
| 2        | Drill Core Preservation   | Per m  | 405            | 200  | 205        | 405            |
| <b>C</b> | <b>LABORATORY STUDIES</b>   |        |                |  |            |                |
| 1        | <b>Chemical Analysis</b>  |        |                |  |            |                |
|          | i) Primary Sampling (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF            | Nos.   | 400            | 204*   | 211*       | 415*           |
|          | ii) Check Sampling Internal 5% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF | Nos.   | 20             | 10   | 10         | 20             |
|          | iii) Check Sampling External 10% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.)      | Nos.   | 40             | 20   | 19         | 39             |
| 2        | <b>Petrological samples (Surface &amp; BH Core Samples)</b>   |        |                |  |            |                |
|          | i) Preparation of thin section  | Nos.   | 10             | 7  | 3          | 10             |
|          | ii) Study of Thin Section   | Nos.   | 10             | 7  | 3          | 10             |
|          | iii) Photomicrograph  | Nos.   | 10             | 4  | 2          | 6              |
| 3        | <b>Bulk Density Determination</b>   |        |                |  |            |                |
|          | ii) Bulk Density  | Nos.   | 2              | 2 Nos. Combined for both Kiranagi 1 and 2 Blocks |            |                |
| <b>D</b> | <b>Report Preparation (5 Hard copies with a soft copy)</b>  | Nos.   | 2              | 1  | 1          | 2              |
| <b>E</b> | <b>Preparation of Exploration Proposal (5 Hard copies with a soft copy)</b>   | Nos.   | 1              | 1  | 1          | 1              |

\*The additional sampling and analysis cost was approved by the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023.

The proposal was made as one together for Kiranagi-1 and 2 Blocks. The approved meterage is 450 inclusive of one stratigraphic borehole out of the 10 nos. of the total approved boreholes in Kiranagi-1 and 2 together. The total meterage was drilled is 225m in Kirnagi-1 Block and 225m in Kiranagi-2 Block. All the boreholes are limestone bearing. The limestone zone intersected after 2 to 4m of top soil cover. Hence the quantum of Primary Samples increased up to 415 nos. which resulting the generation additional 15 nos. samples as against approved 400 nos. of samples. In Kiranagi-1 block, the total quantum of primary samples is 204, where as in Kiranagi Block 2 is 211 nos. It was proposed to approve the sampling and analysis cost in the Malkhed-1 & 2 and Kiranagi-1 & 2 Blocks in the 57<sup>th</sup> TCC meeting held on 26<sup>th</sup> & 27<sup>th</sup> September 2023 held at New Delhi. The Committee approved the additional samples and additional cost of Rs. 1.49 lakh (vide minutes agenda 57.2.13). Subsequently the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023. The total cost and the copy of approval is enclosed as Annexure No XI.

#### **10.4.0 DETAILS OF SURFACE SAMPLING, DRILLING, ETC.**

- 10.4.1 The present scheme of Preliminary Exploration (G-3 stage) in Kiranagi – 1 Block has been formulated by MECL includes geological mapping, drilling, core logging, core sampling and associated laboratory studies to establish the resource of Limestone mineralization at 333 and 334 categories.
- 10.4.2 Considering the potentiality of Limestone and other minerals in the area, MECL carried out Preliminary Exploration (G-3 stage) covering geological mapping at 1: 4,000 scale (Plate-III), drilling of 225m in 5 boreholes and other associated geological and analytical work.
- 10.4.3 On the basis of Geological Mapping and surface investigation, MECL had laid down 5 borehole points on the ground and carried out 225.0 m of drilling. During the present exploration, a total of 204 nos. of primary borehole core samples, 10 nos. of internal check samples and 20 nos. of external check samples were analysed for 9 radicals (9 radicals (CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI) by XRF. The details of analysis of primary core samples, internal check samples and external check samples for 9 radicals CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI are given in Annexure-VA and VB respectively.

## CHAPTER - 11

### **11.0.0 LOCATION DATA POINTS**

#### **1.1.0 ACCURACY AND QUALITY OF SURVEY USED TO LOCATE BLOCK BOUNDARY AND DRILL HOLES**

11.1.1 The entire survey work has been carried out with the help of DGPS (Make-Trimble GNSS System, Model-R8s). With the help of DGPS, co-ordinates of surface features i.e., roads, village boundaries, water bodies, base station and co-ordinates of 28 nos. of block boundary cardinal points with R.L. has been determined (Annexure IA and IB) and accordingly the topographical map is presented (Plate-III). Contour interval in topographical map is taken as 2 m. The topographic survey was done in PPK (Post Precision Kinematics) mode. Positional (horizontal) accuracy of the survey is 10mm while the elevation accuracy is 20mm in PPK mode.

#### 11.1.2 TECHNICAL SPECIFICATION OF DGPS

|       |              |
|-------|--------------|
| MAKE  | TRIMBLE DGPS |
| MODEL | R8-S         |
| YEAR  | 2017         |

**a) MEASUREMENT ACCURACY:**

Static Mode

Horizontal – 10 mm +0.1 ppm or better.

Vertical – 20 mm +0.4 ppm or better.

**b) BASE LINE ACCURACY:**

- a. Accuracy Horizontal shall not be more than 4 mm for 10 km baseline with occupation line of 10 minutes or less.
- b. Accuracy vertical shall not be more than 7.5 mm for 10 km baseline for with occupation of 10 minutes or less.

**c) FAST STATIC:**

- c. Horizontal – 3mm +0.5 ppm
- d. Vertical – 5 mm +0.5 ppm

**▪ GNSS RECEIVER:**

- Trimble R8s Multiple frequency GNSS Receiver has internal on board memory via SD card or internal memory.
- Trimble R8s has 440 channels (GPS + GLONASS +GAGAN) and should be capable of tracking.
- GPS: LIC/A, L2C, L1C, L2E,L5
- GLONASS: LIC/A, L2C/A, L1P, L2P, & L3
- Beidou : B 1 complete with(phase 2) & B2
- SBAS: LIC/A,L5
- Galileo: E1, E5A, E5B

- Systems: EGNOS, QZSS, SBAS, WAAS, GAGAN, (MUST take correction from GAGAN) etc.
- R8s is water proof, shock proof, dust proof, humidity proof, and condensation proof.
- IP 67 with temporary submersion in water up to 1 m.
- **SOFTWARE & COMMUNICATION:** Fully functional and Trimble business centre office post processing software.
  
- **CONTROLLER:**
- Trimble TSC 3 windows based controller for base and 02 nos. Rovers should be provided.
- Alpha numeric hard QWERTY keyboard for Base and 02 no's Rover should be provided.
- Internal Memory – 256 MB RAM & 8 GB Non Volatile memories should be provided.
- Integrated camera for Geo Tagging Must with inbuilt GPS, Compass and Accelerometer should be provided.

**CO-ORDINATE SYSTEM MANAGER:** Should have datum and projection support & should support Grid coordinates.

- **COGO:** support COGO functionality & able to Key in lines, Sub-divide lines and creating parallel lines for staking out purpose.
- **TRANSFER DATA BETWEEN FIELD AND OFFICE:** Should be capable of e-mail data collected in the field, should be able import and export DXF files in the field for effective GIS support.
- **BACKGROUND MAP:** Able to accept background maps in CAD format.
- **OPERATING SYSTEMS:** Windows 6.5 should be provided.
- **EXPORT:** Able to exporting the data in RINEX format as well in CAD format.
- **REPORTING:** Software should be capable of generating reports directly from the surveyed data.
- **POST PROCESSING SOFTWARE ADVANCE CAPABILITY:** Trimble Business Centre Post Processing software capable of processing Base line with IGS station and processing drawing including engineering application such as contouring, Cross section & L section etc. All software shall be same OEM make.

11.1.3 The survey of boreholes drilled in the block has also been carried out by the DGPS (Make-Trimble GNSS System, Model-R8s) (Annexure IC). The base station has been utilised for the fixing of the boreholes position on the ground as well as for reduced levels of the boreholes. The coordinate of base station is given in Table-11.1. DGPS report for the block has been attached as Annexure XII.

**Table No. 11.1**  
**Co-ordinates of the base station for DGPS survey of**  
**Kiranagi -1 block Kalaburagi District, Karnataka.**

| Sl. No. | Point Name | UTM (m)     |            | RL (m)  |
|---------|------------|-------------|------------|---------|
|         |            | Northing    | Easting    |         |
| 1       | BASE T - 1 | 1894247.060 | 703083.330 | 423.206 |

### **11.2.0 QUALITY AND ADEQUACY OF TOPOGRAPHIC CONTROL**

11.2.1 Block boundary co-ordinates, the surface features, contour points were surveyed by DGPS). The topographic survey was done in PPK (Post Precision Kinematics) mode. Positional (horizontal) accuracy of the survey is 10mm while the elevation accuracy is 20mm in PPK mode. The detailed topographical map of Kiranagi - 1 Block has been prepared on 1:4,000 scale

## CHAPTER - 12

### **12.0.0 SAMPLING TECHNIQUES**

#### **12.1.0 NATURE AND QUALITY OF SAMPLING AND MEASURES TAKEN TO ENSURE SAMPLE REPRESENTATIVITY**

12.1.1 The present work has been formulated to take up the Preliminary exploration (G-3 stage) for limestone in Kiranagi - 1 Block. There was no provision for surface samples and trenching/pitting in the block as per the approved quantum of NMET. So, no surface samples or trench samples were generated in the block.

12.1.2 Drilling operation has been taken up for 225m out of 5 boreholes. A total of 204nos. primary borehole core samples, 10 nos. internal check samples and 20 nos. external check samples were generated and analysed accordingly. Sampling, has been done during the exploration programme also includes samples for petrography and bulk density studies.

## **CHAPTER - 13**

### **13.0.0 DRILLING TECHNIQUES AND DRILL SAMPLING EMPLOYED**

#### **13.1.0 DRILLING TYPES AND DETAILS**

13.1.1 MECL has drilled 05 nos. of boreholes with a cumulative meterage of 225.00m and other associated geological analytical works in the Kiranagi-1 block. The details of boreholes are given in Annexure-IB and summary of borehole is given in Table-10.1.

13.1.2 The Drilling operation in the block was performed by skid mounted Kores KME - 1000 Core Drilling Rig. All the boreholes in the block were drilled in NQ size with single barrel wire line, wet core drilling method. Initially 0.00m to 6.00m HW casing was set in each borehole by using HW casing short piece. After setting HW casing, drilling advanced in NQ size till 45m.

Drilling was done by NQ Diamond bit, (Hyden, Sandwik) till closure of the borehole. RD 60 (MEC 349, MEC 352), KDR 600 (MEC 395) rig were deployed in the block.

13.1.3 The quality of drilling was ensured during the operation. After closure, all the boreholes have been properly plugged and sealed with cement pillars.

#### **13.2.0 DEVIATION SURVEY IN DRILLING**

13.2.1 All the exploratory boreholes drilled in the block are vertical boreholes drilled upto 45m depth (MKG-06 to MPK-10). The deviation survey was not performed for the boreholes.

#### **13.3.0 WHETHER CORE AND CHIP SAMPLE RECOVERIES HAVE BEEN PROPERLY RECORDED AND RESULTS ASSAYED**

13.3.1 The core samples have been recorded properly and the detailed run wise litholog and summarized Litholog for boreholes are given in Annexure-IIA and Annexure-IIB respectively. The logging of run wise core as well as the cuttings from boreholes have helped in discerning the physical characters like colour, shape, size and nature of the mineralisation as well as texture, structural features and identification of different litho units.

13.3.2 Core recovery w.r.t. the lithologies are properly recorded and represented in Annexure-IIA.

13.3.3 The mineralised zones /length recorded during the geological core logging have been sampled for Limestone and analysed for 9 radicals i.e., CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>,

Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI. The primary sample had been marked in the mineralized zones intersected in the borehole based on visual inspection/lithology and in general the sample length has been kept as 1.00 m which varied in some instances because of variation in lithology and type and concentration of mineralisation. The details of analysis of primary core samples are given in Annexure-III.

#### **13.4.0 MEASURES TAKEN TO MAXIMIZE SAMPLE RECOVERY AND ENSURE REPRESENTATIVE NATURE OF THE SAMPLES**

13.4.1 The entire core drilling has been done by NQ size diamond drill bit with single barrel wire line, wet core drilling method. Initially 0.00m to 6.00m HW casing was set in each borehole by using HW casing shortpiece. After setting HW casing, drilling advanced in NQ size till. NW casing was set in the drilled ranging from 10m to 25m depending on the formation of the boreholes. The polymer was used as drilling fluid to flush out the cuttings and stabilize the borehole wall. The drilling fluid also works as a coolant to avoid burning of drill bits. Proper core recovery of more than 90% was maintained in Limestone, however in case of weathered, loose and fractured zone and in solution cavities, the core recovery was low. Whenever core recovery is less, the grade of the recovered portion has been extrapolated over the non-recovered section. However, All the precautions like modulated water pressure, proper liner, optimum head pressure and the hands of an expert drilling technician had been taken to maintain the quality of drilling.

#### **13.5.0 WHETHER THE RELATIONSHIP EXISTS BETWEEN SAMPLE RECOVERY AND GRADE**

13.5.1 No such definite relation exists between sample recovery and grade.

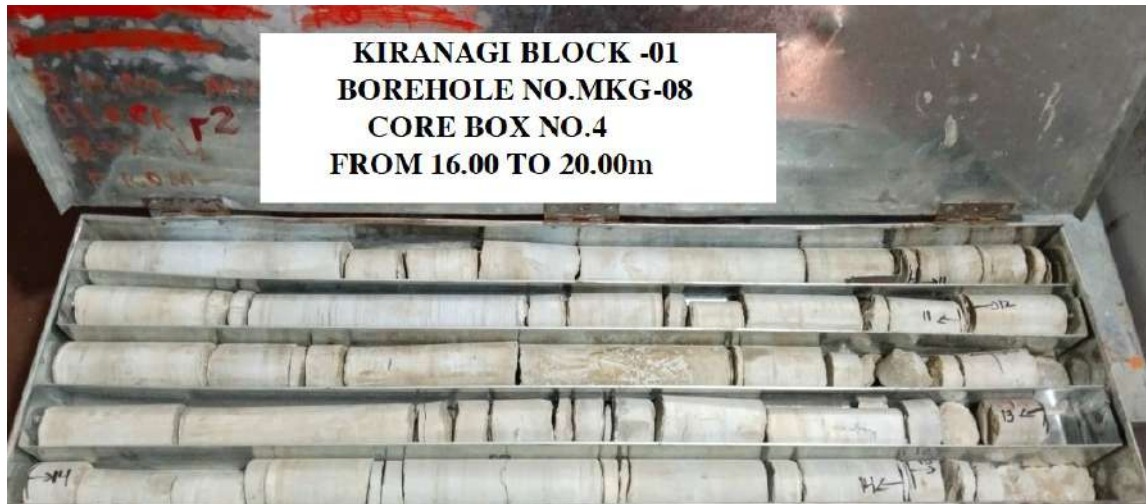
#### **13.6.0 CORE LOGGING**

13.6.1 The entire core recovered by drilling was logged systematically in detail describing lithological units with mineralisation details that can be observed by visual inspection. The details of lithology, grain size, colour, texture, structural features, presence of intercalations and cavities have been recorded. Wherever the recovery is less than 100%, extrapolations of drilled depth were done on proportionate basis considering the physical characteristics of individual units recovered. All the cores were kept and preserved properly in the GI core boxes of specifications given by NMET following

“Book pattern”. The detailed run wise litholog and summarized litholog for boreholes are given in Annexure- IIA and Annexure- IIB respectively.

**13.7.0 ROCK QUALITY DESIGNATION (RQD %)**

13.7.1 The limestone block is supposed to be mined by open cast method, however the RQD data has been maintained for the borehole cores and given in Annexure IIA.



**Photo-10: MKG-08 (16.00m to 20.00m)**



**Photo-11: MKG-08 (29.00m to 33.00m)**

## **CHAPTER - 14**

### **14.0.0 SUB SAMPLING TECHNIQUES AND SAMPLE PREPARATIONS**

#### **14.1.0 WHETHER CUT OR DRAWN AND WHETHER QUARTER, HALF OR ALL CORE TAKEN**

14.1.1 The core sampling and chemical analysis of core samples have been carried out for entire mineralized zones/length intersected in the boreholes drilled. Samples were marked and collected in limestone zones marked on the basis of visual inspection. The mineralized core has been split into two equal halves by core splitter in such a way that the concentrations of ore minerals are uniform in both the equal halves. The whole quantity of half portion of the sample as marked while logging crushed to (-) 100 mesh and about 500g representative sample of (-) 100 mesh was drawn by coning and quartering method of gradual size reduction with the help of crusher and pulverizer. Two samples pouches weighing samples 100gm each were drawn, one of which were sent to Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accredited Laboratory) for Primary Chemical analysis of 9 radicals (CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI) and the other was used for the purpose of check analysis. The remaining 300g fraction was kept for future purpose including composite sample analysis etc.

14.1.2 During the present exploration, a total of 204 nos. of primary core samples, 10 nos. of internal check samples and 20 nos. of external check samples for limestone, mineralization were prepared. The primary and internal check samples have been analysed for 9 radicals i.e., CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accredited Laboratory). External check samples for same 20 radicals and have been analysed at Chemical Laboratory of MECL, Nagpur. The details of analysis of primary core samples, internal check samples and external check samples are given in Annexure-III, VA and VB respectively.

#### **14.2.0 NATURE, QUALITY AND APPROPRIATENESS OF THE SAMPLE PREPARATION TECHNIQUE**

14.2.1 The details of sampling procedure for primary samples are described in para 14.1.0. Quality of the sample preparation is maintained by proper cleaning, maintenance of the equipment and proper crushing, sieving and coning and quartering of samples. For sample preparation, proper technique and expertise has been used.

#### **14.3.0 QUALITY CONTROL PROCEDURES ADOPTED**

14.3.1 The primary core samples have been collected from entire mineralized zones/length intersected in the boreholes drilled and the samples have been prepared at centralized mechanized sampling unit. The standard sampling procedure in supervision of qualified sampling technician has been adopted to control the quality of samples. Similarly, internal check and external check samples have also been prepared under the supervision of qualified sampling technician following the standard sampling procedure.

#### **14.4.0 MEASURES TAKEN TO ENSURE THE SAMPLING IS REPRESENTATIVE OF THE IN SITU MATERIAL COLLECTED**

14.4.1 All the primary samples have been marked and prepared from mineralised cores. During the preparation of primary samples, the mineralised cores have been studied meticulously and samples have been marked properly. These mineralised cores are subjected for preparation of primary samples as per the sampling procedure for primary samples are described in Para 14.1.0. The proper marking of primary samples from drilled cores and following standard procedure for sample preparation shows the representative samples have been collected from the in situ materials.

#### **14.5.0 WHETHER SAMPLE SIZES ARE APPROPRIATE TO THE GRAIN SIZE OF THE MATERIAL BEING SAMPLED**

14.5.1 The primary samples have been prepared (-) 100 mesh size and all the other samples have been prepared from primary samples. As per the previous studies in the area, (-) 100 mesh size is appropriate for the analysis of limestone etc. mineralization in the block area.

## CHAPTER - 15

### **15.0.0 QUALITY OF ASSAY DATA AND LABORATORY TESTS**

#### **15.1.0 THE NATURE, QUALITY AND APPROPRIATENESS OF THE ASSAYING AND LABORATORY PROCEDURES**

15.1.1 The primary and internal check samples from limestone mineralization have been analyzed for 9 radicals i.e., CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI by XRF at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accredited Laboratory) and External check samples for same 9 radicals and composite samples have been analysed at Chemical Laboratory of MECL, Nagpur.

#### **15.2.0 STANDARD OPERATING PROCEDURE (SoP) FOR THE ANALYSIS BY JNARDDC, NAGPUR**

##### **CHEMICAL ANALYSIS**

- 1. Pellet Method (using XRF)**
- 2. XRF (model Axiosm Ax, (Panalytical make)**
- 3. CRM used- NCSDC-16006**

##### **Procedure for Preparation of Pellets by Hydraulic Press:**

For XRF measurement a sample must be homogenized, pulverized to -200 mesh and pressed into pellet.

- (i) Weigh accurately 5 gms of sample and used 10 gms of boric acid as a binder
- (ii) Press the sample at a pressure of around 20-22 tons on a hydraulic press (Pallet Making Machine) with a diameter of 40 mm
- (iii) Calibrate the XRF equipment using known standards for elements present in limestone (Calcium, Magnesium etc)
- (iv) Ensure the instrument is set up correctly according to standard guidelines
- (v) Place the prepared pellet into the sample holder
- (vi) Ensure the sample cup is positioned correctly in the instrument for carrying out analysis
- (vii) Start the XRF analysis using software and initiate the analysis process automatically
- (viii) Allow the XRF instrument to scan the sample. It will emit X-rays onto the sample, causing the atoms to emit fluorescence
- (ix) Record the results in a report, including elemental concentrations and any relevant information about the analysis conditions
- (x) Intermediate check also performed using bead with inbuilt software

## **LOSS ON IGNITION**

### **WCL procedure for determination of LOI:**

- i. Weighed quantity of sample (duly dried at 110°C) is placed in platinum crucible and heated to 1000°C for about an hour. Sample is again weighed after it is cooled. Difference in weight expressed in percentage as LOI.

## **15.3.0 STANDARD OPERATING PROCEDURE (SoP) FOR THE ANALYSIS BY MECL LAB, NAGPUR**

### **15.3.1 SOP OF ANALYSIS BY XRF**

#### **Sample Particle Size:**

The Sample is ground to a particle size <75µm, but <50µm is ideal.

#### **Sample preparation: Pellets preparation**

The process of making pressed pellets for XRF analysis includes grinding the sample to fine particle size and pressing the sample at pressure of between 15 to 35 ton.

#### **Instrumentation:**

1. X-ray irradiates the sample.
2. Sample emits secondary X-ray characteristic of a particular element.
3. Analyzing sample rotates to accurately diffract each wavelength and satisfy Bragg's Law.
4. Detector measures position and intensity of XRF peaks

Photograph of WD-XRF instrument (Rigaku, Japan) at Chemical Lab, MECL, Nagpur have been represented in photo 15.1



Photo: 12. Photographs showing WD-XRF instrument (Rigaku, Japan) at Chemical Lab, MECL, Nagpur

### 15.3.2 STANDARD OPERATING PROCEDURE (SoP) FOR THE DETERMINATION OF LOSS ON IGNITION (L.O.I.) AT MECL LAB

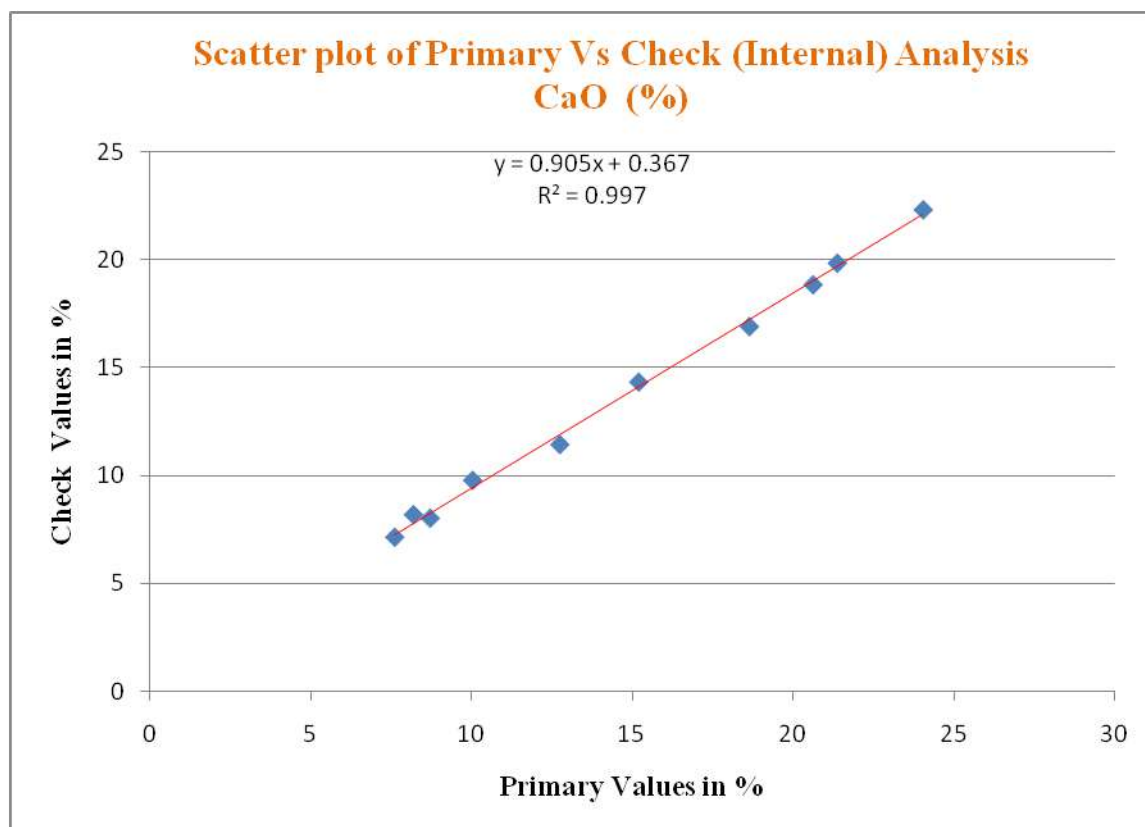
#### Procedure

1. Weigh 1 g of dry sample in silica or platinum crucible.
2. Place this crucible in muffle furnace at a temperature below 300°C. Raise the temperature of the furnace to 1000°C. Keep this at this temperature for about 30 minutes.
3. Cool the crucible in desiccators and weigh the crucible.
4. Find the loss in weight.
5. % Loss on Ignition (LOI) =  $\frac{\text{Loss in weight} \times 100}{\text{Weight of the sample}}$

### 15.4.0 NATURE OF QUALITY CONTROL PROCEDURES ADOPTED

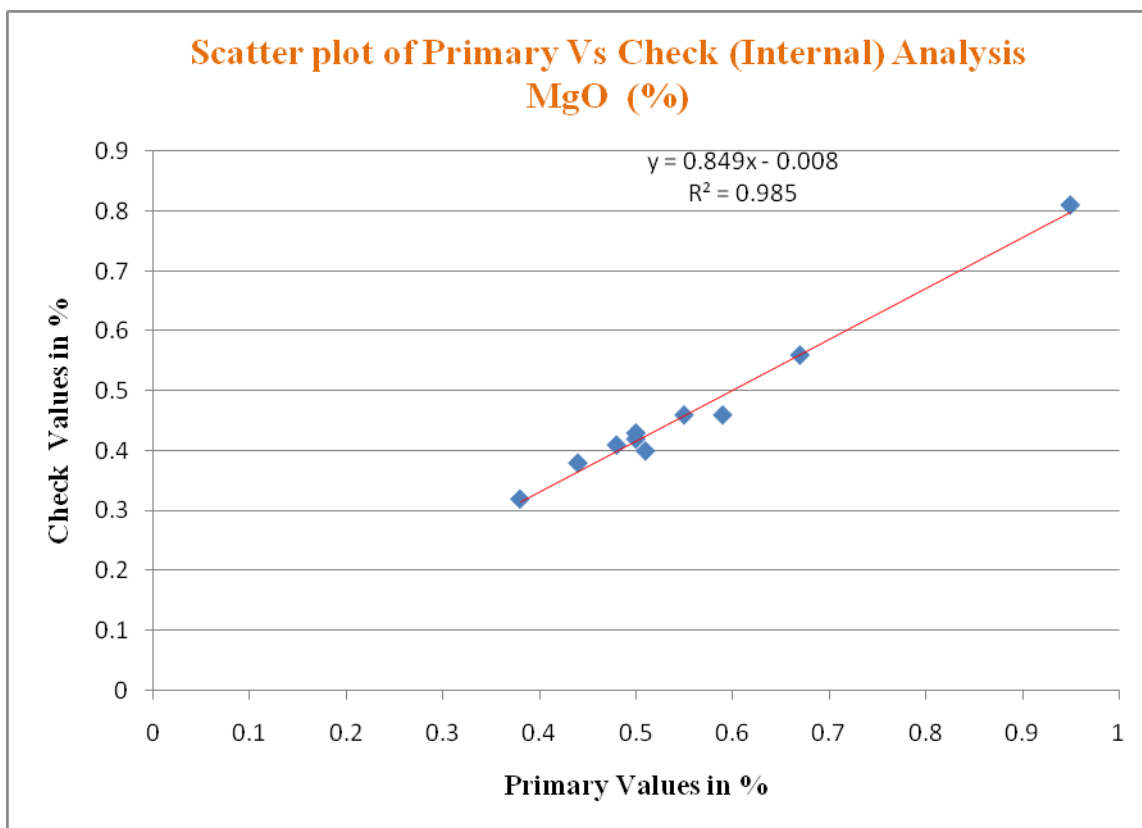
In order to ensure the accuracy of the analyzed samples, NCSDC-16006 has been used as certified reference material. The Certified Reference Material (CRM) was processed under similar conditions as samples and run after every 20 samples.

15.4.1 A total 10 nos. of Internal Check samples have been analysed by JNARDDC laboratory, Nagpur for 3 radicals i.e. CaO, MgO and SiO<sub>2</sub> analysis to check the reliability of chemical analysis and the results are given in Annexure VA & VC. Statistical has been furnished below in the following tables and corresponding figures.



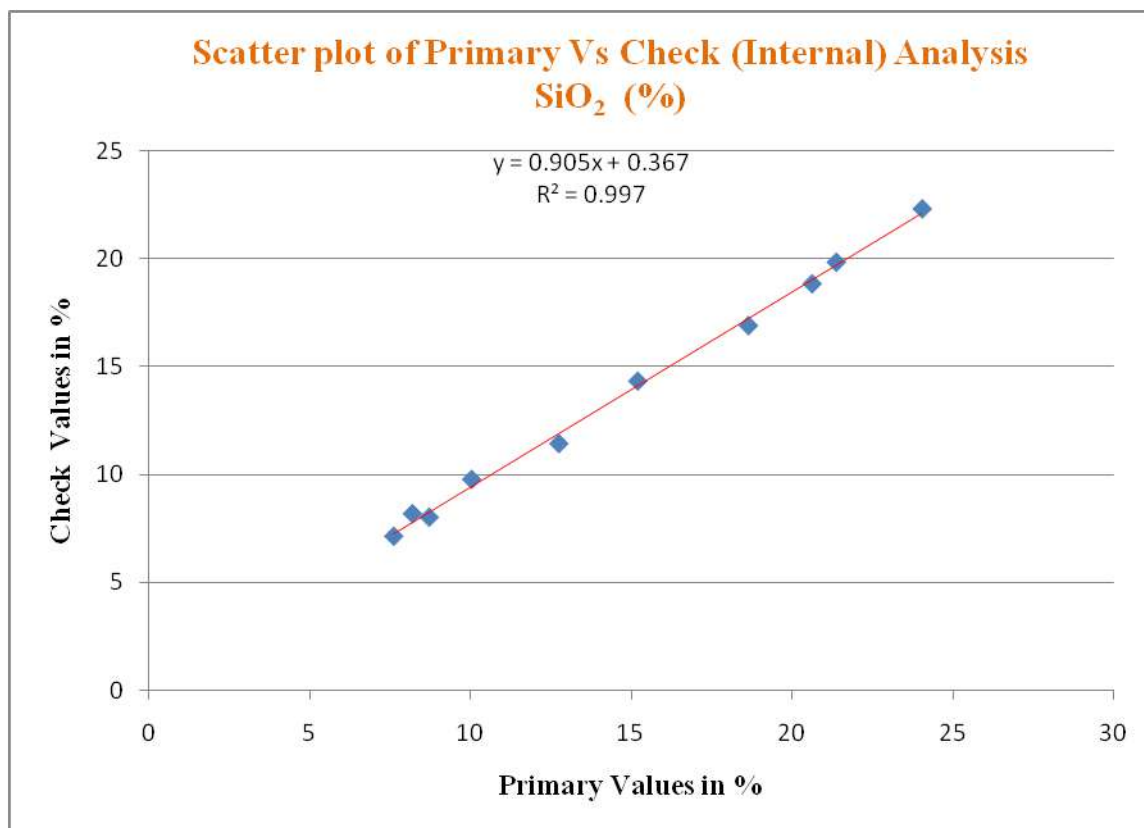
COMPARISON OF PRIMARY Vs. INTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | CaO %   |        |
|----------------------------|---------|--------|
|                            | Primary | Check  |
| No. of Sample Pairs        |         | 10     |
| Arithmetic Mean            | 45.905  | 47.089 |
| Standard Deviation         | 4.064   | 3.62   |
| Std. Error of Mean         | 1.285   | 1.145  |
| Variance                   | 16.517  | 13.105 |
| Mean of Deviation          |         | -1.184 |
| Standard Deviation (Error) |         | 0.542  |
| Correlation Coefficient    |         | 0.997  |
| Mean Absolute Error        |         | 1.184  |
| Mean Relative Random Error |         | 2.579% |
| Paired T value             |         | -6.906 |
| F - test value             |         | 1.26   |



COMPARISON OF PRIMARY Vs. INTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | Primary | MgO %<br>Check |
|----------------------------|---------|----------------|
| No. of Sample Pairs        |         | 10             |
| Arithmetic Mean            | 0.557   | 0.465          |
| Standard Deviation         | 0.151   | 0.129          |
| Std. Error of Mean         | 0.048   | 0.041          |
| Variance                   | 0.023   | 0.017          |
| Mean of Deviation          |         | 0.092          |
| Standard Deviation (Error) |         | 0.027          |
| Correlation Coefficient    |         | 0.993          |
| Mean Absolute Error        |         | 0.092          |
| Mean Relative Random Error |         | 16.517%        |
| Paired T value             |         | 10.581         |
| F - test value             |         | 1.367          |



COMPARISON OF PRIMARY Vs. INTERNAL CHECK ANALYSIS

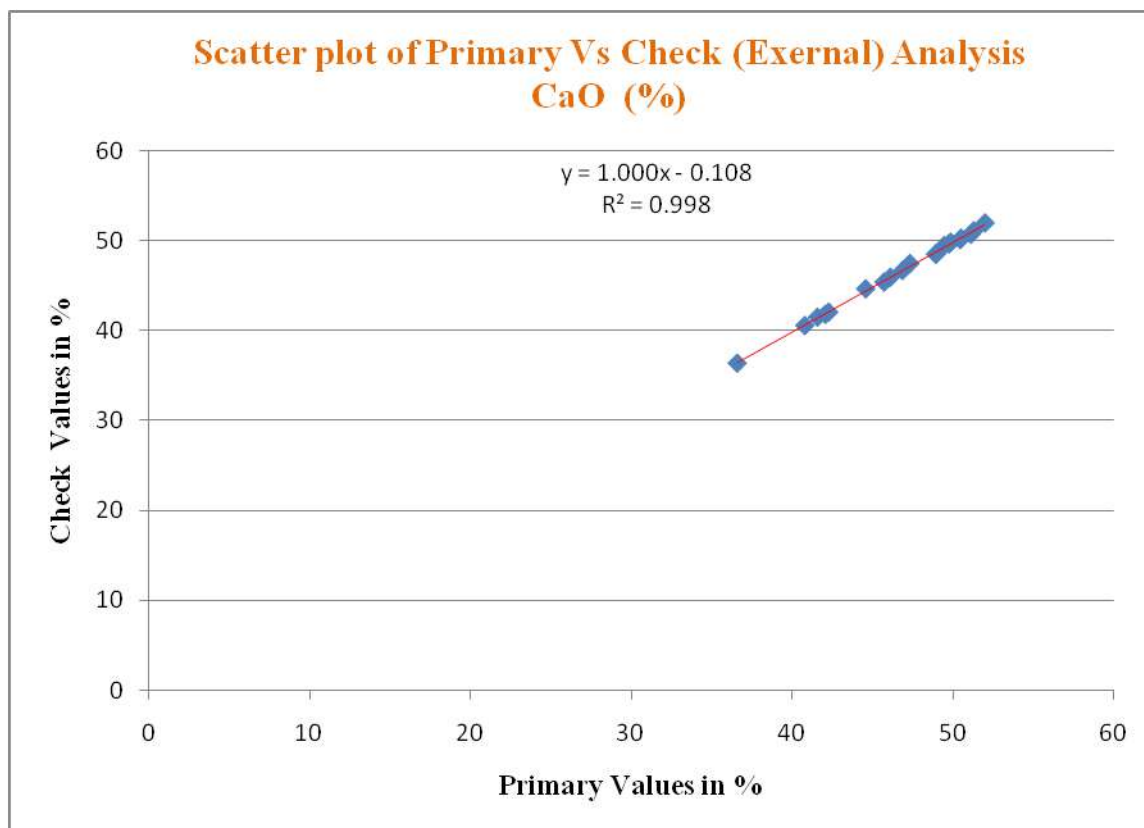
| COMPARISON INDEX           | Primary | SiO <sub>2</sub> %<br>Check |
|----------------------------|---------|-----------------------------|
| No. of Sample Pairs        |         | 10                          |
| Arithmetic Mean            | 14.71   | 13.679                      |
| Standard Deviation         | 5.798   | 5.255                       |
| Std. Error of Mean         | 1.834   | 1.662                       |
| Variance                   | 33.62   | 27.613                      |
| Mean of Deviation          |         | 1.031                       |
| Standard Deviation (Error) |         | 0.62                        |
| Correlation Coefficient    |         | 0.999                       |
| Mean Absolute Error        |         | 1.031                       |
| Mean Relative Random Error |         | 7.009%                      |
| Paired T value             |         | 5.261                       |
| F - test value             |         | 1.218                       |

15.4.3 It has been observed that

- i) The scatter plots clearly shows scatter of values along a band closely following the bisector.
- ii) The arithmetic means of principal and check assays show an excellent agreement for all the radicals.
- iii) The correlation coefficient, which is an index assays showing value for CaO% 0.997, MgO% 0.993 and SiO<sub>2</sub>% 0.999 which implies excellent/agreement for the dataset of primary and check analysis of radicals.

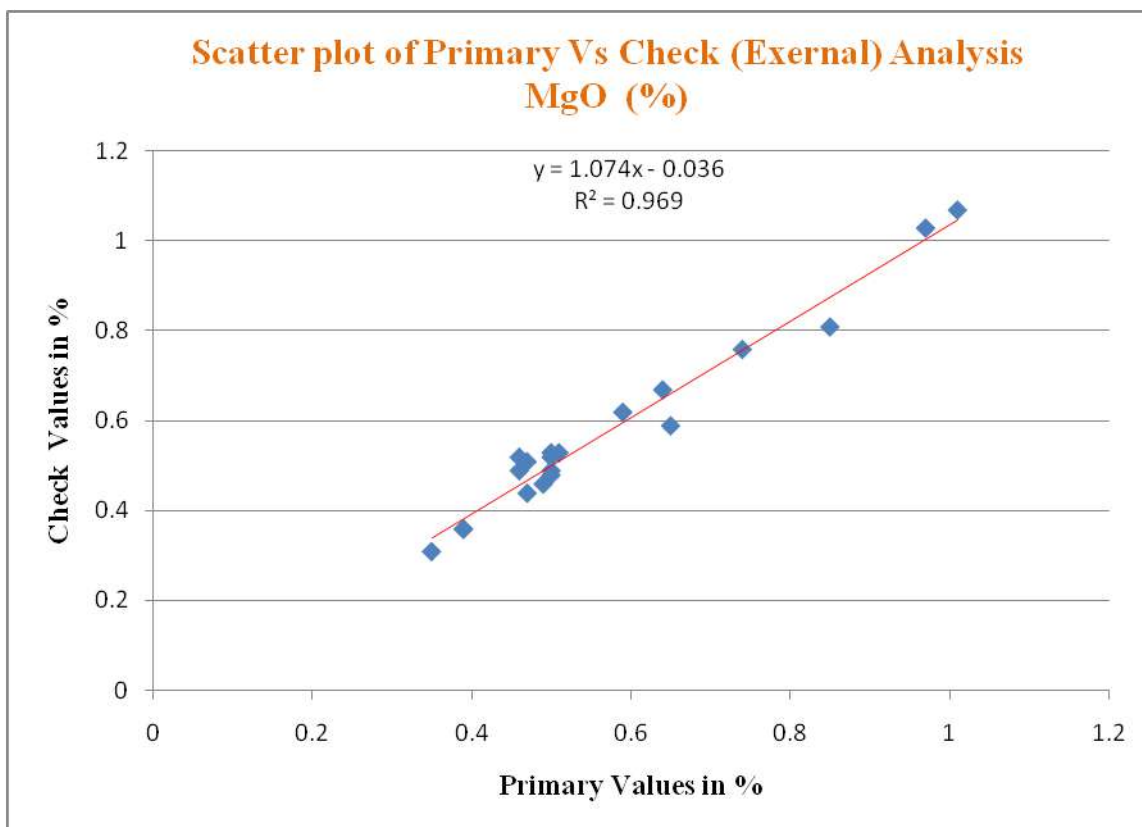
#### **15.5.0 CHECK ANALYSIS FROM NABL ACCREDITED LABORETORY**

15.5.1 The external check samples analyses have been carried out at chemical laboratory of MECL, Nagpur (A NABL accredited laboratory). A total of 20 numbers of external check samples from are analysed for 3 radicals i.e., CaO% , MgO % and SiO<sub>2</sub>%. Details of external check borehole sample results are attached as Annexure-VB & VC. Statistical has been furnished in the following tables and corresponding figures.



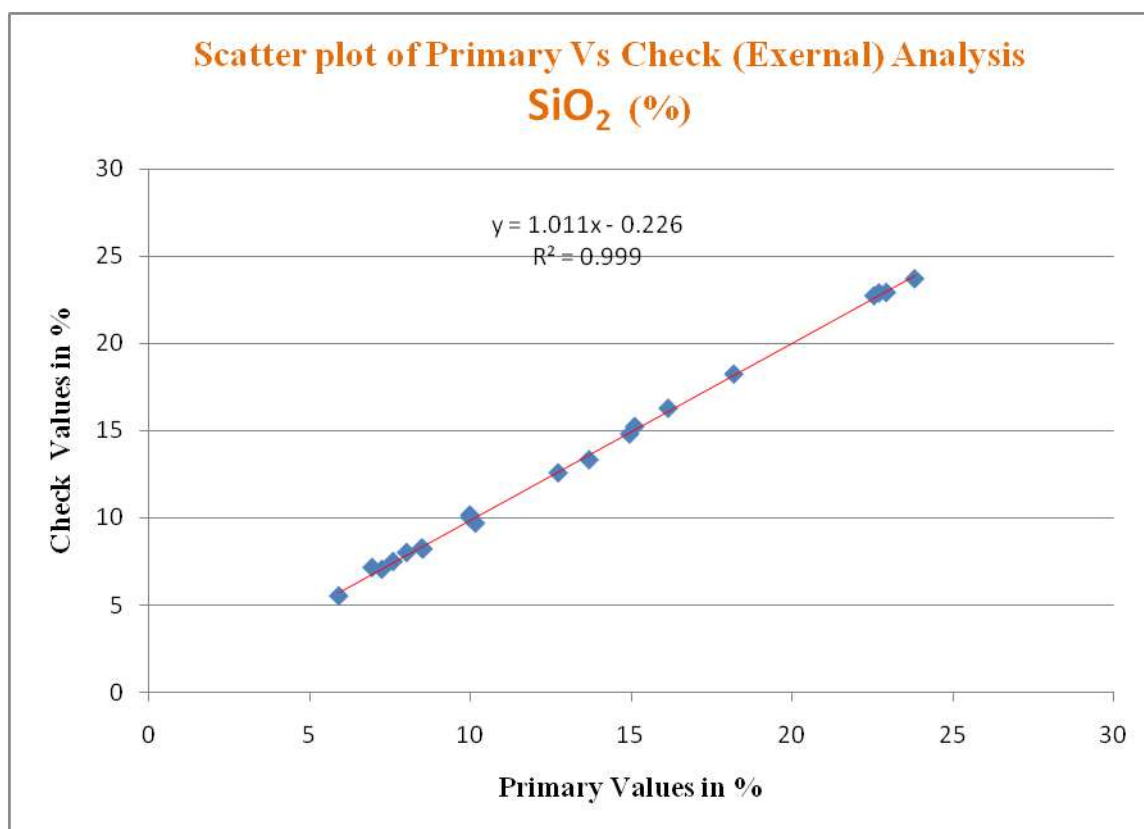
COMPARISON OF PRIMARY Vs. EXTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | CaO %   |        |
|----------------------------|---------|--------|
|                            | Primary | Check  |
| No. of Sample Pairs        |         | 20     |
| Arithmetic Mean            | 46.791  | 46.685 |
| Standard Deviation         | 4.138   | 4.142  |
| Std. Error of Mean         | 0.925   | 0.926  |
| Variance                   | 17.126  | 17.153 |
| Mean of Deviation          |         | 0.106  |
| Standard Deviation (Error) |         | 0.157  |
| Correlation Coefficient    |         | 0.999  |
| Mean Absolute Error        |         | 0.163  |
| Mean Relative Random Error |         | 0.348% |
| Paired T value             |         | 3.018  |
| F - test value             |         | 0.998  |



COMPARISON OF PRIMARY Vs. EXTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | MgO %   |        |
|----------------------------|---------|--------|
|                            | Primary | Check  |
| No. of Sample Pairs        |         | 20     |
| Arithmetic Mean            | 0.572   | 0.578  |
| Standard Deviation         | 0.182   | 0.198  |
| Std. Error of Mean         | 0.041   | 0.044  |
| Variance                   | 0.033   | 0.039  |
| Mean of Deviation          |         | -0.006 |
| Standard Deviation (Error) |         | 0.037  |
| Correlation Coefficient    |         | 0.984  |
| Mean Absolute Error        |         | 0.035  |
| Mean Relative Random Error |         | 6.031% |
| Paired T value             |         | -0.663 |
| F - test value             |         | 0.841  |



COMPARISON OF PRIMARY Vs. EXTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | SiO <sub>2</sub> % |        |
|----------------------------|--------------------|--------|
|                            | Primary            | Check  |
| No. of Sample Pairs        |                    | 20     |
| Arithmetic Mean            | 13.295             | 13.225 |
| Standard Deviation         | 5.853              | 5.925  |
| Std. Error of Mean         | 1.309              | 1.325  |
| Variance                   | 34.26              | 35.103 |
| Mean of Deviation          |                    | 0.07   |
| Standard Deviation (Error) |                    | 0.198  |
| Correlation Coefficient    |                    | 0.999  |
| Mean Absolute Error        |                    | 0.174  |
| Mean Relative Random Error |                    | 1.309% |
| Paired T value             |                    | 1.577  |
| F - test value             |                    | 0.976  |

15.5.2 It has been observed that

- i) The scatter plots clearly show scatter of values along a band closely following the bisector.
- ii) The arithmetic means of principal and check assays show an excellent agreement for all the radicals.
- iii) The correlation coefficient, which is an index assays showing value for CaO% 0.999, MgO% 0.984 and SiO<sub>2</sub>% 0.999 which implies excellent/agreement for the dataset of primary and check analysis of radicals.

#### **15.6.0 SECURITY AND CHAIN OF CONTROL OF SAMPLES SHOULD BE CLEARLY MENTIONED**

15.6.1 The samples have been prepared at centralized mechanized sampling unit with proper labelling and tag and sent to chemical laboratory in supervision of qualified sampling technician. At the sampling unit, standard procedure has been followed and all the precautionary measures have been taken to avoid the contamination. The sampling unit is separate from the chemical laboratory, so there is no chance of contamination.

## 15.7.0 EVALUATION OF MINERALISATION ZONES

15.7.1 The IBM's National Mineral Inventory (NMI) has classified limestone based on end use grade into i) Cement grade ( $\geq 44\%$  Cao,  $< 3.5\%$  MgO and  $< 16\%$  SiO<sub>2</sub>), ii) Blendable grade ( $\geq 38$  to  $< 44\%$  Cao,  $< 5\%$  MgO and  $< 18\%$  SiO<sub>2</sub>) and iii) Threshold grade ( $\geq 34$  to  $< 38\%$  Cao).

15.7.2 The investigation carried out by way of exploratory drilling with associated geological and laboratory studies which have generated the exploration data to establish the shape, size and geometry of the limestone horizons. This formed the basis for evaluation of various deposit parameters of the block. Zones were demarcated based on min 1.0m sample length for all grades based on cut off and correlation with adjacent boreholes, The Zones and grades of limestone etc. intersected in boreholes drilled in the block have been assessed on the basis of end-use grade classification of Limestone. The salient features of the evaluation are discussed below:

15.7.3 **CEMENT (PORTLAND) GRADE ZONES** (CaO $\geq$  44% MgO max 3.50% and SiO<sub>2</sub> max 16%).

Cement grade limestone Zone-I is the only one zone encountered in the explored Kiranagi-1 block.

### CEMENT GRADE (PORTLAND) LIMESTONE ZONE – I

The massive grey limestone is of Cement Grade (Portland) to high grade encountered in the Zone I. Salient features for Zone-I is follows, the thickness is minimum 13.00m (MKG-09) and maximum is 34.00 m (MKG-10). However, the grade of CaO% varies between 48.71% (MKG-10) and 49.63% (MKG-07), MgO% varies between 0.49% (MKG-06) and 0.64% (MKG-08), and SiO<sub>2</sub>% varies between 9.14% (MKG-07) and 10.37% (MKG-10). Average grade of Zone-I in the block is 49.14% of CaO, 0.54% of MgO and 9.95% of SiO<sub>2</sub>. The details of borehole wise zones are presented as **Annexures - IV A** and the same is presented as **Table No: 15.1**.

**Table No. 15.1**

### CEMENT (PORTLAND) GRADE ZONE I

| Bh. No.              | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|----------------------|-----------|-------|-----------|--------------|-------------|--------------------|
|                      | From      | To    |           |              |             |                    |
| MKG-06               | 3.00      | 36.00 | 33.00     | 49.05        | 0.49        | 10.30              |
| MKG -07              | 3.00      | 30.00 | 27.00     | 49.63        | 0.50        | 9.14               |
| MKG -08              | 29.00     | 45.00 | 16.00     | 49.18        | 0.64        | 9.95               |
| MKG -09              | 32.00     | 45.00 | 13.00     | 49.42        | 0.61        | 9.67               |
| MKG -10              | 11.00     | 45.00 | 34.00     | 48.71        | 0.55        | 10.37              |
| <b>Average Grade</b> |           |       |           | <b>49.14</b> | <b>0.54</b> | <b>9.95</b>        |

The thickness distribution and its quality of cement grade (Portland) Zone-I has given Polygon Map (Text Figure Nos.5).

15.7.4 BLENDABLE GRADE LIMESTONE HORIZON ( $\geq 38$  to  $< 44\%$  CaO,  $< 5\%$  MgO and  $< 18\%$  SiO<sub>2</sub>)

As per IBM guidelines. Blendable grade limestone zone was demarcated on CaO% range between  $\geq 38$  to  $\leq 44\%$  and MgO shall not be more than 5%. The blendable grade limestone bands are intersected in the 5 boreholes, as two zones, and the zone-wise salient features are tabulated in the following Table Nos. 15.2 and 15.3. The details of borehole wise zones are presented as **Annexure - IV B**.

**Table No. 15.2**  
BLENDABLE GRADE ZONE-I LIMESTONE

| Bh. No.              | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|----------------------|-----------|-------|-----------|--------------|-------------|--------------------|
|                      | From      | To    |           |              |             |                    |
| MKG-06               | -         | -     | -         | -            | -           | -                  |
| MKG -07              | -         | -     | -         | -            | -           | -                  |
| MKG -08              | 25.00     | 29.00 | 4.00      | 44.25        | 0.58        | 17.51              |
| MKG -09              | 29.00     | 32.00 | 3.00      | 44.78        | 0.49        | 17.79              |
| MKG -10              | 6.00      | 11.00 | 5.00      | 45.72        | 0.44        | 16.51              |
| <b>Average Grade</b> |           |       |           | <b>45.00</b> | <b>0.50</b> | <b>17.16</b>       |

**Table No. 15.3**  
BLENDABLE GRADE ZONE-II LIMESTONE

| Bh. No.              | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|----------------------|-----------|-------|-----------|--------------|-------------|--------------------|
|                      | From      | To    |           |              |             |                    |
| MKG-06               | 39.00     | 41.00 | 2.00      | 42.81        | 0.82        | 16.98              |
| MKG -07              | 30.00     | 33.00 | 3.00      | 42.59        | 0.85        | 17.39              |
| MKG -08              | -         | -     | -         | -            | -           | -                  |
| MKG -09              | -         | -     | -         | -            | -           | -                  |
| MKG -10              | -         | -     | -         | -            | -           | -                  |
| <b>Average Grade</b> |           |       |           | <b>42.68</b> | <b>0.84</b> | <b>17.23</b>       |

It is noteworthy that blendable grade limestone is in continuation with cement grade limestone zone I and it could be mined along with cement grade limestone zones, which will not depreciate the quality of cement grade limestone. The analysis results blendable grade and threshold grade reveals that it is with +42.00% of CaO and -17.50% SiO<sub>2</sub>. Over all the average grade also + 43% of CaO and +16% SiO<sub>2</sub>.

The analysis results blendable grade in the borehole MKG/09 (20.00-23.00) and is with + 42.28 % of CaO and 20.26% SiO<sub>2</sub>. Hence it is classified as blendable/threshold grade and assayed accordingly and the same is tabulated in the following Table No. 15.4. The details of borehole wise zones are presented as **Annexure - IV C**.

**Table No. 15.4**  
BLENDABLE/THRESHOLD GRADE ZONE-II LIMESTONE

| Bh. No.              | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|----------------------|-----------|-------|-----------|--------------|-------------|--------------------|
|                      | From      | To    |           |              |             |                    |
| MKG-06               | -         | -     | -         | -            | -           | -                  |
| MKG -07              | -         | -     | -         | -            | -           | -                  |
| MKG -08              | -         | -     | -         | -            | -           | -                  |
| MKG -09              | 20.00     | 23.00 | 3.00      | 42.28        | 0.45        | 20.26              |
| MKG -10              | -         | -     | -         | -            | -           | -                  |
| <b>Average Grade</b> |           |       |           | <b>42.28</b> | <b>0.45</b> | <b>20.26</b>       |

15.7.5 THRESHOLD GRADE LIMESTONE HORIZON ( $\geq 34$  to  $< 38\%$  Cao)

As per IBM guidelines. Threshold grade limestone zone was demarcated on CaO% range between  $\geq 34$  to  $\leq 38\%$  and MgO shall not be more than 6%. All the five boreholes have intersected threshold grade limestone bands. The threshold grade limestone bands are intersected in the 5 boreholes as two zones (Zone I & II), and the zone-wise salient features are tabulated in the following Table Nos. 15.5 and 15.6. The details of borehole wise zones are presented as **Annexure - IV D**.

**Table No. 15.5**  
THRESHOLD GRADE-I LIMESTONE

| Bh.No.  | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|---------|-----------|-------|-----------|--------------|-------------|--------------------|
|         | From      | To    |           |              |             |                    |
| MKG-06  | -         | -     | -         | -            | -           | -                  |
| MKG -07 | -         | -     | -         | -            | -           | -                  |
| MKG -08 | 4.00      | 25.00 | 21.00     | 41.65        | 0.47        | 23.36              |
| MKG -09 | 2.00      | 20.00 | 18.00     | 41.34        | 0.53        | 23.96              |
|         | 23.00     | 29.00 | 6.00      | 42.16        | 0.51        | 22.67              |
| MKG-10  | 3.00      | 6.00  | 3.00      | 41.86        | 0.46        | 23.08              |
|         |           |       |           | <b>41.61</b> | <b>0.49</b> | <b>23.48</b>       |

**Table No. 15.6**  
THRESHOLD GRADE-II LIMESTONE

| Bh.No. | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|--------|-----------|-------|-----------|--------------|-------------|--------------------|
|        | From      | To    |           |              |             |                    |
| MKG-06 | 41.00     | 45.00 | 4.00      | 37.62        | 0.98        | 21.88              |
| MKG-07 | 33.00     | 38.00 | 5.00      | 35.95        | 1.04        | 23.63              |
| MKG-08 | -         | -     | -         | -            | -           | -                  |
| MKG-09 | -         | -     | -         | -            | -           | -                  |
| MKG-10 | -         | -     | -         | -            | -           | -                  |
|        |           |       |           | <b>36.69</b> | <b>1.01</b> | <b>22.85</b>       |

### **15.8.0 COMPOSITE SAMPLE ANALYSIS**

15.8.1 Composite samples analysis are not approved in the quantum of the Kiranagi-1 and 2 blocks by NMET. Hence, composite samples are not prepared for analysis.

## CHAPTER - 16

### **16.0.0 MOISTURE**

**16.1.0** All the analysis of borehole core samples has been carried out with natural moisture.

## CHAPTER - 17

### **17.0.0 BULK DENSITY**

#### **17.1.0 BULK DENSITY ANALYSIS DETAILS**

The present exploration has been carried out for Limestone, bauxite, fire clay etc. in Kiranagi – 1 block. Bulk density determinations were done on 2nos. of borehole core samples by in MECL Laboratory, Nagpur by **Calliper method:**

- 17.1.1 **Applicability:** This method shall be applicable in hard formations, where regular solid cylindrical drill cores are obtained during the course of drilling. The drill core samples to be used for the study should be of NQ or larger dia.
- 17.1.2 **Sample Preparation:** Take a full cylindrical drill core sample of minimum fifteen (15) centimetre-length with both ends trimmed smoothly at right angle to the core axis using a mechanical core cutter to form a regular cylinder.
- 17.1.3 **Procedure:** Measure the length of the sample, at-least at four locations along its axis by suitably rotating the sample. Measure the diameter of the sample using a calliper scale, at least at four locations, preferably at regular interval. Weigh the air dried sample in a platform balance.
- 17.1.4 **Calculation:** - Take mean average of all the readings for length and diameter. Divide the average mean value of diameter by two to arrive at the radius of the sample. The volume of a core sample is obtained by using formulae:  $V = \pi r^2 h$  (where V = volume, r = radius and h = height or length of the cylindrical core). The bulk density of the sample is determined by using the formula:  $B.D = M/V$  where B.D= bulk density, M= mass (weight) of the sample and V= volume of the sample.
- 17.1.5 **Number of Tests:** - Totally five tests are carried out for each type of ore/mineral formation depending upon the spatial extent of the exploration area involved. The average of these test results for each ore/mineral formation may be taken as the final bulk density for the purpose of estimation of reserves and resources.
- 17.1.6 Average bulk density of limestone comes out to be 2.65, which has been considered for estimation of resource. Analysis results have been represented in Annexure-VII.

## CHAPTER – 18

### **18.0.0 BENEFICIATION STUDIES**

**18.1.0** The present exploration has been carried out for Limestone, bauxite, fire clay etc. in Kiranagi – 1 Block for which there was no provision for beneficiation studies.

## CHAPTER – 19

### **19.0.0 RESOURCE ESTIMATION TECHNIQUE**

#### **19.1.0 GENERAL**

19.1.1 The Preliminary exploration (G-3 stage) has been carried out for Limestone, in Kiranagi - 1 Block. The exploration has been completed by drilling 5 nos. of boreholes in so as to cover the entire block area with the objective to make systematic assessment of grades of Limestone ore and to estimate inferred category (333) resources and associated laboratory studies. There are 204 no. of primary borehole core samples for limestone mineralization has been analysed and the results of the same is furnished in Annexure-III.

19.1.2 Grades and Resource have been assessed on the basis of end-use grade classification given by IBM's National Mineral Inventory (NMI) in following three categories i) Threshold grade ( $\geq 34$  to  $< 38\%$  Cao) in addition to ii) Blendable grade ( $\geq 38$  to  $< 44\%$  Cao,  $< 5\%$  MgO and  $< 18\%$  SiO<sub>2</sub>) and iii) Cement grade ( $\geq 44\%$  Cao,  $< 3.5\%$  MgO and  $< 16\%$  SiO<sub>2</sub>). Apart from this general classification one more classification made for the Zone having  $+44\%$  CaO with  $+20$  SiO<sub>2</sub> and it is demarked in the Cros Sections classified as Blendable/Threshold type. Further Resource have been estimated and categorized as per UNFC and placed as Inferred Resources (333) and Reconnaissance Resources (334) categories by cross seccional method (Annexure-VIII). Total Resources (333+334) has been calculated by polygonal method also (Annexure-IX).

#### **19.2.0 ASSUMPTIONS FOR RESOURCE ESTIMATION**

19.2.1 Resource was computed by “Cross-sectional method” as well as by “Polygonal method”. Certain axiomatic assumptions are inherently involved in estimating overall grade and resource of a deposit, are given below.

19.2.2 Resources estimated for Cement grade limestone CaO  $\geq 44\%$ , 3.5% MgO (Max) and 16% SiO<sub>2</sub> (Max), Blendable Grade CaO  $\geq 38\%$  to  $< 44\%$ , 5.00% MgO (Max) and 18% SiO<sub>2</sub> (Max) and Threshold grade limestone is CaO%  $\geq 34\%$  to  $< 38\%$  are considered for the assessment of limestone resources.

19.2.3 For limestone grade categorization into cement, blendable and threshold grade, Cao% has been considered strictly. For other radicals like in case of MgO and CaO, slight variation on higher side is also considered.

- 19.2.4 The zones of different grades have been demarcated from the values of primary sample analysis as per cut-off limits by End Use Grade specifications by IBM for CaO, MgO and SiO<sub>2</sub>. The minimum cumulative thickness of 1.00m of all grades has been considered for resource calculation in both methods.
- 19.2.5 Although the exploration scheme had been formulated for G-3 level of exploration, it has been observed after the completion of exploration program by drilling of 5 Nos. of boreholes which are falling in three parallel cross section lines SW1-SW1', SW2-SW2' and SW3-SW3' have been drawn along N-S direction. The Limestone body is bedded and continuous within the block. For resource estimation by cross-section method, resources are categorized under Inferred Resources (333) and Reconnaissance Resources (334) of UNFC (as per MEMC 2015 and 2021) Rules.
- 19.2.6 The grade classification and categorisation marked in the cross sections are suitable indexed and enclosed as Plate No IV. Strike and dip influence of maximum 400 m from control point towards the lease boundary has been categorized in Inferred Category (333). Beyond this limit the resources are categorized under Reconnaissance category (334) up to block boundary
- 19.2.7 The average bulk density of limestone has been taken as 2.65 as determined by Calliper's method from 5 limestone samples in MECL Laboratory, Nagpur. This value is taken for computation of resources for cement, blendable, blendable/threshold and threshold grades of limestone.
- 19.2.8 A deduction of 20% from Gross in-situ resources has been made to arrive at Net-in-situ resources by geological cross-section and, polygon method for unseen geological factors i.e. nature of core, recovery factor, cavities/caverns and other structural features.
- 19.2.9 Polygonal resources are calculated for Cement grade, Blendable grade, Blendable/Threshold grade and Theshold grade separately for thickness of limestone zone of respective grades encountered in each boreholes is enclosed as Annexure IX-A, IX-B, IX-C and IX-D.

### 19.3.0 PARAMETERS FOR RESOURCE ESTIMATION

#### 19.3.1 SAMPLING PROCEDURE

19.3.1.1 The primary samples have been collected as per the litho-contact, and depositional nature of limestone. Sample length of one meter has been taken, however due to lithological variations in very few places the sample length was also taken less than 1.00m, but resources has not been calculated for the zones which are less than 1.00m. The analytical data pertaining to these 5 exploratory boreholes of MECL has been considered for delineation and demarcation of ore zones.

19.3.1.2 The borehole samples, collected generally at 1.00m interval but at some places sample length is taken up to 2.00m. Samples from bore hole cores were crushed to (-) 100 mesh size, cone and quartered, thoroughly mixed and representative samples of 100g were prepared and sent to laboratory for analysis of 8 radicals i.e. CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, and LOI for boreholes drilled by MECL and results were obtained to delineate the ore zones.

#### 19.3.2 CHEMICAL ANALYSIS

A total of 204 nos. of samples in Kiranagi – 1 block were analyzed for boreholes drilled by MECL in and JNARDDC Lab, Nagpurr. A total of 10 nos of internal check samples and 20 nos of external check samples have been analyzed at JNARDDC Lab., Nagpur and MECL Lab, Nagpur respectively.

#### 19.3.3 CUT-OFF GRADE

Resources estimated for Cement grade limestone CaO ≥ 44 %, 3.5% MgO (Max) and 16% SiO<sub>2</sub> (Max), Blendable Grade CaO ≥ 38 % to <44% , 5.00% MgO (Max) and 18% SiO<sub>2</sub> (Max) and Threshold grade limestone is CaO% ≥ 34% to <38% are considered for the assessment of limestone resources.

**Table No. 19.1**

**Limestone resource classification**

| Grade                      | CaO %<br>(Min) | MgO %<br>(Max)  | SiO <sub>2</sub> %<br>(Max) |
|----------------------------|----------------|-----------------|-----------------------------|
| <b>Cement (Portland)</b>   | <b>≥ 44.00</b> | <b>3.50</b>     | <b>16.00</b>                |
| <b>Blendable</b>           | <b>≥ 38.00</b> | <b>&lt;5.00</b> | <b>&lt;18.00</b>            |
| <b>Threshold</b>           | <b>≥ 34.00</b> |                 |                             |
| <b>Blendable/Threshold</b> | <b>+40.00</b>  |                 | <b>+20.00</b>               |

### 19.3.4 BULK DENSITY

A total of 5 nos. of limestone core samples from MECL boreholes were subjected to bulk density determination by **Calliper Method** in Petrology laboratory, MECL, Nagpur. The average bulk density of these 5 samples has been determined as 2.65 and the same have been considered for estimation of resources. The results of bulk density determination are presented in Annexure-VII. The procedure of determining the bulk density is already discussed in chapter 17.

**Table No. 19.2**

**Bulk density determination of limestone mineralisation from borehole core samples for Kiranagi – 1 Block , Kalaburagi District. Karnataka.**

| Sl. No.                     | Sample No. | BH No. | From (m) | To (m) | Bulk density (gm/cc) |
|-----------------------------|------------|--------|----------|--------|----------------------|
| 1                           | MKG-04/S1  | MKG-04 | 35.70    | 35.75  | 2.67                 |
| 2                           | MKG-03/S2  | MKG-03 | 29.50    | 29.56  | 2.62                 |
| <b>Average bulk density</b> |            |        |          |        | <b>2.65</b>          |

### 19.4.0 OVERBURDEN

18.4.1 Overburden of limestone includes top layer of soil and subsequent sticky clay/sandstone which lies immediately above limestone in Kiranagi – 1 block.

|               |                |
|---------------|----------------|
| Minimum (m)   | Maximum        |
| 2.00 (MKG-09) | 4.00 (4MKG-08) |

### 19.5.0 METHODOLOGY

18.5.1 The resources of limestone have been estimated by geological cross section method as principal method and Polygon method as check method. The methodology adopted, keeping the above assumptions in view, for resource estimation are described further.

### 19.6.0 METHODOLOGY ADOPTED IN CROSS-SECTION METHOD OF RESOURCE ESTIMATION (PRINCIPAL METHOD)

19.6.1 Three numbers of parallel cross section lines SW1-SW1', SW2-SW2' and SW3-SW3' are drawn along N-S direction from north to south throughout the block which is marked on Plate No. IV. Efforts were made to pass these sections through drilled borehole locations wherever possible. The boreholes which have not fallen on section lines are projected on to the nearest section line. Since the

beds are generally horizontal with very low dip of 1° to 3° due south direction and boreholes drilled are all vertical hence true thickness will be the same as thickness intersected in the exploratory boreholes. Geological cross sections are generated by GDM software. Cross sectional area on each section has been measured with the help of Auto CAD map 2018 software and recorded systematically. Strike influence between two section lines and boreholes has been taken up-to half way distance. However, the influence is up to block boundary has been taken, wherever it was necessary. Each of these areas has been multiplied with sectional influence / strike influence of the section lines to give volume. The volume is then multiplied with average bulk density, to estimate geological in-situ gross resources.

$$R = S_v (X) T (X) \text{ Avg Bulk Density}$$

Where

R = Resources / Tonnage

S<sub>v</sub> = Sectional area of limestone

T = Influence between successive section lines

Sp. gr. = Specific gravity of limestone

19.6.2 The resources are estimated grade wise, borehole wise, section wise and presented as Annexures-VIII.

19.6.3 The average grades for 3 radicals CaO, MgO, SiO<sub>2</sub> have been calculated. Thus, average grade of the block is calculated for all grades of limestone.

### **19.7.0 METHODOLOGY ADOPTED IN POLYGONAL METHOD OF RESOURCE ESTIMATION (CHECK METHOD)**

**19.7.1** The main objective of this method is to demarcate the area of influence of the limestone intersected by a particular borehole. The influence area has been obtained by constructing polygons by drawing perpendicular bisector of triangles, rectangles that connect the adjoining boreholes. The area of the influence of zones has been ascertained by Auto-Cad software. The area of non-development of respective zones is shown on the resource plan. The height of polygons is the cumulative thickness of limestone horizon/bands encountered by the corresponding borehole. The entire limestone body in block is divided into 5 numbers of polygons (P1 to P5) of different thickness. The resource estimation

by Polygon method for Cement Grade, Blendable Grade, Blendable/Threshold Grade and Threshold Grade of this block are estimated and presented in Annexure No IX. Polygon Map for Cement Grade is furnished as Text Figure No.5. The grade assigned to the polygon blocks is same as the weighted average grade of the corresponding boreholes.

The formula of resource estimation is as follows:

$$R = P_A \times Th \times \text{Average bulk density}$$

Where in;  $P_A$  = Area of Polygon

R= Resource/ Tonnage

Th= Thickness of Limestone zone

19.7.2 The resources are estimated grade wise, borehole wise, polygon wise and presented as Annexure IX.

19.7.3 The average grades for 3 radicals CaO, MgO, SiO<sub>2</sub> have been calculated. Thus, average grade of the block is calculated for all grades of limestone.

## CHAPTER - 20

### **20.1.0 REPORTING OF RESOURCES**

#### **20.1.0 RESOURCE ESTIMATION**

**20.1.1** The Resource of limestone have been estimated grade wise, borehole wise and section wise in cross section method (principal method) while in Polygonal method (check method), Resource of limestone have been estimated for different intersected zones/grade wise, borehole wise, polygon wise as per specifications and basic assumptions enumerated earlier.

**20.1.2** The total Net in-situ resource of Cement (Portland), Blendable, Blendable/ Threshold grade limestone and Threshold grade limestone are broadly categorized under inferred (333) and reconnaissance (334). The total inferred and reconnaissance category resources are 432.85 million tonnes, out of which 237.34 million tonnes falls in inferred category (333) and 195.51 million tonnes falls in reconnaissance category. The estimates are computed by cross sectional method.

**Table No. 20.1**

**Summary of Category wise Net-Resource**

**Unit: million tonnes**

| <b>Category and UNFC Code</b> | <b>Cement (Portland) Grade</b> | <b>Blendable Grade</b> | <b>Blendable/ Threshold Grade</b> | <b>Threshold Grade</b> | <b>Total</b>  | <b>Percentage</b> |
|-------------------------------|--------------------------------|------------------------|-----------------------------------|------------------------|---------------|-------------------|
| 333                           | 156.55                         | 22.88                  | 2.66                              | 55.24                  | 237.34        | 54.83%            |
| 334                           | 124.98                         | 27.90                  | 0.61                              | 42.03                  | 195.51        | 45.17%            |
| <b>Total</b>                  | <b>281.43</b>                  | <b>50.78</b>           | <b>3.27</b>                       | <b>97.27</b>           | <b>432.85</b> | <b>100.00%</b>    |

**20.1.2** The total net inferred category resource is 237.34 (54.83% of total Net Geological resource of 432.85) million tonnes. The total net reconnaissance category resource is 195.51 (45.17% of total Net Geological resource of 432.85) million tonnes.

**20.1.3** The resources of limestone for different grades have been estimated borehole wise, section wise, polygon wise for different grades of limestone intersected, as per specifications for different grades and basic assumptions enumerated earlier in this chapter by cross section methods and polygon method. The category wise and grade wise estimated inferred resource estimated by cross sectional method is tabulated in Table Nos.20.2 to 20.8 and the reconnaissance resources estimated by cross sectional methods are tabulated in Table Nos 20.9 to 20.16. The same is enclosed as Annexures – VIII-A-1, B-1, C-1, D-1 (333) category & VIII-A-2, B-2, C-2, D-2 (334) category.

The category wise and grade wise estimated resources by Polygonal method is tabulated in Table No. 20.18 and the same is enclosed as Annexure No IXA/1 (Cement Grade), IX/B/1 (Blendable Grade), IX/C/1 (Blendable/Threshold Grade) and IX/D/1 (Threshold Grade)

20.1.4 The category wise and grade wise estimated resources by Polygonal method is tabulated in Table No. 20.18 and the same is enclosed as Annexure No IXA/1 (Cement Grade), IX/B/1 (Blendable Grade), IX/C/1 (Blendable/Threshold Grade) and IX/D/1 (Threshold Grade)

**Table No. 20.2**  
**Statement showing section wise, borehole wise Inferred category of resource (333) of Cement (Portland) Grade Limestone for Zone I Estimated by Cross Sectional method, Kiranagi-1 (G-3) block, Kalaburagi Dist., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | 26916.70               | 722.00                | 19433857.40              | 51499722.11                         | 41199777.69                       | 49.05           | 0.49        | 10.30              |
| MKG-8                      | SW-1         | 16000.00               | 722.00                | 11552000.00              | 30612800.00                         | 24490240.00                       | 49.18           | 0.64        | 9.95               |
| MKG-9                      | SW-2         | 10408.27               | 523.00                | 5443525.21               | 14425341.81                         | 11540273.45                       | 49.42           | 0.61        | 9.67               |
| MKG-7                      | SW-3         | 21906.75               | 757.00                | 16583407.63              | 43946030.22                         | 35156824.18                       | 49.63           | 0.50        | 9.14               |
| MKG-10                     | SW-3         | 27521.41               | 757.00                | 20833707.37              | 55209324.53                         | 44167459.62                       | 48.71           | 0.55        | 10.37              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>195693218.67</b>                 | <b>156554574.93</b>               | <b>49.13</b>    | <b>0.54</b> | <b>9.96</b>        |

**Resources: Gross 195.69 million tonnes & Net 156.55 million tonnes**

**Table No. 20.3**  
**Statement showing section wise, borehole wise Inferred category of resource (333) of Blendable Grade Limestone for Zone I, Estimated by Cross Sectional method, Kiranagi-1 (G-3) Block, Kalaburagi Dist, Karnataka.**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-8                      | SW-1         | 3366.20                | 722.00                | 2430396.40               | 6440550.46                          | 5152440.37                        | 42.59           | 0.85        | 17.39              |
| MKG-9                      | SW-2         | 2387.67                | 523.00                | 1248751.41               | 3309191.24                          | 2647352.99                        | 44.78           | 0.49        | 17.79              |
| MKG-7                      | SW-3         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-10                     | SW-3         | 4591.89                | 757.00                | 3476057.70               | 9211552.91                          | 7369242.33                        | 45.72           | 0.44        | 16.51              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>18961294.61</b>                  | <b>15169035.69</b>                | <b>44.50</b>    | <b>0.59</b> | <b>17.03</b>       |

**Resources: Gross 18.96 million tonnes & Net 15.17 million tonnes**

**Table No. 20.4**  
Statement showing section wise, borehole wise Inferred category of resource (333)  
of Blendable Grade Limestone for Zone II, Estimated by Cross Sectional method,  
Kiranagi-1 (G-3) Block, Kalaburagi Dist, Karnataka.

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG -6                     | SW-1         | 2388.84                | 722.00                | 1724740.46               | 4570562.21                          | 3656449.77                        | 42.81           | 0.82        | 16.98              |
| MKG -8                     | SW-1         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG -9                     | SW-2         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG -7                     | SW-3         | 2527.50                | 757.00                | 1913317.50               | 5070291.38                          | 4056233.10                        | 42.59           | 0.85        | 17.39              |
| MKG -10                    | SW-3         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>9640853.59</b>                   | <b>7712682.87</b>                 | <b>42.69</b>    | <b>0.84</b> | <b>17.20</b>       |

**Resources: Gross 9.64 million tonnes & Net 7.71 million tonnes**

**Table No. 20.5**  
Statement showing section wise, borehole wise Inferred category of resource (333)  
of Blendable/Threshold Grade Limestone for Zone I, Estimated by Cross Sectional method,  
Kiranagi-1 (G-3) Block, Kalaburagi Dist., Karnataka.

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG -9                     | SW-2         | 2398.40                | 523.00                | 1254363.20               | 3324062.48                          | 2659249.98                        | 42.28           | 0.45        | 20.26              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>3324062.48</b>                   | <b>2659249.98</b>                 | <b>42.28</b>    | <b>0.45</b> | <b>20.26</b>       |

**Resources: Gross 3.32 million tonnes & Net 2.66 million tonnes**

**Table No. 20.6**  
**Statement showing section wise, borehole wise Inferred category of resource (333)**  
**of Threshold Grade Limestone for Zone I, Estimated by Cross Sectional method,**  
**Kiranagi-1 (G-3) Block, Kalaburagi Dist., Karnataka.**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-8                      | SW-1         | 14957.63               | 722.00                | 10799408.86              | 28618433.48                         | 22894746.78                    | 41.65           | 0.47        | 23.36              |
| MKG-9                      | SW-2         | 11607.52               | 523.00                | 6070732.96               | 16087442.34                         | 12869953.88                    | 41.34           | 0.53        | 23.96              |
| MKG-9                      | SW-2         | 4807.53                | 523.00                | 2514336.20               | 6662990.94                          | 5330392.75                     | 42.16           | 0.51        | 22.67              |
| MKG-7                      | SW-3         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-10                     | SW-3         | 1379.21                | 757.00                | 1044061.97               | 2766764.22                          | 2213411.38                     | 41.86           | 0.46        | 23.08              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>54135630.98</b>                  | <b>43308504.78</b>             | <b>41.63</b>    | <b>0.49</b> | <b>23.44</b>       |

**Resources: Gross 54.14 million tonnes & Net 43.31 million tonnes**

**Table No. 20.7**  
**Statement showing section wise, borehole wise Inferred category of resource (333)**  
**of Threshold Grade Limestone for Zone II, Estimated by Cross Sectional method,**  
**Kiranagi-1 (G-3) Block, Kalaburagi Dist., Karnataka.**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | 3379.43                | 722.00                | 2439945.14               | 6465854.62                          | 5172683.69                     | 37.62           | 0.98        | 21.88              |
| MKG-8                      | SW-1         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-9                      | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-9                      | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-7                      | SW-3         | 4212.50                | 757.00                | 3188862.50               | 8450485.63                          | 6760388.50                     | 35.95           | 1.04        | 23.63              |
| MKG-10                     | SW-3         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>14916340.24</b>                  | <b>11933072.19</b>             | <b>36.67</b>    | <b>1.01</b> | <b>22.87</b>       |

**Resources: Gross 14.92 million tonnes & Net 11.93 million tonnes**

**Table No. 20.8**

**Total Reconnaissance Resources (333) Cement (Portland), Blendable, Blendable / Threshold and Threshold Grade Estimated by Cross Sectional method, Kiranagi 1 (G-3 stage) block, Kalaburagi Dist., Karnataka**

| Resource details   | Gross Geological Resource (tonnes) | Net in-situ Resource (tonnes) | Average Quality |             |                    |
|--|------------------------------------|-------------------------------|-----------------|-------------|--------------------|
|  |                                    |                               | CaO %           | MgO %       | SiO <sub>2</sub> % |
| <b>Resources in tonnes</b>   | <b>296671400.57</b>                | <b>237337120.45</b>           | <b>46.56</b>    | <b>0.57</b> | <b>13.87</b>       |
| Resource : Gross 296.67 million tonnes & Net 237.34 million tonnes |                                    |                               |                 |             |                    |

**Table No: 20.9**

**Statement showing section wise, borehole wise Reconnaissance Resource (334) of Cement Grade Limestone, Estimated by Cross Sectional method, Kiranagi 1 (G-3 stage) Block, Kalaburagi Distt., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | 1988.08                | 722.00                | 1435392.39               | 3803789.83                          | 3043031.86                        | 49.05           | 0.49        | 10.30              |
| MKG-8                      | SW-1         | 9851.19                | 722.00                | 7112559.18               | 18848281.83                         | 15078625.46                       | 49.18           | 0.64        | 9.95               |
| MKG-9                      | SW-2         | 9635.32                | 523.00                | 5039272.36               | 13354071.75                         | 10683257.40                       | 49.42           | 0.61        | 9.67               |
|                            | SW-2         | 56034.03               | 523.00                | 29305796.64              | 77660361.11                         | 62128288.89                       | 49.30*          | 0.50*       | 9.80*              |
| MKG-7                      | SW-3         | 1173.52                | 757.00                | 888354.64                | 2354139.80                          | 1883311.84                        | 49.63           | 0.50        | 9.14               |
| MKG-10                     | SW-3         | 20040.71               | 757.00                | 15170817.47              | 40202666.30                         | 32162133.04                       | 48.71           | 0.55        | 10.37              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>156223310.61</b>                 | <b>124978648.49</b>               | <b>49.14</b>    | <b>0.54</b> | <b>9.96</b>        |

\*Average grade of MKG-08 & MKG-07 Resources: Gross 156.22 million tonnes & Net 124.98 million tonnes

**Table No. 20.10**

**Statement showing section wise, borehole wise Reconnaissance Resource (334) of Blendable Grade Limestone Zone-I, Estimated by Cross Sectional method, Kiranagi-I (G-3 stage) Block, Kalaburagi Distt., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-8                      | SW-1         | 3409.20                | 722.00                | 2461442.40               | 6522822.36                          | 5218257.89                     | 44.25           | 0.58        | 17.51              |
| MKG-9                      | SW-2         | 1352.16                | 523.00                | 707179.68                | 1874026.15                          | 1499220.92                     | 44.78           | 0.49        | 17.79              |
| -                          | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-7                      | SW-3         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-10                     | SW-3         | 4542.93                | 757.00                | 3438998.01               | 9113344.73                          | 7290675.78                     | 45.72           | 0.44        | 16.51              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>17510193.24</b>                  | <b>14008154.59</b>             | <b>45.07</b>    | <b>0.50</b> | <b>17.02</b>       |

**Resources: Gross 17.51 million tonnes & Net 14.01 million tonnes**

**Table No. 20.11**

**Statement showing section wise, borehole wise Reconnaissance Resource (334) of Blendable Grade Limestone Zone-II, Estimated by Cross Sectional method, Kiranagi-I (G-3 stage) Block, Kalaburagi Distt., Karnataka Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | 296.03                 | 722.00                | 213735.75                | 566399.75                           | 453119.80                      | 42.81           | 0.82        | 16.98              |
| MKG-8                      | SW-1         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-9                      | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| -                          | SW-2         | 11837.33               | 523.00                | 6190923.59               | 16405947.51                         | 13124758.01                    | 42.68*          | 0.84*       | 17.23*             |
| MKG-7                      | SW-3         | 192.72                 | 757.00                | 145889.04                | 386605.96                           | 309284.76                      | 42.59           | 0.85        | 17.39              |
| MKG-10                     | SW-3         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>17358953.22</b>                  | <b>13887162.57</b>             | <b>42.68</b>    | <b>0.84</b> | <b>17.22</b>       |

\*Average grade of MKG-06 & MKG-07 Resources: Gross 17.34 million tonnes & Net 13.89 million tonnes

**Table No. 20.12**

**Statement showing section wise, borehole wise Reconnaissance Resource (334) of Blendable/Threshold Grade Limestone, Estimated by Cross Sectional method, Kiranagi-I (G-3 stage) Block, Kalaburagi Distt., Karnataka Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-9                      | SW-2         | 546.52                 | 523.00                | 285829.18                | 757447.32                           | 605957.85                      | 42.28           | 0.45        | 20.26              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>757447.32</b>                    | <b>605957.85</b>               | <b>42.28</b>    | <b>0.45</b> | <b>20.26</b>       |

Resources: Gross 0.76 million tonnes & Net 0.61 million tonnes

**Table No. 20.13**

**Statement showing section wise, borehole wise Reconnaissance Resource (334) of Threshold Grade Limestone Zone-I, Estimated by Cross Sectional method, Kiranagi I (G-3 stage) Block, Kalaburagi Distt., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-8                      | SW-1         | 19083.87               | 722.00                | 13778554.14              | 36513168.47                         | 29210534.78                    | 41.65           | 0.47        | 23.36              |
| MKG-9                      | SW-2         | 486.33                 | 523.00                | 254350.59                | 674029.06                           | 539223.25                      | 41.34           | 0.53        | 23.96              |
| MKG-9                      | SW-2         | 1936.86                | 523.00                | 1012977.78               | 2684391.12                          | 2147512.89                     | 42.16           | 0.51        | 22.67              |
| -                          | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-7                      | SW-3         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-10                     | SW-3         | 2724.38                | 757.00                | 2062352.86               | 5465235.08                          | 4372188.06                     | 41.86           | 0.46        | 23.08              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>45336823.73</b>                  | <b>36269458.98</b>             | <b>41.70</b>    | <b>0.47</b> | <b>23.29</b>       |

**Resources: Gross 45.34 million tonnes & Net 36.27 million tonnes**

**Table No. 20.14**

**Statement showing section wise, borehole wise Reconnaissance Resource (334) of Threshold Grade Limestone Zone-II, Estimated by Cross Sectional method, Kiranagi I (G-3 stage) Block, Kalaburagi Distt., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-6                      | SW-1         | 268.78                 | 722.00                | 194061.18                | 514262.13                           | 411409.70                      | 37.62           | 0.98        | 21.88              |
| MKG-8                      | SW-1         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-9                      | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| MKG-9                      | SW-2         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| -                          | SW-2         | 4358.13                | 523.00                | 2279301.99               | 6040150.27                          | 4832120.22                     | 33.59*          | 1.08*       | 26.33*             |
| MKG-7                      | SW-3         | 321.00                 | 757.00                | 242997.00                | 643942.05                           | 515153.64                      | 35.95           | 1.04        | 23.63              |
| MKG-10                     | SW-3         | -                      | -                     | -                        | -                                   | -                              | -               | -           | -                  |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>7198354.45</b>                   | <b>5758683.56</b>              | <b>34.09</b>    | <b>1.07</b> | <b>25.77</b>       |

**\*Average grade of MKG-06 & MKG-07 Resources: Gross 7.20 million tonnes & Net 5.76 million tonnes**

**Table No. 20.15**

**Total Reconnaissance Resources (334) Cement (Portland), Blendable, Blendable / Threshold and Threshold Grade Estimated by Cross Sectional method, Kiranagi I (G-3 stage) block, Kalaburagi Dist., Karnataka**

| Resource details           | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| <b>Resources in tonnes</b> | <b>244385082.56</b>                 | <b>195508066</b>               | <b>46.55</b>    | <b>0.56</b> | <b>13.95</b>       |

Resources: Gross 244.39 million tonnes & Net 195.51 million tonnes

**Table No. 20.16**

**Total Resources (333+334) Estimated by Cross Sectional method, Kiranagi-I (G-3 stage) block, Kalaburagi Dist., Karnataka**

| Resource details  | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|---|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|   |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| Total Inferred Resources (333) of Cement grade Limestone                    | 195693218.67                        | 156554574.93                   | 49.13           | 0.54        | 9.96               |
| Total Reconnaissance Resources (334) of Cement grade Limestone              | 156223310.61                        | 124978648.49                   | 49.14           | 0.54        | 9.96               |
| Total Inferred Resources (333) of Blendable grade Limestone                 | 28602148.20                         | 22881718.56                    | 43.89           | 0.67        | 17.09              |
| Total Reconnaissance Resources (334) of Blendable grade Limestone           | 34869146.46                         | 27895317.16                    | 43.88           | 0.67        | 17.12              |
| Total Inferred Resources (333) of Blendable/Threshold grade Limestone       | 3324062.48                          | 2659249.98                     | 42.28           | 0.45        | 20.26              |
| Total Reconnaissance Resources (334) of Blendable/Threshold grade Limestone | 757447.32                           | 605957.85                      | 42.28           | 0.45        | 20.26              |
| Total Inferred Resources (333) of Threshold grade Limestone                 | 69051971.22                         | 55241576.98                    | 40.56           | 0.60        | 23.31              |
| Total Reconnaissance Resources (334) of Threshold grade Limestone           | 52535178.18                         | 42028142.55                    | 40.66           | 0.55        | 23.63              |
| <b>Total Resources in Tonnes (333+334)</b>                                  | <b>541056483.13</b>                 | <b>432845186.50</b>            | <b>46.55</b>    | <b>0.56</b> | <b>13.91</b>       |
| <b>Total Resources in Million Tonnes (333+334)</b>                          | <b>541.06</b>                       | <b>432.85</b>                  |                 |             |                    |

**Table No. 20.17**

**Summary of the Total Resources (333+334) Estimated by Cross Sectional method, Kiranagi-I (G-3 stage) block, Kalaburagi Dist., Karnataka**

| Resource details                                   | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|--|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|  |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| <b>Resources in tonnes (333)</b>                   | 296671400.57                        | 237337120.45                      | 46.56           | 0.57        | 13.87              |
| <b>Resources in tonnes (334)</b>                   | 244385082.56                        | 195508066.05                      | 46.55           | 0.56        | 13.95              |
| <b>Total Resources in Tonnes (333+334)</b>         | <b>541056483.13</b>                 | <b>432845186.50</b>               | <b>46.55</b>    | <b>0.56</b> | <b>13.91</b>       |
| <b>Total Resources in Million Tonnes (333+334)</b> | <b>541.06</b>                       | <b>432.85</b>                     |                 |             |                    |

**Table No. 20.18**  
**Summary of Grade wise Resources by Polygon method**

| Grade of Limestone   | Resource Category | Zone        | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                  |
|--|-------------------|-------------|-------------------------------------|-----------------------------------|-----------------|-------------|------------------|
|  |                   |             |                                     |                                   | CaO             | MgO         | SiO <sub>2</sub> |
| Cement (Portland) Gr. limestone 333 & 334 for Zone I (R <sub>1</sub> )   | 333 & 334         | Zone I      | 354149405.25                        | 283319524.20                      | 49.15           | 0.54        | 9.92             |
| Blendable Grade Zone I   | 333 & 334         | Zone I      | 35858916.92                         | 28687133.54                       | 44.98           | 0.50        | 17.21            |
| Blendable Grade Zone II  | 333 & 334         | Zone II     | 14024696.68                         | 11219757.34                       | 42.68           | 0.84        | 17.23            |
| Blendable Gr. (R <sub>2</sub> )  | 333 & 334         | Zone I & II | 49883613.60                         | 39906890.88                       | 44.33           | 0.59        | 17.21            |
| Blendable/ Threshold Grade (BT) (R <sub>3</sub> )  | 333 & 334         | Zone I      | 10637866.31                         | 8510293.05                        | 42.28           | 0.45        | 20.26            |
| Threshold Grade  | 333 & 334         | Zone I      | 153971603.85                        | 123177283.08                      | 41.60           | 0.50        | 23.50            |
|  | 333 & 334         | Zone II     | 25247452.97                         | 20197962.37                       | 36.69           | 1.01        | 22.85            |
| Threshold Gr. limestone 333 & 334 for Zone I & II (R <sub>4</sub> )  |                   |             | 179219056.82                        | 143375245.46                      | 40.91           | 0.57        | 23.41            |
| <b>Total (333 &amp; 334 for all Cement, Blendable &amp; Threshold Grade Limestone (R<sub>1</sub>+R<sub>2</sub>+R<sub>3</sub>+R<sub>4</sub>))</b> |                   |             | <b>5913889941.98</b>                | <b>475111953.6</b>                | <b>46.14</b>    | <b>0.55</b> | <b>14.59</b>     |

## 20.2.0 COMPUTATION OF AVERAGE GRADE

All calculations for grade estimation are made by weighted average method. Since the sample interval was uniformly maintained at 1.00m interval with the exception of minor variations or structural implications, the weighted average method of calculation is made by the following formula:

$$\text{Weighted average grade} = \frac{V_1XG_1 + V_2XG_2 + V_3XG_3 + \dots + V_nXG_n}{V_1 + V_2 + V_3 + \dots + V_n}$$

Where 'V' = Volume of Limestone in individual borehole

'G' = Grade of the respective Limestone in the corresponding borehole

## 20.3.0 RELIABILITY OF RESOURCE

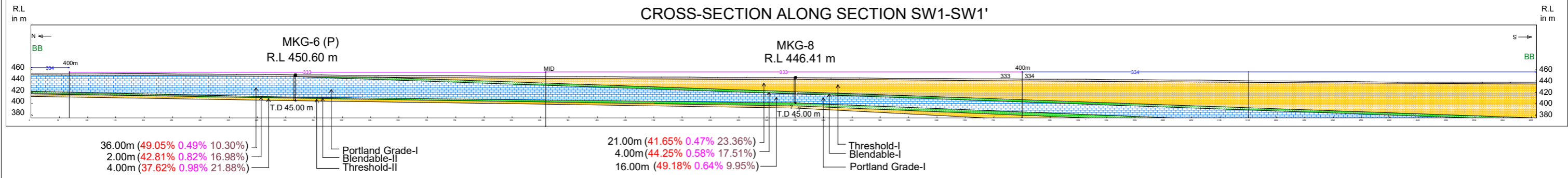
20.3.1 The Limestone resource estimated at different end use cut off by the cross-section method and polygonal method were compared to ascertain the confidence level of estimation. The difference in Resources by two methods comes to 9.76%. The resources calculated by polygonal method are bit higher side due to highly irregular shape of the block. Hence the cross sectional method is more reliable than polygon method. The comparison of resource is given in the Table 20.19.

**Table No. 20.19**  
**Comparison of Net in-situ Resources estimated by**  
**Cross sectional and Polygonal method**

| <b>Method of estimation</b> | <b>Net in-situ Resources (mT)</b> |
|-----------------------------|-----------------------------------|
| Cross sectional method      | 432.85                            |
| Polygonal method            | 475.11                            |
| <b>Difference (%)</b>       | <b>9.76%</b>                      |

# KIRANAGI-1 BLOCK, KALABURAGI DISTRICT, KARNATAKA

## CROSS-SECTION ALONG SECTION SW1-SW1'

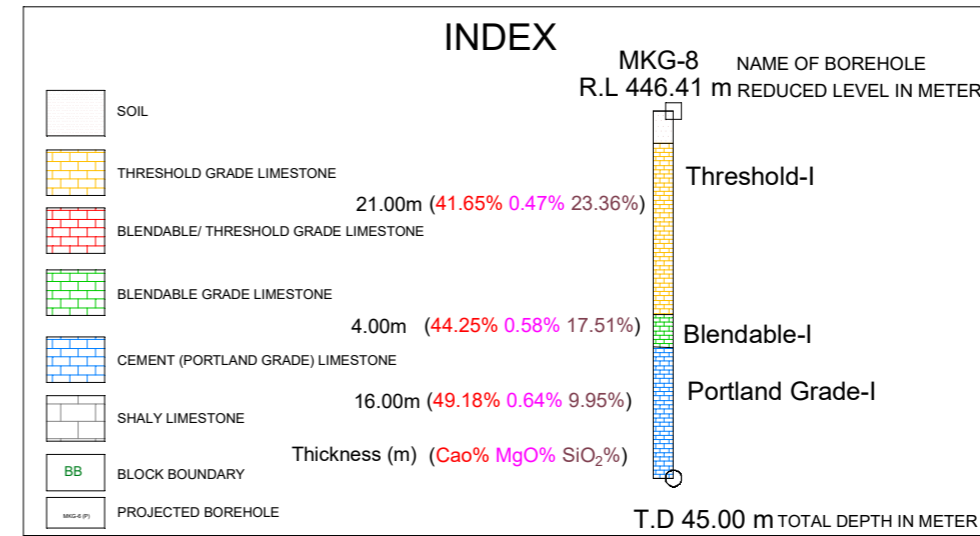


36.00m (49.05% 0.49% 10.30%)  
 2.00m (42.81% 0.82% 16.98%)  
 4.00m (37.62% 0.98% 21.88%)

Portland Grade-I  
 Blendable-II  
 Threshold-II

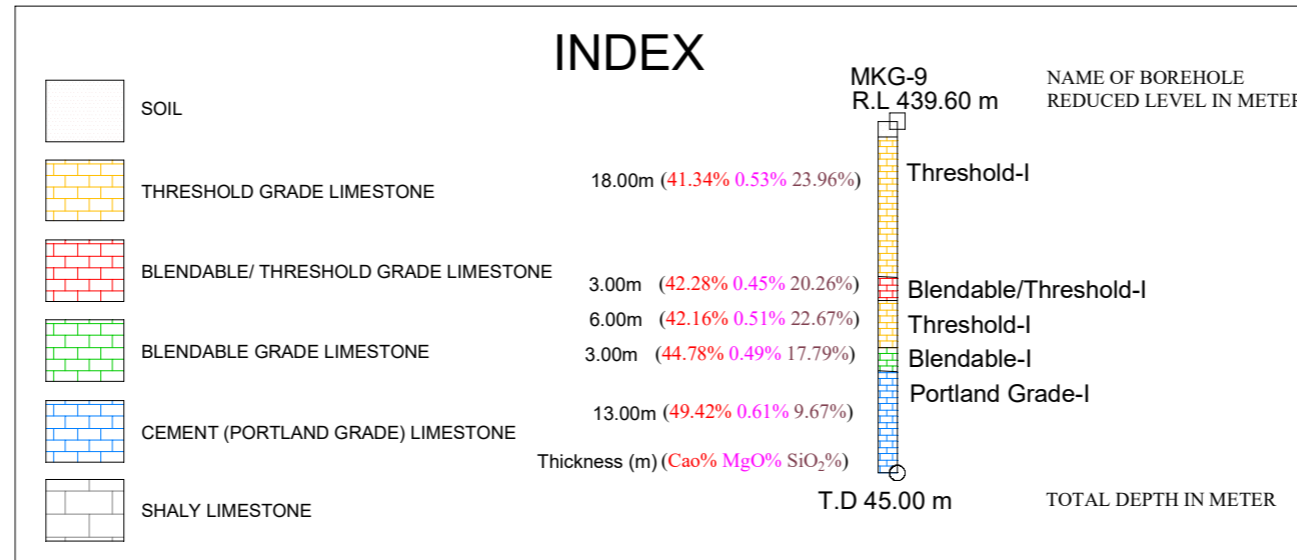
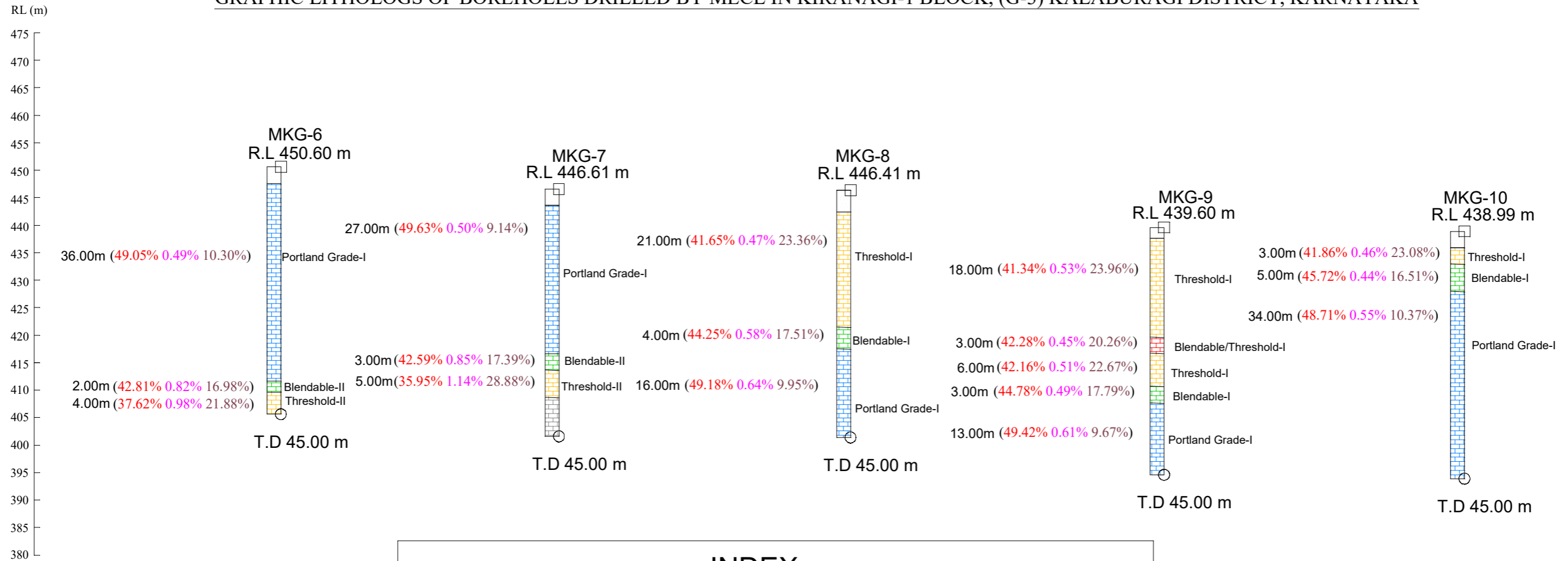
21.00m (41.65% 0.47% 23.36%)  
 4.00m (44.25% 0.58% 17.51%)  
 16.00m (49.18% 0.64% 9.95%)

Threshold-I  
 Blendable-I  
 Portland Grade-I



NOT TO SCALE  
 TEXT FIGURE NO-3

**GRAPHIC LITHOLOGS OF BOREHOLES DRILLED BY MECL IN KIRANAGI-1 BLOCK, (G-3) KALABURAGI DISTRICT, KARNATAKA**



NOT TO SCALE  
TEXT FIGURE NO- 4

#### 20.4.0 POLYGON METHOD (CHECK METHOD):

The main objective of this method is to demarcate the area of influence of the limestone intersected by a particular borehole. The influence area has been obtained by constructing polygons by drawing perpendicular bisector of triangles, rectangles that connect the adjoining boreholes. The area of the influence of zones has been ascertained by Auto-Cad software. The area of non-development of respective zones is shown on the resource plan. The height of polygons is the cumulative thickness of limestone horizon/bands encountered by the corresponding borehole. The entire block is divided into 5 numbers of polygons (P1 to P5) of different thickness.

The resource estimation by Polygon method for Cement (Portland) Grade Zone-I, Blendable Grade Zone-I & Zone-II, Blendable/ Threshold Grade Zone-1 and Threshold Grade Zone-I & Zone-II of this block are presented as Annexure-IX-A, B, C and D. The grade assigned to the polygon blocks is same as the weighted average grade of the corresponding boreholes. The area of non-development of particular grade in borehole has been deducted.

The formula of resource estimation is as follows:

$$R = P_A \times Th \times \text{Bulk Density}$$

Where in;  $P_A$  = Area of Polygon

R= Resource/ Tonnage

Th= Thickness of Limestone

20.4.1 The resources are estimated grade wise, zone wise, borehole wise, polygon wise and presented as **Annexure IX-A, B, C and D**.

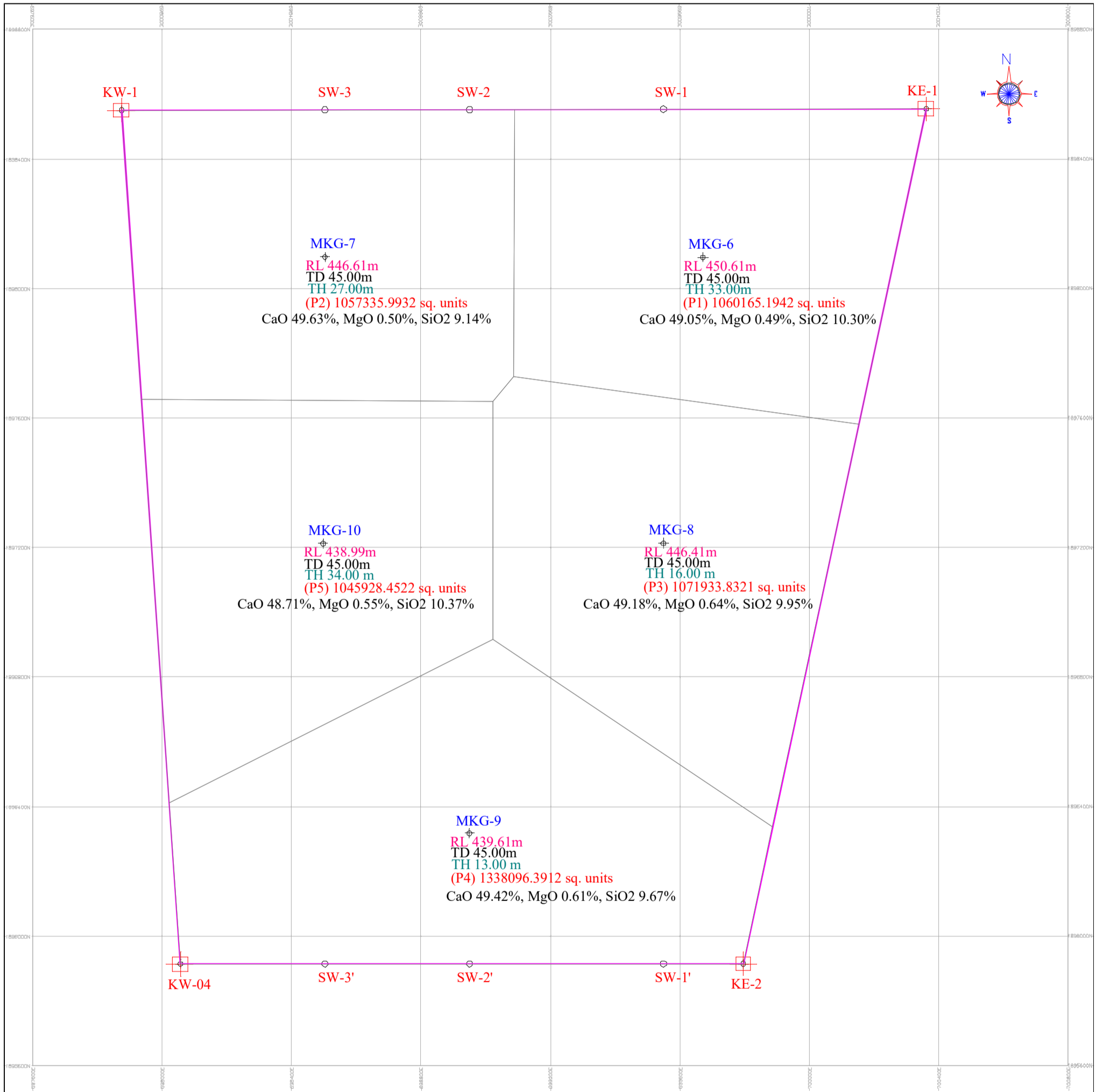
20.4.2 The average grades for 3 radicals CaO, MgO, SiO<sub>2</sub> have been calculated. Thus, average grade of the block is calculated for all grades of limestone.


#### 20.5.0 CATEGORISATION OF RESOURCES

20.5.1 Resources have been categorized under Inferred and Reconnaissance category of limestone resources (333 and 334) as per UNFC. The parameters and assumptions for resources estimation have already been discussed earlier in this chapter.

20.5.2 Limestone zones are computed and categorized based on **End Use Grade** specifications prescribed by Indian Bureau of Mines, Government of India.

**POLYGON MAP OF CEMENT GRADE LIMESTONE SHOWING THICKNESS, DISTRIBUTION AND QUALITY IN KIRANAGI-1 BLOCK, KALABURAGI DISTRICT, KARNATAKA**



| INDEX   |                                     |
|---|-------------------------------------|
| MKG-7   | BOREHOLE DRILLED BY MECL            |
| RL 446.61m  | REDUCED LEVEL IN m                  |
| TD 45.00m   | TOTAL DEPTH IN m                    |
| TH 45.00m / NZ  | THICKNESS IN m / NO ZONE            |
| (P2) 1057335.9932 sq. units   | POLYGON AREA                        |
|  | BLOCK BOUNDARY WITH CARDINAL POINTS |

TEXT FIGURE NO-5  
NOT TO SCALE

## CHAPTER – 21

### 21.0.0 SUMMARY AND RECOMMENDATIONS

#### 21.1.0 SUMMARY

- 21.1.1.** The Kiranagi -1 block for Preliminary Exploration (G-3 stage) for limestone block lies in the well-established Bhima Basin formation of Kalaburagi District, Karnataka State. It falls in parts of the Survey of India Toposheet No. 56C/16 in Kiranagi Village of Kalaburagi District, Karnataka State’
- 21.1.2.** The various rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima Group. The stratigraphic sequence of the litho units exposed in and around the block based on field observations and available data/literature from nearby mine/areas is given in Table No: 21.1.

**Table No. 21.1**

**Stratigraphic Sequence of Litho-units exposed in and around the Block**

| Age  | Group | Sub Group | Formation          | Litho Units  |
|--|-------|-----------|--------------------|--|
| Quaternary                                       | -     | -         | Recent             | Top soil   |
| Upper Proterozoic                                | Bhima | Sedam     | Shahabad Limestone | Siliceous/flaggy limestone<br>Massive grey limestone<br>Shaly limestone                          |
| ----- Gradational and transitional contact ----- |       |           |                    |  |
| -  | -     | -         | RabanpalliClastics | Ferruginous Shales, calcareous shales, Green, Glauconite, fine grained Sandstones and Siltstones |

- 21.1.4.** In the present exploration block the entire area is covered by limestone but for 3 out crops are seen in the western side of the block, however all the drilled boreholes encountered limestone and closed in the limestone only.
- 21.1.5.** The entire exploratory work in the block was commenced May 2023 and completed in June 203 which includes survey work and Geological mapping on 1:4,000 scale, drilling and sampling works. The allied field-works including surveying, geological mapping, drilling and borehole core sampling etc. were completed simultaneously. The analytical /

laboratory studies were also carried out simultaneously in laboratories of MECL and other NABL accredited laboratories, JNARDDC, Nagpur.

**21.1.6** MECL carried out a total of 225m of exploratory drilling in 5 boreholes (i.e. MKG-01, MKG-02, MKG-03, MKG-04 and MKG-05). All the boreholes were drilled up to 45.00m depth. Soil cover intersected in all drilled boreholes vary between 2-4m from surface followed by limestone formation.

**21.1.7** The grades of limestone intersected in the boreholes drilled in Kiranagi-1 block have been assessed as Cement (Portland), Blendable and Threshold grades. These are based on compositional variations of main chemical constituent's viz. CaO, MgO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub> and LOI. The cut off limit for compositional variations of main chemical constituents fixed for different grades are enumerated as  $\geq 44\%$  CaO,  $< 3.5\%$  MgO and  $16\%$  SiO<sub>2</sub> for Cement (Portland) Grade,  $\geq 38\%$  to  $<44\%$  CaO,  $< 5.0\%$  MgO and  $18\%$  SiO<sub>2</sub> for Blendable Grade and  $\geq 34\%$  to  $<38\%$  CaO,  $< 3.5\%$  MgO and  $18\%$  SiO<sub>2</sub> for Threshold Grade, as per the **End User's Grade Specifications by Indian Bureau Of Mines**.

The Portland grade and Blendable grade categories are classified as per IBM specifications. However, there is another category of Blendable grade is having high CaO and high SiO<sub>2</sub> in both blendable and threshold categories. Hence, this category of Blendable Grade and Threshold Grade limestones are clubbed together and categorised as Blendable/ Threshold grade class.

**21.1.18** The total Net in-situ resource of Cement (Portland), Blendable and Blendable/ Threshold grade limestone is broadly categorized under inferred and reconnaissance (333 & 334) resources the details of the same is furnished in the following table. The total inferred category resource is 237.34 million tonnes and reconnaissance category are 195.51 million tonnes by cross sectional method

**Table No. 21.2**  
**Summary of Category wise Resource**

Unit: Million tonnes

| Category and UNFC Code | Cement (Portland) Grade | Blendable Grade | Blendable/ Threshold Grade | Threshold Grade | Total  | Percentage |
|------------------------|-------------------------|-----------------|----------------------------|-----------------|--------|------------|
| 333                    | 156.55                  | 22.88           | 2.66                       | 55.24           | 237.34 | 54.83%     |
| 334                    | 124.98                  | 27.90           | 0.61                       | 42.03           | 195.51 | 45.17%     |
| Total                  | 281.43                  | 50.78           | 3.27                       | 97.27           | 432.85 | 100.00%    |

The total net inferred category resource is 237.34 (54.83% of total Net Geological resource of 432.85) million tonnes. The total net reconnaissance category resource is 195.51 (45.17% of total Net Geological resource of 432.85) million tonnes.

The resources of limestone for different grades have been estimated borehole wise, section wise, polygon wise and zone wise.

#### 21.2.0 **RECOMMENDATIONS**

- 21.2.1 Total Net In-situ Resources of Cement (Portland) Grade resource is 281.43 million tonnes with an average grade of CaO 49.13%, MgO 0.54% and SiO<sub>2</sub> 9.96%. Total Net In-situ Resources of Blendable grade is 50.78 million tonnes CaO 43.88%, MgO 0.67% and SiO<sub>2</sub> 17.11%, Blendable/Threshold grade resource is 3.27 million tonnes with an average grade of CaO 42.28%, MgO 0.45% and SiO<sub>2</sub> 20.26% and Threshold Grade resource is 97.27 million tonnes with an average grade of CaO 40.60%, MgO% 0.58 and SiO<sub>2</sub> 23.45% have also been established.
- 21.2.2 The exploration is carried out as per Mineral (Evidence of Mineral Contents) Rule-2015, Mineral Auction Rule-2015, MMDR Amendment Act - 2015 and in accordance with the Minerals (Evidence of Mineral Contents) Amendments Rules 2021.
- 21.2.3 This level of exploration will facilitate the State government of Karnataka for auctioning of block under Mining Lease.
- 2.2.4 The study suggests that any future mining project may generate employment for the local people and will increase socio-economic status of the people residing in the nearby areas.

## **CHAPTER - 22**

### **22.0.0 PLATES AND MAPS**

- 22.1.0** Location Map of the block showing various topographic and physiographic features nearby the exploration block is given as Plate-I.
- 22.2.0** Regional Geology Map on 1:50,000 scale is given as Plate-II.
- 22.3.0** Topographical Geological Map on 1:4000 scale with borehole locations etc is given as Plate-III.
- 22.4.0** Map showing Geological cross section along section lines SW1-SW1' SW2-SW2' and SW3-SW3' on 1:2000 scale is given as Plate-IV.

## **CHAPTER - 23**

### **23.0.0 ANNEXURE / ENCLOSURES TO THE REPORT**

**23.1.0** The report includes all the relevant annexure and maps/, plans, sections, photographs & photomicrograph etc. List of annexures, tables, maps/plans/sections, photographs, Text figures & photomicrograph etc are provided before the start of the text part of the Geological Report.

## CHAPTER - 24

### 24.0.0 ANY OTHER INFORMATION

#### 24.1.0 UTILISATION ASPECTS AND MINEABILITY (AS PER NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS)

24.1.1 The specifications of limestone for various industrial used are as follows

##### 1. CEMENT INDUSTRY SPECIFICATION

**Table No. 24.1**  
**Cement Industry Specification for Limestone**

|                                |   |                   |
|--------------------------------|---|-------------------|
| CaO                            | : | 44% (min.) to 46% |
| MgO                            | : | 3.50% (max.)      |
| Silica                         | : | 16% (max.)        |
| Al <sub>2</sub> O <sub>3</sub> | : | 2 (max.)          |
| Fe <sub>2</sub> O <sub>3</sub> | : | 2% (max.)         |
| SO <sub>3</sub>                | : | 1.75% (max.)      |

$$\text{Lime Saturation Factor (LSF)} = \frac{\text{CaO}}{2.8 (\text{SiO}_2) + 1.2 (\text{Al}_2\text{O}_3) + 0.65 (\text{Fe}_2\text{O}_3)} = 0.66 \text{ to } 1.02$$

$$\text{Silica Modules} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.2 \text{ to } 4.0$$

$$\text{Iron Modules} = \frac{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.4$$

$$\text{Hydraulic Modules} = \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 0.65 \text{ (min.)}$$

##### 2. B. I. S. (BUREAU OF INDIAN STANDARDS) SPECIFICATION

**Table 24.2**  
**B. I. S. (Bureau of Indian Standards) Specification for Limestone**

|                                      |   |       |
|--------------------------------------|---|-------|
| CaO (Min)                            | : | 42%   |
| MgO (Max.)                           | : | 2.5%  |
| SiO <sub>2</sub> (Max.)              | : | 15%   |
| P <sub>2</sub> O <sub>5</sub> (Max.) | : | 1.5 % |
| FeS <sub>2</sub> (Max.)              | : | 2%    |

### 3. IRON AND STEEL INDUSTRY :

Table No. 24.3

**Iron and Steel Industry for Specification for Limestone**

| Elements  | BF Grade     | SMS Grade   | LD Grade   |
|---|--------------|-------------|------------|
| CaO   | 42% (Min.)   | 48% (Min.)  | 52% (Min.) |
| MgO   | 4% (Max.)    | 3% (Max.)   | 2% (Max.)  |
| SiO <sub>2</sub>                                  | 9% (Max.)    | 4% (Max.)   | 1% (Max.)  |
| SiO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> | 11.5% (Max.) | -           | -          |
| Total Insoluble                                   | 12%          | -           | -          |
| Acid Insoluble                                    | -            | 6.5% (Max.) | -          |

### 4. CHEMICAL INDUSTRY SPECIFICATION

BIS Specifications (IS:3204-1978, Reaffirmed-2003)

Table No. 24.4

**Chemical Industry Specification for Limestone**

| Characteristics   | Requirement in percent by mass for |                  |              |       |
|---|------------------------------------|------------------|--------------|-------|
|   | Calcium carbide                    | Bleaching Powder | Caustic soda | Sugar |
| CaO (Min.)  | 54.0                               | 54.0             | 53.0         | 50.0  |
| MgO (Max.)  | 0.8                                | 2.0              | 1.0          | 1.0   |
| SiO <sub>2</sub> (Max.)   | 1.0                                | 0.75             | -            | 2.0   |
| Fe <sub>2</sub> O <sub>3</sub> (Max.)   | 0.25                               | 0.15             | -            | -     |
| Mn <sub>2</sub> O <sub>3</sub> (Min.)   | -                                  | 0.06             | -            | -     |
| CO <sub>2</sub> (Min.)  | 42.00                              | 42.00            | 42.00        | 41.00 |
| Loss on Ignition (LOI)  | 46.00                              | 46.00            | 46.00        | 44.00 |
| S (Max.)  | 0.10                               | -                | -            | -     |
| P (Max.)  | 0.01                               | -                | -            | -     |
| Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.)                    | 0.50                               | -                | -            | 1.5   |
| SiO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.) | -                                  | -                | 3.0          | -     |

### 5. FERTILIZER INDUSTRY SPECIFICATION

CaCO<sub>3</sub>+ MgCO<sub>3</sub>: 85% (Min)  
SiO<sub>2</sub> : 5% (Max.)

### 6. GLASS INDUSTRY SPECIFICATION

CaCO<sub>3</sub> : 94.5 %  
CaCO<sub>3</sub>+ MgCO<sub>3</sub> : 97.5 %  
Fe<sub>2</sub>O<sub>3</sub> : 0.20 % (Max.)

BIS Specifications (IS:997-1973, Reaffirmed-1998)

CaO : 53.0 %  
SiO<sub>2</sub> : 2.5 %  
Fe<sub>2</sub>O<sub>3</sub> : 0.10 %  
CaO + MgO : 54.50 %

## 7. FOUNDRY INDUSTRY SPECIFICATION

BIS Specifications (IS:4149-1978, Re-affirmed-2008)

**Table N.: 24.5**

### Foundry Industry Specification for Limestone

| Characteristics   | Grade-1 | Grade-2 | Grade-3 |
|---|---------|---------|---------|
| CaO (Min.)  | 52 %    | 50 %    | 45 %    |
| SiO <sub>2</sub> (Max)  | 1.5 %   | 3 %     | 5 %     |
| R <sub>2</sub> O <sub>3</sub> (Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> ) Max. | 1 %     | 1 %     | 2 %     |
| MgO   | 2 %     | 3 %     | 5 %     |
| Insoluble matter  | 0.5     | 1       | 2       |
| Sulphur and Phosphorus  | Traces  | Traces  | Traces  |

## 8. CEMENT, IRON AND STEEL AND CHEMICAL INDUSTRY SPECIFICATION

**Table No. 24.6**

### Cement, Iron and Steel and Chemical Industry Specification for Limestone

| Constituents  | Cement Industry (Specification) | Iron and Steel Industry (Specification) |                      |                      | Chemical Industry BIS Specifications (IS:3204-1978, Reaffirmed-2003) |                         |                     |              |
|---|---------------------------------|---|----------------------|----------------------|--|-------------------------|---------------------|--------------|
|   |                                 |   |                      |                      | Requirement in percent by mass for                                   |                         |                     |              |
|   |                                 | <i>BF Grade</i>                         | <i>SMS- OH Grade</i> | <i>SMS- LD Grade</i> | <i>Calcium carbide</i>   | <i>Bleaching Powder</i> | <i>Caustic soda</i> | <i>Sugar</i> |
| CaO (Min.)  | 44% (Min.) to 48% (Max)         | 42% (Min.)                              | 48% (Min.)           | 52% (Min.)           | 54.0   | 54.0                    | 53.0                | 50.0         |
| MgO (Max.)  | 3.50% (Max.)                    | 4%                                      | 3%                   | 2%                   | 0.8  | 2.0                     | 1.0                 | 1.0          |
| SiO <sub>2</sub> (Max.)   | 16 % ( Max.)                    | 9%                                      | 4%                   | 1%                   | 1.0  | 0.75                    | -                   | 2.0          |
| Fe <sub>2</sub> O <sub>3</sub> (Max.)   | 2% (Max.)                       |   |                      |                      | 0.25   | 0.15                    | -                   | -            |
| Mn <sub>2</sub> O <sub>3</sub>  | --                              | --                                      | --                   | --                   | -  | 0.06                    | -                   | -            |
| CO <sub>2</sub> (Min.)  | --                              | --                                      | --                   | --                   | 42.00  | 42.00                   | 42.00               | 41.00        |
| Loss on Ignition  | --                              | --                                      | --                   | --                   | 46.00  | 46.00                   | 46.00               | 44.00        |
| S (Max.)  | --                              | --                                      | --                   | --                   | 0.10   | -                       | -                   | -            |
| P (Max.)  | --                              |   |                      |                      | 0.01   | -                       | -                   | -            |
| Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.)                    | 2%                              |   |                      |                      | 0.50   | -                       | -                   | 1.5          |
| SiO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.) | --                              | 11.5% (Max.)                            |                      |                      | -  | -                       | 3.0                 | -            |
| <u>Acid Insoluble</u>   |                                 |   | <u>6.5% (Max.)</u>   |                      |  |                         |                     |              |

## **CHAPTER - 25**

### **25.0.0 CERTIFICATE FROM THE QUALIFIED PERSON WITH NAME, DATE AND SIGNATURE**

This is to certify that geological report in respect of Preliminary Exploration (G-3 stage) for limestone in Kiranagi-1 Block, District-Kalaburagi, Karnataka was approved by 28<sup>h</sup> E.C. of NMET held on 27<sup>th</sup> March 2023. Exploration has been carried out in the said block at G-3 level and estimation of limestone resources has been prepared by integrating the exploration data generated by geological mapping, drilling, Lab analysis by Mineral Exploration and Consultancy Limited (MECL) on behalf of Department Mines and Geology (DMG), Karnataka. The report has been prepared in accordance with the Minerals (Evidence of Mineral Contents) Rule 2015 specified under Mineral Auction Rule, 2015 and amended up to 2021.

**NAME: SHRI. P. RAVINDRAN**

**DESIGNATION: GENERAL MANAGER (EXPLORATION)**

**DATE: 14.02.2024**

**LIST OF PERSONNEL ASSOCIATED WITH PRELIMINARY EXPLORATION (G-3 STAGE) FOR LIMESTONE IN KIRANAGI -1 BLOCK, DISTRICT: KALABURAGI, KARNATAKA**

|    |   |  |
|----|---|--|
| 1  | Overall guidance                              | Shri P. Ravindran, GM (Exploration)  |
| 2  | Overall Planning, Co-ordination & Supervision | Shri P. Ravindran, GM (Exploration)  |
|    |   | Shri P. P. Kulkarni, Dy. GM (Exploration)  |
|    |   | : Dr Kuppusamy E, Sr. Manager (Geology)  |
| 3  | Project Management                            | : Shri Anil Tiwari, Project Manager<br>: Shri J Madhu Babu, Assistant Manager (Geology)<br>: Shri Ashok Kumar Shankar ADO (Dilling Engineer)<br>: Shri Kamalesh Kumar Shankar ADO (Dilling Engineer) |
| 4  | Physical Execution of work                    |  |
|    | a) Geology                                    | : Shri J Madhu Babu, Assistant Manager (Geology)   |
|    | b) Survey                                     | : Shri Ripun Paul, T.A. (S & D)<br>: Shri Durgesh Devarshee, Senior Technical Assistant (S & D)  |
|    | c) Drilling                                   | : Shri Ashok Kumar Shankar ADO (Dilling Engineer)<br>: Shri Kamalesh Kumar ADO (Dilling Engineer)  |
| 5  | Sample Processing                             | : Shri Satish Kumar Inaparthi, Sr. Tech. Sampling<br>: Mrs. Shika Sharma, Sr. Tech. Sampling   |
| 6  | Chemical Laboratory                           | Shri P. Ravindran, GM (Exploration)/Lab. in-charge   |
|    |   | Shri Rohit Sharma, Manager (Chemistry)   |
|    |   | Dr Deepti Rahangdale, Manager (Chemistry)  |
|    |   | Shri Pijush Kanti Mohanti, Asstt. Manager (Chemistry)  |
| 7  | Petrographic Studies                          | Shri Sayantan Pal, Asstt. Manager (Geology)  |
| 8  | Documentation                                 | Shri P. P. Kulkarni, Dy. GM (Exploration)  |
|    |   | Dr. Kuppusamy E, Sr. Manager (Geology)   |
| 9  | Non-Coal Geological Report Cell               | Shri P. P. Kulkarni, Dy. GM (Exploration)  |
|    |   | Ms. Moumita Ghosh, Sr. Geologist   |
|    |   | Shri Uday Patil, Sr. Computer Operator   |
|    |   | Shri Shivanand, Sr. Computer Operator  |
| 10 | Reprography and Printing                      | Shri Jagdish Thakral, Survey & Map Officer   |
|    |   | Shri Kaushik Bhattacharya, Assistant Survey & Map Officer  |
|    |   | Shri Durgesh Devarshee Senior Technical Assistant (S & D)  |

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2. A.V. Jayaprakash, F.S.1977-78, Preliminary investigation for Flux Grade and Cement Grade Limestone in Bhima Basin, Kalaburagi District, Karnataka. (GSI).
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5. Geological Report on Preliminary Exploration (G3) for Limestone in Diggaon Block, Sedam Taluka, Kalaburagi District, Karnataka by MECL.
6. Geological Report on Preliminary Exploration (G3) for Limestone in Udagi Block, Sedam Taluka, Kalaburagi District, Karnataka by MECL.
7. Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing of cement.
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11. The F.S. 1976-77, GSI carried out preliminary investigation for Flux grade Limestone near Wadi, Kalaburagi district Karnataka.
12. The G-2 level of exploration by GSI in Bommanalli Limestone Block.
13. The G4 level of exploration in Chitapura SW Block and Sulahalli Limestone Block

### ABBREVIATIONS USED

| SL. No. | Abbreviation | Full form   |
|---------|--------------|---|
| 1       | MECL         | Mineral Exploration and Consultancy Limited                           |
| 2       | GSI          | Geological Survey of India  |
| 3       | CGWB         | Central Ground Water Board  |
| 4       | CPSE         | Central Public Sector Enterprises                                     |
| 5       | NMET         | National Mineral Exploration Trust                                    |
| 6       | TCC          | Technical cum Cost Committee  |
| 7       | EC           | Executive Committee   |
| 8       | DMG, KA      | Directorate of Mines and Geology, Karnataka                           |
| 9       | UNFC         | United Nation Framework Classification                                |
| 10      | NMI          | National Mineral Inventory  |
| 11      | DGCO         | Directorate General Camp Office                                       |
| 12      | NABL         | National Accreditation Board for Testing and Calibration Laboratories |
| 13      | JNARDDC      | Jawaharlal Nehru Aluminium Research Development and Design Centre     |
| 14      | F.S.P.       | Field Season Programme  |
| 15      | MEMC         | Minerals (Evidence of Mineral Contents)                               |
| 16      | MMDR         | Mines & Minerals (Development and Regulation)                         |
| 17      | NH           | National Highway  |
| 18      | WGS-84       | World Geodetic System-84  |
| 19      | UTM          | Universal Transverse Mercator   |
| 20      | RL           | Reduced Level   |
| 21      | cu m         | Cubic Meter   |
| 22      | DGPS         | Differential Global Positioning System                                |
| 23      | DMS          | Degree Minute Second  |
| 24      | M / m        | Meter   |
| 25      | mt           | Million Tonne   |
| 26      | Sq. km/sq.km | Square Kilometer  |
| 27      | M. Sc.       | Master of Science   |
| 28      | M. Sc. Tech  | Master of Science Technology  |
| 29      | NDDP         | Net District Domestic Product   |
| 30      | mRL          | Reduced Level in metre  |
| 31      | R.F.         | Reserve Forest  |
| 32      | XRF          | X-ray Fluorescence  |
| 33      | ML           | Mining Lease  |
| 34      | CRM          | Certified Reference Material  |

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3)  
FOR LIMESTONE IN KIRANAGI-2 BLOCK**

**DISTRICT: KALABURAGI, KARNATAKA**

**TEXT, ANNEXURES, AND PLATES**



**MINERAL EXPLORATION AND CONSULTANCY LIMITED**

*(Formerly known as Mineral Exploration Corporation Limited)*

A Government of India Enterprises  
CORPORATE OFFICE, NAGPUR

**FEBRUARY-2024**

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR  
LIMESTONE IN KIRANAGI-2 BLOCK, DISTRICT- KALABURAGI, KARNATAKA  
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**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR  
LIMESTONE IN KIRANAGI - 2 BLOCK, DISTRICT- KALABURAGI, KARNATAKA**

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**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR  
LIMESTONE IN KIRANAGI-2 BLOCK, DISTRICT- KALABURAGI, KARNATAKA.**

**SALIENT FEATURES**

- | 1.                | Name of the block                                   | Kiranagi -2<br>Tehsil – Kalaburagi, District – Kalaburagi<br>State - Karnataka  |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
|-------------------|---|---|-----------------------------|----------------|----------------|-----------------------------|-------------------|--------------|-------------|--------------|-----------|--------------|-------------|--------------|---------------|--------------|-------------|--------------|
| 2.                | Mineral   | Limestone   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 3.                | Total Area  | 5.8022 Sq. Km   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 4.                | Area covered under present scheme                   | 5.8022 Sq. Km   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 5.                | Period of Exploration                               | May-2023 to June-2023   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 6.                | Metreage drilled by MECL                            | Total 225.00 m at G3 level  |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 7.                | No. of Boreholes drilled by MECL                    | Total 05 Nos. at G3 Level   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 8.                | Thickness (Cumulative) of Different Grade Limestone | Min: 6.00m (MKG-05 Zone-I). Max 6.00m (MKG-05-Zone-I) Cement (Portland) Grade.<br>Min: 36.50m (MKG-05 Zone-I) & Max: 44.00m (MKG-04) Threshold Grade.   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 9.                | Cut-off grade                                       | <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 25%;">Grade</th> <th style="width: 25%;">CaO %<br/>(Min)</th> <th style="width: 25%;">MgO %<br/>(Max)</th> <th style="width: 25%;">SiO<sub>2</sub>%<br/>(Max)</th> </tr> </thead> <tbody> <tr> <td>Cement (Portland)</td> <td>≥ 44.00</td> <td>3.50</td> <td>16.00</td> </tr> <tr> <td>Blendable</td> <td>≥ 38.00</td> <td>&lt;5.00</td> <td>&lt;18.00</td> </tr> <tr> <td>Threshold</td> <td>≥ 34.00</td> <td>&lt; 6.00</td> <td></td> </tr> </tbody> </table>             | Grade                       | CaO %<br>(Min) | MgO %<br>(Max) | SiO <sub>2</sub> %<br>(Max) | Cement (Portland) | ≥ 44.00      | 3.50        | 16.00        | Blendable | ≥ 38.00      | <5.00       | <18.00       | Threshold     | ≥ 34.00      | < 6.00      |              |
| Grade             | CaO %<br>(Min)                                      | MgO %<br>(Max)  | SiO <sub>2</sub> %<br>(Max) |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| Cement (Portland) | ≥ 44.00   | 3.50  | 16.00                       |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| Blendable         | ≥ 38.00   | <5.00   | <18.00                      |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| Threshold         | ≥ 34.00   | < 6.00  |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 10.               | Resources   | 18.32 million tonnes (net in-situ) Cement (Portland) Grade<br><u>494.89 million tonnes (net in-situ) Threshold Grade</u><br><u>513.21 million tonnes (net in-situ) All Grades</u>   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 11.               | Grade   | Cement and Blendable  |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 12.               | Average Grades                                      | <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 25%;">Grade</th> <th style="width: 25%;">Cao %</th> <th style="width: 25%;">MgO %</th> <th style="width: 25%;">SiO<sub>2</sub>%</th> </tr> </thead> <tbody> <tr> <td>Cement</td> <td><b>47.26</b></td> <td><b>0.45</b></td> <td><b>13.87</b></td> </tr> <tr> <td>Threshold</td> <td><b>39.13</b></td> <td><b>0.57</b></td> <td><b>27.16</b></td> </tr> <tr> <td>Average Grade</td> <td><b>39.42</b></td> <td><b>0.56</b></td> <td><b>26.68</b></td> </tr> </tbody> </table> | Grade                       | Cao %          | MgO %          | SiO <sub>2</sub> %          | Cement            | <b>47.26</b> | <b>0.45</b> | <b>13.87</b> | Threshold | <b>39.13</b> | <b>0.57</b> | <b>27.16</b> | Average Grade | <b>39.42</b> | <b>0.56</b> | <b>26.68</b> |
| Grade             | Cao %   | MgO %   | SiO <sub>2</sub> %          |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| Cement            | <b>47.26</b>  | <b>0.45</b>   | <b>13.87</b>                |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| Threshold         | <b>39.13</b>  | <b>0.57</b>   | <b>27.16</b>                |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| Average Grade     | <b>39.42</b>  | <b>0.56</b>   | <b>26.68</b>                |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 13.               | UNFC Category                                       | Inferred Category (333) & Reconnaissance (334)  |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |
| 14.               | Report Submission                                   | February 2024   |                             |                |                |                             |                   |              |             |              |           |              |             |              |               |              |             |              |

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3) FOR  
LIMESTONE IN KIRANAGI-2 BLOCK DISTRICT- KALABURAGI, KARNATAKA**

**CHAPTER-I**

**EXECUTIVE SUMMARY**

**1.1.0 INTRODUCTION**

1.1.1 Limestone, a sedimentary rock, originated mainly by chemical/biochemical precipitation of carbonate minerals in a variety of depositional environments, ranging from marine to terrestrial. The marine system is either neritic (shelf) or pelagic (open-ocean) (James and Jones, 2016). Most of the limestone in geological history is deposited in neritic system. On the other hand, evidences show that pelagic limestones are in the operation since Jurassic time. Each of these depositional environments is controlled by differences in temperature, salinity, depth of photic zone, siliciclastic input and sediment supply. Warm water with normal salinity and low siliciclastic input favours the formation of limestone within the agitated part of the photic zone (the depth of water to which light penetrates) (James and Jones, 2016). This indicates that most of the limestones are deposited in tropical-subtropical belt, within 30° north and south of Equator (Tucker, 2001). In terrestrial setting carbonates are usually formed in lakes, springs, caves depending upon water temperature and local climate.

1.1.2 Calcium carbonate ( $\text{CaCO}_3$ ) in the form of calcite is the predominant mineral constituent of limestone. It also contains some amount of magnesium carbonate ( $\text{MgCO}_3$ ) and/or dolomite ( $\text{Ca Mg}(\text{CO}_3)_2$ ). Variable amount of terrigenous quartz, clay, pyrite, haematite, chert etc., present as non-carbonate minerals, control the quality/grade of limestone.

1.1.3 Limestone is a crucial and versatile mineral commodity. There are evidences that it has been in use as construction material from the early days of human civilization. From the Great Pyramids of Giza to the Golden fort of Jaisalmer, many of the world's most beautiful and historical buildings are made up of limestone. In the modern time, limestone is primarily used to manufacture cement. However, the uses of limestone, now a day, have not been confined only to construction material; rather the versatility in its uses in different industries made it a valuable mineral. In Iron & Steel Industry, limestone is used both in blast furnace and steel melting shop as a flux. In chemical industry, limestone is consumed to produce bleaching powder, toothpaste, calcium carbide etc. It is used as a purifier in the sugar industry. Limestone is also consumed by industries like paper, fertilizer and foundry etc.

- 1.1.4 The total reserves/resources of limestone of all categories and grades as per NMI (National Mineral Inventory) data based on UNFC (United Nations Framework Classification) system as on 1.4.2015 (Mineral Year Book 2020) have been estimated at 203,224 million tonnes, of which 16,336 million tonnes (8%) are placed under reserves category and 1,86,889 million tonnes (92%) are under resources category. Karnataka is the leading state having 27% of the total resources followed by Andhra Pradesh and Rajasthan (12% each), Gujarat (10%), Meghalaya (9%), Telangana (8%), Chhattisgarh and Madhya Pradesh (5% each) and remaining 12% by other states. Grade wise, Cement Grade (Portland) has leading share of about 70% followed by Unclassified Grades (12%) and BF Grade (7%). Remaining (11%) are different Grades.
- 1.1.5 The production of limestone in 2019-20 was 359 million tonnes, decreased marginally by about 5.43% as compared to that of the previous year. There were 659 reporting mines in 2019-20 as against 725 during the previous year. Thirty mines each producing more than 3 million tonnes per annum contributed 42% of the total production of limestone in 2019-20. The share of 26 mines each in the production range of 2 to 3 million tonnes was 17% of the total production. About 19% of the total production was contributed by 51 mines each producing 1 to 2 million tonnes annually. The remaining 22% of the total production was reported by 552 mines and three associated mines during the year. Ten principal producers contributed about 54% of the total production. About 2.82% of the production was reported by public sector mines as against 2.88% in the previous year. About 97% of the total production of limestone during 2019-20 was of cement grade, 2% of iron & steel grade and the rest 1% consisted of chemical grade. (As per Mineral Year Book 2020 by Indian Bureau of Mines).
- 1.1.6 Rajasthan was the leading producing state accounting for (20%) of the total production of limestone, followed by Madhya Pradesh (13%), Andhra Pradesh & Chhattisgarh (12% each), & Karnataka (10%), Tamil Nadu & Telangana (7% each), Gujarat (6%) and the remaining 13% was contributed by Assam, Bihar, Himachal Pradesh, UT of Jammu and Kashmir, Jharkhand, Kerala, Maharashtra, Meghalaya, Odisha and Uttar Pradesh. (As per Mineral Year Book 2020 by Indian Bureau of Mines).
- 1.1.7 India was the second largest cement producing country in the world after China. In 2019-20, the total consumption of limestone, as reported by different industries was 328.62 million tonnes registering negative growth of 0.87% over that of preceding year. Cement was the major consuming industry accounting for 308.66 million tonnes (94%) consumption, followed by iron & steel 12.68 million tonnes (4%) and chemical 5.29 million tonnes (2%). The remaining consumption was reported by aluminium, alloy

steel, sugar, paper, fertilizer, glass, metallurgy, foundry, etc. (As per Mineral Year Book 2020 by Indian Bureau of Mines).

- 1.1.8 Exports of limestone decreased marginally by 3%, to 3.76 million tonnes in 2019-20 from 3.88 million tonnes in the previous year. Limestone was mainly exported to Bangladesh (97.00%) & UK (1.00%). In 2019-20 the import of limestone increased marginally by 5% to 25.64 million tonnes. Limestone was mainly imported from UAE (80.00%), Oman (12.00%), Vietnam (4.00%), Malaysia (3.00%), & Other Countries (1.00%) (As per Mineral Year Book 2020 by Indian Bureau of Mines).

### **1.2.0 DETAILS OF PROJECT AND INVESTIGATING AGENCY**

- 1.2.1 One of the prime objectives of the preliminary exploration (G-3) is to demarcate the various grades of limestone and estimation of resources under 333 & 334 in Kiranagi-2 Block, in Kiranagi, Village, Taluka: Kalaburagi, District: Kalaburagi. Karnataka.
- 1.2.2 The investigating agency for the block is Mineral Exploration and Consultancy Limited (MECL), Nagpur.

### **1.3.0 OBJECTIVES OF INVESTIGATION**

The exploration was proposed with following objectives:

- i) To demarcate the limestone occurrences within the block area by drilling of 5 boreholes at G-3 stage of exploration.
- ii) To estimate the grade wise limestone inferred resources in the block area as per UNFC norms of G-3 stage of exploration.
- iii) To carry out preliminary exploration (G-3) as per the Minerals (Evidence and Mineral Contents) Amendment Rules 2021, Mineral Auction Rule 2015 amended up to 2021, MMDR Amendment Act 2015 in turn to facilitate the State Government (Karnataka) for auctioning of the block under Mining Lease/Block.

### **1.4.0 BASIS FOR TAKING UP INVESTIGATION**

- 1.4.1 The Kiranagi-2 Block falls in the Bhima Basin and it is in nearby to the recently explored Diggaon and Udagi Blocks by MECL. Based on the recent exploration in the nearby area (Diggaon and Udagi Blocks), it has been observed that there is one zone in Shahabad limestone, namely Portland grade Zone-I. Portland Grade Zones; Zone I intersected in borehole MKG-05 only with thickness of 6.00m (MKG-05). The Zone-1 has average 47.26% CaO, average 0.45% MgO and average 13.87% SiO<sub>2</sub> in Kiranagi 2 Block. The explored Kiranagi 2 Block falls to the west of the Diggaon and Udgi limestone blocks explored by MECL.

- 1.4.2 Kiranagi-1 & 2 Blocks are the prospective limestone blocks identified by Directorate of Geology, Government of Karnataka for which MECL has prepared the exploration proposal involving 600m drilling in 10 boreholes at G-3 stage of exploration in Kiranagi, Village, Taluka: Kalaburagi, District Kalaburagi and put up for approval of Technical cum cost Committee (TCC) of NMET. During the 28<sup>th</sup> meeting of TCC, NMET held on 16<sup>th</sup> March, 2023, the said proposal was technically evaluated and approved vide F.No.23/325/2023-NMET/409 dated 27<sup>th</sup> March 2023.
- 1.4.3 On the recommendation of 28<sup>th</sup> TCC of NMET held on 16<sup>th</sup> March, 2023 approved the mineral exploration project to be executed by MECL for Kiranagi 1& 2 Limestone Blocks in Kiranagi Village, Taluka: Kalaburagi, District: Kalaburagi with an estimated cost of Rs.1,27,57,798/- in the time schedule of 10 months together for both Kiranagi 1 & 2 blocks. The approval was together for 10 boreholes for the cumulative meterage of 450m. However, the exploration was executed separately and geological reports are prepared for Kiranagi 1 and Kiranagi 2 separately. The Kiranagi 2 Block was explored by 5 boreholes with the cumulative meterage of 225m.
- 1.4.4 The general trend of all formations is North - South. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses.
- 1.4.5 Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. The rock formations of the Block are horizontally disposed and mostly concealed under top soil.
- 1.4.6 Almost entire area of the blocks is concealed under quaternary sediments i.e. soil cover. Scanty scattered limestone outcrops are seen at places. The beds are horizontally disposed as noticed in nearby areas. Since most of the area is concealed under soil cover the strike and dip of the limestone beds is not observed in the blocks. Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing of cement.
- 1.4.7 The overburden top soil is black in colour, fine to silty, friable when dry and sticky when wet. The overburden soil covers almost the entire Block area. The thickness of the soil varies from 1.00m (MKG-04) to about 4.00m (MKG-01) at places. The overburden of soil is immediately followed by Threshold Grade Limestone in borehole MKG-01 to MKG-05. Portland Grade Limestone intersected in the borehole MKG-05 only from 39.00m to 45.00, below the threshold grade limestone. The limestone comprises Siliceous/flaggy limestone Massive grey limestone and shaly limestone. The bands of

limestone of this block are enriched with lime content which is suitable for manufacture of cement.

### **1.5.0 DETAILS OF THE WORK**

1.5.1 The proposal was made as one together for Kiranagi 1 and 2 Blocks. The approved meterage is 450m (10 Boreholes) together in Kiranagi 1 (225m - 5 Bhs) Block and Kiranagi 2 (225m - 5 Bhs) Block. The total meterage was drilled is 225m in Kiranagi 1 Block and 225m in Kiranagi - 2 Block. All the boreholes intersect limestone. The limestone zone intersected after 2 to 4m of top soil cover. Hence the quantum of Primary Samples was increased up to 415 nos. which resulting in the generation additional 15 nos. samples as against approved 400 nos. of samples. In Kiranagi -1 Block, the total quantum of primary samples is 204, where as in Kiranagi Block 2 is 211 nos. It was proposed to approval of the sampling and analysis cost in the Malkhed 1 & 2 and Kiranagi 1 & 2 Blocks in the 57<sup>th</sup> TCC meeting held on 26<sup>th</sup>& 27<sup>th</sup> September 2023 held at New Delhi. The Committee approved the additional samples and additional cost of Rs. 1.49 lakh (vide minutes agenda 57.2.13) and the copy of approval is enclosed as Annexure No IXB.

After receipt of approval from NMET, MECL has carried out exploration activities in Kiranagi-1 & 2 Block. The details, nature and quantum of work proposed Vs achievement is given below:

**Table No. 1.1**  
**Quantum of Work for Proposed Vs Achieved Kiranagi-1 and 2 Blocks**

| Sl. No.  | Description and Nature of Work  | Unit   | Approved      | Achieved   | Achieved   | Achieved |
|----------|---|--------|---------------|--|------------|----------|
|          |   |        | Kiranagi 1& 2 | Kiranagi 1                                       | Kiranagi 2 | 1 & 2    |
| <b>A</b> | <b>GEOLOGICAL WORK AND SURVEYING</b>  |        |               |  |            |          |
| 1        | Geological Mapping (1:4000 scale)   | Sq. km | 11.41         | 5.5734   | 5.8022     | 11.3756  |
| 2        | Survey Work   |        |               |  |            |          |
|          | i) Topographical Survey (1:4000 scale)  | Sq. km | 11.41         | 5.5734   | 5.8022     | 11.3756  |
|          | ii) Bore Hole Fixation  | Nos.   | 10            | 5  | 5          | 10       |
|          | iii) RL & Coordinate Determination by DGPS  | Nos.   | 10            | 5  | 5          | 10       |
| <b>B</b> | <b>EXPLORATORY DRILLING</b>   |        |               |  |            |          |
| 1        | Drilling up to 300m (Soft Rock)   | m      | 450           | 225  | 225        | 450      |
| 2        | Drill Core Preservation   | Per m  | 405           | 200  | 205        | 405      |
| <b>C</b> | <b>LABORATORY STUDIES</b>   |        |               |  |            |          |
| 1        | <b>Chemical Analysis</b>  |        |               |  |            |          |
|          | i) Primary Sampling (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF            | Nos.   | 400           | 204*   | 211*       | 415*     |
|          | ii) Check Sampling Internal 5% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF | Nos.   | 20            | 10   | 10         | 20       |
|          | iii) Check Sampling External 10% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.)      | Nos.   | 40            | 20   | 19         | 39       |
| 2        | <b>Petrological samples (Surface &amp; BH Core Samples)</b>   |        |               |  |            |          |
|          | i) Preparation of thin section  | Nos.   | 10            | 7  | 3          | 10       |
|          | ii) Study of Thin Section   | Nos.   | 10            | 7  | 3          | 10       |
|          | iii) Photomicrograph  | Nos.   | 10            | 4  | 2          | 6        |
| 3        | <b>Bulk Density Determination</b>   |        |               |  |            |          |
|          | i) Bulk Density   | Nos.   | 2             | 2 Nos. Combined for both Kiranagi 1 and 2 Blocks |            | 2        |
| <b>D</b> | <b>Report Preparation (5 Hard copies with a soft copy)</b>  | Nos.   | 2             | 1  | 1          | 2        |
| <b>E</b> | <b>Preparation of Exploration Proposal (5 Hard copies with a soft copy)</b>   | Nos.   | 1             | 1  | 1          | 1        |

*\*The additional sampling and analysis cost was approved by the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023.*

### 1.6.0 LOCATION OF THE BLOCK

- 1.6.1 The proposed Kiranagi-2 Block is located in Kalaburagi Taluk and District having a total block area of 5.8022 Sq. Km. The block can be approached from the nearest Kalaburagi Taluk head-quarters towards west at a distance of around 24 kms by single lane asphalted village roads. The explored blocks fall in the jurisdiction of Kiranagi Village, Kalaburagi Taluk and District. The district head quarter Kalaburagi is at a distance of 24 kms towards north from the block.
- 1.6.2 Kiranagi-2 Block covers an area of 5.8022 sq.km, as provided by Department of Mines and Geology, Government of Karnataka to MECL to explore through NMET funding.

**Table No. 1.2**  
**Co-ordinates of Cardinal Points of the Block Boundary**  
**(As provided by DMG, Karnataka)**

| Boundary Points | WGS 1984 DMS    |                  | UTM (m)     |            |
|-----------------|-----------------|------------------|-------------|------------|
|                 | Latitude        | Longitude        | Y (N)       | X (E)      |
| KE1             | 17° 9' 46.653"N | 76° 53' 1.247"E  | 1898554.680 | 700360.893 |
| KE2             | 17° 8' 20.961"N | 76° 52' 41.266"E | 1895914.501 | 699795.811 |
| KE3             | 17° 8' 20.026"N | 76° 54' 19.978"E | 1895914.166 | 702713.924 |
| KE4             | 17° 9' 46.437"N | 76° 53' 50.986"E | 1898562.361 | 701831.002 |

- 1.6.3 Most of the infrastructure (Police station, Bank facility, Hospital, workshop facility, bus stand etc) are available in Shahabad which is available at Kalaburagi Taluk at a distance of around 11 kms from the block.

### 1.7.0 REGIONAL GEOLOGICAL SETUP OF THE AREA

- 1.7.1 Bhima basin is the smallest of all Proterozoic basins of India. Bhima Basin is not in contact with the Kaladgi group and it is believed to be younger and they are in close resemblance to the Kurnool group of the Cuddapah Super Group. The Bhima basin is covered by latitude N 16°20' to 17°35' and longitude N 76°15' to 77°40'E. The Bhima basin sediments stretch linearly in N-S for about 160 km with varying width and the maximum being 40 km. It extends over an area of 5200 Sq.km. and is situated to the North-west of Cuddapah basin and North east of Kaladgi basin.
- 1.7.2 Captain New Bold (1842 – 1845) was first to record the Talikote flaggy limestone and Muddebihal red sandstone. R. Bruce Foote (1876) had divided the Bhima Group (mainly of limestone) into lower clastic represented by sandstone and shale and upper mainly of limestone and shales. Further, Mahadevan (1947), Janardhana Rao et.al (1975), Mathur (1977), Mudholkar and Kale (1982) and Mishra et.al (1987) classified Bhima Group. However, Vivek S. Kale, V.G. Phansalkar et.al (1991) classified Bhima Group into Rabanapalli (clastic) formation and Shahabad (limestone) formations.

1.7.3 The Stratigraphic Column of the Bhima Group (after GSI) (after GI) is furnished in below:

**Table No. 1.3**  
**The Stratigraphic Column of the Bhima Group (after GSI), 1975**

| Group  | Sub-Group  | Formation        | Member  | Thickness (m)                                 |           |     |
|--|--|------------------|---|---|-----------|-----|
| <b>Deccan Trap</b>   | -  |                  | Basic flows   |   |           |     |
| <b>Bhima Group</b><br>(Upper Proterozoic )<br>(93-273 m.y) |  | Harwal-Gogi      |   | 5-10  |           |     |
|  | Andola Subgroup in Pulsating basin environment (31-68 m.y) | Katamdevar-halli | Fossil shale member ortho-quartzite chert / pebble conglomerate | 10-40   |           |     |
|  |  | Halkal           |   | 16-18   |           |     |
|  | ----- Paraconformity -----                                 |                  |   |   |           |     |
|  |  |                  |   | Flaggy dark grey and argillaceous limestone   | 4-6       |     |
|  |  |                  |   | Massive dark grey and bluish grey limestone   | 8-20      |     |
|  | Sedam Subgroup with quiescent basin regime (62-2.5 m.y)    |                  | Shahabad  | Variegated and siliceous/cherty limestone     | 20-80     |     |
|  |  |                  |   | Blackish, light grey to bluish grey limestone | 10-15     |     |
|  |  |                  |   | Slabby and flaggy limestone                   | 4-8       |     |
|  |  |                  |   | Purple shale                                  | 2-40      |     |
|  |  |                  |   | Green/yellow shale                            | 5-15      |     |
|  |  |                  |   | Rabanapalli                                   | Siltstone | 3-4 |
|  |  |                  |   | Quartzite/Inter-calated sandstone             | 5-15      |     |
|  |  |                  |   | Conglomerate / grit                           | 1-2       |     |
| ----- Un Conformity -----                                  |  |                  |   |   |           |     |
| Basement Crystallines                                      |  |                  | Younger granite peninsular gneisses                             | -   |           |     |

1.7.4 Recent classification (1991) of revised litho stratigraphy of the Bhima group is furnished below:

**Table No. 1.4**  
**Revised litho stratigraphy of the Bhima Group**  
**(after Vivek S. Kale, V.G. Phansalkar et.al 1991)**

| <b>Formation</b>                                 | <b>Maximum Thickness(m)</b> | <b>Member</b>                     | <b>Main Lithological components</b>  |
|--|-----------------------------|-----------------------------------|--|
| 2. Shahabad Limestone                            | < 75                        |                                   | <ul style="list-style-type: none"> <li>• Grey, argillaceous micritic limestones.</li> <li>• Dark, bluish grey, massive limestones.</li> <li>• Variegated, siliceous and cherty limestones.</li> <li>• Blue- grey, black- micritic limestones.</li> <li>• Flaggy (Partly impure argillaceous and cherty) limestones.</li> </ul> |
| ----- Gradational and transitional contact ----- |                             |                                   |  |
| 1. Rabanpalli Clastics                           | < 70                        | Ekmai shale member                | Ferruginous shales, with calcareous shales at top.   |
|  |                             | Kasturpalli-Glauconitic member    | Green, glauconite, fine grained sandstones and siltstones.   |
|  |                             | Kundrapalli quartz arenite member | Quartzitic sandstones (medium to fine grained).  |
|  |                             | Adki Hill conglomerate member     | Polymictic conglomerates and arkosic, gritty sandstones.   |

1.7.5 The total absence of fossils rules out the sediments of Bhima Group transgresses into the Cambrian. Thus envisaged the upper age limit is not less than 600 million years.

### 1.8.0 BLOCK GEOLOGY

The rocks exposed in the blocks belong to the Shahabad formation of Sedam subgroup of Bhima group. MECL had explored Kiranagi-2 Block at a distance of around 15 kms west of previously explored Diggaon Block by MECL. The general stratigraphic succession of the Kiranagi-2 Block based on field observations and available data/literature from nearby mine/areas is given in Table No. 1.4

### 1.9.0 REGIONAL STRUCTURE

The general trend of all formations is North - South. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses. Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. Deformation is

observed only in the vicinity of faults. The faults have continued into the basement that has exercised control upon the basin configuration.

The basin is well known for its huge reserves of limestone and the newly discovered Uranium occurrence near Gogi. Regional Geological Map Bhima Basin (Part) of the explored Kiranagi-2 Block is shown as Plate – II.

### **1.10.0 EXPLORATION BY SYSTEMATIC DRILLING**

1.10.1 MECL commenced preliminary exploration (G-3 stage) in Kiranagi-2 limestone block on 01.05.2023 and completed geological mapping and drilling of 225.00m in 05 boreholes on 20.05.2023.

1.10.2 The entire core drilling has been carried out by wire line method with NQ borehole size using diamond bits. The polymer was used as drilling fluid to flush out the cuttings and stabilize the wall of exploratory boreholes. The drilling fluid also works as a coolant to avoid burning of drill bits, due care was taken to obtain maximum core recovery of cores. The limestone formation is hard and massive, which resulting in the maximum core recovery of 90-95%.

1.10.3 Lithologically the limestone is very hard and massive with occasional thin intercalation of clays intersected in few places, hence resulted 90-95% core recovery. These factors are considered in resource estimation.

### **1.11.0 SAMPLING AND ANALYSIS**

#### **1.11.1 PRIMARY AND CHECK SAMPLES**

Considering the uniform nature of the limestone over considerable thickness in all the boreholes and after study of lithological data generated during G-3 exploration optimum sample length of 1m is justifiable in evaluating grade of limestone. Thus, it was decided to keep 1m primary sample length considering on lithology. However, sample of shorter and larger lengths were also prepared wherever felt necessary depending on the variations in the lithology.

#### **1.11.2 COMPOSITE SAMPLE ANALYSIS**

Composite samples analysis is not approved, hence not prepared.

### **1.12.0 EVALUATION OF LIMESTONE ZONES**

1.12.1 The investigation carried out by way of exploratory drilling with associated geological and laboratory studies which have generated the exploration data to establish the shape, size and geometry of the limestone horizons. This formed the basis for evaluation of various deposit parameters of the block. Zones were demarcated based on min 1.0 m sample length for all grades, based on cutoff and correlation with adjacent boreholes,

Borehole data of the adjacent explored/mine block were also considered. The salient features of the evaluation are discussed below.

1.12.2 CEMENT GRADE LIMESTONE ZONES ( $\text{CaO} \geq 44.00\%$ ,  $\text{MgO}$  Max 3.50% &  $\text{SiO}_2\%$  Max 16.00%).

1.12.3 BLENDABLE GRADE LIMESTONE ZONES

As per IBM guidelines, Blendable grade limestone zone was demarcated on CaO range between  $\geq 38.00\%$  to  $\leq 44.00\%$  and MgO shall not be more than 5.00% &  $\text{SiO}_2\%$  Max 18.00%).

1.12.4 THRESHOLD GRADE LIMESTONE ZONES

As per IBM guidelines. Threshold grade limestone zone was demarcated on CaO range between  $\geq 34.00\%$  to  $\leq 38.00\%$  and MgO shall not be more than 6.00%.

1.13.0 METHODOLOGY ADOPTED FOR RESOURCE ESTIMATION

1.13.1 The resources of limestone have been estimated by Geological Cross Section method as principal method and Polygon method as check method. The methodology adopted, keeping the above assumptions in view, for resource estimation is as follows:

#### CATEGORISATION OF RESOURCES

Resources have been categorized under inferred and reconnaissance category of limestone resources (333 and 334) as per UNFC. The parameters and assumptions for resources estimation have already been defined under chapter XVIII.

Limestone zones are computed and categorized based on **End Use Grade** specifications prescribed by Indian Bureau of Mines, Government of India.

1.14.0 RESOURCES

1.14.1 The total Net in-situ resource of Cement (Portland), Threshold grade limestone is broadly categorized under inferred and reconnaissance (333 & 334) resources the details of the same is furnished in the following table. The total inferred category resource of Cement (Portland) Grade is 5.34 million tonnes, Threshold Grade Resource is 283.09 million tonnes and total reconnaissance category resource of Cement (Portland) Grade is 12.98 million tonnes, Threshold Grade Resource is 211.80 million tonnes by cross sectional method.

**Table No 1.5**  
**Summary of Category wise Net-Resource**

**Unit: million tonnes**

| <b>Category and UNFC Code</b> | <b>Cement (Portland) Grade</b> | <b>Threshold Grade</b> | <b>Total</b>  | <b>Percentage</b> |
|-------------------------------|--------------------------------|------------------------|---------------|-------------------|
| Inferred (333)                | 5.34                           | 283.09                 | 288.43        | 56.20             |
| Reconnaissance (334)          | 12.98                          | 211.80                 | 224.78        | 43.80             |
| <b>Total</b>                  | <b>18.32</b>                   | <b>494.89</b>          | <b>513.21</b> | <b>100</b>        |

The inferred category net resource is 288.43 (56.20% of total Net resource of 513.21) million tonnes. The resources of limestone for different grades have been estimated borehole wise, section wise, polygon wise and zone wise.

1.15.0 RECOMMENDATIONS

1.15.1 Total Net In-situ Resources of Cement (Portland) Grade resource is 18.32 million tonnes with an average grade of CaO 47.26%, MgO 0.45% and SiO<sub>2</sub> 13.87% and Threshold Grade resource is 494.89 million tonnes with an average grade of CaO 39.13%, MgO 0.57% and SiO<sub>2</sub> 27.16% have also been established.

1.15.2 The exploration is carried out as per Mineral (Evidence of Mineral Contents) Rule-2015, Mineral Auction Rule-2015, MMDR Amendment Act - 2015 and in accordance with the Minerals (Evidence of Mineral Contents) Amendments Rules 2021.

1.15.3 This level of exploration will facilitate the State government of Karnataka for auctioning of block under Mining Lease after further exploration of few more borehole to explore the Cement Grade Limestone bellow 45.00m.

As per the recommendation by the Committee the maximum depth of the borehole was restricted to 45.00m only. Cement Grade limestone intersected from 39.00m to 45.00m in the MKG-05 only. Rest of the 4 boreholes were intersected by Threshold limestone immediately after soil cover up-to the maximum explored depth of 45.00. Hence an additional 5 boreholes are to be drilled up to 100.00m depth to establish additional resources of Cement Grade Limestone.

1.15.4 Gypsum replacing calcite is not observed during present exploration, however acid insoluble test for the generation of chemical plots are recommended for future work (G2/G1).

1.15.5 The study area suggests that any future mining project may generate employment for the local people and will increase socio-economic status of the people residing in the nearby areas.

1.15.6 As approved, 5 boreholes were drilled; and resources are estimated in Inferred Category (333) & Reconnaissance (334) Category as per UNFC. However, the confirmation of resources at higher confidence level, five more boreholes should be drilled at 400 intervals. One Stratigraphy borehole may be needed to drill in this block to intersect the contact with Rebanpalli clastics.

## CHAPTER-II

### अध्याय-II

#### कार्यकारी सारांश

#### 2.1.0 परिचय

2.1.1 चूनापत्थर, एक अवसादीय चट्टान है, जो मुख्य रूप से समुद्री से लेकर स्थलीय तक विभिन्न निक्षेपण वातावरणों में कार्बोनेट खनिजों की रासायनिक/जैव रासायनिक अवक्षेपण से उत्पन्न होती है। समुद्री प्रणाली या तो नेरिटिक (शैल्फ) या पेलजिक (खुला महासागर) है (जेम्स और जोन्स, 2016)। भूवैज्ञानिक इतिहास में अधिकांश चूनापत्थर नेरिटिक प्रणाली में जमा है। दूसरी ओर, प्रमाण बताते हैं कि पेलजिक चूनापत्थर जुरासिक काल से ही प्रचलन में हैं। इनमें से प्रत्येक निक्षेपण वातावरण को तापमान, लवणता, फोटोनिक क्षेत्र की गहराई, सिलिक्लास्टिक इनपुट और तलछट आपूर्ति में अंतर द्वारा नियंत्रित किया जाता है। सामान्य लवणता और कम सिलिक्लास्टिक इनपुट के साथ गर्म पानी (20 सी) फोटिक ज़ोन के उत्तेजित हिस्से (पानी की गहराई जिसमें प्रकाश प्रवेश करता है) के भीतर चूनापत्थर के निर्माण में योगदान देता है (जेम्स और जोन्स, 2016)। यह इंगित करता है कि अधिकांश चूनापत्थर उष्णकटिबंधीय-उपोष्णकटिबंधीय बेल्ट में, भूमध्य रेखा के 30 डिग्री उत्तर और दक्षिण में जमा हैं (टकर, 2001)। स्थलीय सेटिंग में कार्बोनेट आमतौर पर पानी के तापमान और स्थानीय जलवायु के आधार पर झीलों, झरनों, गुफाओं में बनते हैं।

2.1.2 कैल्साइट के रूप में कैल्शियम कार्बोनेट ( $\text{CaCO}_3$ ), चूनापत्थर का प्रमुख खनिज घटक है। इसमें कुछ मात्रा में मैग्नीशियम कार्बोनेट ( $\text{MgCO}_3$ ) और/या डोलोमाइट ( $\text{CaMg}(\text{CO}_3)_2$ ) भी होता है। गैर-कार्बोनेट खनिजों के रूप में मौजूद टेरिजेनस कार्टेज, मिट्टी, पाइराइट, हेमेटाइट, चर्ट आदि की विभिन्न मात्रा चूनापत्थर की गुणवत्ता/ग्रेड को नियंत्रित करती है।

2.1.3 चूनापत्थर एक महत्वपूर्ण और बहुमुखी खनिज वस्तु है। इस बात के प्रमाण हैं कि मानव सभ्यता के शुरुआती दिनों से ही इसका उपयोग निर्माण सामग्री के रूप में किया जाता रहा है। गीज़ा के महान पिरामिडों से लेकर जैसलमेर के स्वर्ण किले तक, दुनिया की कई सबसे खूबसूरत और ऐतिहासिक इमारतें चूनापत्थर से बनी हैं। आधुनिक समय में, चूनापत्थर का उपयोग मुख्य रूप से सीमेंट बनाने के लिए किया जाता है। हालाँकि, आजकल चूनापत्थर का उपयोग केवल निर्माण सामग्री तक ही सीमित नहीं रह गया है; बल्कि विभिन्न उद्योगों में इसके उपयोग की बहुमुखी प्रतिभा ने इसे एक मूल्यवान खनिज बना दिया है। लौह और इस्पात उद्योग में, चूनापत्थर का उपयोग ब्लास्ट फर्नेस और स्टील पिघलने की दुकान दोनों में फ्लक्स के रूप में किया जाता है। रासायनिक उद्योग में, चूनापत्थर का उपयोग ब्लीचिंग पाउडर, टूथपेस्ट, कैल्शियम कार्बाइड

आदि के उत्पादन में किया जाता है। इसका उपयोग चीनी उद्योग में शोधक के रूप में किया जाता है। चूनापत्थर की खपत कागज, उर्वरक और फाउंड्री आदि उद्योगों में भी की जाती है।

- 2.1.4 1.4.2015 (खनिज वर्ष पुस्तक 2020) तक यूएनएफसी (संयुक्त राष्ट्र फ्रेमवर्क वर्गीकरण) प्रणाली पर आधारित एनएमआई (राष्ट्रीय खनिज सूची) डेटा के अनुसार सभी श्रेणियों और ग्रेडों के चूनापत्थर के कुल भंडार/संसाधन 203,224 मिलियन टन, अनुमानित किए गए हैं जिसमें से 16,336 मिलियन टन (8%) को आरक्षित श्रेणी के अंतर्गत रखा गया है और 1,86,889 मिलियन टन (92%) को संसाधन श्रेणी के अंतर्गत रखा गया है। कर्नाटक कुल संसाधनों का 27% हिस्सा रखने वाला अग्रणी राज्य है, इसके बाद आंध्र प्रदेश और राजस्थान (12% प्रत्येक), गुजरात (10%), मेघालय (9%), तेलंगाना (8%), छत्तीसगढ़ और मध्य प्रदेश (5% प्रत्येक) हैं और शेष 12% अन्य राज्यों द्वारा। ग्रेड के अनुसार, सीमेंट ग्रेड (पोर्टलैंड) की अग्रणी हिस्सेदारी लगभग 70% है, इसके बाद अवर्गीकृत ग्रेड (12%) और बीएफ ग्रेड (7%) हैं। शेष (11%) अलग-अलग ग्रेड हैं।
- 2.1.5 2019-20 में चूनापत्थर का उत्पादन 359 मिलियन टन था, जो पिछले वर्ष की तुलना में लगभग 5.43% कम है। पिछले वर्ष के दौरान 725 की तुलना में 2019-20 में 659 रिपोर्टिंग खदानें थीं। प्रति वर्ष 3 मिलियन टन से अधिक उत्पादन करने वाली तीस खदानों ने 2019-20 में चूनापत्थर के कुल उत्पादन में 42% का योगदान दिया। 2 से 3 मिलियन टन की उत्पादन सीमा वाली 26 खदानों की हिस्सेदारी कुल उत्पादन का 17% थी। कुल उत्पादन का लगभग 19% योगदान 51 खदानों का था, जिनमें से प्रत्येक का उत्पादन 1 से 2 मिलियन टन सालाना था। वर्ष के दौरान कुल उत्पादन का शेष 22% 552 खदानों और तीन संबद्ध खदानों द्वारा दर्ज किया गया। दस प्रमुख उत्पादकों ने कुल उत्पादन में लगभग 54% का योगदान दिया। पिछले वर्ष के 2.88% की तुलना में सार्वजनिक क्षेत्र की खदानों द्वारा लगभग 2.82% उत्पादन दर्ज किया गया। 2019-20 के दौरान चूनापत्थर के कुल उत्पादन का लगभग 97% सीमेंट ग्रेड का, 2% लोहा और स्टील ग्रेड का और शेष 1% रासायनिक ग्रेड का था (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)।
- 2.1.6 राजस्थान चूनापत्थर के कुल उत्पादन (20%) का अग्रणी उत्पादक राज्य था, इसके बाद मध्य प्रदेश (13%), आंध्र प्रदेश और छत्तीसगढ़ (12% प्रत्येक), और कर्नाटक (10%), तमिलनाडु और तेलंगाना (प्रत्येक 7%), गुजरात (6%) और शेष 13% का योगदान असम, बिहार, हिमाचल प्रदेश, केंद्र शासित प्रदेश जम्मू और कश्मीर, झारखंड, केरल, महाराष्ट्र, मेघालय, ओडिशा और उत्तर प्रदेश द्वारा किया गया। (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)

2.1.7 भारत चीन के बाद दुनिया का दूसरा सबसे बड़ा सीमेंट उत्पादक देश था। 2019-20 में, विभिन्न उद्योगों द्वारा बताई गई चूनापत्थर की कुल खपत 328.62 मिलियन टन थी, जो पिछले वर्ष की तुलना में 0.87% की नकारात्मक वृद्धि दर्ज करती है। सीमेंट 308.66 मिलियन टन (94%) खपत वाला प्रमुख उपभोक्ता उद्योग था, इसके बाद लोहा और इस्पात 12.68 मिलियन टन (4%) और रासायनिक 5.29 मिलियन टन (2%) था। शेष खपत एल्यूमीनियम, मिश्र धातु इस्पात, चीनी, कागज, उर्वरक, कांच, धातु विज्ञान, फाउंड्री, आदि द्वारा बताई गई थी। (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)।

2.1.8 चूनापत्थर का निर्यात 3% की मामूली कमी के साथ 2019-20 में 3.76 मिलियन टन हो गया, जो पिछले वर्ष 3.88 मिलियन टन था। चूनापत्थर मुख्य रूप से बांग्लादेश (97.00%) और यूके (1.00%) को निर्यात किया गया था। 2019-20 में चूनापत्थर का आयात 5% की मामूली वृद्धि के साथ 25.64 मिलियन टन हो गया। चूनापत्थर मुख्य रूप से संयुक्त अरब अमीरात (80.00%), ओमान (12.00%), वियतनाम (4.00%), मलेशिया (3.00%), और अन्य देशों (1.00%) से आयात किया जाता था। (भारतीय खान ब्यूरो द्वारा खनिज वार्षिकी पुस्तिका 2020 के अनुसार)

## **2.2.0 परियोजना और जांच एजेंसी का विवरण**

2.2.1 प्रारंभिक गवेषण (जी-3) के मुख्य उद्देश्यों में से एक किरानागी, गांव, तालुका: कालाबुरागी, जिला: कालाबुरागी, कर्नाटक में किरानागी-2 ब्लॉक में 333 और 334 के तहत चूना पत्थर के विभिन्न ग्रेडों और संसाधनों का आकलन करना है।

2.2.2. ब्लॉक हेतु जांच एजेंसी मिनरल एक्सप्लोरेशन एंड कंसल्टेंसी लिमिटेड (एमईसीएल), नागपुर है।

## **2.3.0 जांच के उद्देश्य**

गवेषण निम्नलिखित उद्देश्यों के साथ प्रस्तावित किया गया था:

- i) गवेषण के जी-3 स्तर पर 5 बोरहोल की ड्रिलिंग द्वारा ब्लॉक क्षेत्र के भीतर चूनापत्थर की उपस्थिति का सीमांकन करना।
- ii) गवेषण के जी-3 स्तर के यूएनएफसी मानदंडों के अनुसार ब्लॉक क्षेत्र में ग्रेड-वार चूनापत्थर के अनुमानित संसाधनों का आकलन करना।
- iii) राज्य सरकार (कर्नाटक) को सुविधा प्रदान करने के लिए खनिज (साक्ष्य और खनिज सामग्री) संशोधन नियम 2021, खनिज नीलामी नियम 2015, 2021 तक संशोधित, एमएमडीआर संशोधन अधिनियम 2015 के अनुसार प्रारंभिक गवेषण (जी-3) करने के लिए खनन पट्टा/ब्लॉक के अंतर्गत ब्लॉक की नीलामी।

## 2.4.0 जांच करने हेतु आधार

- 2.4.1 किरानागी 2 ब्लॉक भीमा बेसिन में पड़ता है और यह एमईसीएल द्वारा हाल ही में खोजे गए डिगगांव और उडगी ब्लॉक के निकट है। निकटवर्ती क्षेत्र (दिगगांव और उडगी ब्लॉक) में हाल में किए गए गवेषण के आधार पर, यह देखा गया है कि शाहाबाद चूनापत्थर में एक क्षेत्र (जोन), नामतः पोर्टलैंड ग्रेड जोन-1 हैं। पोर्टलैंड ग्रेड जोन; जोन 1 केवल 6.00 मीटर (MKG-05) की मोटाई के साथ बोरहोल MKG-05 में प्रतिच्छेदन करता है। जोन-1 में किरानागी 2 ब्लॉक में औसत 47.26% CaO, औसत 0.45% MgO और औसत 13.87% SiO<sub>2</sub> है। गवेषित किरानागी 2 ब्लॉक एमईसीएल द्वारा गवेषित किए गए डिगांव और उडगी चूना पत्थर ब्लॉक के उत्तर में पड़ता है।
- 2.4.2 किरानागी 1 और 2 ब्लॉक कर्नाटक सरकार के भूविज्ञान निदेशालय द्वारा पहचाने गए संभावित चूनापत्थर ब्लॉक हैं, जिसके लिए एमईसीएल ने किरानागीगांव, तालुका:कालाबुर्गी जिला: कालाबुर्गी में गवेषण के जी-3 स्तर पर 10 बोरहोल में 600 मीटर ड्रिलिंग सहित गवेषण प्रस्ताव तैयार किया है और एनएमईटी की तकनीकी सह लागत समिति (टीसीसी) के अनुमोदन के लिए रखा गया। 16 मार्च, 2023को आयोजित टीसीसी, एनएमईटी की 28वीं बैठकके दौरान, उक्त प्रस्ताव का तकनीकी रूप से मूल्यांकन किया गया और फाईल सं. 23/325/2023-एनएमईटी/409 दिनांक 27मार्च, 2023 के माध्यम से अनुमोदित किया गया।
- 2.4.3 16 मार्च, 2023को आयोजित एनएमईटी की 28वीं टीसीसी की सिफारिश पर एमईसीएल द्वारा किरानागी गांव, तालुका:कालाबुर्गी, जिला: कालाबुर्गी में किरानागी 1 और 2 चूनापत्थर ब्लॉकों के लिए अनुमानित 1,27,57,798/- रुपये की लागत के साथ किरानागी 1 और 2 दोनों ब्लॉकों के लिए 10 महीने की समय-सीमा में एक साथ खनिज गवेषण परियोजना को मंजूरी दी गई। 450 मीटर के संचयी मीटर के लिए 10 बोरहोल के लिए एक साथ मंजूरी दी गई थी। हालाँकि गवेषण को अलग से निष्पादित किया गया था और किरानागी 1 और किरानागी 2 के लिए भूवैज्ञानिक रिपोर्ट अलग से तैयार की गई थी। किरानागी 2 ब्लॉक का गवेषण 225 मीटर की संचयी मीटररेज के साथ 5 बोरहोल द्वारा की गई थी।
- 2.4.4 सभी संरचनाओं की सामान्य प्रवृत्ति उत्तर-दक्षिण है। सीधी रेखीय पूर्व-पश्चिम (ईडब्ल्यू) से उत्तर पश्चिम (एनडब्ल्यू)-दक्षिण पूर्व (एसई) प्रवृत्ति सीमाएँ भ्रंशात्मक हैं जबकि एन-एस और एनएनई-एसएसडब्ल्यू रेखिक प्रवृत्ति अंतर्निहित निसिक के साथ असंगत संबंध दिखाते हैं।
- 2.4.5 भीमा समूह के अवसादीय संरचनात्मक रूप से कम से कम अव्यवस्थित होते हैं और निक्षेपण के समय मूल रूप से प्रभावित अपने क्षैतिज बेडेड वाले रचना को संरक्षित करते हैं। ब्लॉक की चट्टानें क्षैतिज रूप से फैली हुई हैं और ज्यादातर ऊपरी मिट्टी के नीचे ढकी हुई हैं।

- 2.4.6 ब्लॉकों का लगभग पूरा क्षेत्र चतुर्धातुक अवसाद यानी मिट्टी के आवरण के नीचे ढका हुआ है। जगह-जगह चूनापत्थर के बिखरे हुए टुकड़े दिखाई देते हैं। जैसा कि आस-पास के क्षेत्रों में देखा गया है, बेड्स क्षैतिज रूप से व्यवस्थित हुआ है। चूंकि अधिकांश क्षेत्र मिट्टी के आवरण के नीचे ढका हुआ है, इसलिए ब्लॉकों में चूनापत्थर के बेड्स की नतिलंब और नति नहीं देखी गई है। वर्तमान में आसपास के क्षेत्रों में खनन गतिविधियाँ चल रही हैं और सीमेंट के निर्माण के लिए चूनापत्थर की खुदाई की जा रही है।
- 2.4.7 ऊपरी मिट्टी की अधिभार का रंग काला , महीन से लेकर गादयुक्त , सूखने पर भुरभुरी और गीली होने पर चिपचिपी होती है। अधिभार मिट्टी लगभग पूरे ब्लॉक क्षेत्र को कवर करती है। स्थानों पर मिट्टी की मोटाई 1.00 मीटर (MKG-04) से लेकर लगभग 4.00 मीटर (MKG-01) तक होती है । बोरहोल MKG-01 सेMKG-05 में थ्रेसहोल्ड ग्रेड चूना पत्थर है जिसका मिट्टी के अधिभार द्वारा तुरंत ही अनुवर्तन किया जाता है।पोर्टलैंड ग्रेड चूना पत्थर बोरहोल MKG -05 में केवल 39.00 मीटर से 45.00 तक, थ्रेसहोल्ड ग्रेड चूना पत्थर से नीचे प्रतिच्छेदित होता है।चूनापत्थर में सिलिसियस/फ्लैगी चूनापत्थर, विशाल ग्रे चूनापत्थर और शैली चूनापत्थर शामिल है। इस ब्लॉक के चूनापत्थर के बैंड चूने की मात्रा से समृद्ध हैं जो सीमेंट के निर्माण के लिए उपयुक्त है।

## **2.5.0 कार्य का विवरण**

- 1.5.1 यह प्रस्ताव किरानागी 1 और 2 ब्लॉक के लिए एक साथ बनाया गया था। किरानागी 1 (225 मीटर -5 बोरहोल) और 2 (225 मीटर -5 बोरहोल) में एक साथ स्वीकृत मीटरेज 450 मीटर (10 बोरहोल) है। किरानागी 1 ब्लॉक में कुल मीटरेज 225 मीटर (5 बोरहोल) और किरानागी 2 ब्लॉक में 225 मीटर (5 बोरहोल) की ड्रिलिंग की गई थी।सभी बोरहोल चूनापत्थर युक्त हैं। चूनापत्थर क्षेत्र ऊपरी मिट्टी के आवरण के 2 से 4 मीटर के बाद प्रतिच्छेदित हो जाता है। इसलिए प्राथमिक नमूनों की मात्रा 415 तक बढ़ा दी गई है, जिसके परिणामस्वरूप स्वीकृत 400 नमूनों की तुलना में 15 अतिरिक्त नमूने तैयार किए गए हैं।किरानागी ब्लॉक 1 में, प्राथमिक नमूनों की कुल मात्रा 204 है, जबकि किरानागी ब्लॉक 2 में 211 है। 57वीं टीसीसी बैठक में मालखेड 1 और 2 और किरानागी 1 और 2 ब्लॉक में नमूनाकरण और विश्लेषण लागत को मंजूरी देने का प्रस्ताव किया गया था। यह बैठक 26 और 27 सितंबर, 2023 को नई दिल्ली में आयोजित की गई।समिति के द्वारा रू.1.49 लाख (कार्यवृत्त एजेंडा 57.2.13 को देखें) में अतिरिक्त नमूनों और अतिरिक्त लागत हेतु अनुमोदन दिया गया। तत्पश्चात एनएमईटी की कार्यकारी समिति की अपने 32 वें कार्यकारी बैठक जो 06 दिसंबर, 2023 को आयोजित हुआ में रू.1,48,949/- ( एक लाख अड़तालीस हजार नौ सौ उन्चास) केवल के लागत हेतु अनुमोदन दिया गया। फाईल सं.

23/325/2023-NMET/393 दिनांक-18 दिसंबर, 2023 को देखें। अनुमोदन की प्रति अनुलग्नक सं. IXB के रूप में संलग्न है।

एनएमईटी से मंजूरी मिलने के बाद, एमईसीएल द्वारा किरानागी1 और 2 ब्लॉक में गवेषण गतिविधियां शुरू की गई हैं। प्रस्तावित कार्य बनाम उपलब्धि का विवरण, प्रकृति और मात्रा नीचे दी गई है:

**तालिका सं. 1.1**  
**किरानागी 1 और 2 ब्लॉक के लिए प्रस्तावित कार्य की मात्रा वनाम लक्षित**

| क्र.सं.   | कार्य का विवरण एवं प्रकृति  | इकाई      | अनुमोदित        | लक्षित  | लक्षित     | लक्षित  |
|-----------|---|-----------|-----------------|---|------------|---------|
|           |   |           | किरानागी 1 और 2 | किरानागी 1  | किरानागी 2 | 1 और 2  |
| <b>ए</b>  | <b>भूवैज्ञानिक कार्य और सर्वेक्षण</b>   |           |                 |   |            |         |
| 1         | भूवैज्ञानिक मानचित्रण (1:4000 पैमाना)   | वर्ग किमी | 11.41           | 5.5734  | 5.8022     | 11.3756 |
| 2         | सर्वेक्षण कार्य   |           |                 |   |            |         |
|           | i) स्थलाकृतिक सर्वेक्षण (1:4000 पैमाना)   | वर्ग किमी | 11.41           | 5.5734  | 5.8022     | 11.3756 |
|           | ii) बोर होल निर्धारण  | नग        | 10              | 5   | 5          | 10      |
|           | iii) डीजीपीएस द्वारा आरएल और निर्देशांक निर्धारण  | नग        | 10              | 5   | 5          | 10      |
| <b>बी</b> | <b>गवेषणात्मक ड्रिलिंग</b>  |           |                 |   |            |         |
| 1         | 300 मीटर तक ड्रिलिंग (सॉफ्ट रॉक)  | मी        | 450             | 225   | 225        | 450     |
| 2         | ड्रिल कोर संरक्षण   | प्रति मी  | 405             | 200   | 205        | 405     |
| <b>सी</b> | <b>प्रयोगशाला अध्ययन</b>  |           |                 |   |            |         |
| 1         | <b>रासायनिक विश्लेषण</b>  |           |                 |   |            |         |
|           | i) XRF द्वारा प्राथमिक नमूनाकरण (9मूलकों CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O और LOI)            | नग        | 400             | 204   | 211        | 415     |
|           | ii) XRF द्वारा आंतरिक 5% (9 मूलकों CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O और LOI) सैपलिंग की जाँच। | नग        | 20              | 10  | 10         | 20      |
|           | iii) बाहरी सैपलिंग की जाँच 10% (9 मूलकों CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O और LOI)            | नग        | 40              | 20  | 19         | 39      |
| 2         | <b>पेट्रोलॉजिकल नमूने (सतही और बोरहोल कोर नमूने)</b>  |           |                 |   |            |         |
|           | i) थिनसेक्शन की तैयारी  | नग        | 10              | 5   | 5          | 10      |
|           | ii) थिनसेक्शन का अध्ययन   | नग        | 10              | 5   | 5          | 10      |
| 3         | <b>थोक घनत्व निर्धारण</b>   |           |                 |   |            |         |
|           | i) थोक घनत्व  | नग        | 2               | किरानागी 1 और 2 दोनों ब्लॉकों के लिए 2 संयुक्त नग |            | 2       |
| <b>डी</b> | <b>रिपोर्ट तैयार करना (सॉफ्ट कॉपी के साथ 5 हार्ड कॉपी)</b>  | नग        | 2               | 1   | 1          | 2       |
| <b>इ</b>  | <b>गवेषण प्रस्ताव की तैयारी (सॉफ्ट कॉपी के साथ 5 हार्ड कॉपी)</b>  | नग        | 1               | 1   | 1          | 1       |

\*अतिरिक्त नमूनाकरण और विश्लेषण लागत को ईसी समिति (ईसी) एनएमईटी द्वारा 06 दिसंबर 2023 को आयोजित अपनी 32वीं ईसी बैठक में 1,48,949/- (केवल एक लाख अड़तालीस हजार नौ सौ उनतालीस) की मंजूरी दी गई थी।)। फाईल संख्या 23/325/2023-एनएमईटी/393 दिनांक 18 दिसंबर, 2023.

## 2.6.0 ब्लॉक का स्थान

- 2.6.1 प्रस्तावित किरानागी-2 ब्लॉक टोपोशीट संख्या 56सी/16 में आता है और यह कालाबुरागी तालुक और जिले में स्थित है, जिसका कुल ब्लॉक क्षेत्रफल 5.8022 वर्ग किलोमीटर है। ब्लॉक तक निकटतम सेदमतालुक मुख्यालय से पश्चिम की ओर सिंगल लेन डामरीकृत ग्रामीण सड़कों द्वारा लगभग 24 किमी की दूरी पर पहुंचा जा सकता है। गवेषित किए गए ब्लॉक किरानागीगांव, कालाबुरागी तालुक और जिला के अधिकार क्षेत्र में आते हैं। जिला मुख्यालय कालाबुरागी ब्लॉक से उत्तर की ओर 24 किमी की दूरी पर है।
- 2.6.2 किरानागी2 ब्लॉक 5.8022वर्ग किमी के क्षेत्र को कवर करता है और यह एनएमईटी फंडिंग के तहत गवेषण के लिए कर्नाटक सरकार के खान और भूविज्ञान विभाग द्वारा एमईसीएल को प्रदान किया गया है।

**तालिका संख्या 1.2**  
**ब्लॉक सीमा के कार्डिनल बिंदुओं का निर्देशांक**  
**(जैसा कि डीएमजी, कर्नाटक द्वारा प्रदान किया गया)**

| सीमा बिंदु | डब्ल्यूजीएस 1984 डीएमएस |                  | यूटीएम (एम) |            |
|------------|-------------------------|------------------|-------------|------------|
|            | अक्षांश                 | देशान्तर         | Y (N)       | X (E)      |
| KE1        | 17° 09' 46.653"N        | 76° 53' 1.247"E  | 1898554.680 | 700360.893 |
| KE2        | 17° 08' 20.961"N        | 76° 52' 41.266"E | 1895914.501 | 699795.811 |
| KW-1       | 17° 8' 20.026"N         | 76° 54' 19.978"E | 1895914.166 | 702713.924 |
| KW-4       | 17° 9' 46.437"N         | 76° 53' 50.986"E | 1898562.361 | 701831.002 |

- 2.6.3 अधिकांश बुनियादी ढांचा (पुलिस स्टेशन, बैंक सुविधा, अस्पताल, कार्यशाला सुविधा, बस स्टैंड आदि) शाहाबाद में उपलब्ध है जो ब्लॉक से लगभग 11 किमी की दूरी पर कालाबुरागी तालुका में उपलब्ध है।

## 2.7.0 क्षेत्र की क्षेत्रीय भूवैज्ञानिक संरचना

- 2.7.1 भीमा बेसिन भारत के सभी प्रोटेरोज़ोइक बेसिनों में सबसे छोटा है। भीमा बेसिन कलादगी समूह के संपर्क में नहीं है और यह युवा माना जाता है और वे कडप्पा सुपर ग्रुप के कुरनूल समूह से काफी मिलते जुलते हैं। भीमा बेसिन अक्षांश N 16°20' से 17°35' और देशांतर N 76°15' से 77°40'E तक फैला हुआ है। भीमा बेसिन अवसाद एन-एस में अलग-अलग चौड़ाई के साथ लगभग 160 किमी तक रैखिक रूप से फैली हुई है और अधिकतम 40 किमी है। यह 5200 वर्ग किमी के क्षेत्र में फैला हुआ है। और कडप्पा बेसिन के उत्तर-पश्चिम में और कलादगी बेसिन के उत्तर पूर्व में स्थित है।

2.7.2 कैप्टन न्यू बोल्ड (1842-1845) सबसे पहले तालीकोट फ़्लैगी चूनापत्थर और मुद्देबिहाल लाल बलुआ पत्थर को रिकॉर्ड करने वाले थे। आर. ब्रूस फूटे (1876) ने भीमा समूह (मुख्य रूप से चूनापत्थर) को बलुआ पत्थर और शेल द्वारा दर्शाए गए निचले क्लैस्टिक और ऊपरी मुख्य रूप से चूनापत्थर और शैल्स में विभाजित किया था। इसके अलावा, महादेवन (1947), जनार्दन राव इत्यादी (1975), माथुर (1977), मुधोलकर और काले (1982) और मिश्रा इत्यादी (1987) भीमा समूह को वर्गीकृत करते हैं। हालाँकि, विवेक एस काले, वीजी फणसलकर और अन्य (1991) ने भीमा समूह को रबनपल्ली (क्लैस्टिक) संरचना और शाहाबाद (चूनापत्थर) संरचनाओं में वर्गीकृत किया है।

2.7.3 भीमा समूह का स्ट्रैटिग्राफिक कॉलम (जीएसआई के बाद) नीचे दिया गया है:

**तालिका संख्या 1.3**  
**भीमा समूह का स्ट्रैटिग्राफिक कॉलम (जीएसआई के बाद), 1975**

| समूह   | उप-समूह   | गठन                          | सदस्य  | मोटाई(एम)   |                                 |   |
|--|---|------------------------------|--|---|---------------------------------|---|
| डेक्कन ट्रैप   | -   |                              | मूल प्रवाह   |   |                                 |   |
| भीमा समूह<br>(ऊपरी प्रोटेरोज़ोइक )<br>(93-273 एम.वाई ) | अंडोला उप-समूह (31-68 मेरी )                                  | हरवाल-गोगी                   | जीवाश्म शेल सदस्य ऑर्थो -<br>कार्टजाइट चर्ट + कंकड़ समूह | 5-10  |                                 |   |
|  |   | कटमदेवर-हल्ली                |  | 10-40<br>16-18  |                                 |   |
|  |   | हलकल                         |  |   |                                 |   |
|  | ----- पैराकॉन्फ़ॉर्मिटी -----                                 |                              |  |   |                                 |   |
|  | शांत बेसिन क्षेत्र के साथ<br>सेदम उप-समूह (62-2.5<br>एम.वाई ) |                              |  | फ़्लैगी गहरे भूरे और<br>आर्गिलैसियस चूनापत्थर<br>मैसिव गहरे भूरे और नीले भूरे<br>रंग का चूनापत्थर | 4-6<br>8-20                     |   |
|  |   |                              | शाहाबाद  | विभिन्न प्रकार का और<br>सिलिसियस/चेरी चूनापत्थर   | 20-80                           |   |
|  |   |                              | काला, हल्का भूरा से नीला भूरा<br>चूनापत्थर               | 10-15   |                                 |   |
|  |   | रबनपल्ली                     | मैला और झण्डादार एलएसटी                                  | 4-8   |                                 |   |
|  |   |                              | बैंगनी शेल   | 2-40  |                                 |   |
|  |   |                              | हरा/पीला शेल   | 5-15  |                                 |   |
|  |   |                              | सिल्टस्टोन   | 3-4   |                                 |   |
|  |   |                              | कार्टजाइट/इंटर-<br>कैलेटेड बलुआ पत्थर<br>समूह/धैर्य      | 5-15<br>1-2   |                                 |   |
|  |   | ----- अन कॉन्फ़ॉर्मिटी ----- |  |   |                                 |   |
|  |   | निम्नतल क्रिस्टलीय           |  |   | युवा ग्रेनाइट प्रायद्वीपीय गनीस | - |

2.7.4 भीमा समूह की संशोधित लिथो स्ट्रैटिग्राफी का हालिया वर्गीकरण (1991) नीचे दिया गया है:

**तालिका संख्या 1.4**  
**भीमा समूह की संशोधित लिथो स्ट्रैटिग्राफी**  
**( विवेक एस काले, वीजी फणसलकर और अन्य 1991 के बाद)**

| गठन                                       | अधिकतम मोटाई(एम) | सदस्य                              | मुख्य लिथोलॉजिकल घटक   |
|---|------------------|------------------------------------|--|
| 2. शाहाबाद चूनापत्थर                      | <75              |                                    | <ul style="list-style-type: none"> <li>• धूसर, आर्गिलैसियस माइक्रोक्रीक्लाइमस्टोन ।</li> <li>• गहरा, नीला भूरा, विशाल चूनापत्थर ।</li> <li>• विविध, सिलिसियस और चैरी चूनापत्थर ।</li> <li>• नीला-ग्रे, काला- माइक्रोक्रीक्लाइमस्टोन ।</li> <li>• फ्लैगी (आंशिक रूप से अशुद्ध आर्गिलैसियस और चर्ट) चूनापत्थर ।</li> </ul> |
| ----- क्रमिक और संक्रमणकालीन संपर्क ----- |                  |                                    |  |
| 2. रबनपल्लीक्लैस्टिक्स                    | <70              | एकमाई शेल सदस्य                    | लौहयुक्त शैल्स, शीर्ष पर कैलकेरियस शैल्स के साथ।   |
|   |                  | कस्तूरपल्ली - ग्लौकोनितिक सदस्य    | हरा, ग्लौकोनाइट, महीन दाने वाले बलुआ पत्थर और सिल्टस्टोन।  |
|   |                  | कुंद्रापल्ली कार्टेज एरेनाइट सदस्य | क्वाटर्ज़िटिक बलुआ पत्थर ( मध्यम से बारीक दाने वाला)।  |
|   |                  | अदकी हिल समूह के सदस्य             | पॉलिमिक्टिक समूह और आर्कोसिक, किरकिरा बलुआ पत्थर।  |

2.7.5 जीवाश्मों की पूर्ण अनुपस्थिति भीमा समूह की अवसादों को कैम्ब्रियन में स्थानांतरित होने से रोकती है। इस प्रकार परिकल्पित ऊपरी आयु सीमा 600 मिलियन वर्ष से कम नहीं है।

### 2.8.0 ब्लॉक भूविज्ञान

ब्लॉकों में उजागर चट्टानें भीमा समूह के सेदम उप समूह की शाहाबाद संरचना से संबंधित हैं। एमईसीएल ने एमईसीएल द्वारा पहले गवेषित गए डिगगांव ब्लॉक के पश्चिम में लगभग 15 किलोमीटर की दूरी पर किरानागी-2 ब्लॉक की गवेषण की थी। क्षेत्र अवलोकनों और निकटवर्ती खदान/क्षेत्रों से उपलब्ध डेटा/साहित्य के आधार पर किरानागी-2 ब्लॉक का सामान्य स्ट्रैटिग्राफिक अनुक्रमण नीचे तालिका संख्या 1.4 में दिया गया है।

### 2.9.0 क्षेत्रीय संरचना

सभी संरचनाओं की सामान्य प्रवृत्ति उत्तर-दक्षिण है। सीधी रेखीय पूर्व-पश्चिम (ईडब्ल्यू) से उत्तर पश्चिम (एनडब्ल्यू)-दक्षिण पूर्व (एसई) प्रवृत्ति सीमाएँ भ्रंशात्मक हैं जबकि एन-एस और एनएनई-एसएसडब्ल्यू रेखिक प्रवृत्ति अंतर्निहित नीस के साथ असंगत संबंध दिखाते हैं।

भीमा समूह के अवसाद संरचनात्मक रूप से कम से कम अव्यवस्थित होते हैं और अपने क्षैतिज बेड्स वाले रचना को मूल रूप से निक्षेपण के समय प्रभावित करते हैं। विकृति केवल भ्रंशों के आसपास ही देखी जाती है। सामने आई खामियाँ बेसमेंट में जारी हैं जिसने बेसिन विन्यास पर नियंत्रण स्थापित कर लिया है।

यह बेसिन गोगी के पास हाल ही में खोजी गई यूरेनियम की उपस्थिति के लिए जाना जाता है। गवेषित किए गए किरानागी 1 ब्लॉक का क्षेत्रीय भूवैज्ञानिक मानचित्र भीमा बेसिन (भाग) प्लेट-II के रूप में दिखाया गया है।

2.10.0 व्यवस्थित ड्रिलिंग द्वारा गवेषण

**2.10.0 व्यवस्थित ड्रिलिंग द्वारा गवेषण**

2.10.1 एमईसीएल द्वारा 01.05.2023 को किरानागी-2 चूनापत्थर ब्लॉक में प्रारंभिक गवेषण (जी-3 स्तर) शुरू किया गया और 20.05. 2023को 05 बोरहोल में 225.00 मीटर का भूवैज्ञानिक मानचित्रण और ड्रिलिंग पूरी की गई।

2.10.2 संपूर्ण कोर ड्रिलिंग हीरे के बिट्स का उपयोग करके एनक्वू बोरहोल आकार के साथ वायर लाइन विधि द्वारा की गई है। कटिंग को बाहर निकालने और गवेणात्मक बोरहोल की दीवार को स्थिर करने के लिए पॉलिमर का उपयोग ड्रिलिंग तरल पदार्थ के रूप में किया गया था। ड्रिलिंग तरल पदार्थ ड्रिल बिट्स को जलने से बचाने के लिए शीतलक के रूप में भी काम करता है, कोर की अधिकतम कोर रिकवरी प्राप्त करने के लिए उचित देखभाल की गई थी। चूनापत्थर का निर्माण कठोर और विशाल है, जिसके परिणामस्वरूप अधिकतम 90-95% कोर रिकवरी होती है।

2.10.3 लिथोलॉजिकल रूप से चूनापत्थर बहुत कठोर और विशाल है, कुछ स्थानों पर कभी-कभी मिट्टी के पतले मिश्रण का सामना करना पड़ता है, जिसके परिणामस्वरूप 90-95% कोर रिकवरी होती है। संसाधन आकलन में इन कारकों पर विचार किया जाता है।

**2.11.0 नमूनाकरण और विश्लेषण**

2.11.1 प्राथमिक और जांच नमूने

सभी बोरहोलों में काफी मोटाई में चूनापत्थर की एक समान प्रकृति को ध्यान में रखते हुए और जी-3 गवेषण के दौरान उत्पन्न लिथोलॉजिकल डेटा के अध्ययन के बाद, चूनापत्थर के ग्रेड का मूल्यांकन करने के लिए 1 मीटर की इष्टतम नमूना लंबाई उचित है। इसप्रकार ,लिथोलॉजी, पर विचार करते हुए प्राथमिक नमूना लंबाई 1 मीटर रखने का यह निर्णय लिया गया; हालाँकि, जहां भी आवश्यक लगा, लिथोलॉजी और जीवाश्म सामग्री में भिन्नता के आधार पर छोटी और बड़ी लंबाई के नमूने भी तैयार किए गए।

2.11.2 समग्र नमूना विश्लेषण

समग्र नमूनों का विश्लेषण अनुमोदित नहीं है। इसलिए, नमूने विश्लेषण के लिए तैयार नहीं किए गए।

### 2.12.0 चूनापत्थर जोन का मूल्यांकन

2.12.1 संबंधित भूवैज्ञानिक और प्रयोगशाला अध्ययनों के साथ गवेषात्मक ड्रिलिंग के माध्यम से की गई जांच ने चूनापत्थर क्षितिज के आकार, आकार और ज्यामिति को स्थापित करने के लिए गवेषण डेटा उत्पन्न किया है। इसने ब्लॉक के विभिन्न जमा मापदंडों के मूल्यांकन का आधार बनाया। सभी ग्रेडों के लिए न्यूनतम 1.0 मीटर नमूना लंबाई के आधार पर जोनों का सीमांकन किया गया, आसन्न बोरहोल के साथ कटऑफ और सहसंबंध के आधार पर, आसन्न खोजे गए/खदान ब्लॉक के बोरहोल डेटा पर भी विचार किया गया। मूल्यांकन की मुख्य विशेषताओं पर नीचे चर्चा की गई है।

2.12.2 सीमेंट ग्रेड चूनापत्थर जोन (CaO%  $\geq$ 44, MgO% अधिकतम 3.50, SiO<sub>2</sub>% अधिकतम 16)

2.12.3 मिश्रण योग्य ग्रेड चूनापत्थर जोन

आईबीएम दिशानिर्देशों के अनुसार, मिश्रण योग्य ग्रेड चूनापत्थर क्षेत्र को CaO% रेंज पर  $\geq$ 38 से  $\leq$ 44% के बीच सीमांकित किया गया था और MgO 5.00% & SiO<sub>2</sub>% Max 18.00% से अधिक नहीं होना चाहिए।

2.12.4 थ्रेसहोल्ड ग्रेड चूनापत्थर जोन

आईबीएम दिशानिर्देशों के अनुसार, थ्रेसहोल्ड ग्रेड चूनापत्थर क्षेत्र को CaO% रेंज पर  $\geq$ 34 से  $\leq$ 38% के बीच सीमांकित किया गया था और MgO 6% से अधिक नहीं होना चाहिए।

### 2.13.0 संसाधन आकलन के लिए अपनाई गई पद्धति

2.13.1 चूनापत्थर के संसाधनों का अनुमान मुख्य विधि के रूप में भूवैज्ञानिक क्रॉस सेक्शन विधि और चेक विधि के रूप में बहुभुज विधि द्वारा किया गया है। संसाधन आकलन के लिए उपरोक्त मान्यताओं को ध्यान में रखते हुए अपनाई गई पद्धति इस प्रकार है :

संसाधनों का वर्गीकरण

यूएनएफसी के अनुसार संसाधनों को चूनापत्थर संसाधनों (333 और 334) की अनुमानित और आवीक्षण श्रेणी के अंतर्गत वर्गीकृत किया गया है। संसाधनों के आकलन के लिए मापदंडों और मान्यताओं को अध्याय XVII के तहत पहले ही परिभाषित किया जा चुका है।

भारतीय खान ब्यूरो, भारत सरकार द्वारा निर्धारित अंतिम उपयोग ग्रेड विनिर्देशों के आधार पर चूनापत्थर जोन का गणना और वर्गीकृत किया जाता है।

### 2.14.0 संसाधन

2.14.1 सीमेंट (पोर्टलैंड), ब्लेंडेबल और ब्लेंडेबल/थ्रेशोल्ड ग्रेड चूना पत्थर के कुल शुद्ध इन-सीटू संसाधन को मोटे तौर पर अनुमानित और आवीक्षण (333 और 334) संसाधनों के तहत वर्गीकृत किया गया है, जिसका विवरण निम्नलिखित तालिका में प्रस्तुत किया गया है। सीमेंट (पोर्टलैंड) ग्रेड का कुल

अनुमानित श्रेणी संसाधन 5.34 मिलियन टन है, थ्रेसहोल्ड ग्रेड संसाधन 283.09 मिलियन टन है और सीमेंट (पोर्टलैंड) ग्रेड का कुल आवीक्षण श्रेणी संसाधन 12.98 मिलियन टन है, क्रॉस सेक्शनल विधि द्वारा थ्रेसहोल्ड ग्रेड संसाधन 211.80 मिलियन टन है।

#### तालिका सं. 1.5

#### श्रेणीवार संसाधन शुद्ध-संसाधन का सारांश

इकाई: मिलियन टन

| श्रेणी और यूएनएफसी कोड | सीमेंट (पोर्टलैंड) ग्रेड | थ्रेसहोल्ड ग्रेड | कुल    | प्रतिशत |
|------------------------|--------------------------|------------------|--------|---------|
| अनुमानित(333)          | 5.34                     | 283.09           | 288.43 | 56.20   |
| आवीक्षण (334)          | 12.98                    | 211.80           | 224.78 | 43.80   |
| कुल                    | 18.32                    | 494.89           | 513.21 | 100     |

कुल शुद्ध अनुमानित श्रेणी संसाधन 288.43 (513.21 के कुल शुद्ध संसाधन का 56.20%) मिलियन टन है। विभिन्न ग्रेडों के लिए चूना पत्थर के संसाधनों का अनुमान बोरहोल-वार, अनुभाग-वार, बहुभुज-वार और क्षेत्र-वार लगाया गया है।

#### 2.15.0 सिफ़ारिशें

2.15.1 सीमेंट (पोर्टलैंड) ग्रेड संसाधन का कुल शुद्ध इन-सीटू संसाधन 18.32 मिलियन टन है, जिसका औसत ग्रेड CaO47.26%, MgO 0.45% और SiO<sub>2</sub> 13.87% है और थ्रेसहोल्ड ग्रेड संसाधन 494.89 मिलियन टन है, जिसका औसत ग्रेड CaO39.13% है। MgO 0.57% और SiO<sub>2</sub> 27.16% भी स्थापित किया गया है।

2.15.2 गवेषण खनिज (खनिज सामग्री का साक्ष्य) नियम-2015, खनिज नीलामी नियम-2015, एमएमडीआर संशोधन अधिनियम - 2015 और खनिज (खनिज सामग्री का साक्ष्य) संशोधन नियम 2021 के अनुसार किया जाता है।

2.15.3 गवेषण के इस स्तर के द्वारा 45.00 मीटर से नीचे सीमेंट ग्रेड चूना पत्थर का पता लगाने के लिए कुछ और बोरहोल के गवेषण के बाद खनन पट्टे के तहत ब्लॉक की नीलामी के लिए कर्नाटक राज्य सरकार को सुविधा प्रदान करेगा।

समिति की अनुशंसा के अनुसार बोरहोल की अधिकतम गहराई केवल 45.00 मीटर तक सीमित थी। सीमेंट ग्रेड चूना पत्थर केवल एमकेजी-05 में 39.00 मीटर से 45.00 मीटर तक प्रतिच्छेदित है। शेष 4 बोरहोल को अधिकतम गवेषित गहराई 45.00 तक मिट्टी से ढंकने के तुरंत बाद थ्रेसहोल्ड चूना पत्थर से प्रतिच्छेदन किया गया था। इसलिए सीमेंट ग्रेड चूना पत्थर की अतिरिक्त संरचना स्थापित करने के लिए 100.00 मीटर की गहराई तक अतिरिक्त 5 बोरहोल ड्रिल किए जाने हैं।

- 2.15.4 वर्तमान गवेषण के दौरान कैल्साइट की जगह लेने वाला जिप्सम नहीं देखा गया है, हालांकि भविष्य के काम (जी2/जी1) के लिए रासायनिक भूखंडों की तैयारी के लिए एसिड अघुलनशील परीक्षण की सिफारिश की जाती है।
- 2.15.5 अध्ययन क्षेत्र सुझाव देता है कि भविष्य की कोई भी खनन परियोजना स्थानीय लोगों के लिए रोजगार पैदा कर सकती है और आसपास के क्षेत्रों में रहने वाले लोगों की सामाजिक-आर्थिक स्थिति में वृद्धि करेगी।
- 2.15.6 यथा अनुमोदित, 5 बोरहोल ड्रिल किए गए; और संसाधनों का अनुमान यूएनएफसी के अनुसार अनुमानित श्रेणी (333) और आवीक्षण (334) में लगाया गया है। हालाँकि, उच्च विश्वास स्तर पर संसाधनों की पुष्टि के लिए, निकट अंतराल पर कुछ और बोरहोल ड्रिल किए जाने चाहिए।

## CHAPTER-III

### GEOLOGICAL REPORT

#### 3.0.0 INTRODUCTION

##### 3.1.0 GENERAL

- 3.1.1 Limestone, which is used by the industries in bulk quantity, is a bedded type calcareous sedimentary rock mainly composed of carbonates. The two most important constituents are calcite and dolomite. Limestone often contains magnesium carbonates either as dolomite  $\text{Ca Mg} (\text{CO}_3)_2$  or magnesite ( $\text{Mg CO}_3$ ) mixed with calcite  $\text{CaCO}_3$ . Such limestone is then termed as dolomitic or magnesian limestone. Between limestone and dolomite, the variants are dolomitic-calcitic dolomitic-dolomitic limestone and limestone (magnesium limestone and calcitic limestone)
- 3.1.2 Lime is obtained by calcination of limestone which is widely used as flux in manufacture of steel, for preparation of concrete for foundation and flooring works etc. Limestone is basic raw material for manufacture of cement, Iron and steel making industries. Other industries which are using limestone are chemical industries like calcium carbide, bleaching powder, soda ash, precipitated calcium carbonate etc. Besides it is also consumed in sugar, glass and fertilizers industries.
- 3.1.3 India has been endowed with huge resources of limestone, distributed over different parts of the country and attains the 2<sup>nd</sup> place in the world after China in annual capacity and production of cement. Cement (Portland) grade limestone occurs in all limestone bearing areas as compared to SMS, BF and Chemical grade limestone which is restricted in selective areas. In recent years the demand of BF and SMS grade limestone has been substantiated on account of increase in steel production in the country and thus resulted in concerted efforts for locating SMS and BF grade limestone along with cement (Portland) grade limestone.
- 3.1.4 There is a noticeable requirement of limestone from the steel, chemical and paper industry too. Over the past decade, the imports of limestone mineral have grown exponentially at a CAGR of 21% indicating more attention is required towards mineral exploration and opening up of new mines. In 2008-2020 period, the growth of domestic limestone production was aligned to the growth in cement manufacturing at a CAGR of approximately 6%. Rising demand from pharmaceuticals, packaging industry, food and beverage sectors has been a prime driver behind the healthy consumption of mineral limestone.
- 3.1.5 Presently, India is the largest importer of limestone with ~46% global share followed by Bangladesh (6.5%), Taiwan (5%), South Korea (4%) and others. United Arab Emirates

(UAE) is the top exporter of limestone globally representing 40% of the total trade. Imports of limestone in India has increased to 25.64 million tonnes in 2019-20 from 24.40 million tonnes previous i.e., 2018-19 (As per Indian mineral year book-2020 by IBM).

- 3.1.6 The total resources of limestone of all categories and grades as per UNFC system as on 01/04/2015 are estimated at 203,224 million tonnes, of which 16,336 million tonnes (8%) are under reserves category and 186,889 million tonnes (92%) are under remaining resources category. Karnataka is the leading state having 27% of the total resources followed by Andhra Pradesh, and Rajasthan (12% each), Gujarat (10%), Meghalaya (9%), Telangana (8%), Chhattisgarh and Madhya Pradesh (5% each), and remaining 12% is shared by other states. Grade wise, Cement (Portland) grade has been leading share of about 70% followed by unclassified grades (12%) and BF grade (7%). Remaining (11%) are others.
- 3.1.7 As per Mineral year Book-2020 of IBM, the production of limestone in 2019-20 was about 359 million tonnes, which decreased marginally by about 5.43% as compared to 2018-2019. A total of 659 mines reported against 725 mines during previous year. Out of these thirty mines, each producing more than 3 million tonnes per annum contributed about 42% of the total production of limestone in 2019-20. The share of 26 mines, each in the production range of 2 to 3 million tonnes was about 17% of the total production. About 19% of the total production was contributed by 50 mines, each producing 1 to 2 million tonnes, annually. The remaining 22% of the total production was reported by 552 mines and three associated mines during the year. Ten principal producers contributed about 54% of the total production. About 2.82% of the production was reported by public sector mines as against 288% in the previous year. About 97% of production of limestone during 2019-2020 was of cement grade and 3% was of other grades.
- 3.1.8 Rajasthan is the leading producing state accounting for (20%) of the total production of limestone, followed by Madhya Pradesh (13%), Andhra Pradesh and Chhattisgarh (12% each), Karnataka (10%), Tamil Nadu and Telangana (7% each), Gujarat (6%) and the remaining 13% was contributed by Himachal Pradesh, Maharashtra, Meghalaya, Odisha, Uttar Pradesh, Assam, Jharkhand, Kerala, Bihar and Jammu and Kashmir.
- 3.1.9 In the year 2019-20, the total consumption of limestone and other calcareous minerals/materials, as reported by different industries was 328.62 million tonnes. Cement is the major limestone consuming industry accounting for 94% consumption followed by iron and steel (4%) and chemical industry (2%).
- 3.1.10 India is the second largest in cement production after China. There are 210 cement plants in the country with installed capacity of 537 million tonnes in 2019-20 in addition to mini and white cement plants having estimated capacity of 0.99 million tonnes per annum. The

total production of cement reached to 334.37 million tonnes in 2019-20 registering a negative growth of about 0.87% over the preceding year.

- 3.1.11 As per foreign trade policy 2015-20, export of limestone and lime shell is free. The exports decreased marginally by 3% to 3.76 million tonnes in 2019-20 from 3.88 in the previous year. The limestone from India is exported mainly to the adjoining countries like Bangladesh (97%) and UK (1%) on the other hand. The import of limestone is increased by 5% to 25.64 million tonnes in 2019-20 from 24.40 million tonnes in the previous year. The limestone is imported mainly from UAE (80%), Oman (12%), Vietnam (4%) and Malaysia (3%).

### **3.2.0 OBJECTIVES OF INVESTIGATION**

One of the prime objectives of the Preliminary Exploration (G-3) is to demarcate the various grades of limestone and Estimation of resources under inferred category (333) & reconnaissance (334) in Kiranagi-2 Block, Kalaburagi Taluk and District, Karnataka. The exploration was proposed with following objectives:

- i) To demarcate the limestone occurrence within the area by drilling, 5 nos. of exploratory boreholes at G - 3 stage of exploration.
- ii) To estimate the grade wise limestone inferred resources in the block area as per UNFC norms of G - 3 stage of exploration.

To carry out preliminary exploration (G-3) as per Mineral (Evidence and Mineral contents) Rule-2015, Mineral Auction Rule-2015 and MMDR Amendment Act-2015 in turn to facilitate the State Government (Karnataka) for auctioning of the block under Mining Lease.

### **3.3.0 BASIS FOR TAKING UP INVESTIGATION**

- 3.3.1 The Kiranagi-2 Block lies in the Bhima Basin and it is in the nearby area to the recently explored Diggaon and Udagi Blocks by MECL. Based on the recent exploration in the nearby area (Diggaon and Udagi Blocks), it has been observed that there is one zone in Shahabad limestone, namely Portland grade Zone-I. Portland Grade Zones; Zone I having a maximum thickness of 6.00m (MKG-05), with average grade is 47.26% CaO, average 0.45% MgO and average 13.87% SiO<sub>2</sub> in Kiranagi-2 Block. The explored Kiranagi-2 Block falls to the west of the Diggaon and Udgi limestone blocks explored by MECL.
- 3.3.2 Kiranagi-1 & 2 Blocks are the prospective limestone blocks identified by Directorate of Geology, Government of Karnataka for which MECL has prepared the exploration proposal involving 450m drilling in 10 boreholes at G-3 stage of exploration in Kiranagi, Village, Taluka: Kalaburagi, District Kalaburagi and put up for approval of Technical cum cost Committee (TCC) of NMET. During the 28<sup>th</sup> meeting of TCC, NMET held on

16<sup>th</sup> March, 2023, the said proposal was technically evaluated and approved vide F.No.23/325/2023-NMET/409 dated 27<sup>th</sup> March 2023.

- 3.3.3 On the recommendation of 28<sup>th</sup> TCC of NMET held on 16<sup>th</sup> March, 2023 approved the mineral exploration project to be executed by MECL for Kiranagi-1 & 2 Limestone Blocks in Kiranagi Village, Taluka: Kalaburagi, District: Kalaburagi with an estimated cost of Rs.1,27,57,798/- in the time schedule of 10 months together for both Kiranagi-1 & 2 blocks. The approval was together for 10 boreholes for the cumulative meterage of 450m. However the exploration was executed separately and geological reports are prepared for Kiranagi-1 and Kiranagi-2 separately. The Kiranagi-2 Block was explored by 5 boreholes with the cumulative meterage of 225m.
- 3.3.4 The general trend of all formations is North - South. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses.
- 3.3.5 Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. As no outcrops of limestone are exposed in study area, reference of adjacent Kiranagi-1 block is considered and section lines drawn along northerly dipping body in the area.
- 3.3.6 Almost entire area of the block is concealed under quaternary sediments i.e. soil cover. Scanty scattered limestone outcrops are seen at places. The beds are horizontally disposed as noticed in nearby areas. Since most of the area is concealed under soil cover the strike and dip of the limestone beds is not observed in the blocks. Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing of cement.
- 3.3.7 The overburden top soil is black, fine to silty, friable when dry and sticky when wet. The overburden soil covers almost the entire Block area. The thickness of the soil varies from 1.00m (MKG-04) to about 4.00m (MKG-01) at places. The overburden of soil is immediately followed by Threshold Grade Limestone belongs Shahabad formation in all the 05 drilled boreholes MKG-01 to MKG-05. The limestone is underlying the Threshold Grade Zone-I in the explored Kiranagi-2 Block. The limestone comprises Siliceous/flaggy limestone, massive grey limestone and shaly limestone. The bands of limestone of this block are enriched with lime content which is suitable for manufacture of cement.

### 3.4.0 DETAILS OF THE WORK

3.4.1 After receipt of approval from NMET, MECL has carried out exploration activities in Kiranagi-1 and 2 Block. The details, nature and quantum of work proposed Vs achievement is given below:

**Table No.3.1  
Quantum of Work for Proposed Vs Achieved in Kiranagi-1 and 2 Blocks**

| Sl. No.  | Description and Nature of Work  | Unit   | Approved      | Achieved   | Achieved   | Achieved |
|----------|---|--------|---------------|--|------------|----------|
|          |   |        | Kiranagi 1& 2 | Kiranagi 1                                       | Kiranagi 2 | 1 & 2    |
| <b>A</b> | <b>GEOLOGICAL WORK AND SURVEYING</b>  |        |               |  |            |          |
| 1        | Geological Mapping (1:4000 scale)   | Sq. km | 11.41         | 5.5734   | 5.8022     | 11.3756  |
| 2        | Survey Work   |        |               |  |            |          |
|          | i) Topographical Survey (1:4000 scale)  | Sq. km | 11.41         | 5.5734   | 5.8022     | 11.3756  |
|          | ii) Bore Hole Fixation  | Nos.   | 10            | 5  | 5          | 10       |
|          | iii) RL & Coordinate Determination by DGPS  | Nos.   | 10            | 5  | 5          | 10       |
| <b>B</b> | <b>EXPLORATORY DRILLING</b>   |        |               |  |            |          |
| 1        | Drilling up to 300m (Soft Rock)   | m      | 450           | 225  | 225        | 450      |
| 2        | Drill Core Preservation   | Per m  | 405           | 200  | 205        | 405      |
| <b>C</b> | <b>LABORATORY STUDIES</b>   |        |               |  |            |          |
| 1        | <b>Chemical Analysis</b>  |        |               |  |            |          |
|          | i) Primary Sampling (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF            | Nos.   | 400           | 204*   | 211*       | 415*     |
|          | ii) Check Sampling Internal 5% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.) by XRF | Nos.   | 20            | 10   | 10         | 20       |
|          | iii) Check Sampling External 10% (9 radicals CaO, MgO, Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Fe <sub>2</sub> O <sub>3</sub> , SO <sub>3</sub> , P <sub>2</sub> O <sub>5</sub> , K <sub>2</sub> O and LOI.)      | Nos.   | 40            | 20   | 19         | 39       |
| 2        | <b>Petrological samples (Surface &amp; BH Core Samples)</b>   |        |               |  |            |          |
|          | i) Preparation of thin section  | Nos.   | 10            | 7  | 3          | 10       |
|          | ii) Study of Thin Section   | Nos.   | 10            | 7  | 3          | 10       |
|          | iii) Photomicrograph  | Nos.   | 10            | 4  | 2          | 6        |
| 3        | <b>Bulk Density Determination</b>   |        |               |  |            |          |
|          | ii) Bulk Density  | Nos.   | 2             | 2 Nos. Combined for both Kiranagi 1 and 2 Blocks |            | 2        |
| <b>D</b> | <b>Report Preparation (5 Hard copies with a soft copy)</b>  | Nos.   | 2             | 1  | 1          | 2        |

| Sl. No. | Description and Nature of Work                                       | Unit | Approved       | Achieved   | Achieved   | Achieved |
|---------|--|------|----------------|------------|------------|----------|
|         |  |      | Kiranagi 1 & 2 | Kiranagi 1 | Kiranagi 2 | 1 & 2    |
| E       | Preparation of Exploration Proposal (5 Hard copies with a soft copy) | Nos. | 1              | 1          | 1          | 1        |

*\*The additional sampling and analysis cost was approved by the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023.*

The proposal was made as one together for Kiranagi-1 and 2 Blocks. The approved meterage is 450 inclusive of one stratigraphic borehole out of the 10 nos. of the total approved boreholes in Kiranagi-1 and 2 together. The total meterage was drilled is 225m in Kiranagi-1 Block and 225m in Kiranagi-2 Block. All the boreholes are limestone bearing. The limestone zone intersected after 2 to 4m of top soil cover. Hence the quantum of Primary Samples are increased up to 415 nos. which resulting the generation additional 15 nos. samples as against approved 400 nos. of samples. In Kiranagi-1 block, the total quantum of primary samples is 204, where as in Kiranagi Block 2 is 211 nos. It was proposed to approve the sampling and analysis cost in the Malkhed-1 & 2 and Kiranagi-1 & 2 Blocks in the 57<sup>th</sup> TCC meeting held on 26<sup>th</sup> & 27<sup>th</sup> September 2023 held at New Delhi. The Committee approved the additional samples and additional cost of Rs. 1.49 lakh (vide minutes agenda 57.2.13). Subsequently the EC Committee (EC) NMET in its 32<sup>nd</sup> EC meeting held on 06<sup>th</sup> December 2023 accorded approval cost of 1,48,949/- (One lakh forty-eight thousand and nine hundred forty-nine only). Vide F. No. 23/325/2023-NMET/393 Dated 18<sup>th</sup> December 2023. The total cost and the copy of approval is enclosed as Annexure No IXB.

### 3.5.0 ACKNOWLEDGEMENT

- 3.5.1 Mineral Exploration and Consultancy Limited (MECL) expresses its sincere gratitude to the Ministry of Mines, National Mineral Exploration Trust (NMET), Government of India, Geological Survey of India (GSI) and Directorate of Geology and Mining, Karnataka on whose behalf, the exploration work in Kiranagi-2 block has been executed.
- 3.5.2 The local administration/authorities of Kalaburagi District, Karnataka and Asst. Director, Mines and Geology, Kalaburagi District Government of Karnataka also deserve a special mention of thanks for extending all necessary help and guidance in completion of the exploration work successfully.

## CHAPTER -IV

### 4.0.0 DETAILS OF THE QUALIFIED PERSON(S) / EXPLORATION AGENCY

#### 4.1.0 INVESTIGATING AGENCY

MINERAL EXPLORATION& CONSULTANCY LIMITED

(A Govt. of India Enterprise Miniratna PSE)

Dr. Babasaheb Ambedkar Bhavan, High Land Drive Road,  
Seminary Hills, Nagpur-440006

#### 4.2.0 PERSONAL INVOLVED WITH PRELIMINARY EXPLORATION (G-3) IN KIRANAGI – 2 BLOCK, DISTRICT-KALABURAGI, KARNATAKA.

- A : OVERALL GUIDANCE  
: Shri P. Ravindran GM (Exploration)
- B : OVERALL PLANNING and CO-ORDINATION  
: Shri P. Ravindran GM (Exploration)  
: Shri. Pradeep P. Kulkarni, DGM (Exploration)
- C : OVERALL SUPERVISION  
: Shri. Pradeep P. Kulkarni, DGM (Exploration)  
: Dr. Kuppusamy E, Sr. Manager (Geology)
- D PROJECT MANAGEMENT  
: Shri. Anil Tiwari, Project Manager  
: Shri. J. MadhuBabu, AM (Geology)  
: Shri. Ashok Kumar Shankar ADO (Drilling Engineer)  
: Shri, Kamlesh Kumar ADO (Drilling Engineer)
- E : PHYSICAL EXECUTION OF WORK  
: Shri. J. Madhu Babu, AM (Geology)  
: Shri. Ashok Kumar Shankar ADO (Drilling Engineer)  
: Shri. Kamalesh Kumar, ADO  
: Shri. Ripun Paul, TA (S&D)  
: Shri. Nagaraju, Sampling (Tech.)
- F : SAMPLE PROCESSING, MECL, NAGPUR  
: Shri. Sathish Kumar Inaparathi Sr. Tech. Sampling

- : Mrs. Shika Sharam Sr. Tech. Sampling
- G : CHEMICAL LABORATORY, MECL, NAGPUR
- : Shri. Rohit Sharma, Manager (Chemical)
- : Dr. Dipti Rahangdale, Manager (Chemical)
- H : PETROLOGICAL LABORATORY, MECL, NAGPUR
- : Shri. Sayantan Pal, Assistant Manager (Geology)
- I : INFORMATION TECHNOLOGY CENTRE
- : Shri. Uday Patil Sr. Operator (Computer)
- : Shri. N.C.S. Reddy, Console Operator
  
- J : DATA PROCESSING and DOCUMENTATION
- : Shri. Pradeep P. Kulkarni, DGM (Exploration)
- : Dr. Kuppusamy E, Sr. Manager (Geology)
- : Shri. J. Madhu Babu, A.M (Geology)
- : Shri. Jagdish Thakara, Sr. MSO
- : Shri. Durgesh Devarshi STA (Map)

## CHAPTER – V

### 5.0.0 TITLE AND OWNERSHIP

#### 5.1.0 TITLE AND OWNERSHIP

|  |   |
|--|---|
| Title of the report  | Geological Report of Kiranagi-2 Block (G-3), Kalaburagi District, Karnataka.  |
| Ownership  | Department of Geology and Mining, Govt of Karnataka.  |
| Name of Prospector   | Mineral Exploration and Consultancy Limited   |
| Address of Prospector  | Mineral Exploration and Consultancy Ltd.<br>Dr. Babasaheb Ambedkar Bhavan, High Land Drive Road,<br>Seminary Hills, Nagpur, Pin- 440006   |
| E-mail of Prospector   | <b>cmd@mecl.gov.in ; gm-exploration@mecl.gov.in</b>   |
| Telephone numbers of Prospector:   | <b>0712-2510289; 0712-2511829</b>   |
| Details of period of prospecting / mineral right if any  | <b>Execution of field work (G-3 Stage of exploration)</b><br>Geological mapping & Drilling work: May 2023 to June 2023  |
| Details of exploration agency, qualification, experience of associated technical persons engaged in exploration. | Exploration agency: Mineral Exploration and Consultancy Ltd<br>(A Government of India Enterprise-A Miniratna PSE)<br>Experience: Since 1972 (50+ years)<br>Qualification of Technical Personnel: M. Tech (Geology/<br>M.Sc (Applied Geology)/M.Sc (Geology) |

**CHAPTER – VI**  
**PROPERTY DESCRIPTION**

**6.0.0 PROPERTY DESCRIPTION**

**6.1.0 LOCATION OF THE BLOCK**

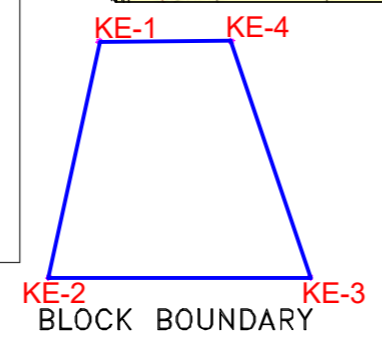
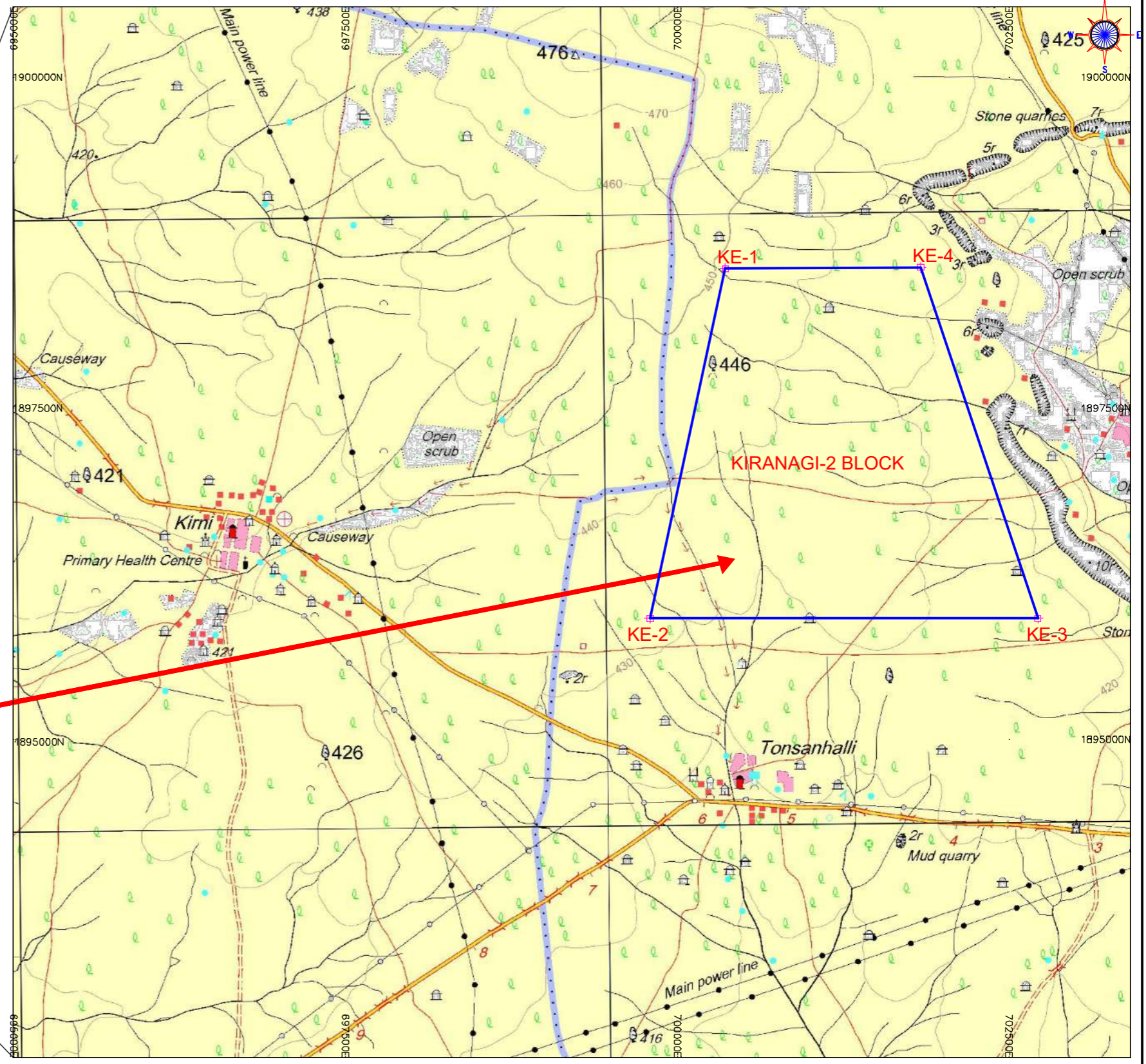
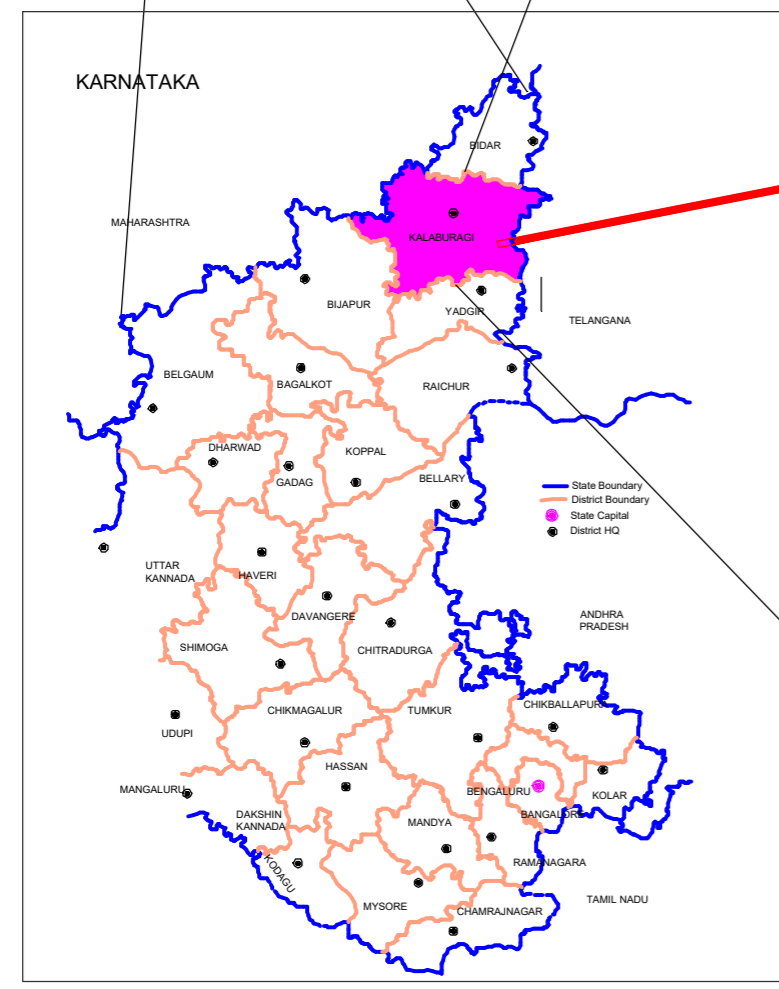
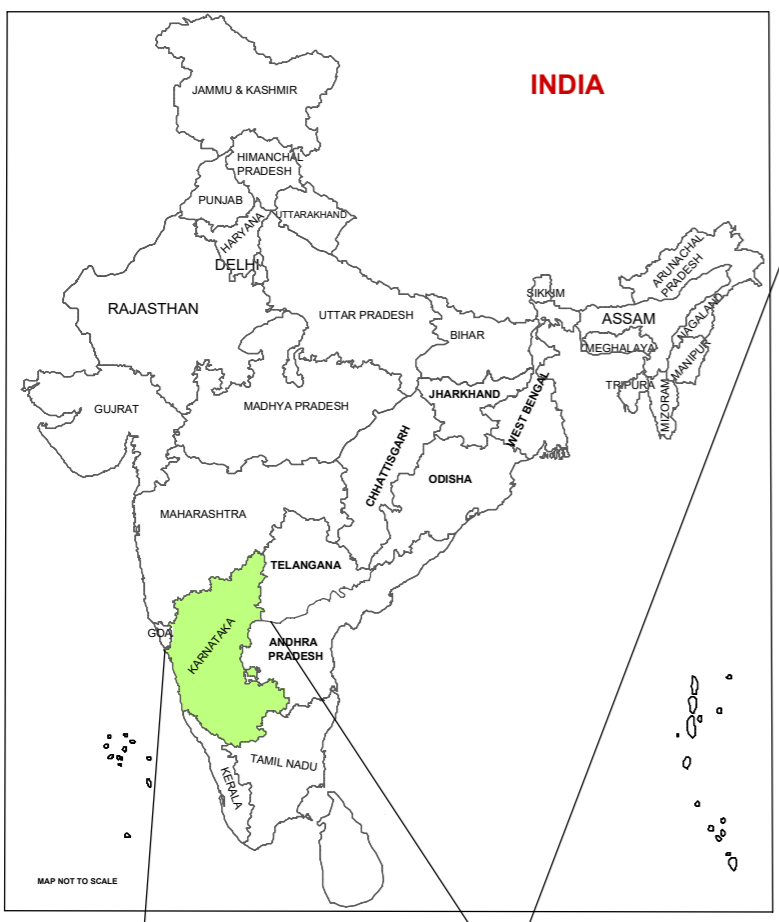
- 6.1.1 The explored Kiranagi-2 block is located in Sedam Taluk, Kalaburagi District. The block can be approached from the nearest Kalaburagi Taluk headquarters towards west at a distance of around 24kms, by single lane asphalted village roads. The explored block fall in the jurisdiction of Kiranagi Village, Kalaburagi Taluk and District. The district head quarter Kalaburagi is at a distance 24kms towards north from the block.
- 6.1.2 A village road from Kiranagi Village to Tonsahalli is passing outside the lease in the south eastern side at about 300m distance from the Kiranagi-2 block.
- 6.1.3 Kiranagi-2 block covers an area of 5.8022 Sq.km as provided by DGM, Karnataka to NMET and MECL, the deposit falls within the Survey of India Toposheet No.56 G/4. The block limits with co-ordinates of cardinal points as given below. (As provided by DGM, Karnataka).

**Table-6.1**  
**CO-ORDINATES OF CARDINAL POINTS OF THE BLOCK BOUNDARY**  
**(UTM CONVERTED)**

| Boundary Points | WGS 1984 DMS    |                  | UTM(m)      |            |
|-----------------|-----------------|------------------|-------------|------------|
|                 | Latitude        | Longitude        | Y (N)       | X (E)      |
| KE1             | 17° 9' 46.653"N | 76° 53' 1.247"E  | 1898554.680 | 700360.893 |
| KE2             | 17° 8' 20.961"N | 76° 52' 41.266"E | 1895914.501 | 699795.811 |
| KE3             | 17° 8' 20.026"N | 76° 54' 19.978"E | 1895914.166 | 702713.924 |
| KE4             | 17° 9' 46.437"N | 76° 53' 50.986"E | 1898562.361 | 701831.002 |

- 6.2.0 Cadastral details of the area with land use, area under forest with type of forest. In case the cadastral details are not available an indicative data of breakup of government, private and forest land.
- 6.3.0 Mineral(s) under investigation or granted under license or lease.  
Limestone

LOCATION MAP OF KIRANAGI-2 BLOCK, KALABURAGI DISTRICT, KARNATAKA



| Point No. | UTM          |             | RL (m)  |
|-----------|--------------|-------------|---------|
|           | Northing (m) | Easting (m) |         |
| KE1       | 1898554.680  | 700360.893  | 450.803 |
| KE2       | 1895914.501  | 699795.811  | 434.850 |
| KE-3      | 1895914.166  | 702713.924  | 427.062 |
| KE-4      | 1898562.361  | 701831.002  | 435.253 |

TEXT FIGURE-1

MAP NOT TO SCALE

## CHAPTER – VII

### PHYSIOGRAPHY AND ENVIRONMENT

#### 7.0.0 PHYSIOGRAPHY AND ENVIRONMENT

#### 7.1.0 PHYSIOGRAPHY

7.1.1 The area is generally flat and maximum area is covered by cultivated fields. The block area depicts plain with gentle slope towards North. The elevation of the area ranges from 450m to 428m above mean sea level. The general slope in the blocks is from Northeast to Southwest.



**Photo-1: A Panoramic view of Kiranagi-2 Block**

#### 7.2.0 DRAINAGE

The blocks are drained by West flowing Kagina rive and Mullamari river forms the main drainage in the area. There is no perennial river within the block area, however a seasonal nala flows across the central part of the block. The drainage pattern of the area is dendritic in nature.

#### 7.3.0 HOST POPULATION (LOCAL TRIBES), HUMAN SETTLEMENTS WITHIN AND NEARBY THE AREA

7.3.1 The initial provisional data released by Census India 2011, shows the density of Kalaburagi District for 2011 had population of 25,66,326 of which male and female were 13,01,755 and 12,64,571 respectively.

7.3.2 Kiranagi -2 block falls in Kiranagi village, Kalaburagi Taluka of Kalaburagi District.

#### **7.4.0 SOCIO DEMOGRAPHIC PROFILE OF THE AREA AND NEARBY**

7.4.1 Kiranagi village has a population of 5465 out of which 2743 are male and 2722 females. Literacy rate combined is 49.80% (Male 79.60% & Female 20.40), out of total population 668 (12.2%) belong to SC community and (7) 0.1% belong to ST community.

7.4.2 Professionally there are workers, agricultural farmers and labourers in Kiranagi Village. Out of total population 5465, Female population 2722 and Male population is 2743. Out of these 44.80% are working population. engaged in work activities.

#### **7.5.0 HISTORICAL SITES AND ARCHAEOLOGICAL MONUMENTS, PLACES OF WORSHIP, PUBLIC UTILITIES ETC. WITHIN OR NEARBY**

7.5.1 Shree Basvaligeshwar, Magamma Devi, Sharvanabasaveshwara and Sanesavara Temples are within 2km radius from the block. In addition to this Jamiy masjid and Eid Gah Masjith are also approachable with-in 10 km radius from the block.

#### **7.6.0 CLIMATE AND RAINFALL**

7.6.1 The climate of the area is tropical monsoon type. The temperature during winter month seldom goes to 10<sup>0</sup> C, while in the peak summer it rises up to 45<sup>0</sup> C. The average rain fall is 770-880mm and the relative humidity varies from 26% in summer to 62% in winter.

#### **7.7.0 FLORA AND FAUNA**

7.7.1 The area is characterised by scanty vegetation and dry crop cultivation. Chilli, maize, groundnut, gingili and pulses are the common dry crops cultivated by rotation. Study area is fertile. Mostly cashew, black gram is cultivated in the study area.

7.7.2 The area has no rare endangered species of flora. The species of fauna found in the area are rat, squirrel, lizard and house crow and reptiles.

7.7.3 Total block area is under cultivation i.e., agricultural activities.

## CHAPTER – VIII

### INFRASTRUCTURE

#### 8.0.0 INFRASTRUCTURE

#### 8.1.0 LOCAL INFRASTRUCTURE DETAILS

8.1.1 The block can be approached from the nearest Kalaburagi Taluk headquarters towards south at a distance of around 24kms. by single lane asphalted village roads. The explored block fall in the jurisdiction of Kiranagi Village, Kalaburagi Taluk and District. The district head quarter Kalaburagi is at a distance 24kms towards north from the block. The nearest airport (Kalaburagi Airport) is at about 30 km from the block.

8.1.2 Banking, Government medical facility, Postal, Police facilities are available at Kiranagi village, and as well as in Kalaburagi Taluka which is 24km from the explored block and educational and other major facilities are available at Kalaburagi Taluk.

8.1.3 Shahabad is the nearest railway station at a distance of around 11 kms from the explored block. Nearest airport is at Kalaburagi at a distance of 24km. The nearest port is Marmagoa, Goa situated at around 480km from the explored block.

8.1.4 The block area is surrounded by cement manufacturing industries and some them are as follows:

- Orient Cement Plant, Itgi, Chittapur
- Ultratech Cement Plant, Malkhed
- Vasavadatta Cement plant, Sedam
- Jaypee Cement Corporation Ltd. Plant, Shahabad
- ACC, Cement, Wadi
- Shree Cement, Kalaburagi

## CHAPTER – IX

### GEOLOGY OF THE AREA

#### 9.0.0 GEOLOGY OF THE AREA

#### 9.0.0 REGIONAL GEOLOGICAL SETUP OF THE AREA

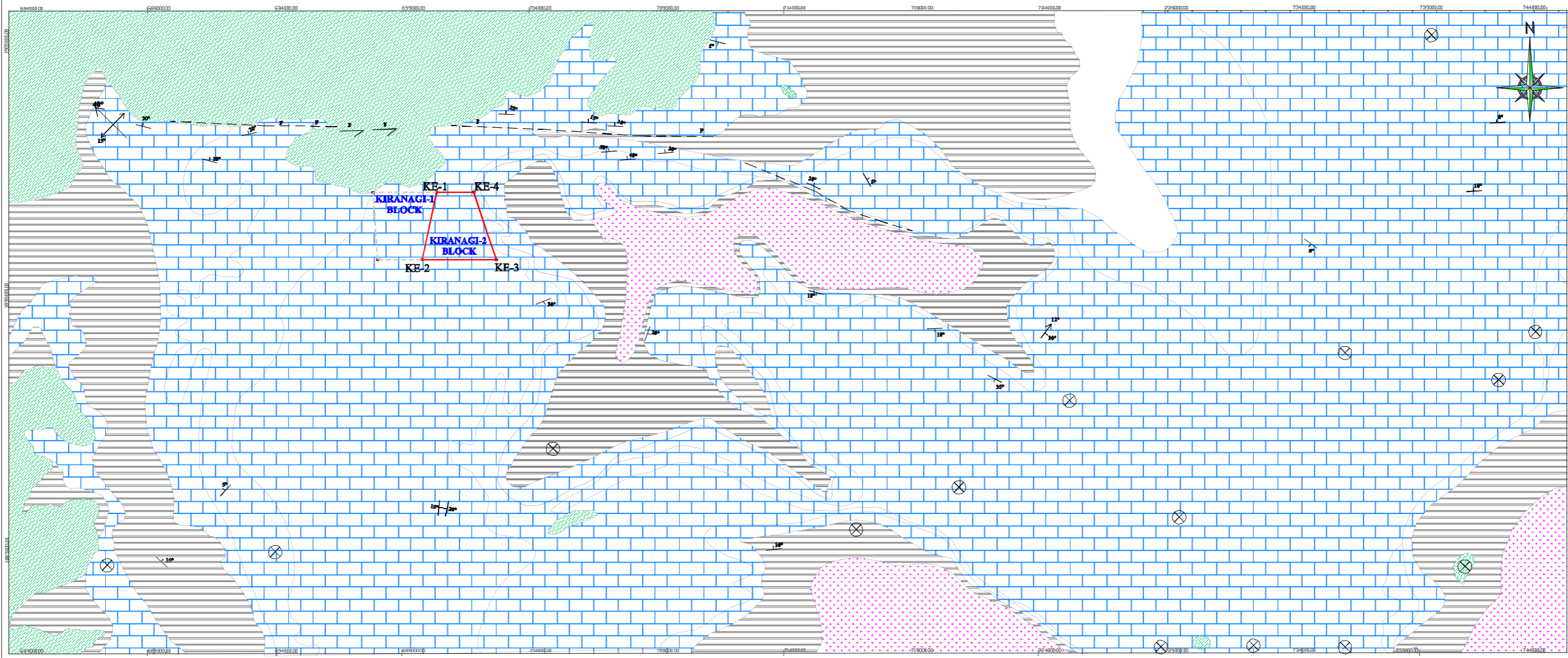
##### 9.1.0 General

9.1.1 Bhima basin is the smallest of all Proterozoic basins of India. They do not actually come in contact with the Kaladgi Group and are believed to be younger. They are in close resemblance to the Kurnool Group of the Cuddapah Super group. The Bhima Basin is covered by latitude N 16°20' to 17°35' and longitude N 76°15' to 77°40'E. The Bhima Basin is trending N-S for about 160 km with varying width and the maximum being 40 km. The Northern and North-Western extensions are concealed under Deccan Traps. The Southern and Eastern margins of the basin mark the unconformity contact with granitic gneisses of Dharwar Craton. It extends over an area of 5200 sq.km. and is situated to the North-West of Cuddapah Basin and North-East of Kaladgi Basin.











9.1.2 Captain New Bold (1842 – 1845) was first to record the Talikote flaggy limestone and Muddebihal red sandstone. R. Bruce Foote (1876) had divided the Bhima Group (mainly of limestone) into lower clastic represented by sandstone and shale and upper mainly of limestone and shales. Further, Mahadevan (1947), Janardhana Rao et.al (1975), Mathur (1977), Mudholkar and Kale (1982) and Mishra et.al (1987) classify Bhima Group. However, Vivek S. Kale, V.G. Phansalkar et.al (1991) classified Bhima Group into Rabanapalli (clastic) formation and Shahabad (limestone) formations.

9.1.3 The Stratigraphic Column of the Bhima Group (after GSI) is furnished in below:

## REGIONAL GEOLOGICAL MAP OF KIRANAGI-2 BLOCK (PART OF BHIMA BASIN), KALABURAGI DISTRICT, KARNATAKA



Source: The Geological Map of Bhima Basin (Parts of Gulbarga and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G, and H) Scale 1:200000, 2007, Published, GSI

| INDEX   |                  |   |                    |
|---|------------------|---|--------------------|
|  | LIMESTONE        |  | GRANITE            |
|  | DECCAN TRAP      |  | HORIZONTAL BEDDING |
|  | SHALE            |  | PLUNGING ANTIFORM  |
|  | FAULT            |  | STRIKE SLIP FAULT  |
|  | KIRANAGI-2 BLOCK |  | BEDDING            |

NOT TO SCALE  
TEXT FIGURE NO-2

**Table-9.1**  
**The Stratigraphic Column of the Bhima Group (after GSI), 1975**

| Group   | Sub-Group  | Formation        | Member  | Thickness(m)                                  |       |
|---|--|------------------|---|---|-------|
| <b>Deccan Trap</b>  | -  |                  | Basic flows   |   |       |
| <b>Bhima Group</b><br>(upper Proterozoic)<br>(93-273 m.y) |  | Harwal-Gogi      |   | 5-10  |       |
|   | Andola Subgroup in Pulsating basin environment (31-68 m.y) | Katamdevar-halli | Fossil shale member ortho-quartzite chert + pebble conglomerate | 10-40<br>16-18                                |       |
|   |  | Halkal           |   |   |       |
|   | ----- Paraconformity -----                                 |                  |   |   |       |
|   |  |                  |   | Flaggy dark grey and argillaceous limestone   | 4-6   |
|   |  |                  |   | Massive dark grey and bluish grey limestone   | 8-20  |
|   | Sedam Subgroup with quiescent basin regime (62-2.5 m.y)    | Shahabad         |   | Variegated and siliceous/cherty limestone     | 20-80 |
|   |  |                  |   | Blackish, light grey to bluish grey limestone | 10-15 |
|   |  |                  |   | Slabby and flaggy limestone                   | 4-8   |
|   |  |                  |   | Purple shale                                  | 2-40  |
|   |  |                  |   | Green/yellow shale                            | 5-15  |
|   |  |                  |   | Siltstone                                     | 3-4   |
|   |  |                  |   | Quartzite/Intercalated sandstone              | 5-15  |
|   |  |                  | Rabanapalli   | Conglomerate / grit                           | 1-2   |
|   | ----- Un Conformity -----                                  |                  |   |   |       |
| Basement Crystallines                                     |  |                  | Younger granite peninsular gneisses                             | -   |       |

9.1.4 Recent classification (1991) of revised litho stratigraphy of the Bhima group is furnished below:

**Table – 9.2**  
**Revised litho stratigraphy of the Bhima Group**  
**(after Vivek S. Kale, V.G. Phansalkar et.al 1991)**

| <b>Formation</b>                                 | <b>Maximum Thickness(m)</b> | <b>Member</b>                     | <b>Main Lithological components</b>  |
|--|-----------------------------|-----------------------------------|--|
| 2. Shahabad Limestone                            | < 75                        |                                   | <ul style="list-style-type: none"> <li>• Grey, argillaceous micritic limestones.</li> <li>• Dark, bluish grey, massive limestones.</li> <li>• Variegated, siliceous and cherty limestones.</li> <li>• Blue- grey, black- micritic limestones.</li> <li>• Flaggy (Partly impure argillaceous and cherty) limestones.</li> </ul> |
| ----- Gradational and transitional contact ----- |                             |                                   |  |
| 3. Rabanpalli Clastics                           | < 70<br><br><br><br>        | Ekmai shale member                | Ferruginous shales, with calcareous shales at top.   |
|  |                             | Kasturpalli-Glauconitic member    | Green, glauconite, fine grained sandstones and siltstones.   |
|  |                             | Kundrapalli quartz arenite member | Quartzitic sandstones (medium to fine grained).  |
|  |                             | Adki Hill conglomerate member     | Polymictic conglomerates and arkosic, gritty sandstones.   |

- 9.1.5 The total absence of fossils rules out the sediments of Bhima Group transgresses into the Cambrian. Thus envisaged the upper age limit is not less than 600 million years.
- 9.1.6 Regional Geological map of Bhima Basin (Part) is enclosed as Plate No. II in 1: 50,000 Scale.

## **9.2.0 GEOLOGY OF BLOCK AREA**

- 9.2.1 The rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima group. The stratigraphic sequence of the litho units exposed in and around the block based on field observations and available data/literature from nearby mine/areas is given in Table-9.3. The Topographical & Geological Map of the Kiranagi-2 Block is enclosed as Plate No III in 1: 4000 Scale.

**Table-9.3**

**Stratigraphic Sequence of Litho-units exposed in and around the Block**

| Age  | Group | Sub Group | Formation           | Litho Units  |
|--|-------|-----------|---------------------|--|
| Quaternary                                       | -     | -         | Recent              | Top soil   |
| Upper Proterozoic                                | Bhima | Sedam     | Shahabad Limestone  | Siliceous/flaggy limestone<br>Massive grey limestone<br>Shaly limestone                          |
| ----- Gradational and transitional contact ----- |       |           |                     |  |
| -  | -     | -         | Rabanpalli Clastics | Ferruginous Shales, calcareous shales, Green, Glauconite, fine grained Sandstones and Siltstones |

**9.3.0 DESCRIPTION OF ROCK TYPES**

9.3.1 Almost entire area of the block is concealed under recent sediments i.e. soil cover with absence of limestone outcrop. Since the entire area is concealed under soil cover the strike and dip of the limestone beds are absent. Mining activities are currently ongoing in the eastern part of the Bhima Basin wherein limestones are being excavated for manufacturing of cement. The lithological description of litho units from top to bottom as obtained from drilled boreholes as well as from nearby mines is given below:

**9.3.2 Top Soil**

The overburden top soil is black in colour, fine to silty, friable when dry and sticky when wet. The overburden soil covers almost the entire Block. The thickness of the soil as intersected in boreholes varies from 1.00m (MKG-04) to about 4.00m (MKG-01) at places.

**9.3.3 Shahbad Limestone**

Limestone is massive, dark grey to light grey, micritic, fine grained and compact. The massive grey limestone is of Cement Grade (Portland) and threshold graded limestone (+ 38% CaO with +18.00 SiO<sub>2</sub>).

**9.4.0 STRUCTURAL FEATURES OBSERVED IN & AROUND THE BLOCK**

**9.4.1 PRIMARY SEDIMENTARY STRUCTURES**

The preservation of primary sedimentary structure in this block is relatively poor. In terms of primary sedimentary structure, bedding planes and laminations are common

within limestone-shale unit. Bedding planes are usually marked by variation in colour, composition and grain size.

#### 9.4.2 **SECONDARY/ DIAGENETIC STRUCTURE**

Stylolites are diagenetic structure usually follow the bedding plane and are filled by ferruginous clayey material. Within the Massive limestone, dolomitic limestone and shaly limestone as thin veins of re-crystallized calcite are present. Solution cavities and vugs filling are found well within the dolomitic limestone and shaly limestone. Sedimentary deformation structures are present at places in shaly limestone.

9.4.3 The general trend of all formations is N45°E. The rectilinear East - West (EW) to North West (NW) - South East (SE) trending boundaries are faulted while the N-S and NNE-SSW linear trends show unconformable relation with the underlying gneisses.

9.4.4 Sediments of Bhima Group are structurally least disturbed and preserve their horizontal bedded character originally impressed at the time of deposition. Deformation is observed only in the vicinity of faults. The faults have continued into the basement that has exercised control upon the basin configuration.

9.4.5 The basin is well known for its huge resources of limestone and the newly discovered Uranium occurrence near Gogi (1998-2000) by AMD. Regional Geological map of Bhima basin is provided as Text Figure No: 2 & Plate No: II.

#### 9.5.0 **STRUCTURE OF THE BLOCK**

The entire block area is covered by soil cover with absence of limestone exposure hence no strike and dip values recorded.

## CHAPTER – X

### PREVIOUS WORK

#### 10.0.0 PREVIOUS WORK

#### 10.1.0 GEOLOGICAL SURVEY OF INDIA AND DMG OF KARNATAKA

- 10.1.1 Previously no work has been carried out in the proposed Kiranagi-1 block. However, the entire Bhima basin was mapped by GSI and exploration at different stages was carried out in a scattered manner. The Geological Map of Bhima Basin (Part) of Kalaburagi and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G, and H) Scale 1:150,000, 2007, Published by GSI is attached as **Plate No. II**.
- 10.1.2 Directorate of Mining & Geology (DMG), Karnataka explored the adjoining area in detail in the year 1976 with the purpose of proving cement grade limestone in the area. The exploration could establish the occurrence of large reserves of cement grade limestone in the area. The results of investigation are given in the report entitled “Limestone Deposits immediately to the East of Chittapur, Kalaburagi District of Karnataka.” The said work was targeted for feasibility to setup cement industry.
- 10.1.3 GSI carried out preliminary investigation for Flux grade Limestone around Wadi, Kalaburagi District Karnataka during the year 1974-75. The area is occupied by Shahabad limestone formation of Bhima Group. Chip samples were collected from vertical faces of the quarries existing in the area. Chemical analysis shows that the MgO content is always very low. A few beds of grey to dark grey soft limestone are of blast furnace grade and the rest are of cement grade. Flaggy to slabby variegated limestones are always siliceous in composition with the insoluble around 15%.
- 10.1.4 During the field season 1976-77, GSI carried out preliminary investigation for Flux grade Limestone near Wadi, Kalaburagi District Karnataka. An area of about 16.75 sq. km. on 1:7,910 scale using the village maps as base map was covered by mapping. A total of 150 samples also collected and analysed. The formations met with here are Rabanapalli shale and flaggy limestone, stylolitic limestone and variegated limestone units of Shahabad Limestone Formation. All those formations are remarkably horizontal and undisturbed. Generally, stylolitic limestone contains CaO 48% and above and insoluble around 10%. Hence it is categorized as Blast Furnace Grade. The other two units can be utilized in cement manufacture if suitably blended with high grade limestone. An inferred reserve of 96 million tonnes of Blast Furnace grade limestone has been estimated over an area of 4.00 sq.km to a depth of 12 m. Drilling can be taken up to explore the depth-wise persistence and lateral extension of the B.F. grade limestone.

- 10.1.5 During the F.S. 1977-78, GSI carried out preliminary investigation for Flux grade Cement grade Limestone in Bhima Basin, Kalaburagi District, Karnataka. Preliminary investigation for flux grade and cement grade limestone in parts of Bhima Basin, Kalaburagi District, Karnataka was taken up an area of 50.5 sq.km area was mapped on 1:10,000 scale using tape and compass and a total of 125 samples were collected, around Wadi and Chittapur. The limestone met with in this area has been classified as fissile limestone, stylolitic limestone and variegated limestone. Stylolitic limestone is of Flux grade (Blast Furnace grade) and occupies over an area of 8.5sq.km. Total inferred reserve of B.F. grade limestone has been calculated as 153 million tonnes for the area under investigation.
- 10.1.6 East of Chittapur and North Diggaon village, MECL has carried out exploration during 2018-19 at G3 level and established 530.80 MT with 45.45% CaO, 1.00% MgO, 11.59% SiO<sub>2</sub> in Diggaon Block and 385.35 MT with 45.66% CaO, 0.55% MgO, 12.98% SiO<sub>2</sub> in Udagi Block of net in-situ resource of Cement grade Limestone.
- 10.1.7 GSI had carried out G-2 exploration in Bommanalli Limestone Block and estimated a resource of B.F Grade 244.27 MMT in Avg 49.83% CaO, 9.92%SiO<sub>2</sub>, 1.16%Al<sub>2</sub>O<sub>3</sub>, Portland Cement Grade 18.921 MMT in Avg 47.42% CaO, 14.41%SiO<sub>2</sub>, 0.91%Al<sub>2</sub>O<sub>3</sub>, 154.246 MMT in Avg 41.80% CaO, 23.37%SiO<sub>2</sub>, 2.12%Al<sub>2</sub>O<sub>3</sub> and 46.488 MMT in Avg 39.12% CaO, 27.17%SiO<sub>2</sub>, 1.65%Al<sub>2</sub>O<sub>3</sub>.
- 10.1.8 GSI had carried out G-2 exploration in Chittapur South Limestone Block and estimated a resource of Portland Cement Grade 89.04 MMT in Avg 46.39% CaO, 15.65%SiO<sub>2</sub>, 0.98%Al<sub>2</sub>O<sub>3</sub>, Beneficiable Cement Grade 228.16 MMT in Avg 39.08% CaO, 27.03%SiO<sub>2</sub>, 1.66%Al<sub>2</sub>O<sub>3</sub>.
- 10.1.9 GSI had carried out G-4 level exploration in Chitapur SW Block and Sulahalli Limestone Block, estimated a resource of 438.00 MMT of Cement Grade Limestone and 466.00 MMT of Cement Grade Limestone respectively.
- 10.1.10 Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing of cement.

## **10.2.0 PREVIOUS WORK DONE BY MECL**

- 10.2.1 MECL has carried out G-3 stage of exploration in Diggaon and Udagi blocks and recently carried G3 level exploration in Malkhed 1 and 2 blocks just in the February-April 2023.
- 10.2.2 East of Chittapur and North Diggaon village, MECL has carried out exploration during 2018-19 at G3 level and established 530.80 MT with average of 45.45% CaO, 1.00% MgO, 11.59% SiO<sub>2</sub> in Diggaon Block and 385.35 MT with average of 45.66% CaO,

0.55% MgO, 12.98% SiO<sub>2</sub> in Udagi Block of net in-situ resource of Cement grade Limestone. Presently these blocks are on auction platform.

- 10.2.3 In the recent exploration carried out by MECL in Malkhed 1 block, MECL estimated a total Geological Net in-situ Resources of Cement (Portland) Grade resource estimate is 686.26 million tonnes with an average of CaO 49.09%, MgO 0.42% and SiO<sub>2</sub> 11.49%. Total Geological Net In-situ Resources of Blendable grade is 25.00 million tonnes CaO 45.87%, MgO 0.48% and SiO<sub>2</sub> 16.84%. However, the Blendable/Threshold grade resource are 346.89 million tonnes with an average of CaO 43.26%, MgO 0.52% and SiO<sub>2</sub> 20.68% have also been established.
- 10.2.4 In the recent exploration carried out by MECL in Malkhed 2 block, MECL estimated about a total Geological Net in-situ Resources of Cement (Portland) Grade resource estimate is 264.02 million tonnes with an average of CaO 48.31%, MgO 0.38% and SiO<sub>2</sub> 13.17%. However, the Blendable/Threshold grade resource are 606.70 million tonnes with an average of CaO 43.51%, MgO 0.48% and SiO<sub>2</sub> 20.58% have also been established.



## **CHAPTER – XI**

### **AERIAL / GROUND GEO PHYSICAL / GEO CHEMICAL EXPLORATION**

#### **11.0.0 AREAL / GROUND GEO PHYSICAL / GEO CHEMICAL EXPLORATION**

No aerial / Geophysical/Geochemical survey was carried out by MECL in the Kiranagi-1 block.

## CHAPTER – XII

### 12.0.0 ACTIVITIES DURING THE PERIOD (GEOSCIENCE INVESTIGATION)

#### 12.1.0 TOPOGRAPHICAL SURVEY

The block boundary is surveyed with the help of DGPS (TRIMBLE make) and topographical survey by total station in WGS-84 datum by the input data provided by DMG, Karnataka. Triangulation network have been laid in the explored area of 5.8022 sq. km. Surface Contouring is done on 1:4,000 at 2m contour intervals along with survey of surface features. Boreholes are fixed on the ground. RL's and co-ordinates of survey and exploration points are determined. Details of Triangulation station are furnished as **Annexure-IA**. The RL and co-ordinates of survey stations and exploration points (boreholes) have been determined and furnished as **Annexure - IB**. The DGPS Processing Report is enclosed separately as Annexure X A, B, C & D.

#### 12.2.0 GEOLOGICAL MAPPING

Geological mapping on 1:4,000 scale was carried out in 5.8022 sq. km. area by taking traverses with the help of GPS. The entire block area is covered with soil/alluvium, and the same is marked in the Topographical and Geological Map enclosed as **Plate No. III** in 1: 4000 Scale.

#### 12.3.0 BLOCK GEOLOGY

12.3.1 The rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima Group. The stratigraphic sequence of the litho units exposed in and around the block based on field observations and available data/literature from nearby mine/areas is given in Table-12.1.

**Table-12.1**

**Stratigraphic Sequence of Litho-units exposed in the Block**

| Age  | Group | Sub Group | Formation              | Litho Units  |
|--|-------|-----------|------------------------|--|
| Quaternary                                       | -     | -         | Recent                 | Top soil   |
| Upper Proterozoic                                | Bhima | Sedam     | Shahabad Limestone     | Siliceous/flaggy limestone<br>Massive grey limestone<br>Shaly limestone                                      |
| ----- Gradational and transitional contact ----- |       |           |                        |  |
| -  | -     | -         | Rabanpalli<br>Clastics | Ferruginous Shales,<br>calcareous shales,<br>Green, Glauconite, fine<br>grained Sandstones and<br>Siltstones |

#### 12.4.0 DESCRIPTION OF THE FORMATIONS IN THE EXPLORED BLOCK

12.4.1 Almost the entire area of the block is concealed under recent sediments i.e soil cover. The lithological description of litho units from top to bottom as obtained from drilled boreholes from the Kiranagi-1 and 2 blocks. The thickness of soil cover is minimum 1m (MKG-04) and maximum 4m (MKG-01) and limestone horizon immediate below of soil cover.

The stratiform and tabular limestone deposit of Kiranagi-2 block is belongs to Bhima Basin formation of Upper Proterozoic age. The details of stratigraphic litho-units in MECL exploratory boreholes are discussed below:

##### 12.4.2 Top Soil

The overburden top soil is black in colour, fine to silty, friable when dry and sticky when wet. The overburden soil covers almost the entire Block. The thickness of the soil as intersected in boreholes varies from 1.00m (MKG-04) to about 4.00m (MKG-01) at places.



**Photo 2: Soil cover with in the Kiranagi -2 Block**

##### 12.4.3 Shahbad Limestone

Limestone is massive, dark grey to light grey, micritic, fine grained and compact. The massive grey limestone is of Cement Grade (Portland) and threshold graded limestone (+ 38% Cao with +18.00 SiO<sub>2</sub>).

### **12.5.0 STRUCTURE OF THE BLOCK**

- 12.5.1 The entire block area is covered by soil cover with absence of limestone exposure hence no strike and dip values recorded. As no outcrops of limestone are exposed in study area, reference of adjacent Kiranagi - 1 block is considered and section lines drawn along Northerly dipping body in the area.
- 12.5.2 The uniform sub-horizontal disposition of the sedimentary sequence in the area of investigation indicates that the area has not undergone any major tectonic disturbances. The formation is generally concealed by alluvial soil. The explored block seems to be undisturbed as could be visualized from cross sections SE1-SE1', SE2-SE2' and SE3-SE3' (Plate No. IV).

## CHAPTER XIII

### EXPLORATION BY SYSTEMATIC DRILLING

#### 13.0.0 EXPLORATION BY SYSTEMATIC DRILLING

MECL commenced exploration (G-3 stage) in Kiranagi-2 block on 01.05.2023 and completed geological mapping and drilling of 225m in 5 exploratory boreholes on 20.05.2023.

#### 13.1.0 DRILLING TECHNIQUE

13.1.1 The entire core drilling has been carried out by wire line method with NQ borehole size using diamond bits. The polymer was used as drilling fluid to flush out the cuttings and stabilize the wall of exploratory boreholes. The drilling fluid also works as a coolant to avoid burning of drill bits, due care was taken to obtain maximum core recovery of cores. The limestone formation is hard and massive, which resulting the maximum core recovery of 90-95%.

13.1.2 Lithologically the limestone is very hard and massive with occasional thin intercalation of shales encountered in few places, hence resulted 90-95% core recovery. These factors are considered in resource estimation.

#### 13.2.0 DRILL CORE LOGGING

13.2.1 The entire core recovered by drilling was logged systematically in detail describing different lithological units. The details of lithology, its grain size, colour, texture, structural features, density of fossil content, presence of intercalations and cavities have been recorded besides the limestone. Due to poor recovery at places, extrapolations of various drilled depth were done on proportionate basis considering the physical characteristics of individual units recovered. All the cores were kept and preserved properly in the GI core boxes of specifications given by NMET following “Book pattern”. The duplicate half core is preserved in GI core boxes and will be handed over to DGM, Karnataka/GSI Southern Region.

13.2.2 The run-wise litho logs of boreholes MKG-01 to MKG-05 drilled by MECL are given as Annexure-IIA and its graphic litho logs with zone details are given as Plate - IV.

#### 13.3.0 LIMITATIONS

13.3.1 The entire assessment of the deposit is based on surface and subsurface data obtained from drilling and sampling during exploration. The behaviour pattern observed in adjacent mines of the limestone deposit is studied and considered at the time of subsurface configuration of the ore body in the area. Thus, there are limitations as regards to logical interpretation with geological prudence.



- 13.3.2 Total five (05) boreholes were approved by NMET for exploration, to be drilled in the block and all those proposed boreholes were drilled MKG-01 to MKG-05 as per the proposed location with some minor shifting towards the available suitable place for the deployment of drills.
- 13.3.3 The entire interpretations of the exploration data are based on the assumptions of gradual change between the points of observations and rule of influence of nearest points.

## CHAPTER XIV

### SAMPLING AND ANALYSIS

#### **14.0.0 SAMPLING AND ANALYSIS**

**14.1.0** As per the approval of NMET, MECL carried out drilling and drilled core was sampled at 1m primary thickness as it is suitable for evaluation of limestone. A total 211 primary, 10 Internal and 19 External check samples, 03 Petrography, 02 Bulk Density samples were analysed, whose details are discussed below.

#### **14.2.0 PRIMARY AND CHECK SAMPLES ANALYSIS OF DRILLED CORE**

14.2.1 Considering the uniform nature of the limestone over considerable thickness in all the boreholes and after study of lithological data generated during G-3 exploration, optimum sample length of 1m is for evaluation of limestone. It was decided to maintain a minimum of 1m primary sample length with consideration of lithology, fossil content; however, sample of shorter and larger lengths were also prepared wherever felt necessary depending on the variations in the lithology and fossil contents.

14.2.2 The borehole core was split into two equal halves by using core splitter. One half was powdered to (-) 200 mesh size and the other half preserved for future studies. The powdered material was mixed thoroughly and about 100 gram of samples were taken for chemical analysis by successive coning and quartering as primary samples and rest of the material (-200 mesh size) kept as duplicate half for future reference.

All the primary samples (211 Nos.) and 10 Internal check samples (5% of primary samples) have been analyzed for 9 radicals i.e. CaO, MgO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI by MECL laboratory. These 9 radicals are the basic and most essential chemical constituents to specify the grade of limestone in view of its utilization aspects in cement, iron and Steel and chemical industries.

About 10% of primary samples i.e. 18 Nos. were analyzed at Jawaharlal Nehru Aluminium Research Development and Design Centre Laboratories, Nagpur (JNARDDC), NABL certified as external check samples for analysis of 9 radicals i.e., CaO, MgO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI. The results of primary analysis of borehole core samples for both 9 radicals of MECL for G3 level are furnished as **Annexure – IIIA**. Analytical results of primary samples versus check internal samples will be furnished in **Annexure-III B** & External check samples as **Annexure-III C**.

#### **14.3.0 COMPOSITE SAMPLE ANALYSIS**

14.3.1 Composite samples analysis are not approved in the quantum of the Kiranagi-1 and 2 blocks by NMET. Hence, composite samples are not prepared for analysis.

#### 14.4.0 LABORATORY PROCEDURE

14.4.1 The primary and internal check samples from limestone mineralization have been analyzed for 9 radicals i.e., CaO, MgO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI by XRF at Jawaharlal Nehru Aluminium Research Development and Design Centre, (JNARDDC) Nagpur (A NABL accredited Laboratory). External check samples for same 9 radicals have been analysed at Chemical Laboratory of MECL, Nagpur.

#### 14.4.2 STANDARD OPERATING PROCEDURE (SoP) FOR THE ANALYSIS BY JNARDDC, NAGPUR

##### CHEMICAL ANALYSIS

1. Pellet Method (using XRF)
2. XRF (model Axiosm Ax, (Panalytical make)
3. CRM used- NCSDC-16006

Procedure for Preparation of Pellets by Hydraulic Press:

For XRF measurement a sample must be homogenized, pulverized to -200 mesh and pressed into pellet.

- (i) Weigh accurately 5 gms of sample and used 10 gms of boric acid as a binder
- (ii) Press the sample at a pressure of around 20-22 tons on a hydraulic press (Pallet Making Machine) with a diameter of 40 mm
- (iii) Calibrate the XRF equipment using known standards for elements present in limestone (Calcium, Magnesium etc)
- (iv) Ensure the instrument is set up correctly according to standard guidelines
- (v) Place the prepared pellet into the sample holder
- (vi) Ensure the sample cup is positioned correctly in the instrument for carrying out analysis
- (vii) Start the XRF analysis using software and initiate the analysis process automatically
- (viii) Allow the XRF instrument to scan the sample. It will emit X-rays onto the sample, causing the atoms to emit fluorescence
- (ix) Record the results in a report, including elemental concentrations and any relevant information about the analysis conditions
- (x) Intermediate check also performed using bead with inbuilt software

### LOSS ON IGNITION

WCL procedure for determination of LOI:

- i. Weighed quantity of sample (duly dried at 110°C) is placed in platinum crucible and heated to 1000°C for about an hour. Sample is again weighed after it is cooled. Difference in weight expressed in percentage as LOI.

#### 14.4.3 STANDARD OPERATING PROCEDURE (SoP) FOR THE ANALYSIS BY MECL LAB, NAGPUR

##### 14.4.4 SoP OF ANALYSIS BY XRF

###### Sample Particle Size:

The Sample is ground to a particle size <75µm, but <50µm is ideal.

Sample preparation: Pellets preparation

The process of making pressed pellets for XRF analysis includes grinding the sample to fine particle size and pressing the sample at pressure of between 15 to 35 ton.

###### Instrumentation:

1. X-ray irradiates the sample.
2. Sample emits secondary X-ray characteristic of a particular element.
3. Analyzing sample rotates to accurately diffract each wavelength and satisfy Bragg's Law.
4. Detector measures position and intensity of XRF peaks

#### 14.4.5 STANDARD OPERATING PROCEDURE (SoP) FOR THE DETERMINATION OF LOSS ON IGNITION (L.O.I.) AT MECL LAB

###### Procedure

1. Weigh 1 g of dry sample in silica or platinum crucible.
2. Place this crucible in muffle furnace at a temperature below 300°C. Raise the temperature of the furnace to 1000°C. Keep this at this temperature for about 30 minutes.
3. Cool the crucible in desiccators and weigh the crucible.
4. Find the loss in weight.
5. % Loss on Ignition (LOI) =  $\frac{\text{Loss in weight} \times 100}{\text{Weight of the sample}}$

#### 14.5.0 EVALUATION OF LIMESTONE HORIZONS

The investigation carried out by way of exploratory drilling with associated geological and laboratory studies which have generated the exploration data to establish the shape, size and geometry of the limestone horizons. This formed the basis for evaluation of various deposit parameters of the block. Zones were demarcated based on min 1.0m sample length for all grades based on cut off and correlation with adjacent boreholes, Borehole data of the adjacent explored block were also considered. The salient features of the evaluation are discussed below:

##### 14.5.1 CEMENT (PORTLAND) GRADE ZONES (CaO $\geq$ 44% MgO max 3.50% and SiO<sub>2</sub> max16%).

14.5.2 Cement grade limestone Zone-I is the only one zone encountered in the explored Kiranagi-2 block.

##### 14.5.3 CEMENT GRADE (PORTLAND) LIMESTONE ZONE – I

The massive grey limestone is of Cement Grade (Portland) to high grade encountered in the Zone I. Over all in all the five boreholes, the blendable and threshold limestone are + 38% Cao with +18.00 SiO<sub>2</sub> and limestone is dark grey to light grey in colour, micritic, fine grained and compact.

Salient features for Zone-I is follows, the Portland Grade Limestone intersected in one borehole (MKG-05) out of the 5 drilled boreholes. thickness is minimum 6.00m (MKG-05). Average grade of Zone-I in the block is 47.26% of CaO, 0.45% of MgO and 13.87% of SiO<sub>2</sub>. The details of borehole wise zones are presented as **Annexures - IV** and the same is presented as **Table No: 14.1**.

Table No: 14.1

#### CEMENT (PORTLAND) GRADE ZONE I

| Bh.No.               | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|----------------------|-----------|-------|-----------|--------------|-------------|--------------------|
|                      | From      | To    |           |              |             |                    |
| MKG-01               | -         | -     | -         | -            | -           | -                  |
| MKG -02              | -         | -     | -         | -            | -           | -                  |
| MKG -03              | -         | -     | -         | -            | -           | -                  |
| MKG -04              | -         | -     | -         | -            | -           | -                  |
| MKG -05              | 39.00     | 45.00 | 6.00      | 47.26        | 0.45        | 13.87              |
| <b>Average Grade</b> |           |       |           | <b>47.26</b> | <b>0.45</b> | <b>13.87</b>       |

14.5.7 The thickness distribution and its quality of Cement Grade (Portland) Zone-I has given Polygon Map as Text Figure No.5.

#### 14.6.0 BLENDABLE GRADE LIMESTONE HORIZON

14.6.1 As per IBM guidelines. Blendable grade limestone zone was demarcated on CaO% range between  $\geq 38$  to  $\leq 44\%$  and MgO shall not be more than 6%. The blendable grade limestone bands are not intersected in all the 5 boreholes.

#### 14.7.0 THRESHOLD GRADE LIMESTONE HORIZON

14.7.1 As per IBM guidelines. Threshold grade limestone zone was demarcated on CaO% range between  $\geq 34$  to  $\leq 38\%$  and MgO shall not be more than 6%. All the five boreholes have intersected threshold grade limestone bands. The threshold grade limestone bands are intersected in all the 5 boreholes as one zone (Zone I), and the zone-wise salient features are tabulated in the following Table Nos. 14.5 and 14.6. The details of borehole wise zones are presented as **Annexure - IV**.

**Table No: 14.2**  
THRESHOLD GRADE-I LIMESTONE

| Bh. No. | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|---------|-----------|-------|-----------|--------------|-------------|--------------------|
|         | From      | To    |           |              |             |                    |
| MKG-01  | 4.00      | 45.00 | 41.00     | 39.17        | 0.59        | 27.15              |
| MKG -02 | 3.00      | 45.00 | 42.00     | 39.19        | 0.55        | 27.42              |
| MKG -03 | 2.50      | 45.00 | 42.50     | 38.80        | 0.59        | 27.74              |
| MKG -04 | 1.00      | 45.00 | 44.00     | 38.81        | 0.56        | 27.60              |
| MKG-05  | 2.50      | 39.00 | 36.50     | 39.82        | 0.54        | 25.87              |
|         |           |       |           | <b>39.14</b> | <b>0.57</b> | <b>27.20</b>       |

Silica modules for Threshold Grade limestone is 9.67

#### 14.8.0 CHEMICAL CONSTITUENTS

##### 14.8.1 MAJOR CONTITUENTS

As mentioned earlier, Limestone is classified into different grades on the basis of three major constituents viz. CaO, MgO and SiO<sub>2</sub>. The Other major chemical constituents of limestone are Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub> and LOI. The Cement (Portland) grade limestone Zone-I intersected in one borehole only in the Kiranagi -2 block and the average grade is given in the following Table No 14.3.

**Table No: 14.3**

Range of Major constituents in Cement (Portland) grade for Zone-I in Kiranagi -2 Block

| LIMESTONE ZONE  | CaO%  |       | MgO% |      | SiO <sub>2</sub> % |       |
|-----------------|-------|-------|------|------|--------------------|-------|
|                 | Min   | Max   | Min  | Max  | Min                | Max   |
| Portland Zone I | 47.26 | 47.26 | 0.45 | 0.45 | 13.87              | 13.87 |

##### 14.8.2 DELETERIOUS CONSTITUENTS

The most deleterious constituent of cement is MgO. It affects the soundness of setting time of cement. It mostly adds through limestone. The Indian cement manufacturers consider 4% as the safe limit. The average MgO % estimated for Zone I in this block is 0.45.

Another harmful impurity in limestone for cement making is sulphur. The SO<sub>3</sub>% content in limestone should not exceed 1.75%, because it forms sulpho-aluminate which has marked swelling property. The average SO<sub>3</sub> content in Primary samples analyzed for Kiranagi -2 block is 0.04% (MKG-05) which is well-within the limit.

#### 14.8.3 MINOR CONSTITUENTS

Besides above broad chemical specifications, cement (Portland) grade limestone bound to have some limitations in the content of minor elements and constituents. Although these minor constituents do not have direct significance in assessing the suitability of a limestone, however, their presence beyond certain limits is undesirable as these may affect the manufacturing process or the quality of cement adversely.

Phosphorus: Content of P<sub>2</sub>O<sub>5</sub> should not exceed 1% as excess phosphorus which inhibits clinker minerals formation and reduces the strength of cement appreciably. Here P<sub>2</sub>O<sub>5</sub> content is 0.13% (MKG-05) which is within the permissible limit.

#### 14.9.0 DETAILS OF ORE ZONES OF THE BOREHOLES DRILLED AND THEIR CORRELATION

14.9.1 Limestone horizons are computed and categorized on basis of **End Use Grade** specifications prescribed by Indian Bureau of Mines, Government of India.

14.9.2 Borehole wise intersection of cement (Portland) grade (i.e.,  $\geq 44\%$  Cao,  $< 3.5\%$  MgO (max) and  $16\%$  SiO<sub>2</sub> (max), Blendable grade limestone (CaO  $\geq 38\%$  to  $< 44\%$ ,  $< 5\%$  MgO and  $18\%$  SiO<sub>2</sub>) and Threshold grades (CaO  $\geq 34\%$   $< 38\%$ ) are presented in the Table Nos. 14.1 and 14.2.

- (a) Out of 5 boreholes Cement (Portland) Grade Zone I is intersected in (01) borehole (MKG-05) and same is furnished as Table No: 14.1
- (b) Out of 5 boreholes, Threshold Grade limestone (Zone I) is intersected in (05) boreholes (MKG-01,02,03,04 & 05) and salient details are furnished as Table No: 14.2.

#### 14.10.0 PETROGRAPHIC STUDIES

A total of 2 nos. of drill core specimens from limestone horizon were drawn during the phase of exploration and petrographic study was carried out in Petrology Laboratory, MECL Nagpur. The rock specimen is identified as micritic limestone. Major mineral is calcite and minor minerals are clay minerals, opaques, sericite, glauconite as accessory minerals The details of studies are furnished as Annexure-VIII.

#### 14.10.1 PHOTOMICROGRAPHIC STUDIES

A total of 2 nos. of drill core specimens from limestone horizon were drawn during the phase of exploration and petrographic study was carried out in Petrology Laboratory, MECL Nagpur.



**Pmg – 1:** Photomicrograph showing very fine micro-crystalline aggregates of micrite in micritic limestoneas seen under cross nicols.  
**Specimen No. : MKG-01/ P1** **Magnification :100X**



**Pmg – 2:** Photomicrograph showing very thin sub-parallelstylolitic cracks within micritic limestone with fracture across and filled with secondary calcite as seen under cross nicols.  
**Specimen No. : MKG-01/ P3** **Magnification:100X**

## CHAPTER XV

### UTILISATION ASPECTS AND MINEABILITY

#### 15.5.0 UTILISATION ASPECTS AND MINEABILITY

##### 15.1.0 UTILISATION ASPECTS AND MINEABILITY (AS PER NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS).

15.1.1 The specifications of limestone for various industrial used are as follows

#### 1. Cement Industry Specification

|                                |   |                   |
|--------------------------------|---|-------------------|
| CaO                            | : | 44% (min.) to 46% |
| MgO                            | : | 3.50% (max.)      |
| Silica                         | : | 16% (max.)        |
| Al <sub>2</sub> O <sub>3</sub> | : | 2 (max.)          |
| Fe <sub>2</sub> O <sub>3</sub> | : | 2% (max.)         |
| SO <sub>3</sub>                | : | 1.75% (max.)      |

$$\text{Lime Saturation Factor (LSF)} = \frac{\text{CaO}}{2.8 (\text{SiO}_2) + 1.2 (\text{Al}_2\text{O}_3) + 0.65 (\text{Fe}_2\text{O}_3)} = 0.66 \text{ to } 1.02$$

$$\text{Silica Modules} = \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.2 \text{ to } 4.0$$

$$\text{Iron Modules} = \frac{\text{CaO}}{\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.7 \text{ to } 2.4$$

$$\text{Hydraulic Modules} = \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 0.65 \text{ (min.)}$$

#### 2. B. I. S. (Bureau of Indian Standards) Specification

|                               |   |              |
|-------------------------------|---|--------------|
| CaO                           | : | 42% (Min)    |
| MgO                           | : | 2.5% (Max.)  |
| SiO <sub>2</sub>              | : | 15% (Max.)   |
| P <sub>2</sub> O <sub>5</sub> | : | 1.5 % (Max.) |
| FeS <sub>2</sub>              | : | 2% (Max.)    |

#### 3. Iron and Steel Industry

| Elements  | BF Grade     | SMS Grade   | LD Grade   |
|---|--------------|-------------|------------|
| CaO   | 42% (Min.)   | 48% (Min.)  | 52% (Min.) |
| MgO   | 4% (Max.)    | 3% (Max.)   | 2% (Max.)  |
| SiO <sub>2</sub>                                  | 9% (Max.)    | 4% (Max.)   | 1% (Max.)  |
| SiO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> | 11.5% (Max.) | -           | -          |
| Total Insoluble                                   | 12%          | -           | -          |
| Acid Insoluble                                    | -            | 6.5% (Max.) | -          |

#### 4. Chemical Industry Specification

BIS Specifications (1S:3204-1978, Reaffirmed-2003)

**Table No: 15.1**

| Characteristics   | Requirement in percent by mass for |                  |              |       |
|---|------------------------------------|------------------|--------------|-------|
|   | Calcium carbide                    | Bleaching Powder | Caustic soda | Sugar |
| CaO (Min.)  | 54.0                               | 54.0             | 53.0         | 50.0  |
| MgO (Max.)  | 0.8                                | 2.0              | 1.0          | 1.0   |
| SiO <sub>2</sub> (Max.)   | 1.0                                | 0.75             | -            | 2.0   |
| Fe <sub>2</sub> O <sub>3</sub> (Max.)   | 0.25                               | 0.15             | -            | -     |
| Mn <sub>2</sub> O <sub>3</sub> (Min.)   | -                                  | 0.06             | -            | -     |
| CO <sub>2</sub> (Min.)  | 42.00                              | 42.00            | 42.00        | 41.00 |
| Loss on Ignition (LOI)  | 46.00                              | 46.00            | 46.00        | 44.00 |
| S (Max.)  | 0.10                               | -                | -            | -     |
| P (Max.)  | 0.01                               | -                | -            | -     |
| Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.)                    | 0.50                               | -                | -            | 1.5   |
| SiO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.) | -                                  | -                | 3.0          | -     |

#### 5. Fertilizer Industry Specification

CaCO<sub>3</sub>+ MgCO<sub>3</sub> : 85% (Min)  
 SiO<sub>2</sub> : 5% (Max.)

#### 6. Glass Industry Specification

CaCO<sub>3</sub> : 94.5 %  
 CaCO<sub>3</sub>+ MgCO<sub>3</sub> : 97.5 %  
 Fe<sub>2</sub>O<sub>3</sub> : 0.20 % (Max.)

BIS Specifications (1S:997-1973, Reaffirmed-1998)

CaO : 53.0 %  
 SiO<sub>2</sub> : 2.5 %  
 Fe<sub>2</sub>O<sub>3</sub> : 0.10 %  
 CaO + MgO : 54.50 %

#### 7. Foundry Industry Specification

BIS Specifications (1S:4149-1978, Re-affirmed-2008)

**Table No: 15.2**

| Characteristics   | Grade-1 | Grade-2 | Grade-3 |
|---|---------|---------|---------|
| CaO (Min.)  | 52 %    | 50 %    | 45 %    |
| SiO <sub>2</sub> (Max)  | 1.5 %   | 3 %     | 5 %     |
| R <sub>2</sub> O <sub>3</sub> (Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> ) Max. | 1 %     | 1 %     | 2 %     |
| MgO   | 2 %     | 3 %     | 5 %     |
| Insoluble matter  | 0.5     | 1       | 2       |
| Sulphur and Phosphorus  | Traces  | Traces  | Traces  |

## 8. Cement, Iron and Steel and Chemical Industry Specification

Table No: 15.3

| Constituents  | Cement Industry (Specification) | Iron and Steel Industry (Specification) |               |               | Chemical Industry<br>BIS Specifications (IS:3204-1978,<br>Reaffirmed-2003) |                  |              |       |
|---|---------------------------------|---|---------------|---------------|--|------------------|--------------|-------|
|   |                                 | BF Grade                                | SMS- OH Grade | SMS- LD Grade | Requirement in percent by mass for   |                  |              |       |
|   |                                 |   |               |               | Calcium carbide  | Bleaching Powder | Caustic soda | Sugar |
| CaO (Min.)  | 44% (Min.) to 48% (Max)         | 42% (Min.)                              | 48% (Min.)    | 52% (Min.)    | 54.0   | 54.0             | 53.0         | 50.0  |
| MgO (Max.)  | 3.50% (Max.)                    | 4%                                      | 3%            | 2%            | 0.8  | 2.0              | 1.0          | 1.0   |
| SiO <sub>2</sub> (Max.)   | 16 % ( Max.)                    | 9%                                      | 4% (Max.      | 1%            | 1.0  | 0.75             | -            | 2.0   |
| Fe <sub>2</sub> O <sub>3</sub> (Max.)   | 2% (Max.)                       |   |               |               | 0.25   | 0.15             | -            | -     |
| Mn <sub>2</sub> O <sub>3</sub> (Min.)   | --                              | --                                      | --            | --            | -  | 0.06             | -            | -     |
| CO <sub>2</sub> (Min.)  | --                              | --                                      | --            | --            | 42.00  | 42.00            | 42.00        | 41.00 |
| Loss on   | --                              | --                                      | --            | --            | 46.00  | 46.00            | 46.00        | 44.00 |
|   |                                 |   |               |               |  |                  |              |       |
| S (Max.)  | --                              | --                                      | --            | --            | 0.10   | -                | -            | -     |
| P (Max.)  | --                              |   |               |               | 0.01   | -                | -            | -     |
| Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.)                    | 2%                              |   |               |               | 0.50   | -                | -            | 1.5   |
| SiO <sub>2</sub> + Al <sub>2</sub> O <sub>3</sub> + Fe <sub>2</sub> O <sub>3</sub> (Max.) | --                              | 11.5% (Max.)                            |               |               | -  | -                | 3.0          | -     |
| <u>Acid Insoluble</u>   |                                 |   | 6.5% (Max.)   |               |  |                  |              |       |

## CHAPTER XVI

### RELIABILITY OF CHEMICAL ANALYSIS

#### 16.1.0 RELIABILITY OF CHEMICAL ANALYSIS

#### 16.1.0 ANALYTICAL RESULTS OF BORHOLE SAMPLES

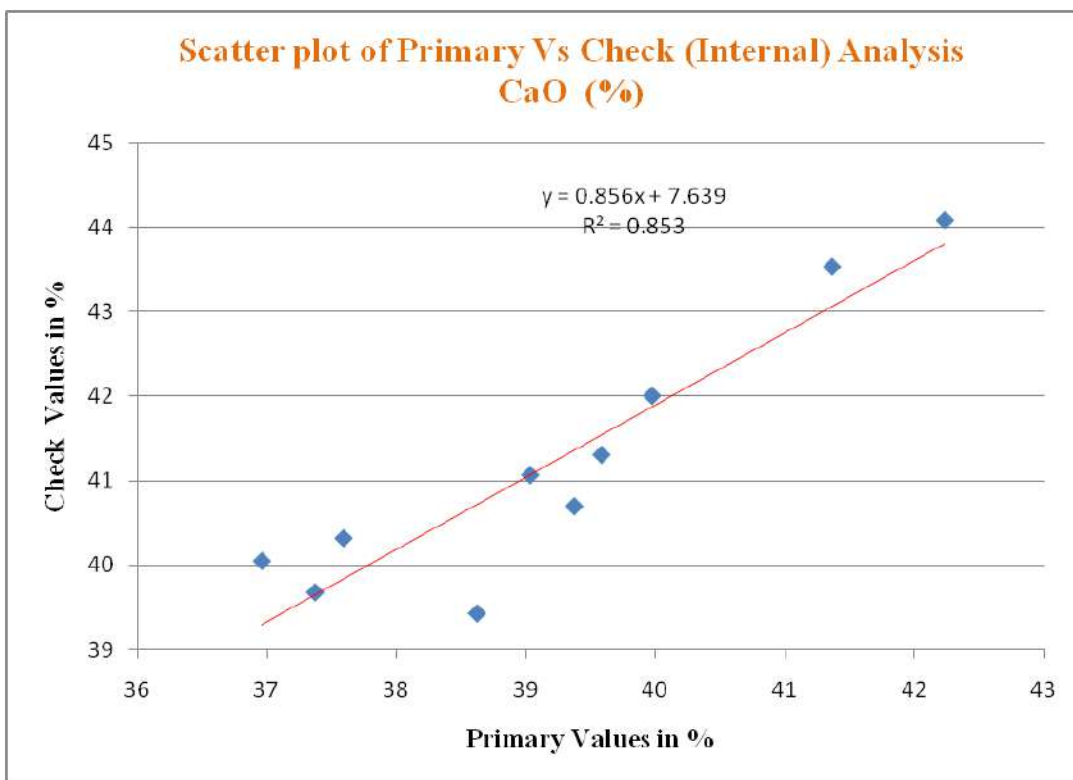
##### 16.1.1 INTRODUCTION

Reliability in statistics is the overall consistency of a measure. A measure is said to have a high reliability, if it produces similar results under consistent conditions. It is the characteristic of a set of test scores that relates to the amount of random error from the measurement process that might be embedded in the analytical results. Analytical results that are highly reliable are accurate, reproducible and consistent from one testing parameters to another. That is, if the testing process were repeated with a group of test takers, essentially the same results would be obtained.

#### 16.2.0 RELIABILITY OF CHEMICAL ANALYSIS

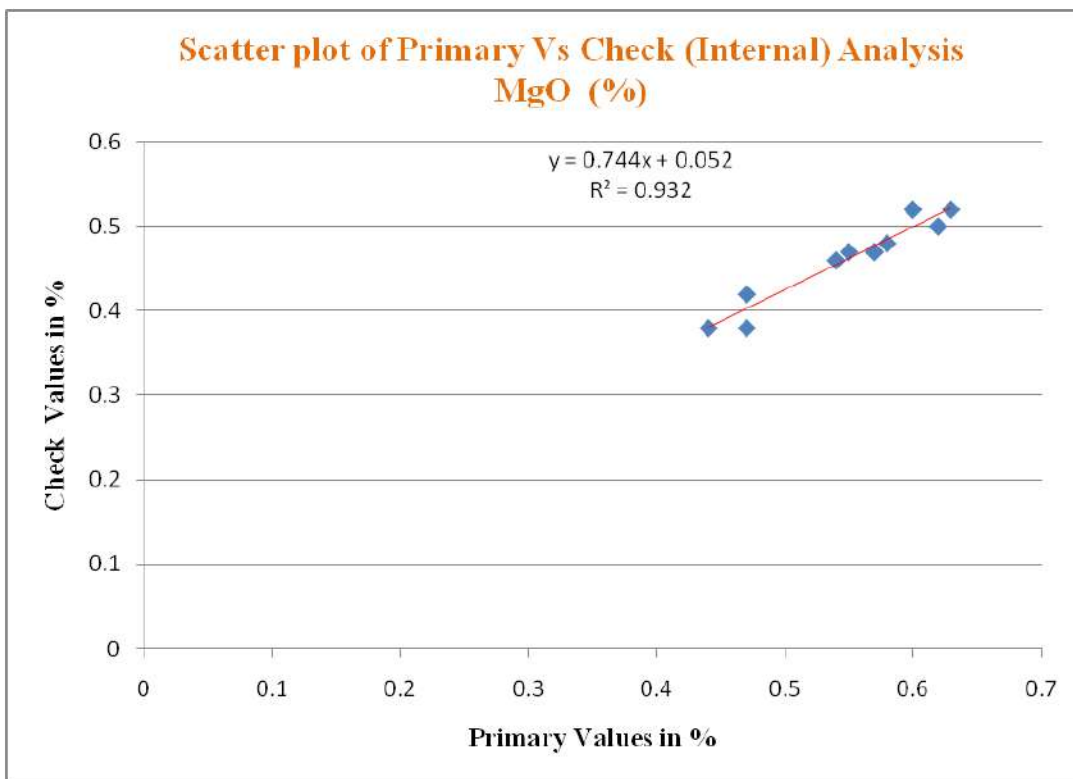
16.2.1 A total 10 nos. of Internal Check samples from boreholes MKG -01 to MKG-05 have been analysed to JNARDDC laboratory, Nagpur for 9 radicals analysis to check the reliability of chemical analysis. The result is furnished in Annexure IIIB

Scatter plot of primary vs internal check samples of borehole samples for the CaO, MgO and SiO<sub>2</sub> radicals and the details of all the statistical parameters pertaining to radicals for CaO, MgO and SiO<sub>2</sub> are provided given below.



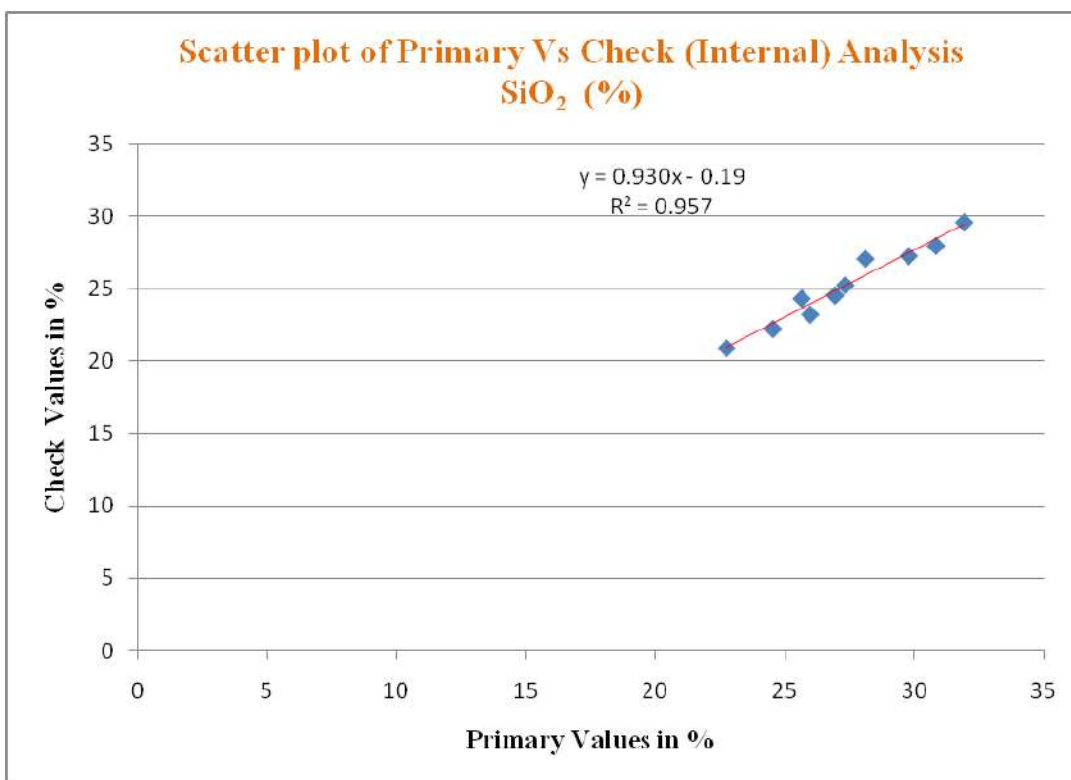
COMPARISON OF PRIMARY Vs. INTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | CaO %   |         |
|----------------------------|---------|---------|
|                            | Primary | Check   |
| No. of Sample Pairs        | 10      |         |
| Arithmetic Mean            | 39.208  | 41.22   |
| Standard Deviation         | 1.61    | 1.493   |
| Std. Error of Mean         | 0.509   | 0.472   |
| Variance                   | 2.594   | 2.23    |
| Mean of Deviation          |         | -2.012  |
| Standard Deviation (Error) |         | 0.617   |
| Correlation Coefficient    |         | 0.923   |
| Mean Absolute Error        |         | 2.012   |
| Mean Relative Random Error |         | 5.132%  |
| Paired T value             |         | -10.309 |
| F - test value             |         | 1.163   |



COMPARISON OF PRIMARY Vs. INTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | Primary | MgO %<br>Check |
|----------------------------|---------|----------------|
| No. of Sample Pairs        | 10      |                |
| Arithmetic Mean            | 0.547   | 0.46           |
| Standard Deviation         | 0.063   | 0.049          |
| Std. Error of Mean         | 0.02    | 0.015          |
| Variance                   | 0.004   | 0.002          |
| Mean of Deviation          |         | 0.087          |
| Standard Deviation (Error) |         | 0.021          |
| Correlation Coefficient    |         | 0.965          |
| Mean Absolute Error        |         | 0.087          |
| Mean Relative Random Error |         | 15.905%        |
| Paired T value             |         | 13.408         |
| F - test value             |         | 1.681          |



COMPARISON OF PRIMARY Vs. INTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | Primary | SiO <sub>2</sub> %<br>Check |
|----------------------------|---------|-----------------------------|
| No. of Sample Pairs        |         | 10                          |
| Arithmetic Mean            | 27.353  | 25.261                      |
| Standard Deviation         | 2.71    | 2.577                       |
| Std. Error of Mean         | 0.857   | 0.815                       |
| Variance                   | 7.346   | 6.64                        |
| Mean of Deviation          |         | 2.092                       |
| Standard Deviation (Error) |         | 0.562                       |
| Correlation Coefficient    |         | 0.979                       |
| Mean Absolute Error        |         | 2.092                       |
| Mean Relative Random Error |         | 7.648%                      |
| Paired T value             |         | 11.778                      |
| F - test value             |         | 1.106                       |

16.2.2 It has been observed that

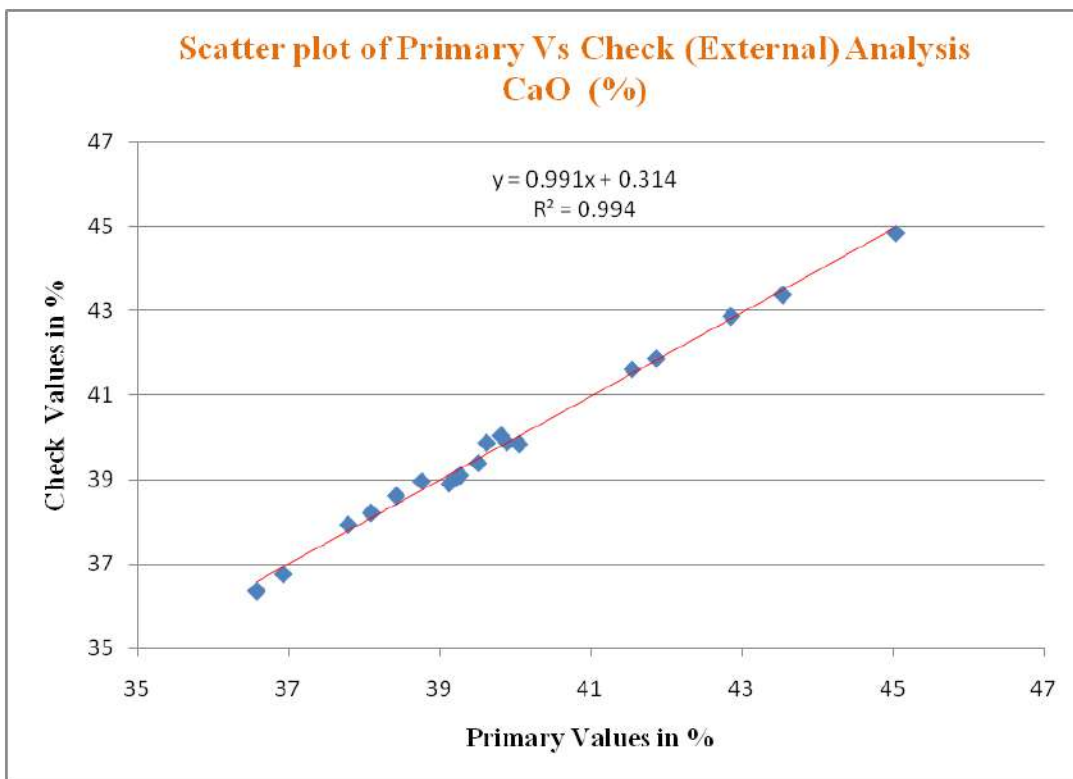
- i) The scatter plots clearly show scatter of values along a band closely following the bisector.
- ii) The arithmetic means of principal and check assays show an excellent agreement for all the radicals.

iii) The correlation coefficient, which is an index assaying showing value for CaO% 0.923, MgO% 0.965 & SiO<sub>2</sub>% 0.979 which implies excellent/agreement for the dataset of primary and check analysis of radicals.

### **16.3.0 RELIABILITY OF INTER LABORATORY CHEMICAL ANALYSIS**

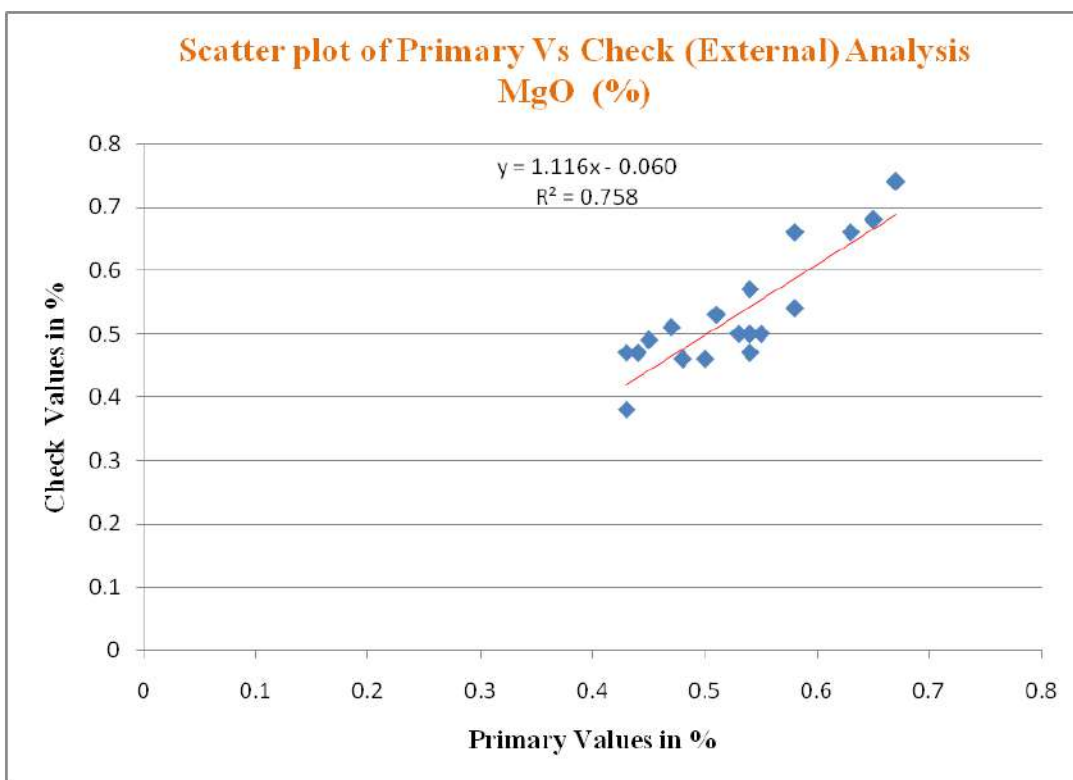
16.3.1 A total of 19 samples from boreholes MKG-01 to MKG-05 have been sent to analyses as External Check sample at MECL lab, Nagpur for 9 radicals analysis to check the reliability of chemical analysis. The result is furnished in Annexure III C

Scatter plot of primary vs external check samples of borehole samples for the CaO, MgO and SiO<sub>2</sub> radicals and the details of all the statistical parameters pertaining to radicals for CaO, MgO and SiO<sub>2</sub> are provided given below.



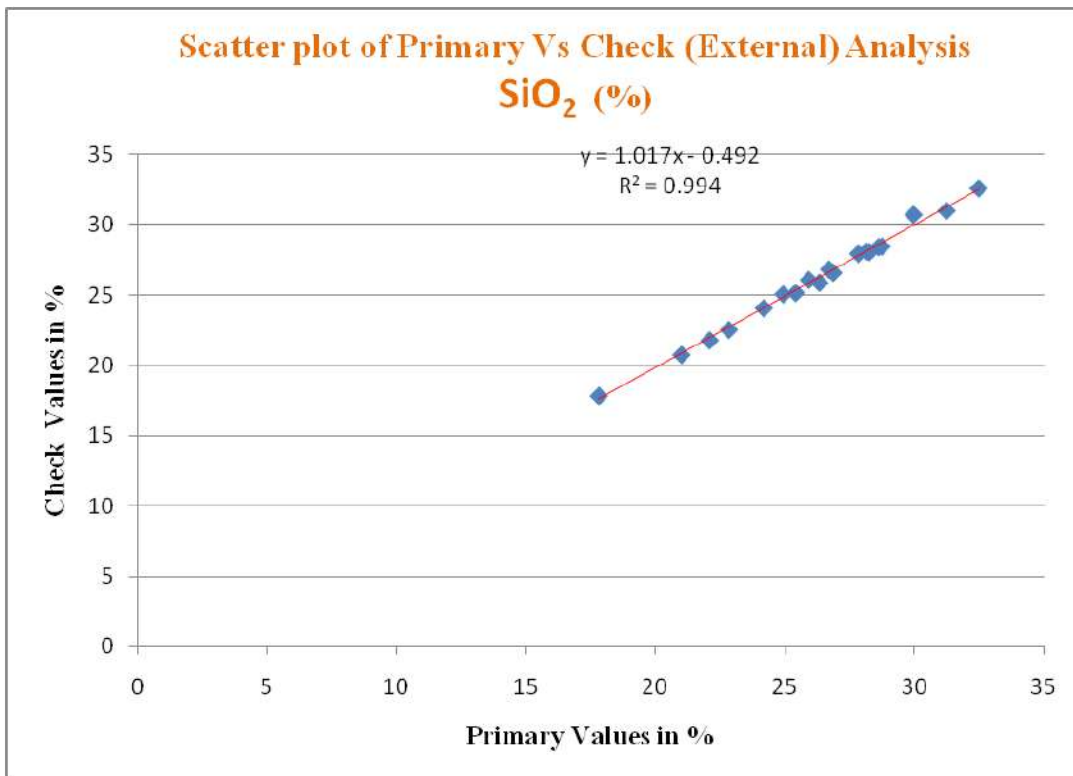
COMPARISON OF PRIMARY Vs. EXTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | Primary | CaO %<br>Check |
|----------------------------|---------|----------------|
| No. of Sample Pairs        |         | 19             |
| Arithmetic Mean            | 39.888  | 39.868         |
| Standard Deviation         | 2.147   | 2.135          |
| Std. Error of Mean         | 0.493   | 0.49           |
| Variance                   | 4.61    | 4.56           |
| Mean of Deviation          |         | 0.021          |
| Standard Deviation (Error) |         | 0.166          |
| Correlation Coefficient    |         | 0.997          |
| Mean Absolute Error        |         | 0.151          |
| Mean Relative Random Error |         | 0.379%         |
| Paired T value             |         | 0.54           |
| F - test value             |         | 1.011          |



COMPARISON OF PRIMARY Vs. EXTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | MgO %   |        |
|----------------------------|---------|--------|
|                            | Primary | Check  |
| No. of Sample Pairs        | 19      |        |
| Arithmetic Mean            | 0.529   | 0.531  |
| Standard Deviation         | 0.069   | 0.089  |
| Std. Error of Mean         | 0.016   | 0.02   |
| Variance                   | 0.005   | 0.008  |
| Mean of Deviation          |         | -0.002 |
| Standard Deviation (Error) |         | 0.045  |
| Correlation Coefficient    |         | 0.870  |
| Mean Absolute Error        |         | 0.042  |
| Mean Relative Random Error |         | 7.853% |
| Paired T value             |         | -0.155 |
| F - test value             |         | 0.608  |



COMPARISON OF PRIMARY Vs. EXTERNAL CHECK ANALYSIS

| COMPARISON INDEX           | Primary | SiO <sub>2</sub> %<br>Check |
|----------------------------|---------|-----------------------------|
| No. of Sample Pairs        | 19      |                             |
| Arithmetic Mean            | 26.261  | 26.235                      |
| Standard Deviation         | 3.514   | 3.586                       |
| Std. Error of Mean         | 0.806   | 0.823                       |
| Variance                   | 12.347  | 12.858                      |
| Mean of Deviation          |         | 0.025                       |
| Standard Deviation (Error) |         | 0.267                       |
| Correlation Coefficient    |         | 0.997                       |
| Mean Absolute Error        |         | 0.214                       |
| Mean Relative Random Error |         | 0.814%                      |
| Paired T value             |         | 0.413                       |
| F - test value             |         | 0.96                        |

16.3.2 It has been observed that

- i) The scatter plots clearly show scatter of values along a band closely following the bisector.
- ii) The arithmetic means of principal and check assays show an excellent agreement for all the radicals.
- iii) The correlation coefficient, which is an index assays showing value for CaO% 0.997, MgO% 0.870 & SiO<sub>2</sub>% 0.997 which implies excellent/agreement for the dataset of primary and check analysis of radicals.

## CHAPTER XVII

### MOISTURE / BULK DENSITY / BENEFICIATION STUDIES

#### 17.0.0 MOISTURE/ BULK DENSITY / BENEFICIATION STUDIES

17.1.0 In Kiranagi-2 block, no studies have been carried for moisture and beneficiation.

17.1.1 A total of 2 nos. of limestone core samples from MECL boreholes were subjected to bulk density determination by **Calliper method:**

**Applicability:** This method shall be applicable in hard formations, where regular solid cylindrical drill cores are obtained during the course of drilling. The drill core samples to be used for the study should be of NQ or larger dia.

**Sample Preparation:** Taken a full cylindrical drill core sample of minimum fifteen (15) centimetre-length with both ends trimmed smoothly at right angle to the core axis using a mechanical core cutter to form a regular cylinder.

**Procedure:** Measure the length of the sample, at-least at four locations along its axis by suitably rotating the sample. Measure the diameter of the sample using a calliper scale, at-least at four locations, preferably at regular interval. Weigh the air dried sample in a platform balance.

**Calculation:** Take mean average of all the readings for length and diameter. Divide the average mean value of diameter by two to arrive at the radius of the sample. The volume of a core sample is obtained by using formulae:  $V = \pi r^2 h$  (where  $V$  = volume,  $r$  = radius and  $h$  = height or length of the cylindrical core). The bulk density of the sample is determined by using the formula:  $B.D = M/V$  where  $B.D$ = bulk density,  $M$ = mass (weight) of the sample and  $V$ = volume of the sample.

**Number of Tests:** Totally five tests are carried out for each type of ore/mineral formation depending upon the spatial extent of the exploration area involved. The average of these test results for each ore/mineral formation may be taken as the final bulk density for the purpose of estimation of reserves and resources.

The average bulk density of these 2 samples has been determined as 2.65 and the same has been considered for estimation of resources. These results of bulk density determination as presented in Annexure VIII.

## CHAPTER XVIII

### RESOURCE AND GRADE

#### 18.0.0 RESOURCE AND GRADE

##### 18.1.0 GENERAL

18.1.1 MECL carried out G-3 stage of exploration to ascertain both along strike, dip the continuity of limestone horizons in the Kiranagi-2 block by drilling five (05) boreholes in the area of 5.8022 sq.km. As an outcome of this exploration, MECL has estimated total net in-situ resources of 5.34 million tonnes (333 category) and 12.98 million tonnes (334 category) of cement (Portland) grade, and Threshold grade limestone resources of 283.09 million tonnes (333 category) and 211.80 million tonnes (334 category). The total Net In-Situ resource is 513.21 million tonnes for all grades of Limestone by cross sectional method.

18.1.2 In Kiranagi-2 block, Cement (Portland) grade limestone horizon demarcated in one zone and marked as Zone-I. Cement (Portland) Grade Limestone is intersected in the MKG-05 boreholes drilled by MECL. Threshold grade limestone intersected below soil cover in all the 5 boreholes (MKG-01 to 05).

##### 18.2.0 BASIC ASSUMPTIONS

18.2.1 In order to estimate the resource and grades of limestone following parameters have been considered

- a) Resources estimated for Cement (Portland) Grade limestone with  $\text{CaO} \geq 44\%$  (Min), 3.50% MgO (Max) and 16%  $\text{SiO}_2$  (Max), Blendable Grade with  $\text{CaO} \geq 38\%$  (Min), 5.00% MgO (Max) and 18%  $\text{SiO}_2$  (Max) and Threshold grade limestone is  $\text{CaO} \geq 34\%$  to  $< 38\%$  and 6.00% MgO (Max) are considered for the assessment of limestone resources as per the threshold value given by IBM.
- b) As the limestone zones other than Portland Grade limestone in the explored block analysed for high  $+34\%$  CaO and higher  $\text{SiO}_2$  the same is categorised as Threshold grade which has been intersected in all the 5 boreholes.
- c) The zones of different grades have been demarcated from the values of primary sample analysis as per cut-off limits by **End Use Grade** specifications by IBM for CaO, MgO and  $\text{SiO}_2$  as explained in Chapter 14 The minimum cumulative thickness of 1.00m of all grades has been considered for resource calculation in both methods.
- d) Although the exploration scheme had been formulated for G-3 stage of exploration, it has been observed after the completion of exploration program by drilling of 5 Nos. of boreholes which are falling in three parallel cross section lines SE1-SE1', SE2-SE2' and SE3-SE3' have been drawn along N-S direction (across strike). The Limestone body is bedded and continuous within the block. Hence the resources may

be categorized under Inferred and Reconnaissance Category (333 and 334) of UNFC (as per MEMC) Rules.

- e) All proposed boreholes could not be planned at suitable grid interval. Boreholes were planned in such a way to cover the entire proposed block. Strike and dip influence of maximum 400m from control point towards the lease boundary has been categorized in Inferred Category (333). Beyond this limit the resources are categorized under Reconnaissance category (334) up to block boundary. Considering the bedded and continuous nature of limestone litho units, the resource in between two boreholes falling in the same section line has also been considered as inferred category of resource (333).
- f) Resources have been estimated by Geological **Cross Section** method (Principal) and validated with **Polygon** method of estimation.
- g) The average Bulk Density of limestone has been taken as 2.65 as determined by Caliper's method from 2 limestone samples in MECL Laboratory, Nagpur. This value is taken for computation of resources for cement, blendable, and threshold grades of limestone. This practice is followed in the nearby working mines around the explored block.
- h) A deduction of 20% from Gross in-situ resources has been made to arrive at Net In-situ resources by geological cross-section and, polygon method for unseen geological factors i.e., nature of core, recovery factor, cavities/caverns and other structural features.

### 18.3.0 BULK DENSITY

18.3.1 A total of 2 nos. of limestone core samples from MECL boreholes were subjected to bulk density determination by **Calliper Method** in Petrology laboratory, MECL, Nagpur. The average bulk density of these 2 samples has been determined as 2.65. The details are given in Annexure VII.

### 18.4.0 OVERBURDEN

18.4.1 Overburden of limestone includes top layer of soil and subsequent sticky clay/sandstone which lies immediately above Limestone in Kiranagi-2 block.

The range of overburden thickness (m) in this block is given below:

| Minimum (m)   | Maximum (m)   |
|---------------|---------------|
| 1.00 (MKG-04) | 4.00 (MKG-01) |

## 18.5.0 METHODOLOGY

18.5.1 The resources of limestone have been estimated by geological Cross Section method as principal method and Polygon method is check method. The methodology adopted, keeping the above assumptions in view, for resource estimation is as follows.

### 18.5.2 GEOLOGICAL CROSS-SECTIONAL METHOD (PRINCIPAL METHOD):

Four numbers of parallel cross section lines SE1-SE1', SE2-SE2' and SE3-SE3' about  $\leq 2.65$ km interval are drawn along N-S direction from East to West throughout the block which is marked on Plate No IV. Efforts were made to pass these sections through drilled borehole locations wherever possible. The boreholes which have not fallen on section lines are projected on to the nearest section line. The entire block area is covered by soil cover with absence of limestone exposure hence no strike and dip values recorded. As no outcrops of limestone are exposed in study area, reference of adjacent Kiranagi - 1 block is considered and section lines drawn along Northerly dipping body in the area. All the boreholes were drilled vertical hence true thickness will be approximately the same as thickness intersected in the exploratory boreholes. Geological cross sections are generated by GDM software. Cross sectional area on each section has been measured with the help of Auto CAD map 2018 software and recorded systematically. Strike influence between two section lines and boreholes has been taken up-to half way distance. However, the influence is 400m on either side of the borehole is categorised under 333 category beyond up to block boundary has been taken in 334 category in the cross sections SE1-SE1' SE2-SE2 and SE3-SE3. Each of these areas has been multiplied with sectional influence / strike influence of the section lines to give volume. The volume is then multiplied with average specific gravity, to estimate geological in-situ gross resources.

$$R = Sv (X) T (X) \text{ Avg Bulk Density}$$

Where

R = Resources / Tonnage

Sv = Sectional area of limestone

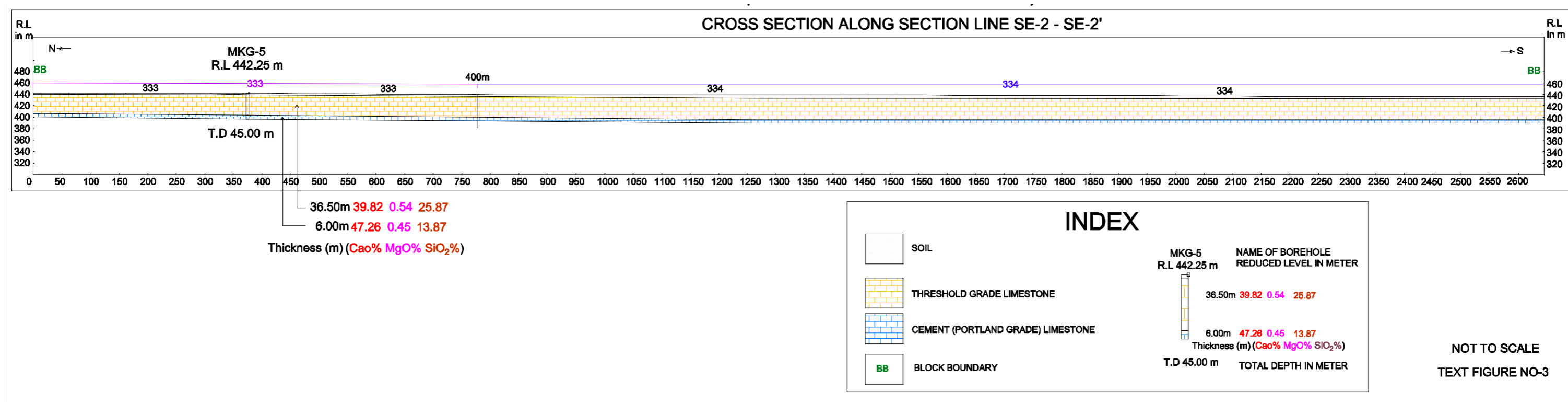
T = Influence between successive section lines

B.D. = Bulk Density of limestone

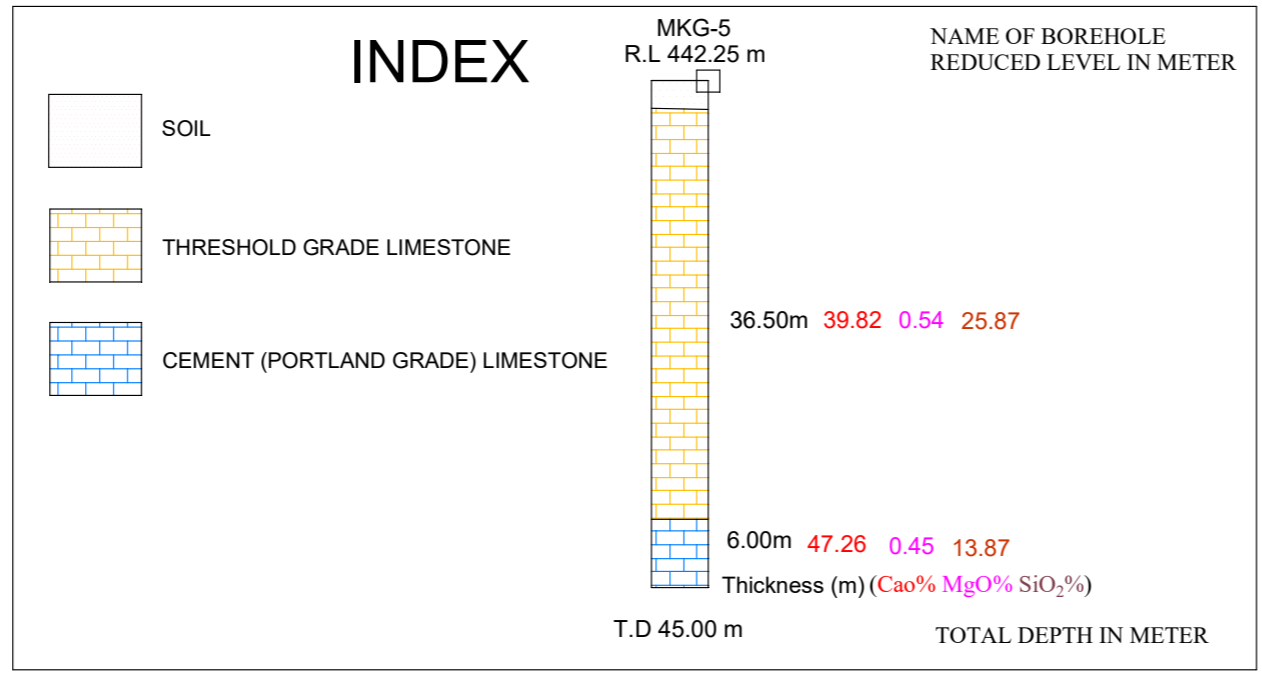
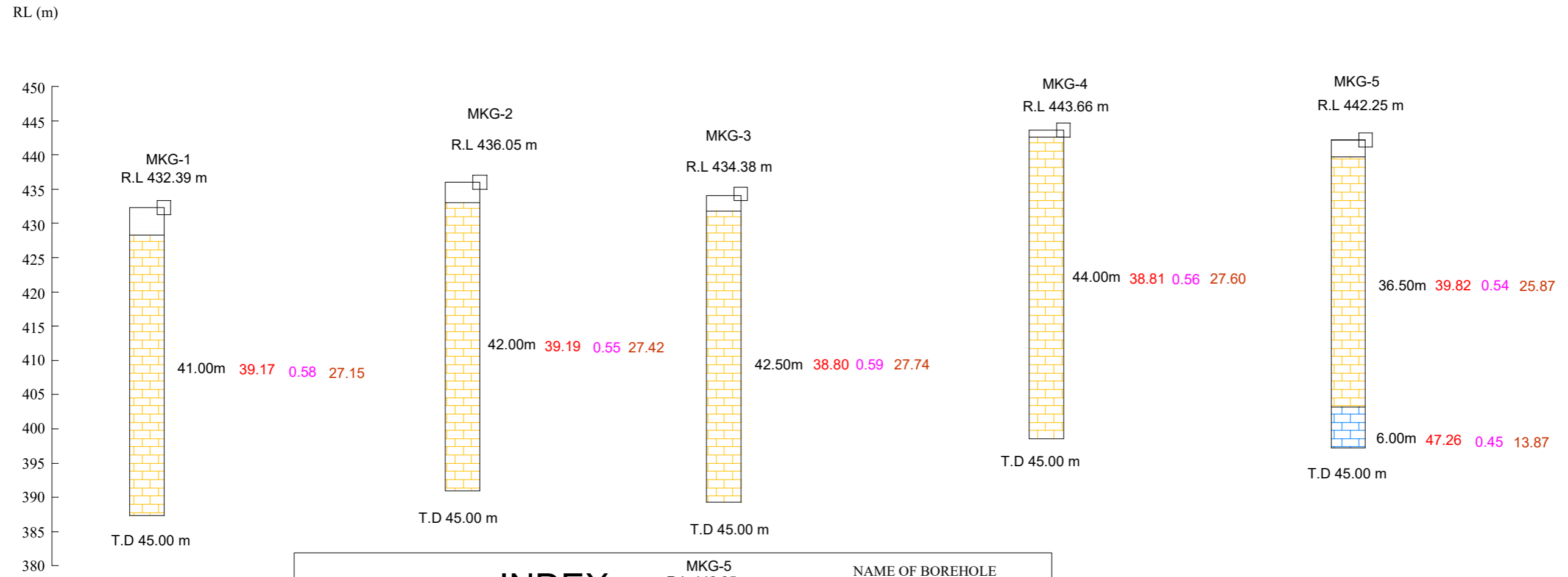
The resources are estimated grade wise, zone wise, borehole wise, section wise and presented as Annexures –VI-A/1 of 3 (333) category & VI-A/2 of 3 (334) category.

The average for 9 radicals CaO, MgO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O and LOI have been calculated. Thus, average grade of the block is calculated for all grades of limestone.

Text Figure No: 3 Geological Cross Sections showing Cement (Portland) and Blendable / Threshold Grade Limestone along SE-2– SE-2' Kiranagi Block-2, Kalaburagi District, Karnataka.



## GRAPHIC LITHOLOGS OF BOREHOLES DRILLED BY MECL IN KIRANAGI-2 BLOCK, (G-3) KALABURAGI DISTRICT, KARNATAKA



NOT TO SCALE  
TEXT FIGURE NO-4

### 18.5.3 POLYGON METHOD (CHECK METHOD):

The main objective of this method is to demarcate the area of influence of the limestone intersected by a particular borehole. The influence area has been obtained by constructing polygons by drawing perpendicular bisector of triangles, rectangles that connect the adjoining boreholes. The area of the influence of zones has been ascertained by Auto-Cad software. The area of non-development of respective zones is shown on the resource plan. The height of polygons is the cumulative thickness of limestone horizon/bands intersected by the corresponding borehole. The entire limestone body in block is divided into 5 numbers of polygons (P1 to P5) of different thickness. The resource estimation by Polygon method for Cement (Portland) Grade Zone-I and Threshold Grade Zone- is given separately in Annexure V. The grade assigned to the polygon blocks is same as the weighted average grade of the corresponding boreholes. The area of non-development of particular grade in borehole has been deducted.

The formula of resource estimation is as follows:

$$R = P_A \times Th \times \text{Bulk Density}$$

Where,  $P_A$  = Area of Polygon

R= Resource/ Tonnage

Th= Thickness of Limestone

18.5.4 The resources are estimated grade wise, zone wise, borehole wise, polygon wise and presented as **Annexure V/1**.

18.5.5 The average grades for 3 radicals CaO, MgO, SiO<sub>2</sub> have been calculated. Thus, average grade of the block is calculated for all grades of limestone.

### 18.6.0 CATEGORISATION OF RESOURCES

18.6.1 Resources have been categorized under Inferred and Reconnaissance category of limestone resources (333 and 334) as per UNFC. The parameters and assumptions for resources estimation have already been discussed earlier in this chapter.

18.6.2 Limestone zones are computed and categorized based on **End Use Grade** specifications prescribed by Indian Bureau of Mines, Government of India.

## 18.7.0 RESOURCES

### 18.7.1 RESOURCES

The total Net in-situ resource of Cement (Portland), Threshold grade limestone is broadly categorized under inferred and reconnaissance (333 & 334) resources the details of the same is furnished in the following table. The total inferred category resource of Cement (Portland) Grade is 5.34 million tonnes, Threshold Grade Resource is 283.09 million tonnes and total reconnaissance category resource of Cement (Portland) Grade is 12.98 million tonnes, Threshold Grade Resource is 211.80 million tonnes are estimated by cross sectional method.

**Table – 18.1**  
**Summary of Category wise Net-Resource**

Unit: million tonnes

| Category and UNFC Code | Cement (Portland) Grade | Threshold Grade | Total  | Percentage |
|------------------------|-------------------------|-----------------|--------|------------|
| Inferred (333)         | 5.34                    | 283.09          | 288.43 | 56.20      |
| Reconnaissance (334)   | 12.98                   | 211.80          | 224.78 | 43.80      |
| Total                  | 18.32                   | 494.89          | 513.21 | 100        |

18.7.2 The net-inferred category resource is 288.43 and it is 56.20% of the total net resource of 494.89 million tonnes.

18.7.3 The resources of limestone for different grades have been estimated borehole wise, section wise, polygon wise for different grades of limestone intersected, as per specifications for different grades and basic assumptions enumerated earlier in this chapter by cross section methods and polygon method. The category wise and grade wise estimated resource is tabulated in Table Nos.18.2 to 18.13 and enclosed as Annexures -V (Polygonal) and VI (Cross Sectional).

18.7.4 A total of 5.34 million tonnes of Cement (Portland) Grade limestone Net In-Situ resources (333) of Zone I is estimated by Cross Sectional method with average grade of 47.26 % CaO, 0.45% MgO and 13.87 % SiO<sub>2</sub>, Same is furnished in the table 18.2 and enclosed as Annexure VI/1 of 3.

**Table No: 18.2**  
**Statement showing section wise, borehole wise Inferred category of resource (333)**  
**of Cement (Portland) Grade Limestone for Zone I Estimated by Cross Sectional method,**  
**Kiranagi-2 (G-3) block, Kalaburagi Dist., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-4                      | SE-3         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-2                      | SE-1         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-5                      | SE-2         | 4662.56                | 540                   | 2517782.72               | 6672124.22                          | 5337699.37                        | 47.26           | 0.45        | 13.87              |
| MKG-3                      | SE-3         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-1                      | SE-3         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>6672124.22</b>                   | <b>5337699.37</b>                 | <b>47.26</b>    | <b>0.45</b> | <b>13.87</b>       |

**Resources: Gross 6.67 million tons and Net 5.34 million tons**

**Table No: 18.3**  
**Statement showing section wise, borehole wise Inferred category of resource (333)**  
**of Threshold Grade Limestone for Zone I, Estimated by Cross Sectional method,**  
**Kiranagi-2 (G-3) Block, Kalaburagi Dist., Karnataka.**

**Specific Gravity: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-4                      | SE-1         | 36265.12               | 808.00                | 29302216.96              | 77650274.94                         | 62120699.96                    | 38.81           | 0.56        | 27.60              |
| MKG-2                      | SE-1         | 34784.12               | 808.00                | 28105568.96              | 74479757.74                         | 59583806.20                    | 39.19           | 0.55        | 27.42              |
| MKG-5                      | SE-2         | 27870.59               | 540.00                | 15050118.06              | 39882812.86                         | 31906250.29                    | 39.82           | 0.54        | 25.87              |
| MKG-3                      | SE-3         | 35436.11               | 866.00                | 30687667.97              | 81322320.12                         | 65057856.09                    | 38.80           | 0.59        | 27.74              |
| MKG-1                      | SE-3         | 35090.00               | 866.00                | 30387944.07              | 80528051.79                         | 64422441.43                    | 39.17           | 0.59        | 27.15              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>353863817.45</b>                 | <b>283091053.96</b>            | <b>39.08</b>    | <b>0.57</b> | <b>27.30</b>       |

**Resources: Gross 353.86 million tons and Net 283.09 million tons**

**Table No: 18.4**  
**Total Inferred Resources (333) of Cement (Portland) and Threshold and Threshold Grade**  
**Estimated by Cross Sectional method, Kiranagi 2 (G-3 stage) block,**  
**Kalaburagi Dist., Karnataka**

| Resource details                   | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|------------------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                                    |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| <b>Resources in tonnes</b>         | <b>360535941.67</b>                 | <b>288428753.34</b>            | <b>39.23</b>    | <b>0.56</b> | <b>27.05</b>       |
| <b>Resources in Million Tonnes</b> | <b>360.54</b>                       | <b>288.43</b>                  |                 |             |                    |

**Resources: Gross 360.54 million tons and Net 288.43 million tons**

**Table No: 18.5**

**Statement showing section wise, borehole wise Inferred category of resource (334) of Cement (Portland) Grade Limestone for Zone I Estimated by Cross Sectional method, Kiranagi-2 (G-3) block, Kalaburagi Dist., Karnataka**

**Bulk Density: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net Geological Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|-----------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                   | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-4                      | SE-3         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-2                      | SE-1         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-5                      | SE-3         | 11338.79               | 540.00                | 6122945.03               | 16225804.34                         | 12980643.47                       | 47.26           | 0.45        | 13.87              |
| MKG-3                      | SE-1         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| MKG-1                      | SE-2         | -                      | -                     | -                        | -                                   | -                                 | -               | -           | -                  |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>16225804.34</b>                  | <b>12980643.47</b>                | <b>47.26</b>    | <b>0.45</b> | <b>13.87</b>       |

**Resources: Gross 16.23 Million Tonnes and Net 12.98 Million Tonnes**

**Table No: 18.6**

**Statement showing section wise, borehole wise Inferred category of resource (334) of Threshold Grade Limestone for Zone I, Estimated by Cross Sectional method, Kiranagi-2 (G-3) Block, Kalaburagi Dist., Karnataka.**

**Specific Gravity: 2.65**

| BH No.                     | Section Line | Area (m <sup>2</sup> ) | Section Influence (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|--------------|------------------------|-----------------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |              |                        |                       |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| MKG-4                      | SE-1         | 33760.53               | 808.00                | 27278507.59              | 72288045.12                         | 57830436.10                    | 38.81           | 0.56        | 27.60              |
| MKG-2                      | SE-1         | 2926.86                | 808.00                | 2364901.10               | 6266987.92                          | 5013590.34                     | 39.19           | 0.55        | 27.42              |
| MKG-5                      | SE-2         | 69748.90               | 540.00                | 37664405.57              | 99810674.76                         | 79848539.80                    | 39.82           | 0.54        | 25.87              |
| MKG-3                      | SE-3         | 34022.94               | 866.00                | 29463867.17              | 78079247.99                         | 62463398.39                    | 38.80           | 0.59        | 27.74              |
| MKG-1                      | SE-3         | 3618.50                | 866.00                | 3133616.67               | 8304084.18                          | 6643267.34                     | 39.17           | 0.59        | 27.15              |
| <b>Resources in tonnes</b> |              |                        |                       |                          | <b>264749039.96</b>                 | <b>211799231.97</b>            | <b>39.21</b>    | <b>0.56</b> | <b>26.97</b>       |

**Resources: Gross 264.75 million tons and Net 211.80 million tons**

**Table No: 18.7**

**Total Inferred Resources (334) of Cement (Portland) and Threshold Grade Estimated by Cross Sectional method, Kiranagi 2 (G-3 stage) block, Kalaburagi Dist., Karnataka**

| Resource details           | Gross Geological Resources (tonnes) | Net in-situ Resources (tonnes) | Average Quality |             |                    |
|----------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|                            |                                     |                                | CaO%            | MgO%        | SiO <sub>2</sub> % |
| <b>Resources in tonnes</b> | <b>280974844.30</b>                 | <b>224779875.44</b>            | <b>39.67</b>    | <b>0.56</b> | <b>26.21</b>       |

**Resources: Gross 280.97 million Tons and Net 224.78 million tons**

**Table No: 18.8**

| <b>Total Resources(333+334) Estimated by Cross Sectional method, Kiranagi-2 (G-3 stage) block, Kalaburagi Dist., Karnataka</b> |  |                                       |                        |              |                          |
|--|--|---------------------------------------|------------------------|--------------|--------------------------|
| <b>Resource details</b>  | <b>Gross Geological Resources (tonnes)</b> | <b>Net in-situ Resources (tonnes)</b> | <b>Average Quality</b> |              |                          |
|  |  |                                       | <b>CaO %</b>           | <b>MgO %</b> | <b>SiO<sub>2</sub> %</b> |
| Total Inferred Resources (333) of Cement grade Limestone   | 6672124.22                                 | 5337699.37                            | 47.26                  | 0.45         | 13.87                    |
| Total Reconnaissance Resources (334) of Cement grade Limestone   | 16225804.34                                | 12980643.47                           | 47.26                  | 0.45         | 13.87                    |
| Total Inferred Resources (333) of Threshold grade Limestone  | 353863817.45                               | 283091053.96                          | 39.08                  | 0.57         | 27.30                    |
| Total Reconnaissance Resources (334) of Threshold grade Limestone  | 264749039.96                               | 2117799231.97                         | 39.21                  | 0.56         | 26.97                    |
| <b>Total Resources in Tonnes (333+334)</b>   | <b>641510785.97</b>                        | <b>513208628.78</b>                   | <b>39.42</b>           | <b>0.56</b>  | <b>26.68</b>             |

Resources: Gross 641.51 million tons and Net 513.21 million tons

**Table No: 18.9**

| <b>Summary of the Total Resources (333+334) Estimated by Cross Sectional method, Kiranagi-2 (G-3 stage) block, Kalaburagi Dist., Karnataka</b> |  |  |                        |              |                          |
|--|--|--|------------------------|--------------|--------------------------|
| <b>Resource details</b>  | <b>Gross Geological Resources (tonnes)</b> | <b>Net Geological Resources (tonnes)</b> | <b>Average Quality</b> |              |                          |
|  |  |  | <b>CaO %</b>           | <b>MgO %</b> | <b>SiO<sub>2</sub> %</b> |
| <b>Cement Grade &amp; Threshold Grade Resources in tonnes (333)</b>  | 360535941.67                               | 288428750.34                             | 39.23                  | 0.56         | 27.05                    |
| <b>Cement Grade &amp; Threshold Grade Resources in tonnes (334)</b>  | 280974844.30                               | 224779875.44                             | 39.67                  | 0.56         | 26.21                    |
| <b>Total Cement and Threshold Gr. Resources in tonnes (333+334)</b>  | <b>641510785.97</b>                        | <b>513208628.78</b>                      | <b>39.42</b>           | <b>0.56</b>  | <b>26.68</b>             |

Resources: Gross 641.51 million tons and Net 513.21 million tons

**Table No: 18.10**

| <b>Summary Statement showing Category wise, grade wise resources (333+334) of (Cement+Threshold Grade) Limestone by Cross Sectional method, Kiranagi-2 (G-3 stage) block, District-Kalaburagi, Karnataka.</b> |  |  |                        |              |                          |
|---|--|--|------------------------|--------------|--------------------------|
| <b>Resource details</b>   | <b>Gross Geological Resources (tonnes)</b> | <b>Net Geological Resources (tonnes)</b> | <b>Average Quality</b> |              |                          |
|   |  |  | <b>CaO %</b>           | <b>MgO %</b> | <b>SiO<sub>2</sub> %</b> |
| <b>Resources of Cement Grade Limestone (333+334)</b>  | 22897928.56                                | 18318342.85                              | 47.26                  | 0.45         | 13.57                    |
| <b>Resources of Threshold Grade Limestone (334+334)</b>   | 618612857.42                               | 494890285.93                             | 39.13                  | 0.57         | 27.16                    |
| <b>Total Resources (333+334) of Limestone (Cement+Threshold)</b>  | <b>641510785.97</b>                        | <b>513208628.78</b>                      | <b>39.42</b>           | <b>0.56</b>  | <b>26.68</b>             |

Resources: Gross 641.51 million tons and Net 513.21 million tons

18.7.5 A total of 15.15 million tonnes of Cement (Portland) Grade limestone Net in-situ resources (333) of Zone I is estimated by Polygonal method with average grade of 47.26 % CaO, 0.45% MgO and 13.87 % SiO<sub>2</sub>, Same is furnished in the table 18.11 and enclosed as Annexure V/1.

**Table No: 18.11**

**Statement showing Polygon wise, borehole wise resources of Cement Grade Limestone by Polygonal Method, Kiranagi - 2 Block (G-3 stage) Limestone block, District-Kalaburagi, Karnataka.**

**Bulk Density: 2.65**

| Polygon No.   | BH No. | Polygon Area (m <sup>2</sup> ) | Thick-nes (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net In-situ Resources (tonnes) | Average Quality |             |                    |
|---|--------|--------------------------------|---------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|   |        |                                |               |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| P5  | MKG-05 | 1190873.9967                   | 6.00          | 7145243.98               | 18934896.55                         | 15147917.24                    | 47.26           | 0.45        | 13.87              |
| <b>Total Resources of cement grade limestone in tonnes</b>          |        |                                |               |                          | <b>18934896.55</b>                  | <b>15147917.24</b>             |                 |             |                    |
| <b>Total Resources for cement grade limestone in million tonnes</b> |        |                                |               |                          | <b>18.93</b>                        | <b>15.15</b>                   | <b>47.26</b>    | <b>0.45</b> | <b>13.87</b>       |

**Table No: 18.12**

**Statement showing Polygon wise, borehole wise resources of Threshold Grade Limestone by Polygonal Method, Kiranagi - 2 Block (G-3 stage) Limestone block, District-Kalaburagi, Karnataka.**

**Bulk Density: 2.65**

| Polygon No.  | BH No. | Polygon Area (m <sup>2</sup> ) | Thickness (m) | Volume (m <sup>3</sup> ) | Gross Geological Resources (tonnes) | Net In-situ Resources (tonnes) | Average Quality |             |                    |
|--|--------|--------------------------------|---------------|--------------------------|-------------------------------------|--------------------------------|-----------------|-------------|--------------------|
|  |        |                                |               |                          |                                     |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| P1   | MKG-01 | 1246197.5275                   | 40.00         | 49847901.10              | 132096937.92                        | 105677550.33                   | 39.17           | 0.59        | 27.15              |
| P2   | MKG-02 | 1234489.9218                   | 42.00         | 51848576.72              | 137398728.30                        | 109918982.64                   | 39.19           | 0.55        | 27.42              |
| P3   | MKG-03 | 1069409.8986                   | 42.50         | 45449920.69              | 120442289.83                        | 96353831.86                    | 38.80           | 0.59        | 27.74              |
| P4   | MKG-04 | 1061250.8274                   | 44.00         | 4,66,95,036.41           | 123741846.47                        | 9,89,93,477.18                 | 38.81           | 0.56        | 27.60              |
| P5   | MKG-05 | 1190873.9967                   | 36.50         | 43466900.88              | 115187287.33                        | 92149829.86                    | 39.82           | 0.54        | 25.87              |
| <b>Total Resources of threshold grade limestone in tonnes</b>          |        |                                |               |                          | <b>628867089.85</b>                 | <b>503093671.88</b>            |                 |             |                    |
| <b>Total Resources for threshold grade limestone in million tonnes</b> |        |                                |               |                          | <b>628.87</b>                       | <b>503.09</b>                  | <b>39.13</b>    | <b>0.57</b> | <b>27.20</b>       |

**Table No: 18.13**

**Summary Statement showing Polygon wise, grade wise resources (333+334) of (Cement+Threshold) Grade Limestone by Polygonal method, Kiranagi-2 Block (G-3 stage) Limestone block, District-Kalaburagi, Karnataka.**

| Resource details   | Gross Geological Resources (million tonnes) | Net In-situ Resources (tonnes) | Average Quality |             |                    |
|--|---|--------------------------------|-----------------|-------------|--------------------|
|  |   |                                | CaO %           | MgO %       | SiO <sub>2</sub> % |
| <b>Total Resources of Cement grade Limestone</b>                 | <b>18.93</b>                                | <b>15.15</b>                   | <b>47.26</b>    | <b>0.45</b> | <b>13.87</b>       |
| <b>Total Resources of Threshold grade Limestone</b>              | <b>628.87</b>                               | <b>503.09</b>                  | <b>39.13</b>    | <b>0.57</b> | <b>27.20</b>       |
| <b>Total Resources (333+334) of Limestone (Cement+Threshold)</b> | <b>647.80</b>                               | <b>518.24</b>                  | <b>39.37</b>    | <b>0.56</b> | <b>26.81</b>       |

### 18.8.0 RELIABILITY OF RESOURCES

18.8.1 The Net in-situ resources (333 and 334) of Cement (Portland) grade limestone by **Cross Section** and **Polygon** methods are **18.32** and **15.15** million tonnes respectively; Net in-situ resources of Cement (Portland) and Threshold Grade limestone by Cross Section and Polygon methods are **494.89** and **503.09** million tonnes respectively.

18.8.2 The combined Cement and Threshold grade resource estimated at different end use cut off by the cross-section method and polygonal method were compared to ascertain the confidence level of estimation. The difference in Resources by two methods comes to 0.98%. The resources calculated by polygonal method are marginally higher side due to the shape of the block. Hence the cross-sectional method is more reliable than polygon method. The comparison of resource is given in the following Table.

**Table No.18.14**  
**Comparison of Net in-situ Resources estimated by Cross sectional and Polygonal method**

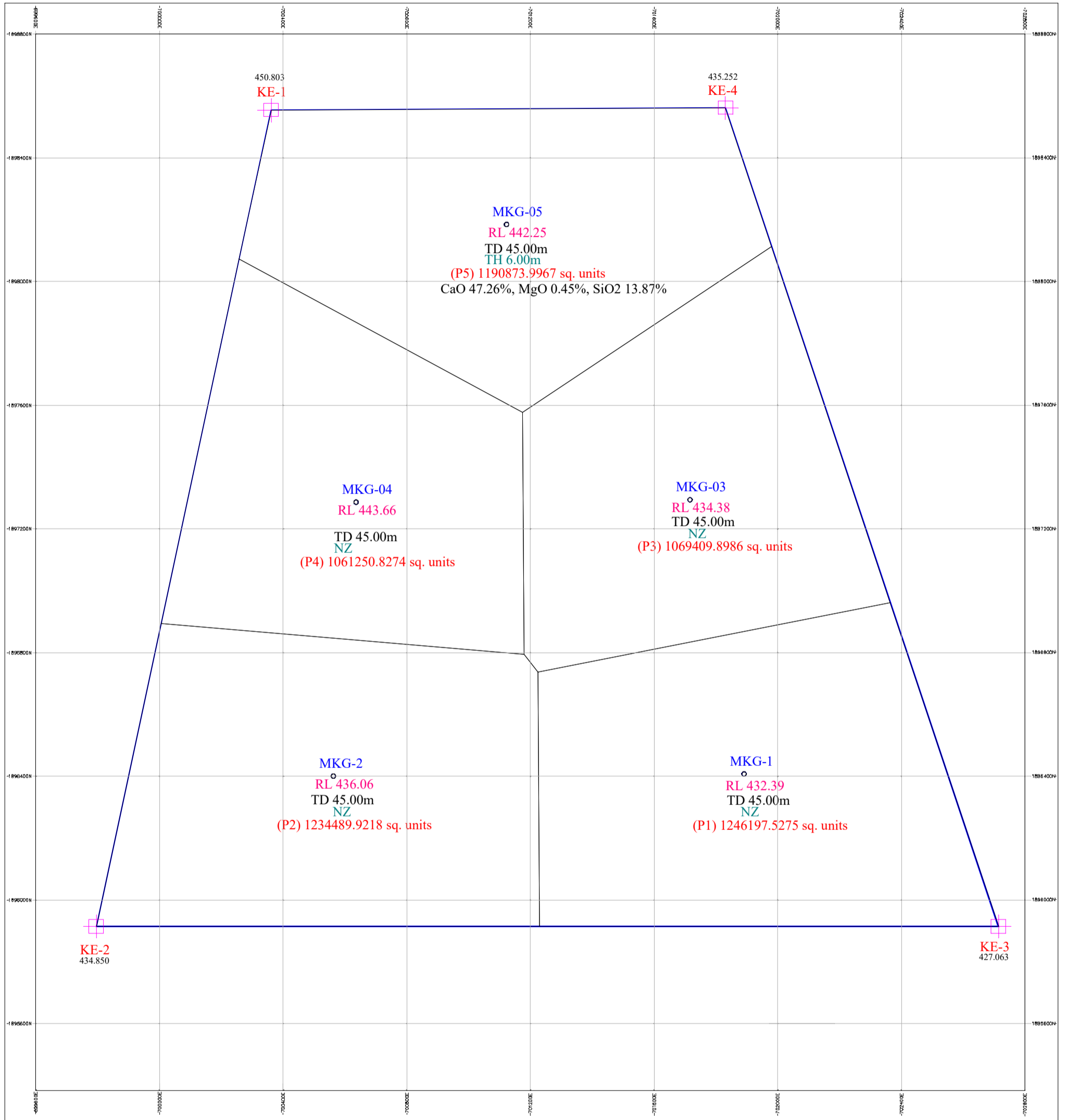
| Method of estimation   | Net in-situ Resources (million tonnes) | Grade            |
|------------------------|--|------------------|
| Cross sectional method | 513.21                                 | Cement+Threshold |
| Polygonal method       | 518.24                                 | Cement+Threshold |
| <b>Difference (%)</b>  | <b>0.98%</b>                           |                  |

**Table No 18.15**  
**Comparison of Quantity and Average Grade of Cement (Portland) Grade and Threshold Grade by**  
**Geological Cross-Section method and Polygon Method**

| Limestone Grades           | Cross Section Method       |        |         |       |                    | Polygon Method             |        |         |       |                    | Cross Section Method - Polygon Method |       |         |      |                    |
|----------------------------|----------------------------|--------|---------|-------|--------------------|----------------------------|--------|---------|-------|--------------------|---------------------------------------|-------|---------|------|--------------------|
|                            | Quantity in Million Tonnes |        | Quality |       |                    | Quantity in Million Tonnes |        | Quality |       |                    | Difference                            |       |         |      |                    |
|                            | Gross                      | Net    | CaO %   | MgO % | SiO <sub>2</sub> % | Gross                      | Net    | CaO %   | MgO % | SiO <sub>2</sub> % | Quantity in Million Tonnes            |       | Quality |      |                    |
|                            |                            |        |         |       |                    |                            |        |         |       |                    | Gross                                 | Net   | CaO%    | MgO% | SiO <sub>2</sub> % |
| Total Cement Grade         | 22.90                      | 18.32  | 47.26   | 0.45  | 13.87              | 18.93                      | 15.15  | 47.26   | 0.45  | 13.87              | 3.97                                  | 3.17  | 0       | 0    | 0                  |
| Total Threshold Grade Zone | 618.61                     | 494.89 | 39.08   | 0.57  | 27.30              | 628.87                     | 503.09 | 39.13   | 0.57  | 27.20              | -10.26                                | -8.20 | -0.05   | 0    | 0.10               |

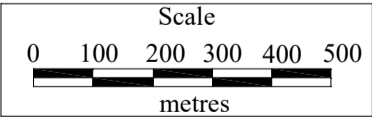
18.8.1 As observed from the table 18.14, the Net In-Situ resources for the Cement and Threshold grade limestone of the block estimated by the Cross-Section method confirms to that of estimated by the polygonal method and is reasonably good in comparison. The degrees of variation are Cement (Portland) Grade is within the limit; thus, estimation of resources is highly reliable along with average grade of the block.

**POLYGON MAP OF CEMENT GRADE LIMESTONE ZONE-I SHOWING THICKNESS, DISTRIBUTION AND QUALITY IN KIRANAGI-2 BLOCK, KALABURAGI DISTRICT, KARNATAKA**



**INDEX**

|  |   |
|--|---|
| <p><b>MKG-05</b><br/>○<br/>RL 442.25<br/>TD 45.00m<br/>TH 6.00m/NZ<br/>(P5) 1190873.9967 sq. units</p> | <p>BOREHOLE DRILLED BY MECL<br/>REDUCED LEVEL IN m<br/>TOTAL DEPTH IN m<br/>THICKNESS IN m / NO ZONE<br/>POLYGON AREA</p> |
| <p>— KE1 — KE4</p> <p>— KE2 — KE3</p>  | <p>BLOCK BOUNDARY WITH CARDINAL POINTS</p>  |



TEXT FIGURE NO-5

## CHAPTER XIX CORE PRESERVATION

### 19.0.0 CORE PRESERVATION

#### 19.1.0 EXPLORATORY BOREHOLE CORE PRESERVATION

Drill core generated from drilling were kept and preserved properly wrapped in polythene tubing in the GI core boxes following “Book Pattern”. The borehole cores were split into two equal halves, one half was powdered to (-) 200 mesh and processed for representative sample. Half splitted drill core generated at G3 level from boreholes MKG-01 to MKG-05 are preserved in specified size core boxes at MECL premises presently which will be handed over to DGM, Karnataka or GSI core library, after getting permission for deposition of drill core for future references.

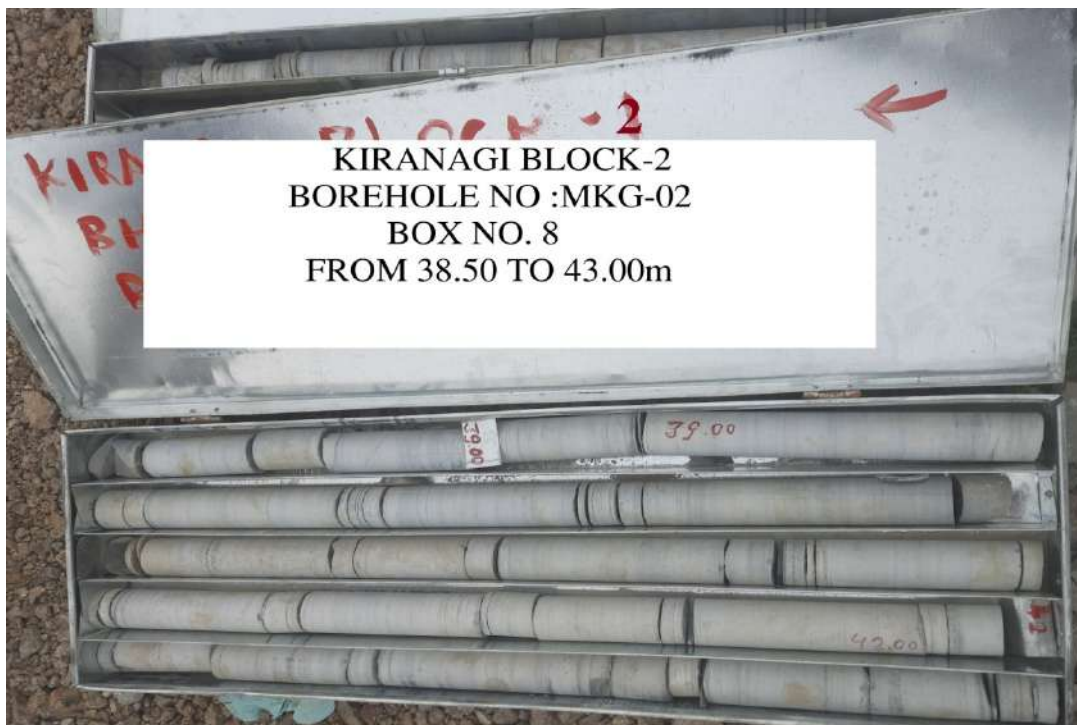


Photo 3 - : MKG-02 (38.50m to 43.00m)

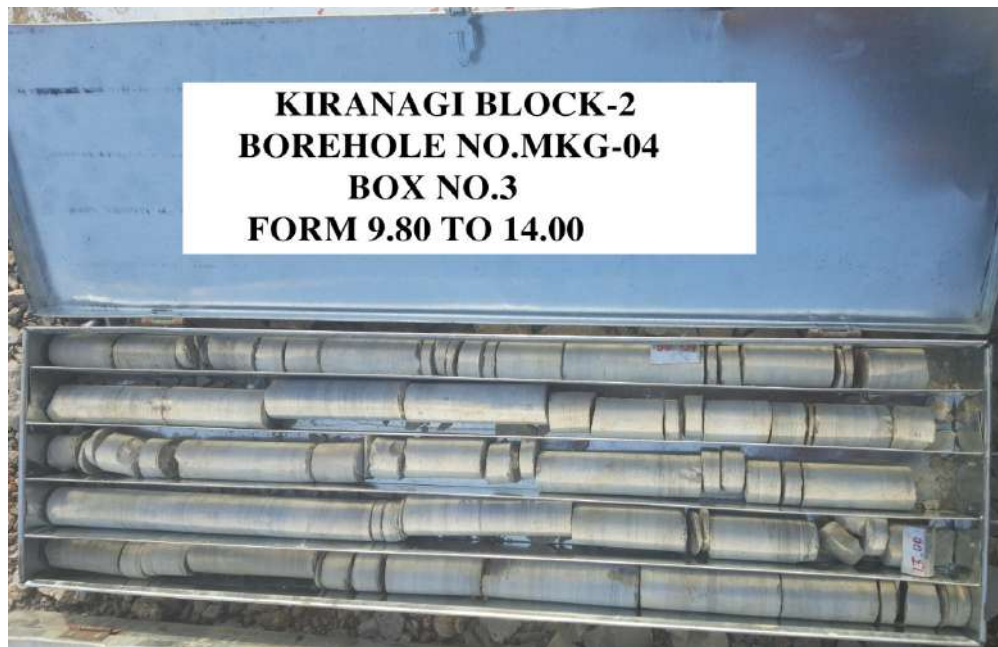


Photo 4 - : MKG-04 (9.80m to 14.00m)



Photo 5 - : MKG-05 (40.00m to 45.00m)

## **CHAPTER XX**

### **CONCLUSION AND RECOMMENDATIONS**

#### **20.0.0 CONCLUSION AND RECOMMENDATION**

#### **20.1.0 CONCLUSIONS**

- 20.1.1 On enactment of MMDR Amendment Act-2015, Mineral (Evidence of Mineral Contents) Rule- 2015 and Mineral Auction Rule - 2015, Govt. of India directed State Governments to speed up exploration work for different Mineral Commodities especially Notified Minerals i.e. Iron ore, Manganese, Bauxite and Limestone in the respective states.
- 20.1.2 Kiranagi-1 & 2 Blocks are the prospective limestone blocks identified by Directorate of Geology, Government of Karnataka for which MECL has prepared the exploration proposal involving 450m drilling in 10 boreholes at G-3 stage of exploration in Kiranagi Village, Kalaburagi Taluk, and District and put up for approval of Technical cum cost Committee (TCC) of NMET. District Kalaburagi and put up for approval of Technical cum cost Committee (TCC) of NMET. During the 28<sup>th</sup> meeting of TCC, NMET held on 16<sup>th</sup> March, 2023, the said proposal was technically evaluated and approved vide F.No.23/325/2023-NMET/409 dated 27<sup>th</sup> March 2023.
- 20.1.3 On the recommendation of 28<sup>th</sup> TCC of NMET held on 16<sup>th</sup> March, 2023 approved the mineral exploration project to be executed by MECL for Kiranagi-1 & 2 Limestone Blocks in Kiranagi Village, Taluka: Kalaburagi, District: Kalaburagi with an estimated cost of Rs.1,27,57,798/- in the time schedule of 10 months together for both Kiranagi-1 & 2 blocks. The approval was together for 10 boreholes for the cumulative meterage of 450m. However, the exploration was executed separately and geological reports are prepared for Kiranagi-1 and Kiranagi-2 separately. The Kiranagi-2 Block was explored by 5 boreholes with the cumulative meterage of 225m.
- 20.1.4 The entire core drilling has been carried out by wire line method with NQ borehole size using diamond bits. The polymer was used as drilling fluid to flush out the cuttings and stabilize the walls of exploratory boreholes. The drilling fluid also works as a coolant to avoid burning of drill bits. Due care was taken to obtain maximum core recovery in boreholes. The core recovery is about 90% to 95% in limestone horizons.
- 20.1.5 Lithologically the limestone formation is continuous below the overburden of soil and continued up to the bottom of the borehole. All boreholes closed in the limestone formation only.

20.1.6 The various rock types exposed in the block belong to the Shahabad Formation of Sedam subgroup of Bhima Group. The stratigraphic sequence of the litho units exposed in and around the block based on field observations and available data/literature from nearby mine/areas is given in Table-20.1.

**Table-20.1**

| <b>Stratigraphic Sequence of Litho-units exposed in and around the Block</b> |              |                 |                     |  |
|--|--------------|-----------------|---------------------|--|
| <b>Age</b>   | <b>Group</b> | <b>Subgroup</b> | <b>Formation</b>    | <b>Litho Units</b>   |
| Quaternary   | -            | -               | Recent              | Top soil   |
| Upper Proterozoic  | Bhima        | Sedam           | Shahabad Limestone  | Siliceous/flaggy limestone<br>Massive grey limestone<br>Shaly limestone                                |
| ----- Gradational and transitional contact -----                             |              |                 |                     |  |
| -  | -            | -               | Rabanpalli Clastics | Ferruginous Shales,<br>Calcareous shales,<br>Green, Glauconite, fine grained Sandstones and Siltstones |

20.1.7 The grades of limestone intersected in the boreholes drilled in Kiranagi-2 block have been assessed as Cement (Portland), Blendable and Threshold grades. These are based on compositional variations of main chemical constituent's viz. CaO, MgO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub> and LOI. The cut off limit for compositional variations of main chemical constituents fixed for different grades are enumerated as  $\geq 44\%$  CaO,  $< 3.5\%$  MgO and  $16\%$  SiO<sub>2</sub> for Cement (Portland) Grade,  $\geq 38\%$  to  $<44\%$  CaO,  $< 5.0\%$  MgO and  $18\%$  SiO<sub>2</sub> for Blendable Grade and  $\geq 34\%$  to  $<38\%$  CaO,  $< 3.5\%$  MgO and  $18\%$  SiO<sub>2</sub> for Threshold Grade, as per the **End User's Grade Specifications by Indian Bureau Of Mines.**

#### 20.1.8 GEOLOGICAL MAPPING

Geological mapping on 1:4000 scale was carried out in 5.8022 sq.km. area by taking traverses with the help of DGPS/Total Station. The entire block area is covered with soil/alluvium and plotted on the geological map.

#### 20.1.9 CEMENT GRADE LIMESTONE (CaO% $\geq 44$ , MgO% Max 3.50, SiO<sub>2</sub>% Max 16)

The massive grey limestone is of Cement Grade (Portland) to high grade intersected in the Zone I. Over all in all the five boreholes, the blendable and threshold limestone are  $+38\%$  CaO with  $+18.00$  SiO<sub>2</sub> and limestone is dark grey to light grey in colour, micritic, fine grained and compact.

Salient features for Zone-I is follows, the Portland Grade Limestone intersected in one borehole (MKG-05) out of the 5 drilled boreholes. thickness is minimum 6.00m (MKG-05). Average grade of Zone-I in the block is 47.26% of CaO, 0.45% of MgO and 13.87% of SiO<sub>2</sub>. The details of borehole wise zones are presented as **Annexures - IV A** and the same is presented as **Table No: 20.2**.

Table No: 20.2

CEMENT (PORTLAND) GRADE ZONE I

| Bh.No.               | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|----------------------|-----------|-------|-----------|--------------|-------------|--------------------|
|                      | From      | To    |           |              |             |                    |
| MKG-01               | -         | -     | -         | -            | -           | -                  |
| MKG -02              | -         | -     | -         | -            | -           | -                  |
| MKG -03              | -         | -     | -         | -            | -           | -                  |
| MKG -04              | -         | -     | -         | -            | -           | -                  |
| MKG -05              | 39.00     | 45.00 | 6.00      | 47.26        | 0.45        | 13.87              |
| <b>Average Grade</b> |           |       |           | <b>47.26</b> | <b>0.45</b> | <b>13.87</b>       |

The thickness distribution and its quality of cement grade (Portland) Zone-I has given as Text figure no.5.

20.1.10 BLENDABLE GRADE LIMESTONE

As per IBM guidelines. Blendable grade limestone zone was demarcated on CaO% range between  $\geq 38$  to  $\leq 44\%$  and MgO shall not be more than 6%. The blendable grade limestone bands are not intersected in all the drilled (5) boreholes.

20.1.11 THRESHOLD GRADE LIMESTONE

As per IBM guidelines. Threshold grade limestone zone was demarcated on CaO% range between  $\geq 34$  to  $\leq 38\%$  and MgO shall not be more than 6%. All the five boreholes have intersected threshold grade limestone bands. The threshold grade limestone bands are intersected in all the drilled (5) boreholes as one zone (Zone I), and the zone-wise salient features are tabulated in the following Table No.20.3. The details of borehole wise zones are presented as **Annexure - IV B**.

Table No: 20.3

THRESHOLD GRADE-I LIMESTONE

| Bh. No. | Depth (m) |       | Thick (m) | CaO %        | MgO %       | SiO <sub>2</sub> % |
|---------|-----------|-------|-----------|--------------|-------------|--------------------|
|         | From      | To    |           |              |             |                    |
| MKG-01  | 4.00      | 45.00 | 41.00     | 39.17        | 0.59        | 27.15              |
| MKG -02 | 3.00      | 45.00 | 42.00     | 39.19        | 0.55        | 27.42              |
| MKG -03 | 2.50      | 45.00 | 42.50     | 38.80        | 0.59        | 27.74              |
| MKG -04 | 1.00      | 45.00 | 44.00     | 38.81        | 0.56        | 27.60              |
| MKG-05  | 2.50      | 39.00 | 36.50     | 39.82        | 0.54        | 25.87              |
|         |           |       |           | <b>39.14</b> | <b>0.57</b> | <b>27.20</b>       |

The Threshold Grade in this block is having average grade of 39.14% of CaO, MgO is 0.57% and 27.20% SiO<sub>2</sub>. Silica modules for Threshold Grade limestone is 9.67

### 20.1.13 RESOURCES

The total Net in-situ resource of Cement (Portland), Threshold grade limestone is broadly categorized under inferred and reconnaissance (333 & 334) resources the details of the same is furnished in the following table. The total inferred category resource of Cement (Portland) Grade is 5.34 million tonnes, Threshold Grade Resource is 283.09 million tonnes and total reconnaissance category resource of Cement (Portland) Grade is 12.98 million tonnes, Threshold Grade Resource is 211.80 million tonnes by cross sectional method.

**Table No: 20.4**  
**Summary of Category wise Net-Resource**

**Unit: million tonnes**

| <b>Category and UNFC Code</b> | <b>Cement (Portland) Grade</b> | <b>Threshold Grade</b> | <b>Total</b>  | <b>Percentage</b> |
|-------------------------------|--------------------------------|------------------------|---------------|-------------------|
| 333                           | 5.34                           | 283.09                 | 288.43        | 56.20             |
| 334                           | 12.98                          | 211.80                 | 224.78        | 43.80             |
| <b>Total</b>                  | <b>18.32</b>                   | <b>494.89</b>          | <b>513.21</b> | <b>100.00</b>     |

The net-inferred category resource is 288.43 (56.20% of total Net resource of 513.21) million tonnes.

The resources of limestone for different grades have been estimated borehole wise, section wise, polygon wise and zone wise.

### 20.2.0 RECOMMENDATIONS

20.2.1 Total Net in-situ Resources of Cement (Portland) Grade resource is 18.32 million tonnes with an average grade of CaO 47.26%, MgO 0.45% and SiO<sub>2</sub> 13.87% and Threshold Grade resource is 494.89 million tonnes with an average grade of CaO% 39.13%, MgO% 0.57 and SiO<sub>2</sub>% 27.16 have also been established.

20.2.2 The exploration is carried out as per Mineral (Evidence of Mineral Contents) Rule-2015, Mineral Auction Rule-2015, MMDR Amendment Act - 2015 and in accordance with the Minerals (Evidence of Mineral Contents) Amendments Rules 2021.

20.2.3 This level of exploration will facilitate the State government of Karnataka for auctioning of block under Mining Lease after further exploration of few more borehole to explore the Cement Grade Limestone bellow 45.00m.

As per the recommendation by the Committee the maximum depth of the borehole was restricted to 45.00m only. Cement Grade limestone intersected from 39.00m to 45.00m in the MKG-05 only. Rest of the 4 boreholes were intersected by Threshold limestone

immediately after soil cover up-to the maximum explored depth of 45.00. Hence an additional 5 boreholes are to be drilled up to 100.00m depth to establish additional resources of Cement Grade Limestone.

- 20.2.4 Gypsum replacing calcite is not observed during present exploration, however acid insoluble test for the generation of chemical plots are recommended for future work (G2/G1).
- 20.2.5 The study area suggests that any future mining project may generate employment for the local people and will increase socio-economic status of the people residing in the nearby areas.
- 20.2.6 As approved, 5 boreholes were drilled; and resources are estimated in Inferred Category (333) & Reconnaissance (334) Category as per UNFC. However, the confirmation of resources at higher confidence level, five more boreholes should be drilled at 400 intervals. One Stratigraphy borehole may be needed to drill in this block to intersect the contact with Rebanpalli clastics.

## REFERENCES

1. The Bhima Basin Geological Map by GSI and in Kalaburagi and Bijapur Districts of Karnataka and Ranga Reddy district Andhra Pradesh in Parts of Degree Sheets 56 C, D, G, and H Scale 1:150,000, 2007, published by GSI.
2. Directorate of Mining & Geology (DMG), Karnataka explored the adjoining area in detail in the year 1976 with the purpose of proving cement grade limestone in the area. The results of investigation are given in the report entitled “Limestone Deposits immediately to the East of Chittapur, Kalaburagi District of Karnataka.”
3. Jayaprakash A.V, F.S.1974-75, Preliminary investigation for Flux Grade and Cement Grade Limestone around Wadi, Kalaburagi District, Karnataka. (GSI)
4. The F.S. 1976-77, GSI carried out preliminary investigation for Flux grade Limestone near Wadi, Kalaburagi district Karnataka.
5. Jayaprakash A.V, F.S.1977-78, Preliminary investigation for Flux Grade and Cement Grade Limestone in Bhima Basin, Kalaburagi District, Karnataka. (GSI).
6. Pattabhiramaiah N.R, D.S. Malkai, 1978, Preliminary Report on the Feasibility of Establishing a Cement Factory in Malkahid, Sedam Taluk, Kalaburagi District.
7. The G-2 level of exploration by GSI in Bommanalli Limestone Block.
8. The G4 level of exploration in Chitapura SW Block and Sulahalli Limestone Block
9. Mining activities are currently ongoing in surrounding areas and limestone being excavated for manufacturing of cement.
10. MSTC E commerce Website
11. Geological Report on Preliminary Exploration (G3) for Limestone in Diggaon Block, Sedam Taluka, Kalaburagi District, Karnataka by MECL.
12. Geological Report on Preliminary Exploration (G3) for Limestone in Udagi Block, Sedam Taluka, Kalaburagi District, Karnataka by MECL.
13. District Profile document from district website

## CERTIFICATE

This is to certify that geological report in respect of Kiranagi -2 Block (G-3) approved by 28<sup>th</sup> E.C. of NMET held on 28<sup>th</sup> March 2023. Exploration has been carried out in the said block at G-3 stage and estimation of limestone resources has been prepared by integrating the exploration data generated during drilling and exploration reports of nearby areas in Kalaburagi District, Karnataka by Mineral Exploration and Consultancy Limited (MECL) on behalf of Department of Geology and Mining (DGM), Karnataka. The report has been prepared in accordance with the Minerals (Evidence of Mineral Contents) Rule 2015 specified under Mineral Auction Rule, 2015 and amended up to 2021.

**GENERAL MANAGER (EXPLORATION)**

Date 28/02/2024