Reconnaissance Survey (G4) for Basemetal in Burogaon-Biltala-Mogan areas, Lalitpur district, Uttar Pradesh under NMET

(Basemetal)

By

Geovale Services Private Limited

Place: Kolkata

Date: 7th January, 2025

Contents

Summary of the Block for Reconnaissance Survey

(G4 Stage)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	Details
	Block ID	GSPL/NMET/UP/2024/BLOCK-1
	Exploration Agency	Geovale Services Private Limited
	Commodity	Basemetal
	Mineral Belt	Bundelkhand craton
	Completion Period with entire Time schedule to complete the project	18 months
	Objectives	(i) To explore for mineralization potential for Cu, Mo, Au, tellurides in and around Burogaon-Biltala-Mogan region (ii) Identify basemetal mineralization targets for Geological Resource (G3) assessment
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	The exploration will primarily be carried out by the proposed agency. Some elements of the exploration program like sample assay, drilling etc. will be outsourced (details mentioned in the exploration plan). The name of outsourced agencies and the components to be outsourced will be decided based upon the results from early stages of exploration.
	Name/ Number of Geoscientists	
	Expected Field days (Geology)	Total field man-days (Geologist): approximately 240 man-days

	Geological Party Days	Geological Party Days: Approximately 6 months in phases
1.	**Location**	
	Latitude (N)	24.749968° to 24.918150°
	Longitude (E)	78.608435° to 78.749834°
	Localities	Burogaon, Tera, Gugarwara, Mirchwara, Biltala, Banpur
	Tehsil/ Taluk	Mahrauni and Lalitpur
	District	Lalitpur
	State	Uttar Pradesh
2.	**Area (hectares/ square kilometers)**	
	Block Area	166 square kilometers
	Forest Area	-
	Government Land Area	Not known
	Private Land Area	Not known
3.	**Accessibility**	
	Nearest Rail Head	Lalitpur Junction
	Road	NH-25 and NH-26
	Airport	Gwalior Airport, Raja Bhoj International Airport
4.	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	Dendritic to sub-parallel
	Rivers/ Streams	Shahzad, Sajnam and Jamni Rivers
5.	**Climate**	
	Mean Annual Rainfall	128.56mm (5.06in)

	Temperatures	Minimum (January): 11.71ºC / 53.08ºF Maximum (May): 42.46ºC / 108.43ºF
6.	**Topography**	
	Toposheet Number	54L/9 (Plate 4)
	Morphology of the Area	This area is generally undulatory with inselbergs and long serrated ridges.
7	**Availability of baseline geoscience data**	
	Geological Map (1:50K/ 25K)	Available
	Geochemical Map	Available
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Not Available in GSI Portal
8.	**Justification for taking up reconnaissance survey / Regional Exploration**	Bundelkhand craton spans over 29,000 sq. Km in central India (Pati, 2020). It mainly comprises of younger granite-granodiorite rock suites and older supracrustals of ages ranging from ~3.4 Ga to 2.5 Ga. Older granitoids belong to both sodic and potassic TTG clans and are restricted in large swaths along the E-W trending Bundelkhand Tectonic Zone in the central part of the craton (Fig.1). Younger granitic rocks belong to I-type and some S-type granites. These granites cover majority areas of the craton. These granites span a period of ~700 My between 1.9 Ga and 2.58 Ga (Pati et al., 2020). Two very conspicuous features of southern and western part of the Bundelkhand craton are: i. Extensive presence of advance argillic alteration represented by many pyrophyllite-diaspore deposits, and ii. The presence of many NNE-SSW trending Giant Quartz

Veins (GQVs) that continue for few tens of kilometers with a width of few tens of meters (Basu, 1986; Bhattacharya and Singh, 2013) (Fig.1). Commonly, GQVs and the locales of advanced argillic alteration are spatially associated.

Neither the advanced argillic alteration zones nor the GQVs are studied or characterized well to understand their genetic relationship, relations with the host granitoids, the fluids responsible for the extensive alterations. There is a strong possibility that such large tracts of advanced argillic alteration represent either high sulphidic alteration (commonly associated with porphyry Cu-Mo-Au deposits), or chloride-dominated acidic alteration (commonly associated with Iron Oxide Cupper Gold/IOCG type of deposits). The GQVs on the other hand, are related to extensive hydrothermal activity associated with some epigenetic mineralization.

Some previous reports of Au, Mo and Cu mineralization incidences in the area exist (Pati et al., 2014; Pati et al., 1997; Singh and Singh, 1986). A few of these reports are later followed up by geophysical surveys and detailed geochemical analyses. Some test drilling was also carried out in the Palar area located in the northern of the present block (Absar et al., 1999). The test drillings were not successful in locating any substantial base-metal or gold mineralization. However, the drilling data indicated a strong possibility of finding base metal and gold mineralization at depths beyond the drilled depth. As such Absar et al (1999) recommended continuing further exploration in the area.

GSI's NGCM data show positive anomaly (i.e >5 times crustal abundance) for elements like Au, As and Bi in different parts of the block (Fig.2).

		In view of positive leads provided by earlier workers, the Geovale team attempted a Mineral System Analyses (MSA) based on available data. Such analyses also hint at good possibility of undercover Cu-Mo-Au-telluride deposits in the area. A summary of the prospectivity analyses of the area in a Mineral System Analyses (MSA) framework is given in section II (page 11).

DETAILED DESCRIPTION OF THE BLOCK

I. Block Summary

Physiography

The study area falls in the southernmost part of Uttar Pradesh and in the north-eastern part of the Lalitpur district. It is a part of Southern Bundelkhand plateau having general slope in north-easterly direction. This area is generally rocky and undulatory with inselbergs and long serrated ridges, having a highest ground in the extreme south with scraps of the Vindhyan plateau and gradually breaking up into a confined mass of hills, parts of which approach a height of 650 m above average mean sea level. The principal rivers traversing the area are the Shahzad, the Saznam and the Jamni. Jamni is one of the vital tributaries of River Betwa that finally goes on to meet the river, Yamuna. The General flow direction of rivers is towards North to North –East and follows the slope of the area. In general drainage pattern is dendritic to sub-parallel in nature.

Boundary Coordinates:

Corner Points	Latitude	Longitude
A	78.7497	24.8582
B	78.7500	24.7500
C	78.6085	24.7976
D	78.6449	24.8536
E	78.6115	24.8733
F	78.6250	24.9184

Background Geology (Regional Geology, Geology of the Block)

Regional geology:

The study area is an integral part of the Bundelkhand Craton also known as Bundelkhand Granitoid Complex (BGC). The BGC covers 29,000 km^2, lying between 24°11' to 26°27' N and 78°10' to 81°24' E, represents a semicircular outcrop (Fig.1). Broadly, it is delimited by Great Boundary Fault (GBF) in the west and the Son-Narmada lineament in the south. The low-grade metamorphic rocks of the Bijawar Group (Paleoproterozoic) occur to the south, southeast, and the Vindhyan Supergroup (Meso-to Neoproterozoic) occur to the southeast, south, southwest, and west.

The granitic rocks of the BGC mainly comprise of granite-granodiorite rock suites and supracrustals of different ages ranging from ~3.4 Ga to 2.5 Ga. The older granitic suites and supracrustals are concentrated as large swaths along the central part of the craton marking the Bundelkhand Tectonic Zone (BTZ). They are characteristically well foliated and are dominated by TTG gneisses with minor supracrustal represented by amphibolite, BIF, meta-ultramafics, calc-silicate rocks etc.

The younger granitic rocks mostly span a period of ~700 My between 1.9 Ga and 2.58 Ga (Pati et al., 2020). These younger granitic rocks cover the majority of the areas of the Bundelkhand craton. They are represented by different varieties of granite like mozogranite, syenogranite, high potash anatectic granite, granodiorite etc.

There are over 15 major quartz reefs spaced at 12.5 km to 19 km apart with width of 50 to 60 m and average length of 35 to 40 km are seen in BGC. Dolerite /gabbro dykes intrude all the granitic rocks representing the last phase of granitic activity. They predominantly trend in NW – SE direction. These quartz reefs are the most prominent litho-units in the area as these form linear hills/ridges rising sharply above the ground. They are generally white to buff in color and generally show pinching and swelling nature.

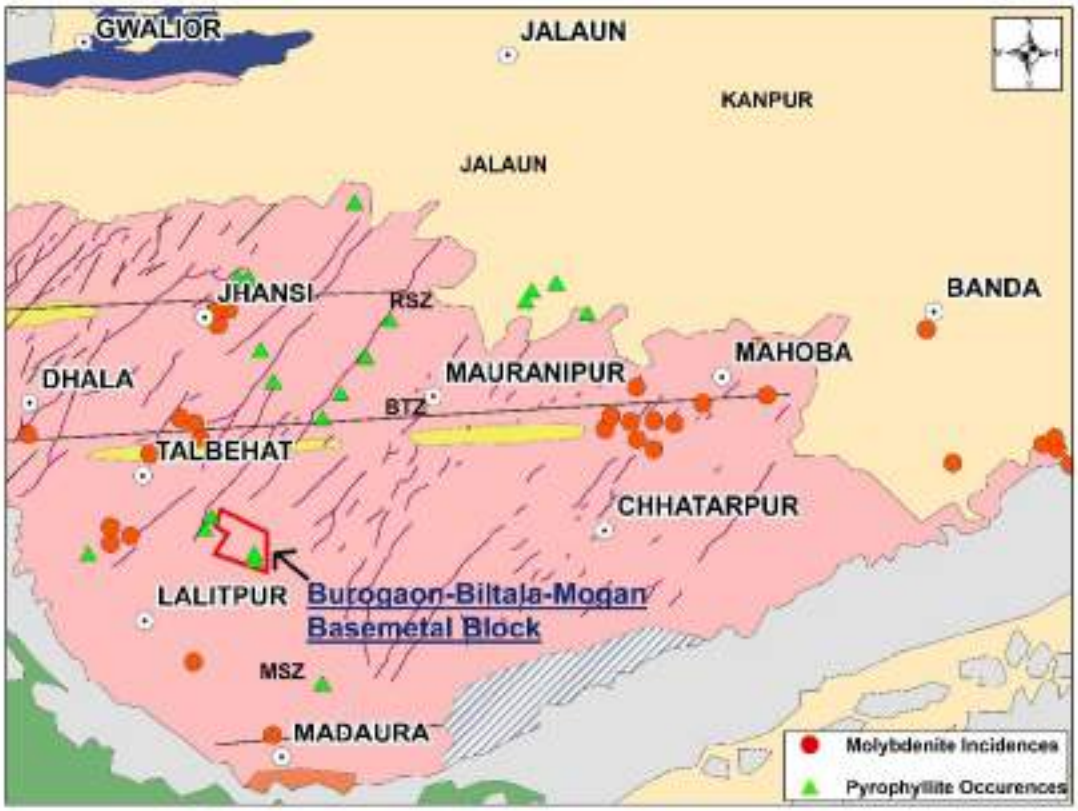

Figure 1. Geological map of Bundelkhand craton. Note: Dense array of Giant Quartz Veins (GQV) shown in red lines. Outline of the proposed Burogaon-Biltala-Mogan block is marked by red line.

Geology of the proposed block:

The proposed block is largely occupied by massive (non-foliated) granites of different modal composition (Plate 1). They include the following:

i. Fine and medium grained pink granite
ii. Fine to medium grained grey granite
iii. Porphyritic pink and grey granite
iv. Coarse porphyritic pink and grey granite
v. Dolerite dykes and quartz veins

Apart from one or two small patches, these granites are largely devoid of supracrustal enclaves. Beside one major GQV trending NE-SW near Tera region, there are many smaller GQVs that mostly trend NE-SW but also present as E-W trending veins, in the northern part of the block (Plate 1).

Mineral potentiality of the block based on geology, geophysics, ground geochemistry, etc.:

1. Presence of several modal varieties of massive granites in the small area of the large Bundelkhand batholith indicate fractional crystallization in this area, making it potentially fertile (Plate 1).

2. Presence of extensive quartz veins including the GQV in extensional tectonic regimes and their association with pyrophyllite deposits in this area indicate large scale advanced argillic alteration. Such large-scale alteration of the area might have been caused by high sulphidation alteration associated with porphyry Cu-Mo-Au type of deposits or chloride dominated alterations usually associated with IOCG type of Cu-Au-U-Fe deposits.

3. The proposed block has anomalous value for Au and other associated semi metals like As and Bi (Fig.2).

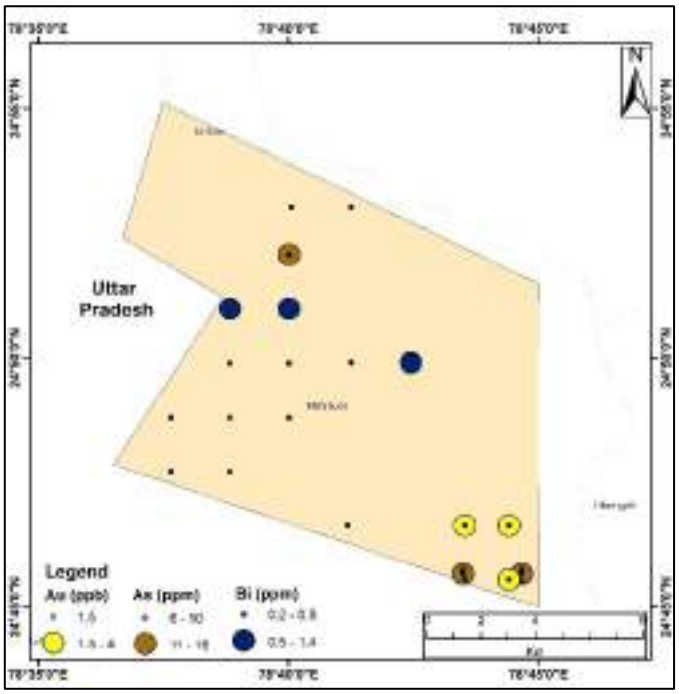

Figure 2 NGCM values of the project area

The above points indicate good potential for either porphyry type of Cu-Mo-Au mineralization or IOCG type of mineralization along with epithermal Gold-Telluride mineralization in the area. In view of such mineralization potential of the area for porphyry copper/IOCG/vein-type gold deposits as indicated above, the area needs to be studied for its fertility and mineralization in a Mineral System Analysis Framework.

II. Observation and Recommendations of previous work:

Previous reports of mineralization in the adjoining area:

a. Pati et al., (2014) reported molybdenite mineralization in granitic pegmatites, coarse grained pink porphyritic granite, medium grained grey granites and medium grained pink granites, predominantly associated with Bundelkhand Tectonic Zone in the southern part of Babina which lies adjacent to the block.

b. Incidences of gold in the neighboring areas, like that of Talbehat region by Pati et al., (1997), is another important report of mineralization.

GSI's NGCM mapping in this area:

The proposed area is covered by GSI's NGCM survey. The Cu (max- 489 ppm) -Mo (max-8000 ppm) show high values along with the high values for Co (upto 8855 ppm), Cr (upto 2602 ppm), Ni (upto 1038ppm), Pb (upto 313 ppm), Sr (upto 1183 ppm), Th (upto 474ppm), V (upto 1167ppm), Zn (upto 556ppm), As (upto 982ppm), F (upto 1060 ppm), Hg (upto 422 ppb), W (upto 444 ppm) U (upto 61ppm) and B (upto 467ppm) Analysis of NGCM data reveal high mercury (>10ppb), high arsenic (>10 ppm), high antimony (>1ppm) in a large area in the southern part of the proposed block. (Fig. 2) Anomalous gold (10-200 ppb) and bismuth (>0,5 ppm) are also present in some areas of the toposheet no 54L/5 and 54L/9.

GSI's NGPM mapping in this area:

Regional gravity-magnetic surveys over the proposed area have been carried out to configure subsurface geological structures and provide data input for National Geophysical Mapping Programme (NGPM). Broad gravity and magnetic low zones are aligned to the direction of older enclave rocks in the area. High gradient zone in gravity anomalies indicate the boundaries between lithologies of coarse grained granite, granite gneisses, medium grained granites, fine grained granites, porphyritic granite and older metamorphic rocks (Singh et al. 2016).

High variation in Bouguer gravity data is indicative of a significant change in the composition of rock types in the area.

The magnetic (TF) anomaly values are low in the northern part and high in the southern part. It indicates dominance of metasediments with more mafic contents in the southern part of the area as compared to the northern part.

Previous Exploration in adjoining area (Regional area):

a. It may be noted that back in late 1990s GSI pursued the possibility of tracking down a porphyry copper deposit by drilling down some of the GQVs of the Palar-Gaurari area (about 50 km north of the present block) that are associated with advanced argilllic pyrophyllite-diaspore alteration (Absar et al., 1999). They conducted total 8 boreholes totalling 1849m, the deepest one being 632m. A significant finding of the work had been identification of systematic alteration zones usually associated with porphyry copper system. In one of the deep boreholes, the advanced argillic alteration was followed down the depth by chloritic alteration, sericitic alteration and potassic alteration. Another significant finding is the increase in copper concentration down the depth of the boreholes. The authors made a strong recommendation for pursuing exploration to target a possible porphyry copper deposit further down the depth. Back in 1990s such effort of tracking down the porphyry copper deposit by following alteration zones was an incredible effort.

However, a scrutiny of the planning of the boreholes in the area as well as chemical assay obtained in the light of present day understanding of porphyry copper deposit model brings out following deficiency in the approach:

i. The authors assumed that porphyry copper would be associated with quartz reefs associated with advanced argillic alteration. This assumption is not well founded. Porphyry copper are commonly associated with potassic and sericitic alteration that formed at hydrothermal temperature range of ~550°C. Advanced argillic alteration and associated quartz reef represent an alteration temperature range of ~250°C and are unlikely the host for porphyry copper deposits.

ii. The drill plan was not based on a prior study of surficial (or shallow subsurface) alteration mineralogy studies. Had this been done, drilling points could have been judiciously selected to intersect a zone of alteration representing a temperature range of ~550°C that is likely associated with porphyry copper deposits.

iii. The quartz reefs on which most of the drilling was conducted represent a hydrothermal alteration at ~250°C that are likely locales for gold-telluride deposition associated with porphyry copper systems. However, gold and telluride assay were not conducted in the borehole core samples.

b. In January 2022, MECL carried out a G4 level exploration programme in 45 sq. km area within the proposed block for copper, lead, zinc and gold in the Laron area using NMET fund. This

c. project included geological mapping, geophysical survey (gravity and magnetic), geochemical sampling, trenching and drilling (5 nos. boreholes of maximum 100m depth each) within a GQV. However, initial results of this exploration program by the MECL were not encouraging for Cu, Pb, Zn and Gold (Au) and the program was stopped mid-way.

A critical analysis of the MECL's work brings out the following:

(I) The exploration programme was based on the assumption that GQVs would host the copper, lead, zinc and gold mineralization. This assumption is fundamentally weak. Usually, in the case of a porphyry system, the zones at the boundaries between the potassic and sericitic alteration host copper mineralization. An alteration mineralogy and alteration geochemistry mapping should have guided the drill site selection so as to intersect boundaries between potassic and sericitic alteration zone.

(II) On the other hand, parts of the quartz vein might be important for gold mineralization but, here also a prior phase mapping of the GQVs were necessary. Phase mapping would indicate zones of physiochemical breaks during the emplacement of quartz veins that usually host gold mineralization.

(III) Only 5 samples were analysed for fire assay gold analysis. This is too little data for an assessment of gold mineralization potential of the area.

(IV) Alteration zone mapping and phase mapping of quartz veins are to be made pre-requisite study to guide drill site selection.

Highlights of Geovale's exploration work in adjoining Mailar area, which is about 20 km west from this proposed exploration block:

1. High values of copper and zinc along with zones of advanced argillic, sericitic and potassic alteration have been identified through alteration mineralogy mapping in Mailar area.

2. Presence of high-sulphidation (epithermal) quartz lode mineralization in Gulenga area with highly anomalous values of zinc, lead and copper vales in the bed rock.

Knowledge gaps for prospectivity analyses in a Mineral System Framework:

i. Even though extensive occurrences of advanced argillic alteration and GQVs are reported for long time, there is no work to characterize such alteration in terms of their alteration temperature, depth of alteration and fluids responsible for such alteration. It is important to understand the fluid composition for such advanced argillic alteration, whether sulphidic, chloritic or carbonic fluids. Such fluid environment is commonly associated with distinctive mineralization styles. Thus, a sulphidic alteration is commonly associated with porphyry mineral system, a chloritic alteration is commonly related to IOCG type of mineralization etc.

ii. Timing is GQV is interpreted to be between 2.0 Ga to 1.5 Ga in age based on some conjectural arguments (Sukla and Pati, 1997). It is necessary to date the alteration and GQVs by some robust techniques (hydrothermal zircon etc.). A porphyry system can only be a plausible explanation if the timing of alteration matches with some major intrusion.

iii. Much of the present area is covered (~80%), which presumably holds much information on fertility vector and alteration. Such areas need to be probed (by shallow drilling, pitting etc.) regionally for proper area selection.

iv. Granitoids need to be analysed for fertility vectoring.

v. A high-resolution magnetic survey would be necessary for aid to mineralization potential analyses.

II. Prospectivity analyses of the Burogaon-Biltala-Mogan exploration block in a Mineral System Analyses framework:

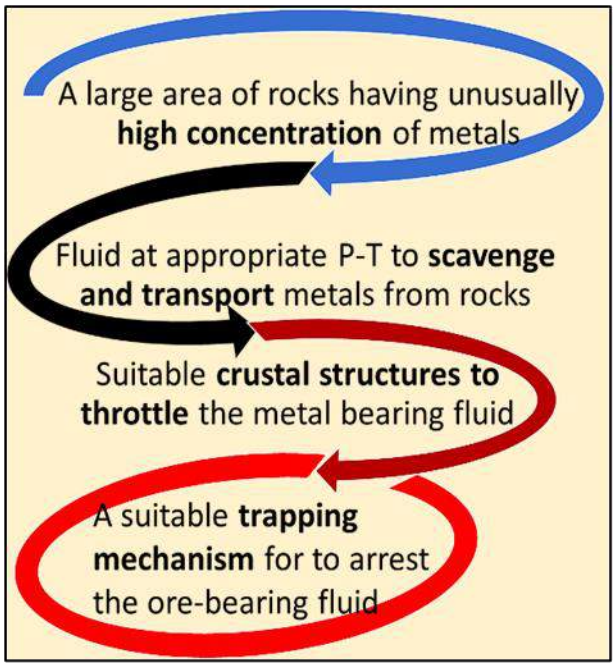

Figure 3.Principal components of Mineral System Analysis (MSA) and their relationship

A mineral system analyses revolves round four important components (Fig. 3)

(i) A fertile host rock terrain

(ii) Fluids to scavenge metals from fertile host rocks

(iii) Tectonic force and architecture to channelize the metal bearing fluids and

(iv) Suitable structural or lithological traps

(i) Host rock fertility of the area:

The host rock for a possible mineralization in the area include both Archean older foliated TTG granitioids and supracrustals as well as the younger and more extensive non-foliated granites. The older TTG suite of rocks show modal variation from dioritic to granitic composition. Both sodic and potassic variety of TTG are present and have moderate to high $(La/Yb)_{CN}$ and Sr/Y values (14.7-33.5 and 5-99, respectively) (Ram Mohan et al., 2017) indicating their derivation from partial melting of hydrous basaltic mantle rocks. They are potentially fertile for Cu-Mo-Au. Younger granitic rocks mostly span a period of ~700 My between 1.9 Ga and 2.58 Ga (Pati et al., 2020). They are represented by different varieties of granite like monzogranite, syenogranite, high potash

anatectic granite, granodiorite etc. Of late there has been a number of publications available for the area that deals mainly with geochemical evolution of the granitoids of the Bundelkhand craton (Ram Mohan et al., 2012; Joshi et al., 2017; Singh et al., 2019). The granites have been interpreted to have formed in a sub-arc subduction setting (Ramiz and Mondal, 2017). However, much published works browse through the generalities of evolution of the granitiods of the Bundelkhand craton and lack treatment of granites of different time separately in their spatial evolutionary framework. Thus, such data are of not much use for a fertility analysis of granitiods of different times. Nevertheless, a large modal variation of younger granitoids, their general lack of enclaves and derivation in a supra-subduction setting are favourable indications for a Cu-Mo-Au host environment.

(ii) **Fluids to scavenge metals**:

The principal mover for considering the Burogaon-Biltala-Mogan block as a potentially mineralized area is the large-scale presence of pyrophyllite-diaspore alteration and spatially associated Giant Quartz Veins (GQVs). Pyrophyllite-diaspore association ominously indicate advanced argillic alteration due to passage of highly acidic hydrothermal fluids through the area. Advanced argillic alteration is typically found in high-sulfidation (or high-chloride dominated) epithermal systems at shallow depths where K^+/H^+ and Na^+/H^+ activity ratios as well as temperatures of aqueous hydrothermal fluids are very low, resulting in the formation of minerals such as alunite (in case of high sulphidic fluid) or scapolite (in high hydrogen chloride dominated fluid) along with pyrophyllite at the higher temperature ends, and kaolinite, dickite, etc at lower temperatures. The formation of acidic hydrothermal fluids responsible for advanced argillic alteration assemblages can occur through several processes. At depth, a degassing magma releases aqueous fluid rich in SO_2, H_2S, or HCl that can remain as a single fluid phase or may undergo exsolution to produce a liquid brine and low-salinity vapor phase if the pressure decreases. Ascending magmatic vapor may condense where it encounters cooler, shallow meteoric water to form low-pH, moderate-temperature fluids that produce acid-sulphate high-sulfidation alteration characterized by alunite, quartz, pyrophyllite, and dickite (Al). Ascending dilute, nearly neutral, low-temperature (200-300°C) fluids typical of low-sulfidation environments can boil upon ascension. Vapours produced by such boiling condensation at 100°C produce steam-heated acid-sulphate alteration typified by alunite, kaolinite, and chalcedonic or opaline silica.

Current models of porphyry copper deposits propose that a shallow, epithermal ore environment may lie above a porphyry copper system that servers as the discharge area for deep-seated ore-bearing fluids (White and Hedenquist, 1995; Hedenquist et al., 1998). Thus, possibility exists for a whole range of mineral system from porphyry copper (in case the fluid is high sulphidic fluid) or IOCG type deposits (in case the fluid is hydrogen chloride dominated) at depth (1-5km) to

epithermal deposits of gold-tellurides might exists along with low-sulphidation or advanced argillic alteration (at depths 0-3km). Usually, high-sulphidic alteration exists close to and above the porphyry copper alteration system. The low-sulphidic alteration, on the other hand, are developed away from porphyry copper alteration system, usually within a spatial distance of 5-10 km from the epicentre of porphyry system.

Presence of large tracts of pyrophyllite-diaspore alteration, kaolinite-cherts alteration, and large tracts of Giant Quartz Veins (GQVs) presents an excellent opportunity to work out different alteration styles associated with different hydrothermal fluid regime and temperature regime. Reconstruction of such alteration zones and systems could be used as a vector to the porphyry copper system or IOCG system. The work would involve characterizing the distribution and mineralogy of advanced argillic, sericitic, kaolinitic alteration in the area to deduce physiochemical conditions of hydrothermal alteration and attempt to link the timing and origins of the causative fluids and their relationship with the deeper porphyry copper or IOCG environment.

(iii) **Crustal architecture to throttle mineralizing fluids**:

The strong NNE-SSW trending orientation bias of the GQVs and associated advanced argillic alteration is a favorable indication that the mineralizing fluids might have moved in response to some crustal extensional regime. This is a positive factor for localizing mineralization.

IV. Broad exploration approach as proposed:

Our present knowledge of hydrothermal activity in the area is based on the study of the exposed areas that constitute only about one-fourth of the area. Such areas would be studied for alteration minerology and alteration geochemistry for vectoring to possible mineralization.

The three-fourth of the area that is regolith covered might as well host significant hydrothermal mineralization. The exploration approach must give due weightage to this possibility. An elaborate work strategy is designed to study the regolith evolution and probe the in-situ regolith horizons by surface and subsurface regolith sampling. The decisions for detailed geophysical survey and drilling to track down mineralization would be based on geological and geochemical data and vectoring analyses carried out both in exposed areas as well as in regolith covered areas. Main aspects of exploration program would include the following and is illustrated in Fig.4.

i. Regional geochemical fertility, alteration analyses and physicochemical conditions of emplacement of granitic rocks and GQVs. As much of the area is under alluvial cover, it is proposed to hand auger or Geoslicer to access bedrock samples for fertility vectoring.

ii. Alteration study would include both alteration mineralogy to understand physicochemical conditions of alteration as well as alteration geochemistry for understanding of mass balance related to mineralization.

iii. GQVs would be mapped in detail in terms of their textures (field and petrography) to understand physicochemical breaks during their emplacement as such breaks are likely locales for gold-telluride mineralization.

iv. Existing NGCM data as well as mineral system analyses strongly suggest possibility of epigenetic Au-Mo-telluride mineralization associated with GQVs. However, since epigenetic golds are generally very fine grained and readily forms alloys, presence of gold-tellurides would be assessed by analysing clay-fractions (<2µm) of samples rather than bulk analyses or panning analyse.

v. Once a target zone for favourable alteration system is identified, detailed mineral chemistry variation would be used as a vectoring tool for mineral deposit.

vi. Exploratory drilling would be carried out after intensive mineralization vector analyses.

Innovative components of the proposed exploration:

Geovale proposes to carry out a G4 exploration in the area by exploring both the granitoid rocks and the GQVs. Exploration workflow for the Burogaon-Biltala-Mogan block would incorporate four modern and innovative components: (i) area reduction based on understanding of physicochemical conditions of hydrothermal fluids (alteration mineralogy and alteration geochemistry), (ii) understanding of physicochemical conditions of emplacement of quartz veins (phase mapping of quartz veins), (iii) Separation and analyses of soil-clay (<2µm) fractions for gold assay, (iv) bedrock/ saprock sampling in anomalous covered areas.

Exploration task flow:

As discussed above the prospective mineral system of the project area include both porphyry Cu-Mo-Au (alternatively, IOCG related) mineral system and an epigenetic gold-molybdenite-telluride mineral system. Modern understanding is that these two types of mineral systems could spatially and genetically related. Two broad task flow are designed: one for targeting gold-telluride mineralization associated with GQVs and the other for targeting porphyry copper/IOCG mineral system.

A flow diagram for the exploration plan is given in Fig. 4.

Scope of the present exploration:

The exploration task flow is proposed to be done in two phases, each having distinct tasks and milestone. A summary of activities and milestones in both phases of the proposed exploration is given below:

Phase I (Approximately 6 to 8 months):

[stage 1 to 3, in *Annexure-II*] For the total block area, fertility assessment will be performed by geochemical analyses of granites and by identifying mineralogical phase variations with intensity of alteration and marking out the intense alteration zones. Regional geological mapping at 1:12,500 scale, petrography and geochemistry of the exposed rocks will be done to determine the fertility vectors with special emphasis on the extensive alteration study in Burogaon-Biltala-Mogan. The area of exploration will also be reduced from this mapping stage. Regolith mapping will also be done in the covered areas to reinterpret NGCM data and to prepare the weighted geochemical anomaly maps.

Phase II (Approximately 10 to 12 months):

[stage 4 to 17, month in *Annexure-II*] This phase will be starting by narrowing down the anomalous area for geochemical mapping at 1:12,500 scale followed by petrography and geochemistry. Magnetic survey and EM survey will be performed in the identified anomalous mineralized targets for detection of drilling targets.

Core drilling will be done for litho-geochemical characterisation to identify and characterise potential mineralized zones/ore bodies. This would further lead to prioritize the targets and recommend it for Geological Resource assessment (G3).

Decision points

The exploration strategy incorporates the GO- NO GO milestones to be collaboratively decided between the Geovale Services, State of Uttar Pradesh and the NMET based on the results of the ongoing phases. The total duration of the work plan is 18 months. The exploration plan incorporates one decision point.

Progressing from one phase to another would be an internal/external decision point for the exploration program based on the results of the ongoing phase. Geovale Services would engage the State of Uttar Pradesh and the NMET to collaboratively decide about progressing through different phases of exploration program.

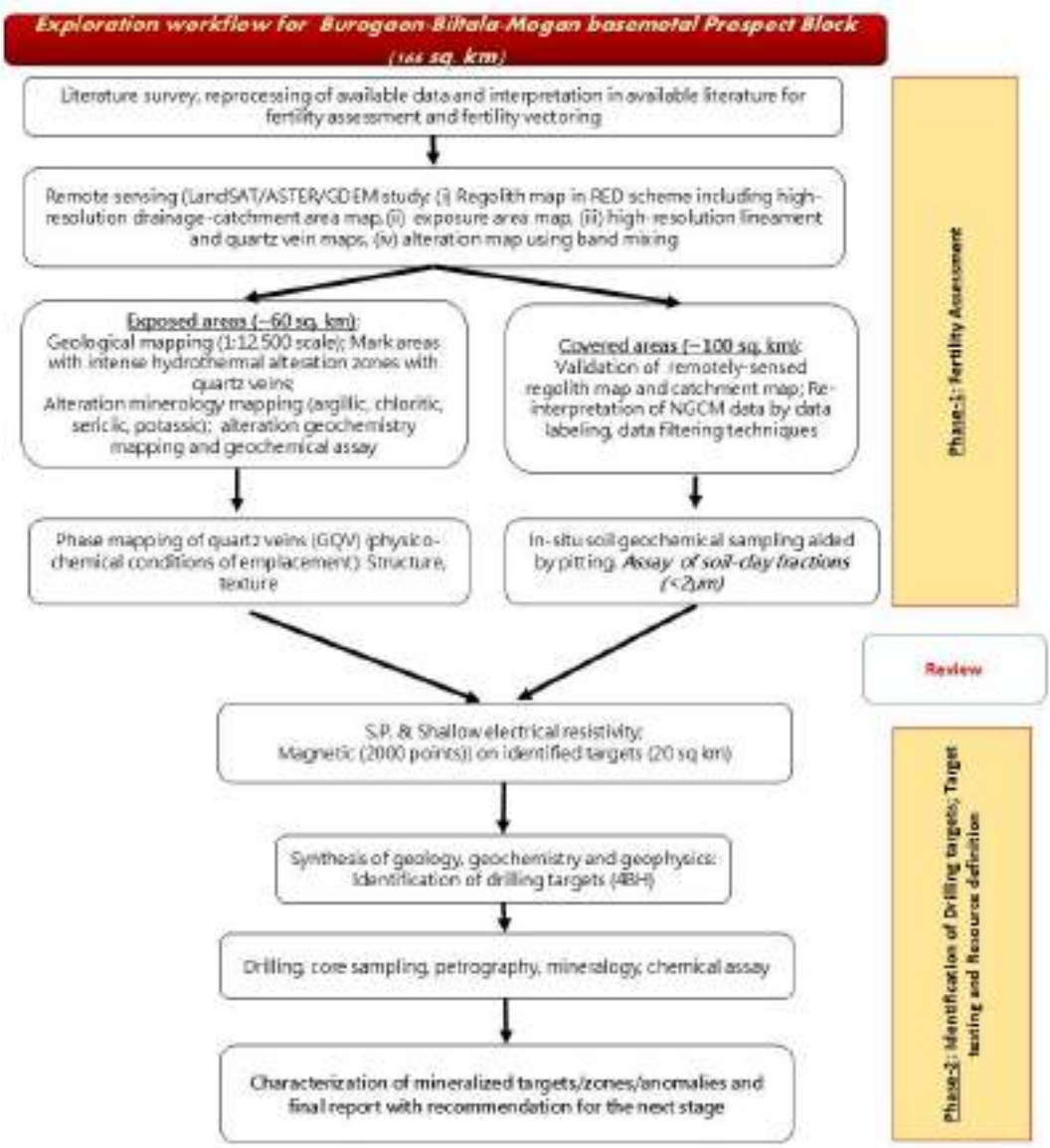

Figure 4. Exploration workflow for the Burogaon-Biltala-Mogan basemetal prospect block.

V. Nature Quantum and Target

A table containing the NQT table is given in *Annexure I*.

Borehole spacing (As per MEMC, 2015)

Type of deposit	Bedded Stratiform and Tabular deposit of regular habit minerals to be identified	Bedded stratiform and tabular deposits of irregular habit (Minerals to be identified)	Lenticular bodies occurring en echelon Lenses, pockets. (Different minerals)

G4 Stage	Not Applicable	Not Applicable	4 core drilling; 1 BH 400m, 3 BH 200m each
(Vertical depth of intersection of mineralized zone should be specified (first level), number of boreholes, approximate borehole spacing, approximate length of boreholes may be specified)			

Geophysical Studies

Geophysical studies may be introduced at a later stage based on reconnitory studies carried out in the area and on an understanding of the structural/ lithological control of the mineralization. S.P. & Shallow electrical resistivity (10-20 line km) and Magnetic survey (2000 points) will be done on identified targets for drilling target generation.

VI. Manpower Deployment

A table containing the manpower deployment table is given in *Annexure II*.

VII. Breakup of Expenditure

The breakup expenditure for each phase is given in *Annexure III.*

VII. Summary cost sheet

The summary cost sheet of expenditure for each phase is given in the table below.

Reconnaisance Survey (G4) for Burogaon-Biltala-Mogan Basemetal Prospect Block, Lalitpur district, UP		
Summary Expenditure		
Sl. No	**Item**	**Estimated Cost in INR**
1	Geological Work	4,754,420
2	Laboratory Studies	2,708,243
3	Petrological Studies	329,250
4	Geophysical Survey	5,160,000
5	Geological Work (Drilling)	14,037,600
6	Laboratory Studies (BH samples)	3,509,008
7	Petrological studies (After Review)	329,250
8	Exploration Proposal preparation	500,000
9	Report preparation	924,833
10	Peer review charges	30,000
11	GST (18%)	5,810,869
	Grand Total	**38,093,472**

VIII. Timeline

Time Schedule for Reconnaisance Survey (G4) for Burogaon-Biltala-Mogan Basemetal Prospect Block, Lalitpur district, UP																							
Sl. No.	Activities	Unit	MONTHS																				Total (Days)
			1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16	17	18		
1	Geologist Party days	day																					120
2	Sampling Party days	day																					120
3	Geologist Party days, HQ	day																					30
4	Laboratory Studies	Nos.																					60
5	Petrographic Studies	Nos.																					60
6	Geophysical Survey	day																					60
7	Geological Work (after review) (drilling)	m.																					30
8	Report Writing	day																					60
9	Peer Review	day																					60

Review

NOTE	
1	**Commencement of project may be reckoned from the day the exploration acreage is available along with all statutory clearances.**
2	**Time loss on account of monsoon/agricultural activity/forest clearance / local law & order problem/ lockdown etc will be additional to above time line.**

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List of Plates

Plate 1: Geological Map of Burogaon-Biltala-Mogan areas on 1:50,000 scale

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Plate 4: Accessibility Map of the Proposed G4 Burogaon-Biltala-Mogan Block on 1 : 50,000 scale.

Plate 5: Land Use Land Cover Map of the Proposed G4 Burogaon-Biltala-Mogan Block on 1 : 50,000 scale.

Plate 6: Proposed Burogaon-Biltala-Mogan Block over Topographic Map on 1: 50,000 scale.

Annexure- I

Title of Project - Reconnaissance Survey (G4) for Burogaon-Biltala-Mogan Basemetal Prospect Block, Lalitpur district, UP					
NQT table					
S.N	**Nature of work**	**Quantum**	**Unit**	**Target**	**Remarks**
1	**Geological Work**				
A	**Geological Mapping (1:12,500) & sampling**				166 sq km
a	Geologists (HQ) days (1 No)	60	one geologist per day	Identification of anomalous mineralized zones for detailed characterization	
b	Geologist field-days (2 No. geologists for 120 days)	240	one geologist per day		166 sq.km
c	Labor (Field days) (2 workers per geologist, i.e Total 4 No.)	480	per labour day		Amount will be reimbursed as per the notified rates by the Central Labor Commission or respective State Govt. whichever is higher
B	**Pitting**				
a	Pitting	250	per cu.m		No of samples 60 samples
2	**Laboratory Studies**				
A	**Geochemical Analysis for regional and detail survey**				40 BRS; 100 Auger drilling sample; 60

					pitting samples
a	XRF (major oxides)	100	per sample	Fertility assessment and target selection	10% of total sample
b	Check samples for XRF	10	per sample		
c	ICPMS (34 elements)	200	per sample		10% of total sample
d	Analysis for gold by fire assay technique	50	per sample		10% of total sample
e	Check samples	5	per sample		
f	XRD	50	per sample		10% of total samples
g	Sampler man-days	52	one sampler per day		
h	Labor (4 workers per sampler)	208	per labour day		Amount will be reimbursed as per the notified rates by the Central Labor Commission or respective State Govt. whichever is higher
3	**Petrological studies**				
a	Thin section preparation	50	per sample		
b	Microscopic study	50	per sample		
4	**Geophysical Survey**				

a	S.P. & Shallow electrical resistivity (10-20 line km)	20	per line km	To identify drilling targets	
b	Magnetic (20 sq km, 2000 points)	2000	per station		
c	Expert Charges for Geophysicist (Field)	40	Geophysicist per day		
5	**Geological Work (Drilling)**				
a	Core drilling up to 400m depth (4 BH)	800	per meter	Characterising potential anomalous targets	No of samples 300 samples
b	Core drilling between 301 to 400 m (1BH 200 to 400m)	200	per meter		
c	Land / Crop Compansation	4	per BH		
d	Transportation of Drill Rig & Truck associated per drill (2 rigs)- Two way	4800	km		
e	Monthly Accomodation Charges for drilling Camp	4	month		
f	Drilling Camp Setting Cost	1	Nos		
g	Drilling Camp Winding up Cost	1	Nos		
h	Approach Road making for rugget/hilly terrain	4	km		
i	Drill core preservation	800	per meter		

6	**Laboratory Studies**				
A	**Geochemical Analysis (BH samples)**				(200BHS)
a	XRF (major oxides)	100	per sample	Characterization and prioritization of mineralized targets/zones/anomalies	10% of total sample
b	Check samples for XRF	10	per sample		
c	ICPMS (34 elements)	300	per sample		
d	Analysis for gold by fire assay technique	50	per sample		10% of total sample
e	Check samples	5	per sample		
f	XRD	20	per sample		10% of total samples
g	EMPA	10	per hour		
h	Sampler man-days	61	per day		
i	Labor (4 workers per sampler)	243	per labor day		Amount will be reimbursed as per the notified rates by the Central Labor Commission or respective State Govt. whichever is higher
7	**Petrological studies (After Review)**				
a	Thin section preparation	50	per sample		
b	Microscopic study	50	per sample		

8	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	1	Lumpsum		This amount will be reimbursed after submission of the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCCNMET in its meeting while clearing the proposal.
9	Final report preparation	1	3% of project cost or 7.5 lakh whichever is higher		Final report submission, peer review and project conclusion
10	Report Peer Review	1	Lump sum		

Annexure- II

Manpower Deployment Reconnaissance Survey (G4 stage) for Basemetal -Prospect in Burogaon-Biltala-Mogan area, Lalitpur district, UP					
Activity	**Type of Job**	**Geologist HQ (mandays)**	**Geologist (mandays)**	**Labour (mandays)**	**Sampler (mandays)**
Geological Mapping, sampling and pitting	Field	10	240	688	52
Laboratory Studies	Field+desktop	10			
Petrographic Studies	Desktop	20			
Review					
Geophysical Survey	Field		40		
Core drilling, minerology and chemical assay	Field	10		243	61
Report Preparation and Recommendation	Desktop				
Discussion with State authorities and NMET	Desktop				

Annexure-III

Title of Project - Reconnaissance Survey (G4 stage) for Basemetal -Prospect in Burogaon-Biltala-Mogan area, Lalitpur district, UP
Name of the Exploration Agency - Geovale Services Pvt. Ltd.
Total Area - 166 sq. km; **Core drilling: 4BH 1000m (1 BH 400m, 3 BH 200m each)**;
Completion Time -18 Months, **Review:** 6 months & 12 months

S. N	Item of work	Unit	Rates as per NMET SoC		Estimated Cost of the Proposal		Remarks
			SoC-Item - Sl No.	Rates as per SOC	Quantum	Total Amount (Rs)	
1	**Geological Work**						
A	**Geological Mapping (1:12,500) & sampling**	166 sq km					
a	Geologists (HQ) days (1 No)	one geologist per day	1.2	9,000.00	60	540,000.00	
b	Geologist field-days (2 No. geologists for 60 days)	one geologist per day	1.2	11,000.00	240	2,640,000.00	2 geologist @120 days (4months)
c	Labor (Field days) (2 workers per geologist, i.e Total 4 No.)	per labour day	5.7	504.00	480	241,920.00	Amount will be reimburse as per the notified rates by the Central Labor Comission or respective State Govt. whichever is higher
B	**Pitting**						

a	Pitting	per cu.m	2.1.3	5,330.00	250	1,332,500.00	No of samples 60 samples
	Sub-Total 1					**4,754,420.00**	
2	**Laboratory Studies**						
A	**Geochemical Analysis for regional and detail survey**						140 BRS; 60 pitting samples
a	XRF (major oxides)	per sample	4.1.15 a	4,200.00	100	420,000.00	10% of total sample
b	Check samples for XRF	per sample	4.1.15 a	4,200.00	10	42,000.00	
c	ICPMS (34 elements)	per sample	4.1.14	7,731.00	200	1,546,200.00	10% of total sample
d	Analysis for gold by fire assay technique	per sample	4.1.5a	2,380.00	50	119,000.00	10% of total sample
e	Check samples	per sample	4.1.5a	2,380.00	5	11,900.00	
f	XRD	per sample	4.5.1	4,000.00	50	200,000.00	10% of total samples
g	Sampler man-days	one sampler per day	1.5.2	5,100.00	52	264,562.50	
h	Labor (4 workers per sampler)	per labour day	5.7	504.00	208	104,580.00	
	Sub-Total 2					**2,708,242.50**	
3	**Petrological studies**						

a	Thin section preparation	per sample	4.3.1	2,353.00	50	117,650.00	
b	Microscopic study	per sample	4.3.4	4,232.00	50	211,600.00	
	Sub-Total 3					**329,250.00**	
Review							
4	**Geophysical Survey**						
a	S.P. & Shallow electrical resistivity (10-20 line km)	per line km	3.3c	60,000.00	20	1,200,000.00	
b	Magnetic (20 sq km, 2000 points)	per station	3.2a	1,800.00	2000	3,600,000.00	
c	Expert Charges for Geophysicist (Field)	Geophysicist per day	3.18	9,000.00	40	360,000.00	
	Sub-Total 4					**5,160,000.00**	
5	**Geological Work (Drilling; In-house)**						
a	Core drilling up to 400m depth (4 BH)	per meter	2.2.1.4 a	11,500.00	800	9,200,000.00	No of samples 300 samples
b	Core drilling between 301 to 400 m (1BH 200 to 400m)	per meter	2.2.1.4 b	12,420.00	200	2,484,000.00	
c	Land / Crop Compansation	per BH	5.6	20,000.00	4	80,000.00	In house drilling 1200 km from Kolktata to Burogaon (2 rigs, 2
d	Transportation of Drill Rig & Truck associated per drill (2	km	2.2.8	36.00	4800	172,800.00	

	rigs)-Two way						trucks to and fro)
e	Monthly Accomodation Charges for drilling Camp	month	2.2.9	50,000.00	4	200,000.00	
f	Drilling Camp Setting Cost	Nos	2.2.9a	250,000.00	1	250,000.00	
g	Drilling Camp Winding up Cost	Nos	2.2.9b	250,000.00	1	250,000.00	
h	Approach Road making for rugget/hilly terrain	km	2.2.10 b	32,200.00	4	128,800.00	
i	Drill core preservation	per meter	5.3.0	1,590.00	800	1,272,000.00	
	Sub-Total 5					**14,037,600.00**	
6	**Laboratory Studies**						
A	**Geochemical Analysis (BH samples)**						(300BHS)
a	XRF (major oxides)	per sample	4.1.15 a	4,200.00	100	420,000.00	10% of total sample
b	Check samples for XRF	per sample		4,200.00	10	42,000.00	
c	ICPMS (34 elements)	per sample	4.1.14	7,731.00	300	2,319,300.00	
d	Analysis for gold by fire assay technique	per sample	4.1.5a	2,380.00	50	119,000.00	10% of total sample
e	Check samples	per sample	4.1.5a	2,380.00	5	11,900.00	

f	XRD	per sample	4.5.1	4,000.00	20	80,000.00	10% of total samples
g	EPMA	per hour	4.4.1	8,540.00	10	85,400.00	
h	Sampler man-days	per day	1.5.2	5,100.00	61	309,187.50	
i	Labor (4 workers per sampler)	per labor day	5.7	504.00	243	122,220.00	
	Sub-Total 6					**3,509,007.50**	
7	**Petrological studies (After Review)**						
a	Thin section preparation	per sample	4.3.1	2,353.00	50	117,650.00	
b	Microscopic study	per sample	4.3.4	4,232.00	50	211,600.00	
	Sub-Total 7					**329,250.00**	
	Total (Sub-Total 1-7)					**30,827,770.00**	
8	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	Lumpsum	5.1	2% of the cost subject to a maximum of 5 lakhs	1	500,000.00	
9	Final report preparation	3% of project cost or 7.5 lakh whichever is higher	5.2	For the projects having cost exceeding 150 lakhs but less than 300 lakhs-A	1	924,833.10	Final report submission, peer review and project conclusion

				minimum of 7.5 lakhs or 3% of the value of work whichever is more			
10	Report Peer Review	Lump sum	As per EC	30,000.00	1	30,000.00	
					Project Cost without GST	**32,282,603.10**	
					18% GST	**5,810,868.56**	GST will be reimbursed as per actual and as per the applicable notified rate
					Total Project Cost	**38,093,471.66**	

GEOLOGICAL MAP OF BUROGAON BILTALA MOGAN AREA

78°35'E 78°40'E 78°45'E

24°55'N 24°50'N 24°45'N

PLATE 1

N W E S

SCALE

1:50,000

2 1 0 2 4

Kilometers

Legend

Lithology

- AMPHIBOLITE
- CHLORITE SCHIST
- COARSE GRAINED, PORPHYRITIC GRANITE
- DOLERITE
- FINE GRAINED GRANITE
- FINE GRAINED PINK GRANITE
- GREY SAND, SILT AND CLAY
- MEDIUM GRAINED GRANITE
- MEDIUM GRAINED PINK GRANITE
- MIGMATITE
- PORPHYRITIC GRANITE
- PORPHYRITIC GRANITE GNEISS
- PYROPHYLLITE
- QUARTZ VEIN
- SILT-CLAY WITH KANKAR & RED QUARTZOFELPATHIC SAND

GEOVALE SERVICES

GEOLOGICAL MAP OF BUROGAON BILTALA MOGAN AREA WITH LOCATION INDEX

78°35'E 78°40'E 78°45'E

24°55'N 24°50'N 24°45'N

Paron
Bhailonisuba
Bhouragarh
Mastapur
Saimra dang
Chaturbhuji Temple
Khera
Vijaypur
Basatguwan
Khaira
Lalitpur
Thatkhera
Teela
Semarkhera
Kakdari
Mogan
UPCGCL Township
Udaipura
Karmai
Dangrana
Sayakheda
Tera
Billa
Untitled Placemark
Gugarwara

PLATE 2

N W E S

SCALE

1:50,000

2 1 0 2 4
Kilometers

Legend

Lithology

- AMPHIBOLITE
- CHLORITE SCHIST
- COARSE GRAINED, PORPHYRITIC GRANITE
- DOLERITE
- FINE GRAINED GRANITE
- FINE GRAINED PINK GRANITE
- GREY SAND, SILT AND CLAY
- MEDIUM GRAINED GRANITE
- MEDIUM GRAINED PINK GRANITE
- MIGMATITE
- PORPHYRITIC GRANITE
- PORPHYRITIC GRANITE GNEISS
- PYROPHYLLITE
- QUARTZ VEIN
- SILT-CLAY WITH KANKAR & RED QUARTZOFELPATHIC SAND

GEOVALE SERVICES

GEOLOGICAL MAP OF PROPOSED BUROGAON BILTALA MOGAN BLOCK WITH LOCATION INDEX

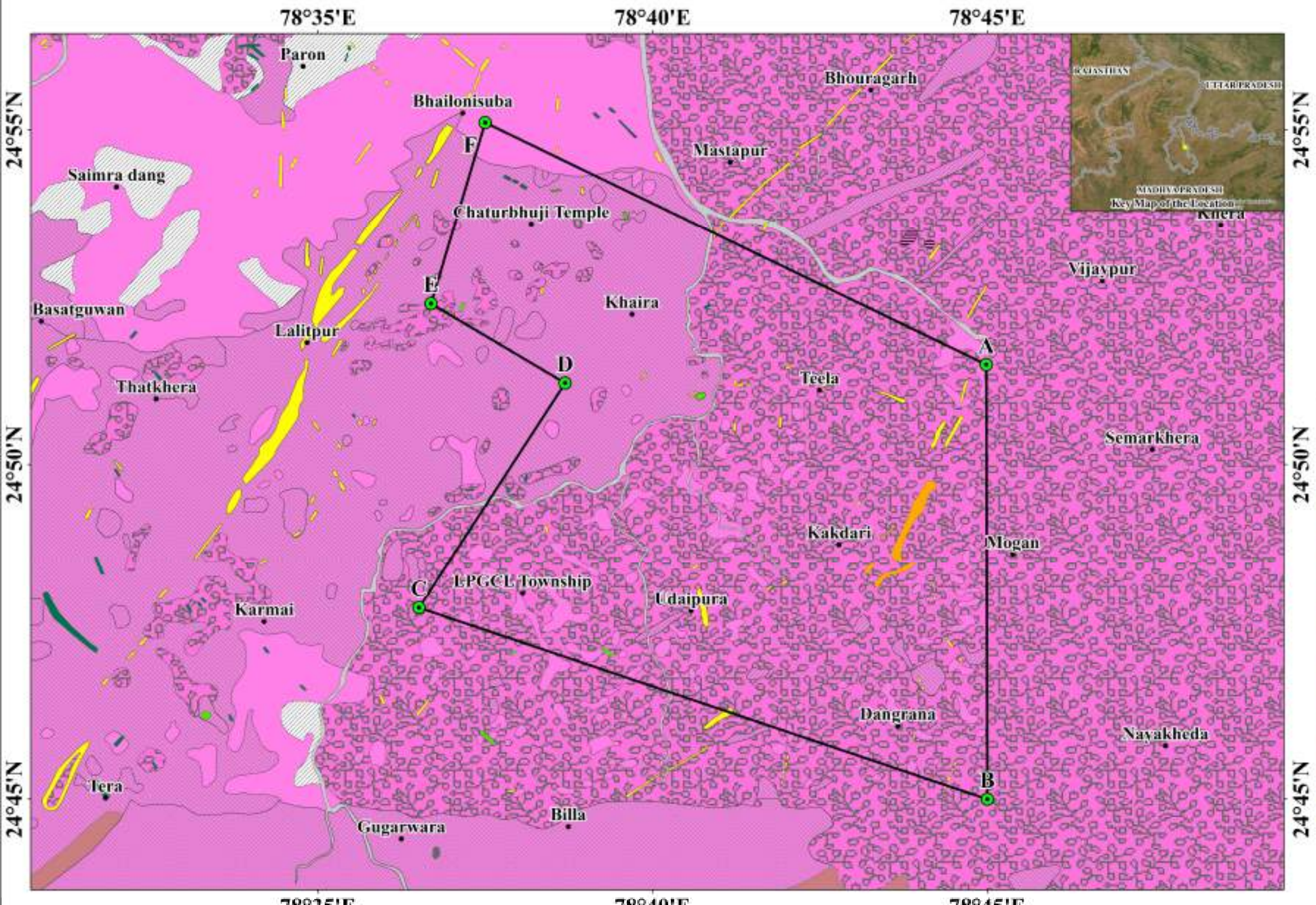

PLATE 3

N
W
E
S

SCALE

1:50,000

2 1 0 2 4
Kilometers

Legend

- Burogaon Biltala Mogan Block

Lithology

- AMPHIBOLITE
- CHLORITE SCHIST
- COARSE GRAINED, PORPHYRITIC GRANITE
- DOLERITE
- FINE GRAINED GRANITE
- FINE GRAINED PINK GRANITE
- GREY SAND, SILT AND CLAY
- MEDIUM GRAINED GRANITE
- MEDIUM GRAINED PINK GRANITE
- MIGMATITE
- PORPHYRITIC GRANITE
- PORPHYRITIC GRANITE GNEISS
- PYROPHYLLITE
- QUARTZ VEIN
- SILT-CLAY WITH KANKAR & RED QUARTZOFELPATHIC SAND

GEOVALE SERVICES

LOCATION ACCESSIBILITY MAP OF PROPOSED BUROGAON BILTALA MOGAN BLOCK

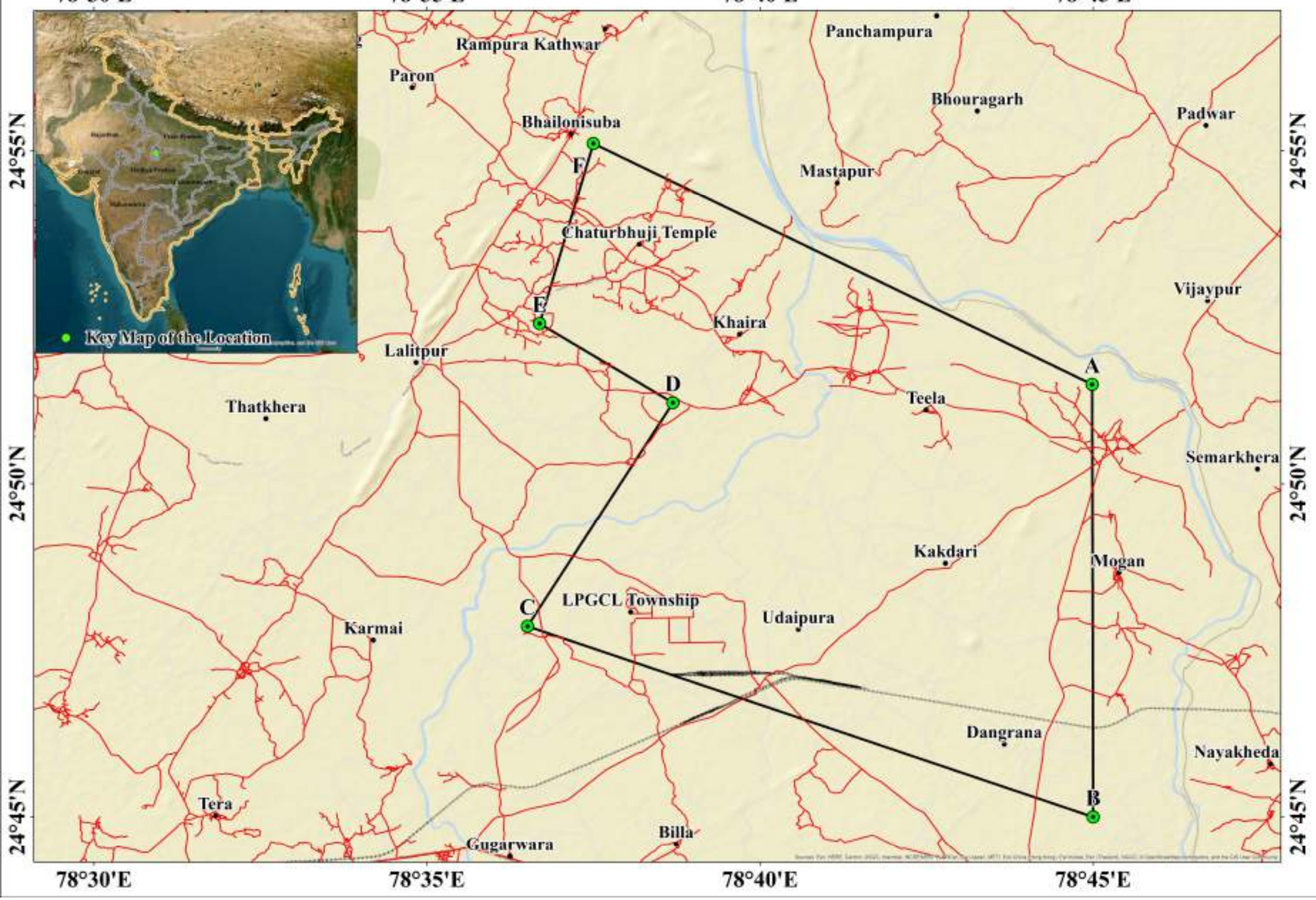

PLATE 4

N

W E

S

SCALE

1:50,000

2 1 0 2 4

Kilometers

Legend

Burogaon Biltala Mogan Block

Road Network

Railway Network

GEOVALE SERVICES

LAND USE LAND COVER MAP OF PROPOSED BUROGAON BILTALA MOGAN BLOCK WITH LOCATION INDEX

78°35'E 78°40'E 78°45'E

24°55'N 24°50'N 24°45'N

Paron
Bhailonisuba
Bhouragarh
Mastapur
Saimra dang
Chaturbhuji Temple
Khera
Vijaypur
Basatguwan
Lalitpur
Khaira
Thatkhera
Teela
Semarkhera
Kakdari
Mogan
LPGCL Township
Udaipura
Karmai
Dangrana
Nayakheda
Tera
Billa
Gugarwara

A
B
C
D
E
F

PLATE 5

N
W E
S

SCALE

1:50,000

2 1 0 2 4
Kilometers

Legend

Burogaon Biltala Mogan Block

Land Use Land Cover

- Built-up
- Crop land
- Barren land
- Vegetation
- Waterbody
- Wet land

GEOVALE SERVICES

TOPOSHEET MAP OF PROPOSED BUROGAON BILTALA MOGAN BLOCK

78°35'E 78°40'E 78°45'E

24°55'N 24°50'N 24°45'N

Paron
Bhailonisuba
Bhouragarh
Mastapur
Saimra dang
Chaturbhuji Temple
Khera
Vijaypur
Basatguwan
Khaira
Lalitpur
Teela
Thatkhera
Semarkhera
Kakdari
Mogan
LPGCL Township
Udaipura
Karmai
Dangrana
Nayakheda
Tera
Billa
Gugarwara

A
B
C
D
E
F

PLATE 6

N
W E
S

SCALE

1:50,000

2 1 0 2 4
Kilometers

Legend

Burogaon Biltala Mogan Block

GEOVALE SERVICES