

**Report On
Reconnaissance Survey (G4) for Diamond in Part of a Palaeo-
Channel in Krishna Basin Near Mangalagiri, Guntur District,
Andhra Pradesh
(Toposheet No. 65D/11)**

By



GEO MARINE SOLUTIONS PVT LTD

Earth, Ocean Science & Exploration Division,

15-17-909/9, 5th Cross Shivabagh, Kadri,

Mangalore-575005, Karnataka, INDIA

Email: mail@geomarinesolutions.in

www.geomarine.in

For



National Mineral Exploration and Development Trust (NMEDT)

Ministry of Mines

9th Floor, Jeevan Prakash LIC Building,

Kasturba Gandhi Marg,

New Delhi, 110001

Ref. No: 23/525/2024-NMET/615 dated 30th December 2024

Aug 2026

**Report On
Reconnaissance Survey (G4) for Diamond in Part of a Palaeo-
Channel in Krishna Basin Near Mangalagiri, Guntur District,
Andhra Pradesh
(Toposheet No. 65D/11)**

By



GEO MARINE SOLUTIONS PVT LTD

Earth, Ocean Science & Exploration Division,

15-17-909/9, 5th Cross Shivabagh, Kadri,

Mangalore-575005, Karnataka, INDIA

Email: mail@geomarinesolutions.in

www.geomarine.in

For



National Mineral Exploration and Development Trust (NMEDT)

Ministry of Mines

9th Floor, Jeevan Prakash LIC Building,

Kasturba Gandhi Marg,

New Delhi, 110001

Ref. No: 23/525/2024-NMET/615 dated 30th December 2024

Aug 2026

Project Information		
Document Type	:	G4 Exploration report
Project	:	Reconnaissance Survey (G4) for Diamond in Part of a Palaeo-Channel in Krishna Basin Near Mangalagiri, Guntur District, Andhra Pradesh (Toposheet no. 65D/11)
Client	:	National Mineral Exploration and Development Trust (NMEDT)
NPEA	:	Geo Marine Solutions Pvt. Ltd, Mangalore, Karnataka, India

Revision Control		
Revision No.	:	1
Document no.	:	Mangalagiri/NMET/2024-25/Final report
Revision Title	:	Final report
Prepared By	:	Aparna C.V (Geophysicist) M. Balakrishnan (Lead Geophysicist) A.C. Dinesh (Chief Technology Officer, Geo Marine Solutions Pvt. Ltd.)
Checked By	:	Dr. Fareeduddin (Project Coordinator, Geo Marine Solutions Pvt. Ltd.) P. Praveen Kumar (Director, Geo Marine Solutions Pvt. Ltd.)

Contents		Page No.
CHAPTER 1.0	EXECUTIVE SUMMARY	1-6
CHAPTER 2.0	DETAILS OF THE QUALIFIED PERSON (S) / EXPLORATION AGENCY	
2.1	Investigating agency	7
2.2	Technical Personal involved in the project	7-9
CHAPTER 3.0	TITLE AND OWNERSHIP	
3.1	Name of the explorer	11
3.2	Details of period of prospecting	11
CHAPTER 4.0	DETAILS OF THE AREA UNDER STUDY	
4.1	Details of the area (Village name, District, State)	14
4.2	Survey of India Toposheet No.	14
4.3	Cadastral details, land use/cover, forest with type of forest, free hold/lease hold details	14
4.4	Mineral under investigation	16
CHAPTER 5.0	PHYSIOGRAPHY AND ENVIRONMENT	
5.1	Relief, Drainage pattern, natural water courses, reservoirs etc	21
5.2	Road, Railway and other communication Details	21
5.3	Population	21
5.4	Socio Demographic profile of the area	22
5.5	Archaeological & Historical sites	22
5.6	National parks and Environmental settings of the area	22
5.7	Flora/Fauna	22
5.8	Water Bodies	23
5.9	Climate	23
5.10	Geomorphology	24
CHAPTER 6.0	INFRASTRUCTURE	25
CHAPTER 7.0	GEOLOGY	
7.1	Regional geological set up of the area with stratigraphy	26
7.2	Structure, metamorphism	26
7.3	Surface indication of mineralization	26
CHAPTER 8.0	PREVIOUS EXPLORATION	
8.1	Name and address of prospecting agency or permit holder or licensee involved in the exploration of the area with year and period of exploration	29
8.2	Details of previous exploration/investigation carried out by other agencies/parties	29
CHAPTER 9.0	AERIAL OR GROUND GEOPHYSICAL OR GEOCHEMICAL DATA	
9.1	Geophysical exploration	31
9.1.1	Different methods adopted for ground geophysical exploration (Methodology)	31

9.1.2	Instrument used	32
9.1.3	Survey layout	32
9.1.3.1	Electrical Resistivity Profiling (ERP)	32
9.1.3.2	Vertical electrical soundings (VES)	33
9.1.3.3	Shallow Seismic Refraction Survey	33
9.1.4	Statistical details	34
9.1.5	Data Processing	34
9.1.6	Interpretation of geophysical data	36
9.1.6.1	Electrical Resistivity Profiling	36
9.1.6.2	Vertical electrical soundings (VES)	53
9.1.6.3	Seismic refraction survey	98
9.1.6.4	Interpreted gravel zones by geophysical investigations	217
CHAPTER 10.0	EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION	
10.1	Geological Mapping	220
10.2	Pitting, Trenching	220
10.2.1	Drilling	220
10.3	Data spacing for reporting of exploration results	222
CHAPTER 11.0	LOCATION OF DATA POINT	223
11.1	Accuracy and quality of Survey used to locate drill holes	
CHAPTER 12.0	SAMPLING TECHNIQUES	
12.1	Nature and Quality of Sampling	224
12.2	Measures taken to ensure sample representation	224
12.3	Mineralogy of the ore zones and ore textures	224
12.3.1	Ore Zone	224
CHAPTER 13.0	SAMPLING TECHNIQUES	
13.1	Drilling and types of Drilling	226
13.2	Whether core and chip sample recoveries have been properly recorded and results assessed	226
13.3	Measures taken to maximise recovery	226
13.4	Relationship between core recovery and grade of the sample	228
13.5	Borehole logging	228
13.6	Discussion on the analysis results of handheld X-ray fluorescence (XRF), if used in the investigation	234
CHAPTER 14.0	INTEGRATION OF GEOPHYSICAL AND GEOLOGICAL STUDIES	
14.1	Comparison diagram with seismic data and litho- log	
CHAPTER 15.0	SUB-SAMPLING TECHNIQUES AND SAMPLE PREPARATION	
15.1	If core, whether cut or sawn and whether quarter, half or all core taken	242
15.1a	Sieving	242
15.1b	Jigging and panning	243
15.1 c.	Two level Magnetic/Electro-magnetic and gravity Separation	243
15.1 d.	Electromagnetic separator	244
15.2	Hand picking of Coarser fractions	246
15.3	Laboratory procedures	246
15.3a.	Hand Picking of Indicator Minerals using microscope	246
15.3b.	Mount Preparation/ Polished section preparation	248

15.3c.	Microscopic Examination and Grain Selection	248
15.4	EPMA Studies	255
CHAPTER 16.0	QUALITY OF ASSAY DATA AND LABORATORY TESTS	
16.1	The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total	268
16.2	Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.	268
16.3	Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.	268
CHAPTER 17.0	MOISTURE	269
CHAPTER 18.0	BULK DENSITY	269
CHAPTER 19.0	BENEFICIATION STUDIES AS MAY BE REQUIRED	269
CHAPTER 20.0	RESOURCE ESTIMATION TECHNIQUES & REPORTING OF RESOURCE	
20.1	Estimated gravel volume using borehole data	270
CHAPTER 21.0	SUMMARY & RECOMMENDATIONS	271
	REFERENCES	273
	LOCALITY INDEX	277
	REVIEWERS COMMENTS & ACTION TAKEN	278
CHAPTER 22.0	PLATES AND MAPS	281
CHAPTER 23.0	ANNEXURES OR ENCLOSURES TO THE REPORT	288
CHAPTER 24.0	ANY OTHER INFORMATION	293
CHAPTER 25.0	CERTIFICATE FROM THE QUALIFIED PERSON WITH NAME, DATE AND SIGNATURE	294

CHAPTER 1. EXECUTIVE SUMMARY

A reconnaissance-level (G4) geophysical and geological investigations were conducted over 25.1 sq. km area in Mangalagiri block, Guntur District, Andhra Pradesh, to explore alluvial diamond-bearing strata and associated heavy minerals within a paleo-channel of Krishna River Basin. Historically recognized as "Diamond River," Kolluru-Partiala belt of the Krishna Valley is globally famous for producing legendary diamonds such as the Koh-i-noor, Great Moghul, and Regent.

To locate buried gravel beds within this sedimentary basin, an integrated exploration approach was implemented by Geo Marine Solutions Pvt. Ltd. under the National Mineral Exploration & Development Trust (NMEDT) framework. The project methodology combined remote sensing analysis with extensive ground geophysical surveys, including:

- Electrical Resistivity Profiling: Completed across 20.11 lkm to identify lateral variations in resistivity.
- Vertical Electrical Sounding (VES): Totaling 78 soundings (15.46 lkm) using Schlumberger configurations to evaluate vertical resistivity layers.
- Shallow Seismic Refraction Surveys: Executed across 12.75 lkm utilizing characteristic P-wave velocity variations (IS 15681:2006 standards) to delineate sub-surface strata such as dry/wet alluvium, sand, gravels and compact clayey layers.

By observing high resistivity anomalies which are characterized by sand/ gravel presence, vertical electrical soundings (VES) are conducted at these locations to find the vertical extension of it. This VES data plotted in double log graph, from the apparent resistivity parameters, gives a K -type curve, i.e., $\rho_1 < \rho_2 > \rho_3$, with high resistivity at the middle followed by low resistivities on both flanks. Since the depth estimation and delineation of gravel is not specific by resistivity analysis, seismic refraction survey is conducted to identify them. An inhouse developed wireless seismograph, with 170kg to 210kg weight drop device as signal source, is deployed for this project. The specific P-wave velocity reference is initially considered for computation from IS code of practice for geophysical exploration such as:

- 500 to 900 m/s for gravel zone with dry alluvium and sand,
- 1100 to 1600 m/s for gravel zone in wet alluvium and sand.

Integrated geophysical profiling (VES, resistivity profiling and seismic refraction) effectively mapped different layers from the subsurface investigations which successfully identified buried paleo-channel sediment disposition by tracking discontinuous gravel-bearing paleochannel sediment disposition by tracking discontinuous gravel-bearing paleochannel pockets beneath a

cover of black cotton soil and alluvium within the Mangalagiri block.

Accordingly, twenty-five prospective locations were identified as potential gravel bearing zones. These data were correlated with that of lithology of the first borehole and brought out generalized velocity vs lithology table for this survey area.

It is observed that the gravel zone represents 820 to 880 m/s velocity range and thereby, the remaining drilling locations were precisely relocated along with gravel thickness by considering every seismic shot point and the geophone array positions. Due to land use constraints and multi crop cultivation, out of 25 gravel sites selected, at 7 locations were drilled totaling to 301m against a target of 300m meterage. These boreholes have successfully intercepted gravel horizons at depths ranging from 5 m and 40 m bgl (below ground level).

Scout core drilling (301 m across 7 boreholes) confirmed the presence of fine to very coarse-grained sand and gravel beds resting at different depths, corroborating the predictive geophysical anomalies for paleo-alluvial deposition in the region. The main lithounits of the area are top soil, sand- gravel with or without mud, mud, compact black clay etc.

A total of 20 composite samples were generated from the drill cores and processed through sieving, jigging and panning at the GSI Diamond Processing Plant at Wajrakarur, AP and heavy mineral (HM) concentrates were generated. Further concentration of HM by heavy media separation, hand magnet separation, two level magnetic separation using Electro Magnetic separator, mineral segregation using lens and binocular microscope were carried out at Geo Marine Solutions Lab at Mangalore. Segregated heavy mineral fractions (garnet, pyroxenes, opaques etc.) were further examined under microscope and eight grain mount polished sections were prepared for selected grains. These grains were subjected to Electron Probe Micro Analyzer (EPMA) studies at Petrology Lab, GSI, Hyderabad.

Despite successful physical recovery and processing of composite gravel samples through heavy liquid separation, different levels of magnetic fractionation, and detailed microscopic evaluations, no raw diamonds were recovered from the 20 processed composite samples. However, the presence of diamond/kimberlite/mantle associated minerals such as diopside and garnets were identified from EPMA data.

The Krishna River palaeo-channel heavy detritus is dominated by garnets, pyroxenes and opaques with a little amphibole, rutile etc. The opaques include magnetite, ilmenite, iron-oxides and others. The ilmenites examined under EPMA were of crustal origin. Apart from ilmenites, 93 garnets and 39 pyroxenes were analysed using EPMA. Out of total 132 analysis of garnets and pyroxenes, about 43% are of mantle paragenesis.

Garnets of mantle eclogitic paragenesis and clino-pyroxenes pertaining to peridotitic and eclogitic origin are reported from EPMA data. Among clino-pyroxenes (cpx), two Cr-diopsides are falling

within the diamond stability of Boyd et al., 1984 provides compelling evidence of diamondiferous mantle sampling. Further, the eclogitic garnets are present in six boreholes out of seven and cpx of mantle paragenesis are retrieved from five boreholes and reported within 5m and 36m core depth suggesting KIMs are distributed both spatially and temporally covering most part of the exploration block.

The reported non-diamondiferous lamproites of Krishna Lamproite Field (KLF) are geochemically distinct from the Mangalagiri Kimberlite Indicator Mineral (KIM) suite. The distinct geochemical signatures between the two suites suggest that the reported Krishna Lamproite Field (KLF) bodies are likely not the primary source host rocks for the Mangalagiri Kimberlite Indicator Minerals (KIMs).

The exposed lamproites of the (KLF) have historically been documented as non-diamondiferous or depleted in deep mantle xenocrysts. The surrounding Krishna alluvial tract is historically well known for hosting diamondiferous gravels. The presence of mantle indicator suites such as eclogitic garnets and clino-pyroxenes (especially diamond stability field Cr-diopsides) in the Mangalagiri block suggests either a previously unmapped, concealed diamondiferous primary host rock in proximity which may be brought to light by high resolution drone magnetic and EM surveys within about 50km radius.

Bulk sampling weighing up to 300-500 tons may be carried out from shallow potential zones within Mangalagiri block and studied for diamonds and KIMs. The Mangalagiri block and its upstream and downstream areas may be subjected to systematic drilling to bring out the 3D Model of sand-gravel beds, presence of diamonds and KIMs.

कार्यकारी सारांश

आंध्र प्रदेश के गुंटूर जिले के मंगलागिरी ब्लॉक में 25.1 वर्ग किमी क्षेत्रफल में पुनरावलोकन स्तर (G4) का भूभौतिकीय एवं भूवैज्ञानिक अन्वेषण किया गया। इस अन्वेषण का उद्देश्य कृष्णा नदी बेसिन के एक पुरा-चैनल में स्थित जलोढ़ हीरा-धारी स्तरों तथा उनसे संबद्ध भारी खनिजों की खोज करना था। ऐतिहासिक रूप से “हीरा नदी” (Diamond River) के नाम से प्रसिद्ध कृष्णा घाटी का कोल्लूरू-पार्थाला क्षेत्र विश्व स्तर पर प्रसिद्ध है तथा यहां कोह-ए-नूर, ग्रेट मोगुल और रीजेंट जैसे प्रसिद्ध हीरों के प्राप्त होने का ऐतिहासिक उल्लेख मिलता है।

इस अवसादी द्रोणी में भूमिगत बजरी स्तरों का पता लगाने के लिए Geo Marine Solutions Pvt. Ltd. द्वारा राष्ट्रीय खनिज अन्वेषण एवं विकास न्यास (NMEDT) के अंतर्गत एकीकृत अन्वेषण पद्धति अपनाई गई। परियोजना में सुदूर संवेदन विश्लेषण के साथ विस्तृत भूभौतिकीय सर्वेक्षण किए गए, जिनमें निम्नलिखित प्रमुख विधियां शामिल थीं:

- विद्युत प्रतिरोधकता प्रोफाइलिंग: प्रतिरोधकता में होने वाले पार्श्विक परिवर्तनों की पहचान करने के लिए 20.11 lkm विभिन्न क्षेत्रों में सर्वेक्षण किया गया।
- ऊर्ध्वाधर विद्युत ध्वनि परीक्षण (VES): श्लम्बरजर विन्यास का उपयोग करते हुए कुल 78 VES (15.46 lkm) किए गए, जिससे अधस्तलीय प्रतिरोधकता परतों की ऊर्ध्वाधर स्थिति एवं विस्तार का आकलन किया गया।
- उथला भूकंपीय अपवर्तन सर्वेक्षण: IS 15681:2006 के मानकों के अनुसार P-तरंग वेग में होने वाले परिवर्तनों का उपयोग करते हुए 12.75 lkm के क्षेत्र में सर्वेक्षण किया गया। इसका उद्देश्य शुष्क/आर्द्र जलोढ़, बालू, बजरी तथा सघन चिकनी मिट्टी जैसी अधस्तलीय परतों का सीमांकन करना था।

उच्च प्रतिरोधकता वाली विसंगतियों, जो सामान्यतः बालू/बजरी की उपस्थिति को दर्शाती हैं, को चिह्नित करने के बाद इन स्थानों पर ऊर्ध्वाधर विद्युत ध्वनि परीक्षण (VES) किया गया, ताकि इनके ऊर्ध्वाधर विस्तार एवं गहराई का निर्धारण किया जा सके। VES के आंकड़ों को द्वि-लघुगुणकीय आलेख (Double Log Graph) पर प्रदर्शित किया गया। प्राप्त आभासी प्रतिरोधकता मापदंडों के आधार पर इन स्थानों पर मुख्यतः K-प्रकार वक्र, अर्थात् $\rho_1 < \rho_2 > \rho_3$, प्राप्त हुआ। इसमें मध्य परत की प्रतिरोधकता अधिक तथा दोनों ओर की परतों की प्रतिरोधकता अपेक्षाकृत कम होती है।

चूंकि केवल प्रतिरोधकता विश्लेषण के आधार पर बजरी की वास्तविक गहराई एवं मोटाई का सटीक निर्धारण संभव नहीं था, इसलिए इसकी पहचान एवं सीमांकन के लिए भूकंपीय अपवर्तन सर्वेक्षण किया गया। इस परियोजना में संकेत स्रोत के रूप में 170–210 किग्रा भार वाले भार-पतन उपकरण (Weight Drop Device) के साथ स्वदेश में विकसित वायरलेस भूकंपलेखी (Wireless Seismograph) का उपयोग किया गया। प्रारंभिक गणना के लिए भूभौतिकीय अन्वेषण हेतु भारतीय मानक कार्य-पद्धति के अनुसार निम्नलिखित P-तरंग वेग सीमाओं को संदर्भ के रूप में लिया गया:

- 500–900 m/s: शुष्क जलोढ़ एवं बालू के साथ बजरी क्षेत्र।
- 1100–1600 m/s: आर्द्र जलोढ़ एवं बालू के साथ बजरी क्षेत्र।

VES, विद्युत प्रतिरोधकता प्रोफाइलिंग तथा भूकंपीय अपवर्तन के एकीकृत भूभौतिकीय सर्वेक्षण से अधस्तलीय विभिन्न परतों का प्रभावी रूप से मानचित्रण किया गया। इस अध्ययन से मंगलागिरी ब्लॉक में काली कपासीय मिट्टी एवं जलोढ़ आवरण के नीचे स्थित, असंतत रूप से वितरित बजरी-धारी पुरा-चैनल अवसादों की सफलतापूर्वक पहचान एवं सीमांकन किया गया।

इसके आधार पर 25 संभावित स्थानों को बजरी-धारी क्षेत्रों के रूप में चिह्नित किया गया। इन आंकड़ों का प्रथम बोरहोल से प्राप्त शैलविन्यास संबंधी आंकड़ों के साथ सहसंबंध किया गया तथा अध्ययन क्षेत्र के लिए वेग बनाम शैलविन्यास की एक सामान्यीकृत तालिका तैयार की गई।

अध्ययन से यह पाया गया कि 820–880 m/s की P-तरंग वेग सीमा बजरी क्षेत्र का प्रतिनिधित्व करती है। इस आधार पर प्रत्येक भूकंपीय प्रहार बिंदु तथा जियोफोन सरणी की स्थिति को ध्यान में रखते हुए शेष वेधन स्थानों का अधिक सटीक निर्धारण किया गया तथा बजरी की मोटाई का आकलन किया गया।

भूमि उपयोग संबंधी प्रतिबंधों तथा बहु-फसली कृषि के कारण चयनित 25 बजरी-धारी स्थलों में से केवल 7 स्थानों पर वेधन किया जा सका। इन 7 बोरहोलों में कुल 301 मीटर वेधन किया गया, जबकि निर्धारित लक्ष्य 300 मीटर था। इन बोरहोलों में भूमि सतह से 5 से 40 मीटर नीचे की गहराई पर बजरी स्तरों का सफलतापूर्वक प्रतिच्छेदन हुआ।

कुल 301 मीटर अन्वेषणात्मक कोर वेधन के माध्यम से 7 बोरहोलों से प्राप्त कोर में विभिन्न गहराइयों पर बारीक से अत्यंत मोटे दाने वाली बालू तथा बजरी स्तरों की उपस्थिति की पुष्टि हुई। इससे क्षेत्र में पुरा-जलोढ़ निक्षेपण से संबंधित भूभौतिकीय विसंगतियों की पुष्टि हुई। क्षेत्र की प्रमुख शैल इकाइयों में ऊपरी मृदा, बालू-बजरी युक्त मृदा/गाद, गाद तथा सघन काली चिकनी मिट्टी शामिल हैं।

ड्रिल कोर से कुल 20 संयुक्त नमूने तैयार किए गए। इन नमूनों का GSI हीरा प्रसंस्करण संयंत्र, वाज्रकरूर, आंध्र प्रदेश में छलनीकरण, जिगिंग तथा पैनिंग द्वारा प्रसंस्करण किया गया तथा भारी खनिज सांद्रण तैयार किए गए। इसके पश्चात भारी खनिज सांद्रण का आगे भारी माध्यम पृथक्करण, हस्त-चुंबकीय पृथक्करण तथा दो-स्तरीय चुंबकीय पृथक्करण द्वारा विद्युतचुंबकीय पृथक्कारक की सहायता से सांद्रण किया गया। इसके बाद लेंस तथा द्विनेत्री सूक्ष्मदर्शी की सहायता से विभिन्न खनिजों का पृथक्करण किया गया।

पृथक किए गए भारी खनिज अंशों, जैसे गार्नेट, पाइरोक्सीन तथा अपारदर्शी खनिजों आदि का सूक्ष्मदर्शी के अंतर्गत विस्तृत अध्ययन किया गया तथा चयनित खनिज कणों के लिए कुल 8 कण-माउंट पॉलिशित अनुभाग तैयार किए गए। इन खनिज कणों का इलेक्ट्रॉन प्रोब सूक्ष्म विश्लेषक (EPMA) द्वारा शैलविज्ञान प्रयोगशाला, GSI, हैदराबाद में विश्लेषण किया गया।

यद्यपि 20 संयुक्त बजरी नमूनों का भारी द्रव पृथक्करण, विभिन्न स्तरों का चुंबकीय प्रभाजीकरण तथा विस्तृत सूक्ष्मदर्शीय मूल्यांकन द्वारा सफलतापूर्वक प्रसंस्करण किया गया, तथापि किसी भी नमूने से प्राकृतिक हीरा प्राप्त नहीं हुआ। हालांकि, EPMA आंकड़ों से हीरा/किम्बरलाइट/मैटल-संबद्ध खनिजों, विशेष रूप से डायोप्साइड तथा गार्नेट, की उपस्थिति की पहचान हुई।

कृष्णा नदी के पुरा-चैनल के भारी अपक्षयित अवसादों में मुख्यतः गार्नेट, पाइरोक्सीन तथा अपारदर्शी खनिज पाए गए, जबकि एम्फिबोल, रूटाइल आदि अल्प मात्रा में उपस्थित थे। अपारदर्शी खनिजों में मैग्नेटाइट, इल्मेनाइट, लौह ऑक्साइड आदि शामिल हैं। EPMA द्वारा अध्ययन किए गए इल्मेनाइट भूपर्पटीय उत्पत्ति के पाए गए। इल्मेनाइट के अतिरिक्त कुल 93 गार्नेट तथा 39 पाइरोक्सीन का EPMA विश्लेषण किया गया। गार्नेट एवं पाइरोक्सीन के कुल 132 विश्लेषणों में लगभग 43% खनिज मैटल पाराजेनेसिस के पाए गए।

EPMA आंकड़ों से मैटल एक्लोजाइटिक पाराजेनेसिस के गार्नेट तथा पेरिडोटाइटिक एवं एक्लोजाइटिक उत्पत्ति से संबंधित क्लिनोपाइरोक्सीन (Cpx) की पहचान हुई। क्लिनोपाइरोक्सीन में से दो क्रोमियम-डायोप्साइड (Cr-diopsides) Boyd et al. (1984) के हीरा स्थायित्व क्षेत्र में स्थित पाए गए। यह अवलोकन क्षेत्र के नीचे स्थित हीरा-धारी मैटल से संबंधित महत्वपूर्ण प्रमाण प्रदान करता है।

इसके अतिरिक्त, एक्लोजाइटिक गार्नेट 7 में से 6 बोरहोलों में पाए गए, जबकि मैटल पाराजेनेसिस के क्लिनोपाइरोक्सीन 7 में से 5 बोरहोलों से प्राप्त हुए। ये खनिज 5 से 36 मीटर कोर गहराई के बीच पाए गए, जिससे यह संकेत मिलता है कि किम्बरलाइट सूचक खनिज (KIMs) पूरे अन्वेषण ब्लॉक में स्थानिक एवं ऊर्ध्वाधर रूप से व्यापक रूप से वितरित हैं।

कृष्णा लैम्प्रोइट क्षेत्र (KLF) के रिपोर्ट किए गए हीरा-रहित लैम्प्रोइट मंगलागिरी के किम्बरलाइट सूचक खनिज संघ (KIM Suite) से भू-रासायनिक रूप से भिन्न पाए गए। दोनों खनिज समूहों के विशिष्ट भू-रासायनिक अभिलक्षण यह संकेत देते हैं कि कृष्णा लैम्प्रोइट क्षेत्र की ज्ञात चट्टानें संभवतः मंगलागिरी क्षेत्र से प्राप्त KIMs की प्राथमिक धारक चट्टानें नहीं हैं।

KLF की सतह पर उजागर लैम्प्रोइट चट्टानों को ऐतिहासिक रूप से हीरा-रहित अथवा गहरे मैटल के पराशैल-स्फटिकों की दृष्टि से अल्प/क्षीण के रूप में दर्ज किया गया है। इसके विपरीत, आसपास का कृष्णा जलोढ़ क्षेत्र ऐतिहासिक रूप से हीरा-धारी बजरी के लिए प्रसिद्ध है। मंगलागिरी ब्लॉक में एक्लोजाइटिक गार्नेट तथा क्लिनोपाइरोक्सीन, विशेष रूप से हीरा स्थायित्व क्षेत्र में स्थित क्रोमियम-डायोप्साइड, की उपस्थिति किसी पूर्व में अज्ञात अथवा आच्छादित हीरा-धारी प्राथमिक धारक चट्टान की निकटता की संभावना को इंगित करती है। इस संभावित स्रोत की पहचान के लिए लगभग 50 किमी त्रिज्या के क्षेत्र में उच्च-रिज़ॉल्यूशन ड्रोन चुंबकीय तथा विद्युतचुंबकीय सर्वेक्षण किए जा सकते हैं।

मंगलागिरी ब्लॉक में उथले संभावित क्षेत्रों से 300–500 टन तक थोक नमूना-संग्रह किया जा सकता है तथा इन नमूनों का हीरा एवं किम्बरलाइट सूचक खनिजों (KIMs) के लिए विस्तृत अध्ययन किया जा सकता है। इसके अतिरिक्त, मंगलागिरी ब्लॉक तथा इसके ऊर्ध्वप्रवाह एवं अधोप्रवाह क्षेत्रों में व्यवस्थित वेधन कर बालू-बजरी स्तरों का त्रि-आयामी मॉडल तैयार किया जा सकता है तथा हीरा एवं KIMs की उपस्थिति का विस्तृत निर्धारण किया जा सकता है।

CHAPTER-2 DETAILS OF THE QUALIFIED PERSON (S) / EXPLORATION AGENCY

2.1 Investigating agency

M/s. Geo Marine Solutions Pvt. Ltd (CIN U74900KL2011PTC28241) is a Notified Private Exploration Agency (NPEA), Science and Technology Services Company with a vision to take proactive role in nation building by providing latest scientific know-how in the Earth System Science. The company draws its inspiration and ability to undertake challenging projects from Team Leaders in different disciplines of Earth Sciences who are former scientists from prestigious organizations like Geological Survey of India, National institute of Oceanography etc. Each of the Domain Leaders of Geo Marine Solutions is the leading scientists in their fields and brings in about more than three decades of experience in Offshore and Onshore Geo Scientific Survey and Exploration.

The entire work components were planned and executed by the firm, under the coordination of Dr. Fareeduddin (former Director (Geology), Geological Survey of India), Project Coordinator, and A.C Dinesh, (former Director (Geology), Geological Survey of India), Chief Technology Officer, Geo Marine Solutions Pvt. Ltd.

Name and address of the NPEA

Geo Marine Solutions Pvt Ltd

15-17-909/9, 5th Cross Shivabagh, Kadri,

Mangalore-575005, Karnataka, INDIA

Contact Mobile No: +91-9038534560, +91-8277363919

E-Mail id: mail@geomarinesolutions.in, oed@geomarinesolutions.in

2.2 Technical Personal involved in the project.

The Table-2.1 shows the technical experts deployed for this exploration with their qualification, designation and major contributions in the investigation.

Table-2.1 Technical persons engaged in exploration

Sl no	Name	Qualification	Designation	Main contributions
1	Dr. Fareeduddin	PhD in Geology with 43 years of experience in Mineral Exploration and Geological mapping	Former Director, GSI, Principal Consultant - Geo Marine Solutions Pvt Ltd. and NABET approved Project Coordinator.	Guidance throughout the field season and report writing.
2	A.C Dinesh	M.Sc. Marine Geology, with 38 years of experience in Mineral Exploration and Geological mapping	Former Director, GSI and Chief Technology Officer, Geo Marine Solutions Pvt. Ltd.	Supervision and guidance during Geophysical survey drilling and report writing.
3	P. Praveen Kumar	MSc (Tech) Applied Geology, with 33 years of experience in Mineral Exploration and Geological mapping	Former Director, GSI and Director, Geo Marine Solutions Pvt. Ltd	Field planning and writing of report.
4	M. Balakrishnan	M.Sc. Physics, with 39 years of experience in Geophysical exploration	Former Director (Geophysics), GSI and Lead - Geophysical Exploration, Geo Marine Solutions Pvt. Ltd	Guidance and supervision throughout the Geophysical surveys, data interpretation and report writing.
5	Pabolu Ramachandra Rao	M.Sc. Geophysics, with 37 years of experience in Geophysical exploration	Former Director (Geophysics), GSI and Lead - Geophysical Exploration, Geo Marine Solutions Pvt. Ltd	Supervision throughout the Geophysical surveys.

Table-2.1 Technical persons engaged in exploration

Sl no	Name	Qualification	Designation	Main contributions
6	Aparna C V	M.Sc. Marine Geophysics with 5 years of experience.	Geophysicist, M/s. Geo Marine Solutions Pvt. Ltd.	Geophysical survey, field planning, Preparation of maps, Data interpretation and report writing
7	Renu O. V	M.Tech. Electrical and Electronics Engineering (EEE) with 6 years of experience	Engineer, M/s. Geo Marine Solutions Pvt. Ltd.	Seismic survey (Instrumental repair and data acquisition)
8	Guruprasad S.	M.Sc. Geology with 7 years of experience.	Sr. Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Supervision and coordination of drilling, sub-sampling and sample analysis
9	Bidisha Mahanty	M.Sc. Geology.	Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Assisting Geophysical data acquisition and processing
10	Rajasree Biswas	M.Sc. Geology	Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Assisting Geophysical data acquisition
11	Rithesh Melric Mendonca	M.Sc. Marine Geology	Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Execution of drilling, Core logging and sample analysis
12	Nagarjun Patil	M.Sc. Applied Geology	Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Execution of drilling and Core logging
13	Abhilash A. D.	M.Sc. Applied Geology	Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Execution of drilling and Core logging
14	Mehul Samatha	M.Sc. Geology	Geologist, M/s. Geo Marine Solutions Pvt. Ltd.	Execution of drilling and Core logging

Other agencies involved with this project are:

All field components of Geophysical investigation like Resistivity sounding, Resistivity profiling and seismic refraction surveys, as well as DGPS survey for borehole fixing, Core drilling, sample collection as well as post field components like two level magnetic and gravity separations, were conducted Inhouse by Geo Marine Solutions Pvt. Ltd. The associated agencies in the laboratory analysis are mentioned below.

I. Diamond processing Plant of Geological Survey of India, Wajrakaruru, Andhra Pradesh.

The Diamond Processing Plant at Wajrakarur, Andhra Pradesh, is dedicated to the study and processing of samples for diamonds. The plant is established and maintained by Geological Survey of India.

The initial stages of sample processing of samples by jigging and panning of 20 composite samples were carried at Diamond Processing Plant at Wajrakarur, Andhra Pradesh.

II. EPMA lab, Petrology division, Geological Survey of India, Bandlaguda, Hyderabad.

Electron Probe Micro Analyzer (EPMA) studies for Electromagnetically separated samples were carried out at EPMA lab, Petrology division, Geological Survey of India, Bandlaguda, Hyderabad. The segregated targeted minerals from the sub samples using binocular microscope were subjected to grain mounting and preparation of polished sections were also carried out.

CHAPTER 3. TITLE AND OWNERSHIP

3.1 Name of the explorer:

Geo Marine Solutions Pvt Ltd
15-17-909/9, 5th Cross Shivabagh, Kadri,
Mangalore-575005, Karnataka, INDIA
Contact Mobile No: +91-9038534560, +91-8277363919
E-Mail id: mail@geomarinesolutions.in, oed@geomarinesolutions.in

3.2 Details of period of prospecting:

Quantum of work proposed vs achievement (Table)

The Reconnaissance survey (G4) for Diamond bearing gravel bed in Mangalagiri block with quantum of work and targets achieved are given in Table-3.1.

Table: 3.1 Quantum of Work – Mangalagiri (G4) Block

Sl. No	Description of Work	Quantum of work proposed (Sq Km/ Number)	Achievement	Remarks
1.	Block Area	22.6 sq. km.	25.1 sq. km.	Due to continuous cultivation in the southern part of the area, adequate information on gravel occurrence and depth could not be obtained. Hence, the southern boundary was extended further south to delineate the gravel-bearing zones, increasing the exploration area from 22.6 sq. km to 25.1 sq. km.
2.	Electrical Resistivity Sounding	15 Lkm	15.46 Lkm	
3.	Resistivity profiling	20 Lkm	20.11 Lkm	Twin separation (AB/2-20m&30m) with station interval 10m
4.	Shallow seismic refraction survey	12 Lkm	12.753 Lkm	Wireless Seismograph with 170 kg and 210 kg weight drop as signal source
5.	Core drilling	300m	301m	HX size drilling

6.	Mineral Separation and Identification (Two level Magnetic separation and Gravity separation)	20 nos.	20 nos.	
7.	EPMA	6 hours.	6 hours	
8.	Gem identification test	20 nos.	NIL	Since, Grains qualified for gem testing are not present.

Details of period of prospecting:

During this investigation, the work was executed in three different stages, namely pre-field studies, field studies and post-field studies. The different components and procedures followed in each stage are discussed below.

B. Pre-field studies: It includes preliminary research (published papers and field visits) and feasibility studies on concerned toposheets (65D/11), geological maps, OSM sheets, previous reports and delineation of paleo channel using satellite data to identify potential area of exploration and preparation of proposal and detailed project report (DPR).

C. Field studies: The field studies were undertaken between the period from 8th March 2025 to 30th June 2025 and 6th February 2026 to 25th March 2026. The drilling camp establishment and drilling work were carried out between April 22nd and 10th June 2026. Reconnaissance survey was conducted initially to assess the actual conditions of roads, accessibility in different parts of the area, communication links therein, hydrography (drainage pattern and nearby streams) and climatic conditions. A total of 25.1 sq.km area was covered by Geophysical investigations employing resistivity sounding, resistivity profiling and shallow seismic refraction survey.

During Geophysical investigation period a total of 78 soundings (15.469 Lkm of VES), 20.11 Lkm of resistivity profiling and 12.753Lkm of seismic refraction survey were completed. Based on the geophysical investigations, gravel-bearing zones were delineated. From these zones, 11 locations were suggested for core drilling. The drilling depth varied from place to place, depending on the extent of the gravel-bearing layers. By considering the field constraints due to multi crop cultivation and local land owner's permissions, a total of 7 scout boreholes were drilled with a cumulative of 301m depth to achieve approved meterage of 300.0m. For further analysis and studies, drill cores were split in to two halves. One part of the sample is

kept as repository and other was used for laboratory studies. 20 no. of composite samples were generated and studied.

D. Post field studies: The post field study includes data compilation, gravity separation, magnetic separation, sample analysis, summarizing analytical results, finalization of maps and writing of report.

CHAPTER 4. DETAILS OF THE AREA UNDER STUDY

4.1 Details of the area (Village name, District, State)

Table 4.1 Details of the area (Village name, District, State)

Block name	:	Mangalagiri block
Villages	:	Pedavadlapudi, Nutakki, Mellempudi, Ippatam, Gundimeda, Vadeswaram
Mandal / Taluk	:	Mangalagiri
District	:	Guntur
State	:	Andhra Pradesh

Key location map of the study area is given in (Figure 4.1).

4.2 Survey of India Toposheet No.

The area under investigation consists of palaeo-channel near Krishna basin. The Mangalagiri block of G4 Level exploration falls in the Survey of India's old toposheet 65D/11 and OSM E44U/11 (Fig. 4.2).

Geo-coordinates of the corner points of the investigated area

The boundary coordinates of the block considered for the geophysical survey and borehole drilling are given below (Table 4.2). The total area covered within the below given coordinates is 25.1 sq km.

Table 4.2 The boundary coordinates of Mangalagiri block

Sl. No.	Longitude (DD)	Latitude (DD)
1	80.61026	16.44944
2	80.61113	16.44656
3	80.60914	16.43721
4	80.60601	16.43198
5	80.59557	16.42019
6	80.59152	16.41079
7	80.5895	16.4069
8	80.6561	16.4086
9	80.65509	16.41103
10	80.65192	16.41953
11	80.65177	16.4248
12	80.65282	16.42972
13	80.65139	16.44235
14	80.65062	16.45017

4.3 Cadastral details, land use/cover, forest with type of forest, free hold/lease hold details

Major portion of the study area is private land. There is no record of leasehold area or forest.

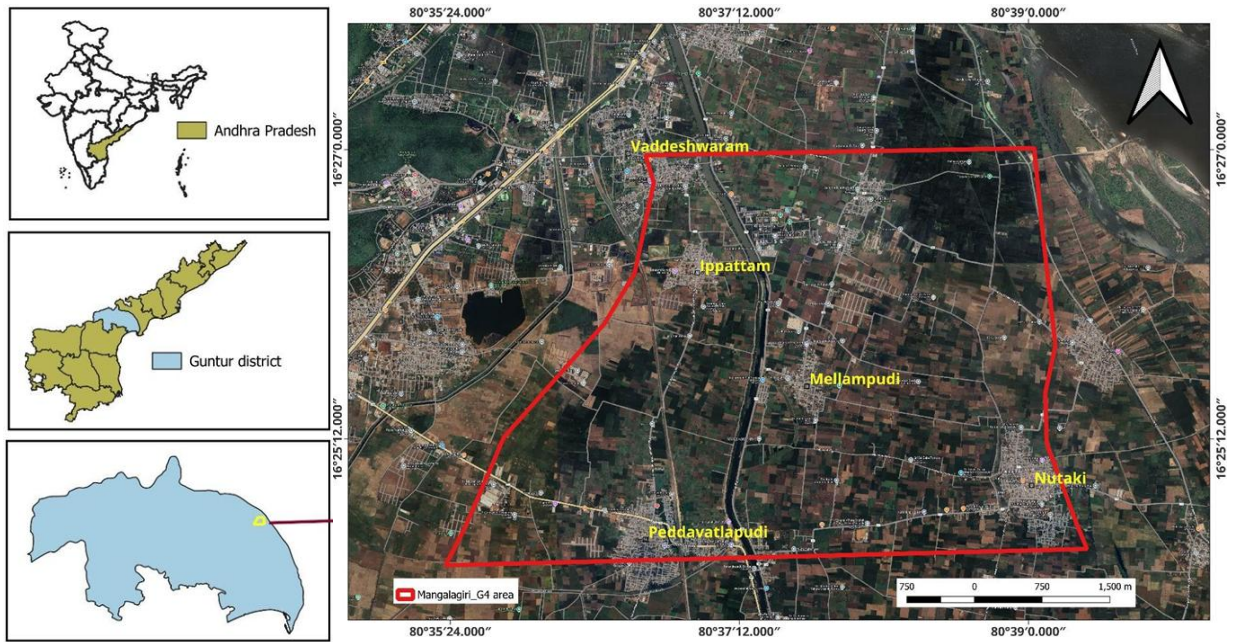


Figure 4.1: Location map of Mangalagiri block

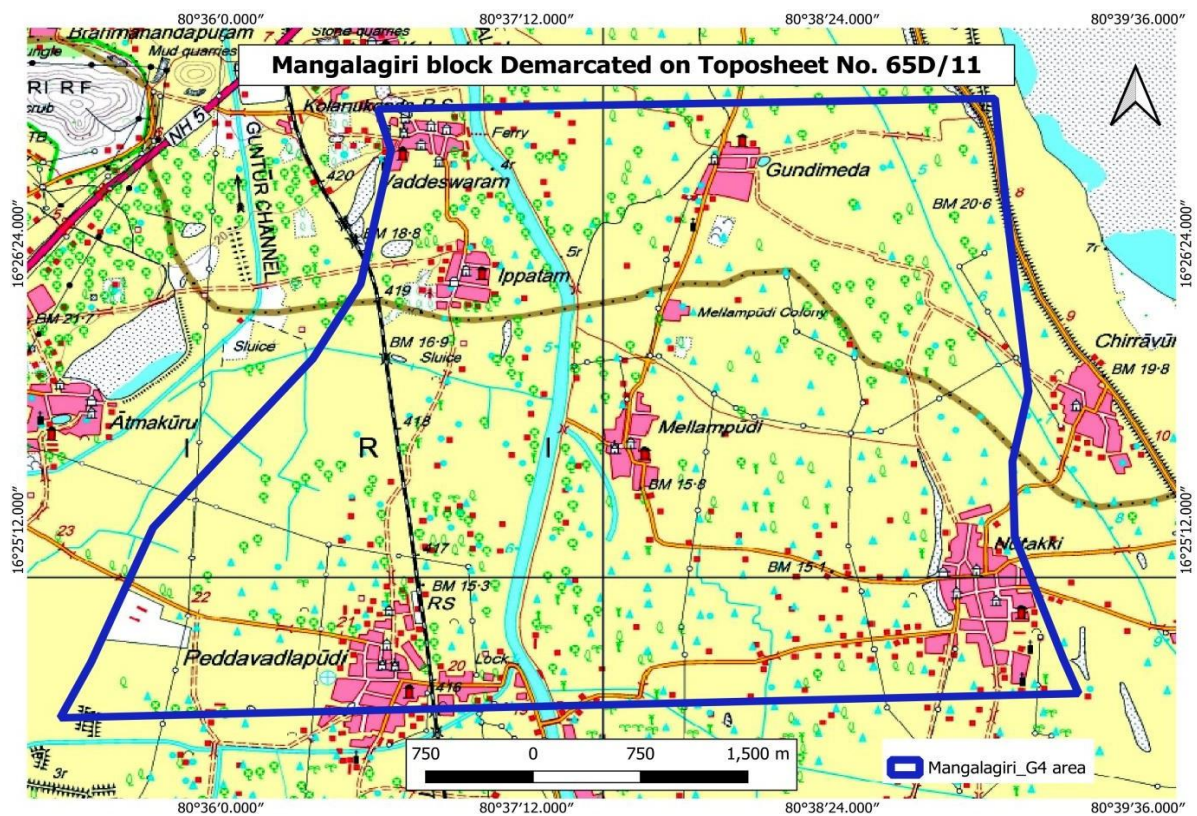


Figure 4.2 Mangalagiri block in Toposheet no. 65D/11

4.4 Mineral under investigation

This project focuses on the exploration of alluvial diamonds in the paleichannel of Krishna River. The present project focuses on the exploration of alluvial diamonds occurring within the palaeochannel sediments of the Krishna River near Mangalagiri, Guntur District, Andhra Pradesh.

Details of project

The Southern Peninsular region of India is recognized as the earliest known source of diamonds globally and has made a remarkable contribution to the history of diamond mining and trade, which thrived for over 2,500 years until the 18th century A.D. The banks of Krishna River—often referred to as "Diamond River"—stretching approximately 300 kilometers between Sangam (the confluence of Krishna and Tungabhadra Rivers near Kurnool) and Vijayawada, particularly in Kolluru–Paritala belt, experienced extensive mining operations that yielded several historically renowned diamonds.

Since 1676 A.D., numerous researchers have evaluated the diamond potential of the Krishna gravels. Additionally, Quaternary geological and geomorphological studies have been conducted to identify older or paleo-terraces, paleo-channels, and other geologically favorable locations for the occurrence of diamond-bearing gravel deposits along Krishna River and its tributaries. (Kar.R et.al., 2018)

Based on the above-mentioned fact, a reconnaissance-level geophysical and geological investigation was undertaken in Mangalagiri Block of Andhra Pradesh, under the aegis of National Mineral Exploration and Development Trust (NMEDT). The primary objective of this project is to explore diamond and associated minerals within the alluvial gravel zones of the palaeo-channels of Krishna River Basin. A comprehensive geophysical investigation, involving resistivity sounding, resistivity profiling and shallow seismic refraction survey and geological works involving drilling, sampling and laboratory analysis were taken up under the reconnaissance project of NMEDT at Mangalagiri block of Andhra Pradesh. This integrated approach aims to delineate potential mineral-bearing zones, particularly within buried palaeo-channels, and to evaluate their economic significance for further exploration and development.

Objectives of investigation

- Objective of this investigation is Reconnaissance Survey (G4), for Diamond, in Parts of a Palaeo-Channel in Krishna Basin Near Mangalagiri, Guntur District, Andhra Pradesh.
- To understand the spatial distribution, thickness and downward continuity of gravel beds within alluvium in parts of a palaeo channel near Mangalagiri, Guntur Dist, Krishna

Basin, Andhra Pradesh.

- To estimate the valuable resource within the exploration area and to recommend the feasibility for further level of exploration.

Basis for taking up this investigation

Diamond itself and many famous historical diamonds were introduced to the world by India, wherein production was largely by alluvial mining that was spread over seven States (i.e. Andhra Pradesh, Chattisgarh, Jharkhand, Karnataka, Maharashtra, Madhya Pradesh and Telangana). The quaternary gravels deposited along the alluvial tracts of Krishna and Penner Rivers in Andhra Pradesh are known to have been the major source for diamonds in the historic past. The Koh-i-noor (186 ct), the Great Moghul (787 ct), the Pitt / Regent (410 ct), the Orlov (189 ct) and the Blue Hope (45 ct) to name a few are the world-famous diamonds produced from the gravels of the Krishna Valley (Figure.4.3). The Intensity of mining was more over a 60 km long belt, between Kolluru (Guntur district) on the right bank and Partiala (Krishna district) on the left bank. The present proposed block is lying in the middle of Kolluru- Partiala belt (Ravi et al., 2018).



Figure 4.3: World famous diamonds from Krishna River alluvium, Guntur district, Andhra Pradesh, India (Source: [www. andhra-rayalaseema-diamondmines.com](http://www.andhra-rayalaseema-diamondmines.com))

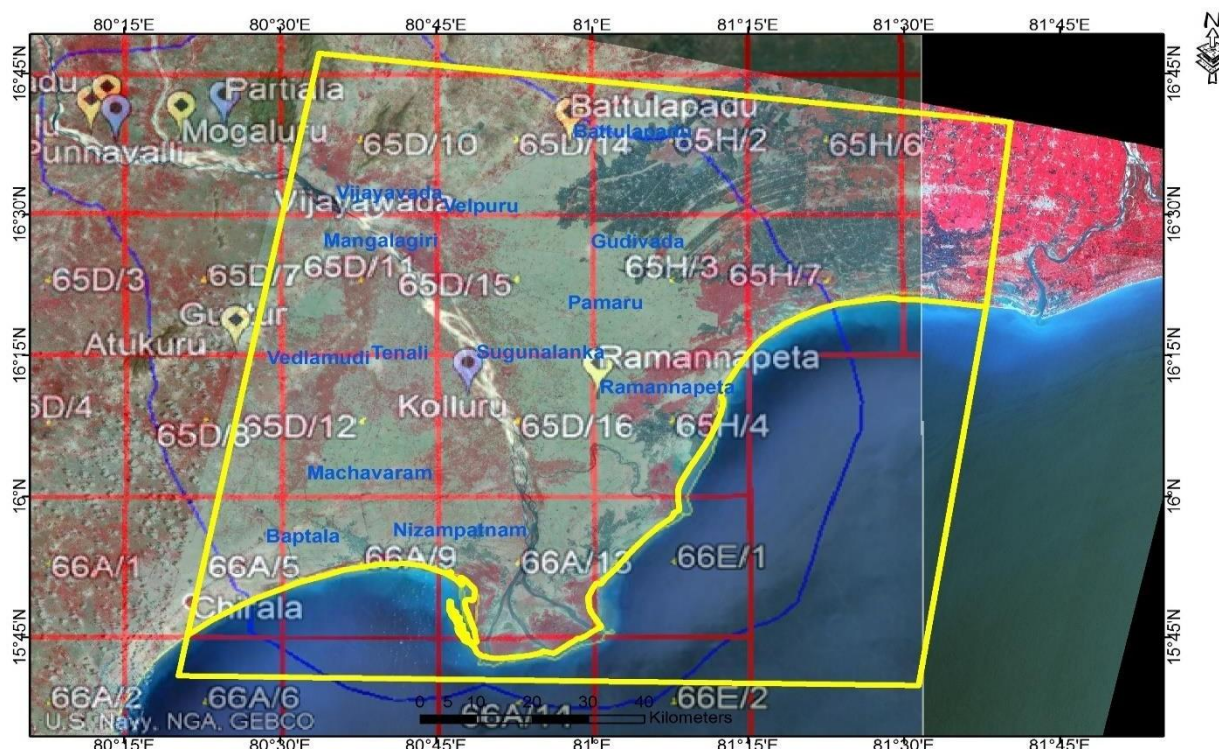


Figure 4.4: Image Showing Krishna Basin Region, the Kolluru-Partiala alluvial tract

Partiala-Kodavattikallu-Kollur area is famous for diamond occurrences for the past several centuries. The world-famous diamonds "Kohinoor" and "Great Mogul" were obtained from Kollur area and the "Pitt" from Partiala area. Even the old dumps in Partiala and Kodavattikallu areas (Figure.4.4) still yield occasional diamonds, as reported by villagers. Capt. Munn (1929) of the Hyderabad Geological Survey, collected all available information on these workings, and published it in the Memoir Vol. I of Hyderabad Geological Survey in 1929. According to him, Heyne had stated Kodavattikallu mine which yielded bullock-cart loads of diamonds on first discovery (Ravi et al., 2018).

An attempt to open the Partiala mine was made in 1890 by Hyderabad Deccan Company, who had obtained the mineral rights over this area. The actual pit, which the ancients mined, was reopened and the excavated alluvium was processed by modern machinery resulting in the extraction of 3,444 stones weighing 2085 carats. Deshpande and Sagar carried out detailed investigations during 1968 - 1973. They carried out large scale mapping, deep pitting, auger drilling and bulk treatment of gravel materials. They delineated a few subsurface gravel horizons and also recovered three diamonds, weighing 0.25, 0.625 and 3.25 carats during 1971-'72 (Ravi et al., 2018).

The Krishna River flows undivided for a distance of about 60 km from its delta apex near Vijayawada, before a relatively small distributary branches out at Puligadda village. Further

downstream, the river again splits into three distributaries just within 15 km from the shoreline forming the main delta lobe. Both these adjacent rivers built their deltas on the east coast India where they join Bay of Bengal. Swerving of Krishna River course throughout its deltaic reaches and the clock-wise bending of the active Krishna delta lobe into Nizampatnam offshore sub-basin appear to be associated with the Krishna Cross Trend fault (Ravi et al., 2018).

The basin which was initially formed in the Late Jurassic as a major rift graben, bounded by two major faults – the Basin Margin Fault along the landward (northwest) side, and Matyapuri-Palakollu (MP) Fault, which marks the Eocene shelf edge (According to Raghavendra Rao, 1991, cited in Nageswara Rao et al., 2012) on its seaward margin with a landward tilt along the latter (According to Manmohan et al. 2003, cited in Nageswara Rao et al., 2012). Recurrence of tectonics in the Late Cretaceous led to an echelon fault giving rise to second order horst-graben structures within the K-G sedimentary basin. There are two cross-trend faults, namely Chintalapudi Cross Trend and Krishna Cross Trend, which divide the overall K-G sedimentary basin into three major blocks. The 8-km-wide beach ridge complex that separates Kolleru and the southern mudflat largely coincides with Kaja-Kaikaluru Ridge (horst) that lies in between Gudivada and Bantumilli Sub-basins (grabens). Based on the lineaments conjectured in the Krishna delta through the interpretation of large-scale aerial photographs, Nageswara Rao (1988) observed the general orientation of majority of these lineaments in two preferred directions towards ENE-WSW and NE-SW coinciding with the basement trends indicating neotectonic movements in the area (Ravi et al., 2018).

The deltaic area is a flat country, sloping gently eastward from the foot of Eastern Ghats to Bay of Bengal with isolated hills or group of hills jutting out at the western boundary of the area (with in Vijayawada city and north of Manglagiri). The delta plains exhibit two broad units – the fluvial plain in the upper part of the delta and the strand plain in the lower part. The former is a gently rolling, river-built plain sloping towards the coast characterized by landforms such as abandoned river courses and natural levees. In contrast, the lower strand plain, including the inter-delta plain, exhibits feature like beach ridges, mudflats, mangrove swamps, lagoons, and spits reflecting the marine influence. The sandy beach ridges in the strand plain represent former shoreline positions in these prograding deltas. The innermost beach ridge that lies even up to 35 km inland from the present shoreline marks the maximum Holocene transgression limit, which was tentatively dated to be around 6 ka based on about ten C-14 dates from this region (According to Nageswara Rao et al. 2005, cited in Nageswara Rao et al., 2012). The delta area upstream of this maximum

Holocene transgression limit is considered as the fluvial plain as it is essentially a floodplain of either the present or abandoned distributary courses within the delta. The lower part of the delta, seaward of this limit is the strand plain. Although most part of the sediments in the delta is contributed by the river, the material is reworked and deposited by the marine processes along the shore leading to the progradation of the delta. Therefore, the strand plain that constitutes the lower part of the delta is essentially a marine-built plain. The sediments that filled the Krishna - Godavari (K-G) sedimentary basin range from the Cretaceous to the Recent (According to Biswas & Agarwal 1999, cited in Nageswara Rao et al., 2012) and vary in thickness from about 2.0 to 2.5 km over the basement highs (According to Manmohan et al. 2003 cited in Nageswara Rao et al., 2012) to as much as 5.0 to 7.0 km over the graben structures containing at least eight hiatuses (According to Govindan 2004, cited in Nageswara Rao et al., 2012).

The fluvial deposits of Quaternary/Recent age recognized in the area (from Kondavattikadu) include (1) the Quaternary gravels associated with paleo-channel terraces (2) older and younger flood plain alluvium (3) Recent alluvium and gravels of the present-day river channel. A major palaeo-channel of Krishna River, identified from the present course of Krishna River at Ustapalli, gets forked out into two separate channels and rejoins the present course of Krishna River at Pokkunuru (16°30': 80° 10') and Kodavatkallu (16° 38'30": 80° 11'30") cumulative length of the palaeo-channel is about 12 km and the width varies from 1 to 2 km (According to Nageswara Rao et al. 2005, cited in Nageswara Rao et al., 2012).

CHAPTER 5. PHYSIOGRAPHY AND ENVIRONMENT

5.1 Relief, Drainage pattern, natural water courses, reservoirs etc.

The study area is characterized by low-relief, gently undulating to nearly flat alluvial terrain of the Krishna River Basin, with extensive agricultural land. An irrigation canal passes through the study block and forms an important component of the local surface-water network. Minor seasonal drainage channels and natural water courses occur locally.

The Krishna River is the principal regional drainage system and lies outside the study block. The Prakasam Barrage, located across the Krishna River near Vijayawada, is also outside the block and at a considerable distance. The regional drainage and irrigation system, together with buried palaeochannels, is important for understanding the distribution of alluvial and gravel-bearing horizons targeted for diamond exploration.

5.2 Road, Railway and other communication Details

The project area is bounded by latitudes 16°24'24.84"N to 16°26'57.98"N and longitude 80°35'22.20"E to 80°39'21.96"E in Survey of India toposheet no. 65D/11. Pedavadlapudi, Ippatam, Gundimeda, Mellempudi, Nutakki, Vadeshvaram are the villages in the survey area. The study area can be approached by Chennai-Kolkata National Highway (NH-16) and smaller localities in the area are well connected by a network of state and district level roads as well as village roads. The nearest railway stations are Pedavadlapudi, Kolanukonda and Vijayawada. Pedavadlapudi railway station is within the survey area, Kolanukonda railway station is at a distance of 640 m from survey boundary and Vijayawada railway station is at 8 km from vadeswaram. Nearest airport is Vijayawada international airport at a distance of 20 km from the mangalagiri area. The nearest national highway is Chennai-Kolkata National Highway (NH-16) and the nearest state highways are SH-316, SH-174, SH-151, SH-185, SH-175, SH-139, These state highways are in the study area.

5.3 Population

According to the 2011 Census of India, Guntur District had a population of 4,887,813, comprising 2,440,521 males and 2,447,292 females, with a sex ratio of 1,003 females per 1,000 males. Based on demographic projections, the district's population is expected to rise to about 5.30–5.39 million (52.99–53.97 lakh) by 2011, reflecting a growth of around 10% over the 2011 figures. These estimates indicate a trend of moderate but steady population growth across the decade. (India Census, 2011).

5.4 Socio Demographic profile of the area: The study area is primarily agricultural, with most land owned by nearby villagers. The local population relies heavily on crop cultivation as their main source of income and livelihood.

5.5 Archaeological & Historical sites

Guntur District of Andhra Pradesh is renowned for its rich archaeological and historical heritage. The Undavalli Caves, dating back to the 4th–5th centuries CE, showcase remarkable rock-cut architecture influenced by Buddhist, Jain, and Hindu traditions. The district is also home to the famous Amaravati Buddhist site, which includes the ancient Amaravati Stupa (Mahachaitya) from the 3rd century BCE to 3rd century CE, along with the towering Dhyana Buddha statue that stands as a symbol of peace. Another prominent site is the Kondaveedu Fort, a 14th-century hilltop fortress built by the Reddy dynasty, which later came under the control of several ruling powers. The island site of Nagarjunakonda, once a flourishing Buddhist learning center, now houses relocated relics and a museum preserving its legacy. In addition, places like Chebrolu, with its ancient temples and inscriptions, and Mallavaram, known for Iron Age burial structures, further highlight the district's deep historical and cultural significance.

5.6 National parks and Environmental settings of the area

Guntur district does not contain any national park within its territorial limits; however, it is located in close proximity to ecologically important protected wetlands, including the Krishna Wildlife Sanctuary and the Kolleru Bird Sanctuary. These sites are recognized for their critical role in the conservation of migratory avifauna and wetland biodiversity. The environmental setting of the district is largely influenced by the Krishna River delta system, which, together with the prevailing tropical climatic conditions, sustains intensive agricultural practices. Additionally, the landscape is marked by fragmented stretches of dry deciduous forests and scrub vegetation that provide habitats for rural biodiversity, while the associated wetland ecosystems contribute significantly to the ecological balance of the region (Source: Andhra Pradesh Forest Department; Wetlands Authority of India; District Census Handbook, Guntur, 2013).

5.7 Flora/Fauna

Mangalagiri is characterized by hilly terrain with deciduous and scrub forests forming the dominant terrestrial ecosystem. The vegetation consists mainly of shade-providing tree species, grasses, and shrubs that support small mammals, reptiles, and common forest birds. Though detailed floral records are limited, the broader Guntur region is known for tree species such as

Pongamia pinnata, *Terminalia* spp., and dry deciduous forest elements. Avifauna of the taluk remains under-documented, but migratory birds including painted storks and spot-billed pelicans are regularly seen in the nearby Uppalapadu Bird Sanctuary during the winter months, Kubo et al., (2017). Reptiles like monitor lizards and snakes, along with small carnivores and rodents, are likely to inhabit the reserve forest areas. The taluk also falls close to the paleo-channel of the Krishna River, which in the past shaped the alluvial plains and wetlands that continue to support agriculture and pockets of biodiversity, Nageswara Rao et al. (2012). In the wider district, the Krishna Wildlife Sanctuary enriches the ecosystem with mangrove flora such as *Avicennia*, *Rhizophora*, and *Sonneratia*, and fauna including fishing cats, otters, estuarine crocodiles, and numerous waterbirds, (District survey Report (2023), Department of Mines and Geology, Andhra Pradesh, 2023).

5.8 Water Bodies

The River Krishna flowing adjacent in NE corner to the study area along the NW-SE direction. Also, a canal from Prakasam Barrage is running in the middle of the block from N to S direction.

5.9 Climate

Guntur is the central part of the state. The district has a coastline having a length of ~100km on the right bank of Krishna River, that separates it from Krishna district and NTR district. Tropical climate conditions with extremely hot summer and cold winter prevail in the Guntur district. April to June months are the hottest months with high temperature in May. The climate of the district is moderate and characterized by tropical rainy climate with aggressive summer. The period from December to middle of February is generally dry and cool winter season. The Summer season is from March to May. The weather averages for the month of July, temperature averages around 33.3°C and at night it feels like 25.5. The maximum and minimum temperature are overall the district 40.5°C. to 44.4°C and 18.3°C to 28.3°C.

The average annual rainfall of the district is 877.12 mm, of which 596.04 mm as South-West (June- September) monsoon and 196.09 mm as North-East (October-December) monsoon. The mean minimum and maximum temperatures recorded in the district are 40.5°C to 44.4 °C in May (District survey Report (2023), Department of Mines and Geology, Andhra Pradesh, 2023).

5.10 Geomorphology

The main fluvial landforms in the delta are the present channel of Krishna, levee, flood basin and palaeo-channel. These landforms are characterized by their forms and associated sediments. The lithological units consist of sand, silt, clay and their admixtures. The fluvial delta is a flat area which may be differentiated into active channel, levee, flood basin and palaeo-channels with very minor elevation difference. The Palaeo-channel between Tsundur and Revendrapadu forms a distinct geomorphic unit characterized by thick palmyra growth. The fluvial sediments of the palaeo-channels are covered by black clay of later flood plain deposit. Levee forming slightly higher ground is developed along the western bank of the Krishna River over a width of 0.50 km to 1.50 km. It gradually merges with the flood basin. (Nageswara rao et. al 2012).

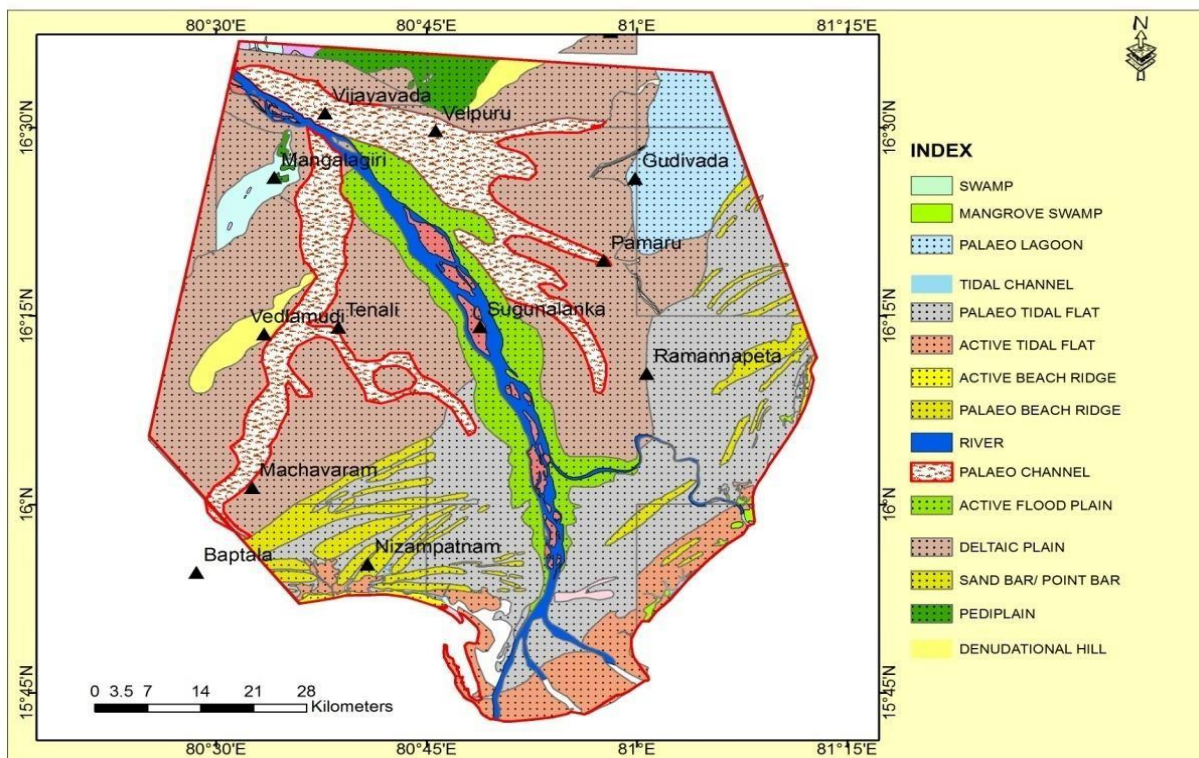


Figure 5.1: Geomorphology of the Krishna Basin area and Demarcated Palaeo Channels (Source: Geomorphology map is downloaded from Bhuvan Site is crosschecked and updated with the same map from Bhukosh site)

CHAPTER 6. INFRASTRUCTURE

6.1 Local infrastructure

The study area is accessible via the Chennai–Kolkata National Highway (NH-16), while nearby localities are well connected through a network of state, district, and village roads. The nearest railway stations are Pedavadlapudi, Kolanukonda, and Vijayawada. Of these, Pedavadlapudi station lies within the survey area. The nearest airport is Vijayawada International Airport, approximately 20 km from the Mangalagiri region. There are only few hotels and home-stays near the survey area while more extensive options can be found in nearby Vijayawada. Medical needs are met through local primary health centers, with advanced healthcare services accessible in Vijayawada and Guntur. In addition, local markets and community amenities cater to residents, and the region holds eco-tourism potential due to its natural and cultural heritage.

CHAPTER 7. GEOLOGY

7.1 Regional geological set up of the area with stratigraphy

The survey area is predominantly covered by black clay underlain by sand, which is interpreted as early Holocene in age and represents older fluvial depositional activity. In the northeastern sector, however, a small, localized patch is characterized by black silty clay of Meghalayan age, indicating a younger sedimentary phase and a distinct depositional environment within the Holocene sequence. (source: Geological map of GSI, Figure.7.1)

7.2 Structure, metamorphism

Since the present study area is part of a palaeo channel of Krishna River, there is no hard rock exposure present within the block. As well as there is no indication of structure and metamorphism within the block.

7.3 Surface indication of mineralization

The area under study forms part of the Eastern Ghats mobile belt, which is a major physiographic and a principal Pre-Cambrian metamorphic unit of peninsular India. The prominent regional geological formations in the study area belong to Archaean and Quaternary. The Archaean system includes mainly Khondalites and Charnockites. Quaternary system includes Laterite and surficial deposits. The term “Khondalite” was first coined by Walker I (1902) in place of descriptive name of garnet-sillimanite-graphite schist. The name has been extended to the garnetiferous-sillimanite-gneisses. These are occupying the extensive areas of peninsular India.

Major portion of the area is covered with black soil (**Figure 7.1.**) There are no surface exposures available. In nearby areas of Mangalagiri block, the rock types represented under the khondalite suite of rocks are garnet-sillimanite-gneisses and garnet-biotite sillimanite gneisses.

Since the project is concentrating on the geophysical surveys to identify the diamond and associated minerals in the palaeo channel deposits, the surface indication of mineralization is irrelevant. The project does not demand the geological mapping.

Black cotton soil comprises more clay content and sticky in nature. Because of high content of clay, the soils are not well drained. Red sandy soils are seen on the upland areas and on the plains around hills and pediments. The soils are believed to be deposited by creep-built. The low laying areas of the study area are mainly occupied by red soils. These red soils are the fine degraded products of khondalite rocks. Lateritic soils are reddish brown and mostly pebbly in nature. They are formed due to concentration of iron hydroxides in the soils. The iron hydroxides are derived mainly from ferro-magnesian minerals present in khondalite rocks.

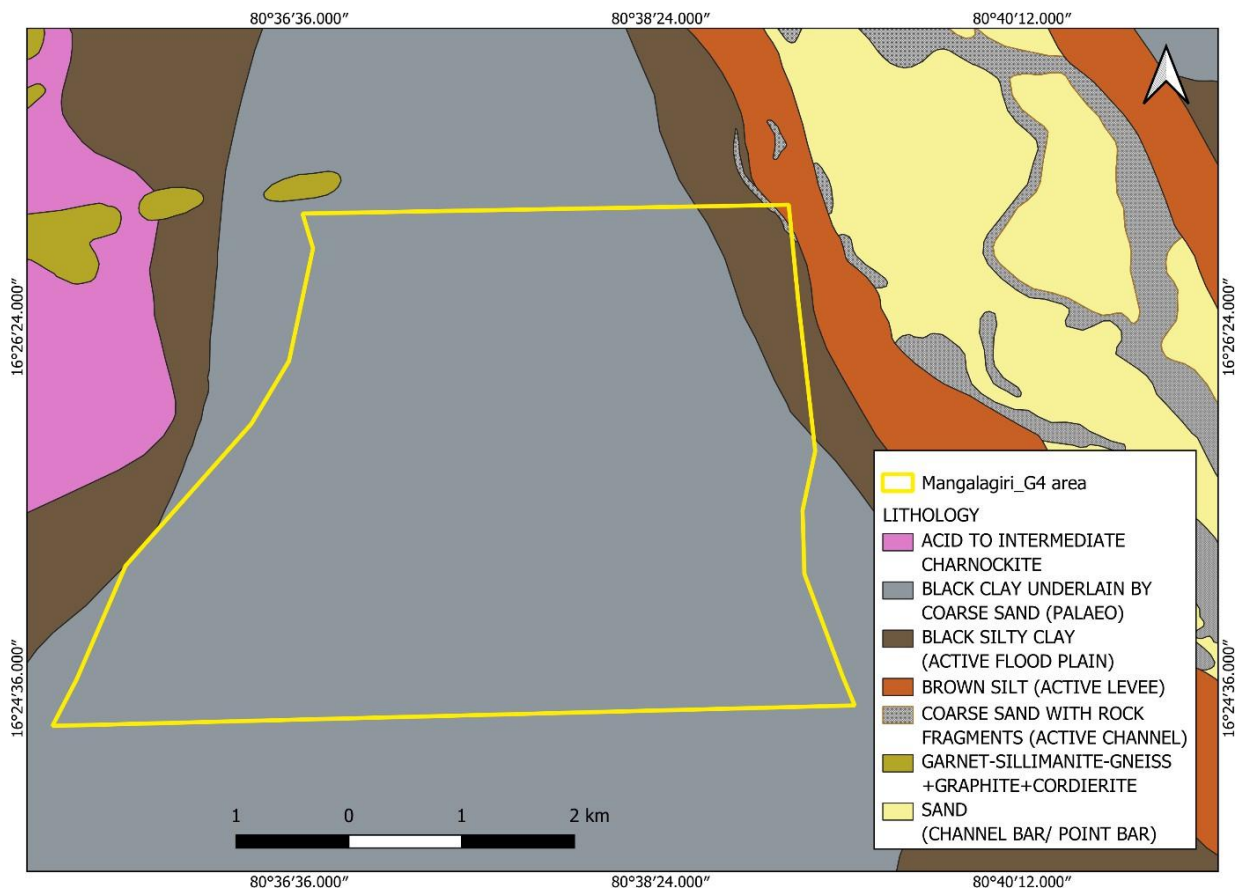


Figure 7.1: Geological map of Mangalagiri block (1:50000 scale, Toposheet No. 65D/11; Source: NGDR)

CHAPTER 8. PREVIOUS EXPLORATION

Palaeo channels: The palaeo-channel has great significance in the exploration for placer diamonds. During the field studies it was found that the area (Kodavattikallu) in an around covered by the palaeo-channel predominantly comprises gravel made up of water worn pebbles and cobbles in a finer matrix. Some of the old workings near Kodavattikallu fall within this channel, and according to old records these workings yielded a rich bonanza of diamonds. The important river Krishna and its tributaries drain the northern part whereas in the southern and central parts there are only a number of small streams. Two major palaeo channels are identified on both sides (left and right bank) of the present-day river course based on the studies on satellite imagery. The paleo channel identified on the left bank of the river runs parallel to the present-day river course. One additional palaeo channel branching out from palaeo-channel on the right bank is also demarcated. Calcretes are commonly used as an indicator of Palaeo-environmental conditions prevailed during Pleistocene period. The last glacial maxima during Pleistocene period dry climatic conditions prevailed for the formation of calcretes. Calcretes described in these deltaic clays at a depth of 7m to 75m reflects a water table overprint on the stratigraphic sequences.

Alluvial Diamonds:

Alluvial diamond occurs in five main types of deposit: fluvial, marine, wind deflation, lacustrine and glacial. Although the degree of diamond concentration varies considerably in different deposits of any one category, the most economically significant deposit type is the marine, followed by the fluvial (Ravi et al., 2018).

The importance of gaining a thorough understanding of the geomorphological history of an area to be explored for alluvial diamonds is well illustrated from various places, where active alluvial diamond mining is taking place viz., Sierra Leone, South Africa, Brazil, Ghana etc.,

Diamonds in the South Africa and Namibian Coasts

Unlike primary diamondiferous rocks, secondary diamond deposits may be found in almost any tectonic setting. Although most alluvial deposits have been found on Archaean cratons, near their primary source rocks, by far the most economically significant deposits occur off-craton, or on craton margins. The extensive marine alluvial deposits of south-western Africa are far removed from the Kaapvaal craton from whence the bulk of the diamonds were derived.

In other parts of the world, especially in South Africa off the mouth of orange river (Namibia),

such offshore occurrences of diamonds have not only been proved but such diamonds are also mined economically. Those diamonds travelling hundreds of kilometers from the source landed off the coast of what is now Namibia, creating the world's richest marine-diamond deposit. The country's territorial waters are now estimated to hold 80 million carats, and the world's biggest diamond miner, De Beers, has quietly built up an armada off the coast to vacuum up those precious gems (Bluck et al., 2005).

8.1 Name and address of prospecting agency or permit holder or licensee involved in the exploration of the area with year and period of exploration

This is a reconnaissance survey, and no prior exploration activities have been carried out in this survey area.

8.2 Details of previous exploration/investigation carried out by other agencies/parties.

8.2.1 Presence of microdiamonds in the beach sediments of Andhra Pradesh

AMD has reported microdiamonds at the mouth of Krishna River from beach sediments in 2005 (Anil Kumar et al., 2005). The microdiamonds collected are colourless to brownish yellow and contain inclusions. Since the diamonds are not in coarser size fractions i.e. found only in 425,250,177,150 and 105 μm the identification was purely based on microscopic studies.

8.2.2 Confirmation of presence of palaeo channels in the Survey area

The Geological Survey of India conducted G4 level Reconnaissance to examine the quaternary formations and geomorphology of the western Krishna delta, spanning from Revendrapudu to Tsundur in Guntur district, Andhra Pradesh. This region comprises an inner fluvial delta surrounded by a pediplain to the west. The fluvial delta exhibits active channels, levees, flood basins, and palaeochannels, each showcasing distinct lithological units. The convergence of Modukuru and Tenali palaeo-channels occurs west of Tenali, stretching northwards to Tadepalle.

8.2.3 Presence of alluvial sediments in the down stream of proposed Exploration block

The research topic described in the paper "Preparation of profiles of Quaternary deposits in Krishna delta, east coast Andhra Pradesh (under IGCP-475)" by Shah et al., 2006, focuses on analyzing the subsurface composition of the Quaternary delta profile from Amrutuluru towards the inland area, near the present shoreline of Nizampatnam bay. Five stratigraphic boreholes were drilled on the western side of the delta, spanning a length of 21 linear kilometers, with

basement depths ranging from 110 to 180 meters having 48 to 94m thick medium to coarse gravelly-sand unit intersected at the base and it continues in all the boreholes between Amrutuluru and Nizampatnam, within the Survey of India T.S.Nos.65D/12 & 66A/9. The reported clayey sediments contain Higher lanthanides, zirconium, Co (up to 171 ppm), Y (67 ppm) and Zr (191 ppm) values. XRD data indicates the presence of small amounts of anorthite, sanidine, talc, amphibole and leucophyllite in the samples. Though the geochemistry of sediments indicates a dominant granitic province, but contributions from the ultramafic sources (anorthite, talc) or potassic ultramafic rocks (sanidine, amphiboles) are also indicated from trace chemistry and mineralogy. In view of the above, the substratum of the Mangalgiri Block has been chosen to prospect for the gravel beds. If present, such gravel beds could contain diamond bearing detritus.

Further work by ONGC indicates that the sediment deposition, consisting of a substantial volume of loose to semi-consolidated gravel, sand, silt, and clay, occurred in a frequently changing depositional environment and the basement depths were recorded between 115m to 185m in the boreholes drilled at Uppugunduru and Kanuparti (P.V.L.P.Babu, 1975, ONGC).

Stratigraphic succession from Shah et al., 2006.

Table 8.2.3.1 Stratigraphic succession from Shah et al., 2006.

Lithology	Environment
Upper cover of sandy/silty unit	Sub-aerial/fluvial/ aeolian
Dark grey silty clay unit	Marine / lagoonal
Brown silty clay unit with sand horizons oxidized	Fluvial /sub-aerial
Medium to coarse yellowish sand with silty clay	Tidal flat- marine with intermittent sub-aerial exposure
Greyish clay with mottled texture	
Grey sand & silty clay with pie-sized calcrete	Fluvial
Sand-clay alternation Sticky brown silty clay with calcretes	Marine
Medium to coarse gravelly sand with calcrete and horizons of silty clay.	Fluvial

CHAPTER 9. AERIAL OR GROUND GEOPHYSICAL OR GEOCHEMICAL DATA

9.1 Geophysical exploration

Ground geophysical surveys such as vertical electrical soundings, resistivity profiling and seismic refraction surveys were conducted for delineating the gravel bed in 25.1 Sq.km area.

9.1.1 Different methods adopted for ground geophysical exploration (Methodology)

The paleochannel was first identified and mapped using satellite imagery, which revealed a predominant north–south (N–S) trend with lateral extension in the east–west (E–W) direction. Based on the interpreted channel geometry, an E–W-oriented baseline was established to investigate its lateral extent and subsurface characteristics.

As a preliminary investigation, seven (7) Vertical Electrical Sounding (VES) surveys were conducted using the Schlumberger configuration with AB/2 spacing as 200 m. These stations were distributed within the study area to obtain an initial understanding of vertical extension of resistivity in the subsurface. Based on the results of preliminary survey, resistivity profiling was planned in the survey area. These profiling traverses were oriented approximately perpendicular to the inferred N–S trend of the paleochannel to identify lateral variations of resistivity in the subsurface. Approximately 20 line-kilometers (Lkm) of resistivity profiling were conducted along selected traverses crossing the presumed paleochannel. Profiling was carried out using twin-electrode configuration with AB/2 separations as 20 m and 30 m, with a station spacing of 10 m.

Based on profiling data and observing the high resistivity variations, laterally, seventy-one (71) additional VES measurements were subsequently carried out to improve the spatial coverage and subsurface resolution. The AB/2 spacings used for the additional VES measurements ranged from 70 to 350 m at different locations in the survey area.

These VES data were plotted on double-logarithmic graphs and interpreted the variation of apparent resistivity with thickness of strata and depth. Several VES stations exhibited K-type resistivity curves ($\rho_1 < \rho_2 > \rho_3$), indicating a relatively high-resistivity intermediate layer bounded by low-resistivity layers. These high-resistivity zones were interpreted as possible sand- and gravel-bearing horizons.

However, since resistivity data alone cannot reliably determine the depth and thickness of gravel deposits, seismic refraction survey was undertaken for further delineation of the strata based on the acoustic velocity (P-wave) parameters at selected locations corresponding to the identified high-resistivity anomalies. An in-house-developed wireless seismograph was used

for seismic data acquisition, with 170 to 210 kg adjustable weight-drop device, as seismic signal source. The seismic refraction results were integrated with the VES and resistivity-profiling data to improve the identification, depth estimation, thickness determination, and subsurface delineation of coarse-grained deposits associated with the presumed paleochannel.

9.1.2 Instruments used

The various instruments deployed for conducting the geophysical surveys are tabulated in the following table

Table 9.1 Instruments deployed for conducting the geophysical surveys

Sl. No.	Method	Instrument deployed	Make	Accuracy
1.	VES	SSR-MP1	IGIS, Hyderabad	±1%
2.	Resistivity Profiling	SSR-MP1	IGIS, Hyderabad	±1%
3.	Seismic refraction	Multichannel seismic refraction system	In house developed	
4.	Position location	Etrex30	Garmin	3-5m

9.1.3 Survey layout

9.1.3.1 Electrical Resistivity Profiling (ERP)

Electrical resistivity profiling was conducted using the Schlumberger configuration, with twin electrode separations keeping $AB/2 = 20\text{m}$ and 30m , respectively with potential electrode spacing at 10 m intervals. This will identify the lateral variation in resistivity along E-W direction, perpendicular to the paleo river course.



Figure 9.1.3.1 Electrical resistivity Profile field photos in profile1 (near VES1) and profile 6 (near VES 20)

9.1.3.2 Vertical Electrical Sounding (VES)

Vertical electrical sounding was performed using the Schlumberger configuration, with AB/2 spacing ranging from 1.5 m to 350 m. with MN/2 spacing changed in five increments viz; 0.5 m, 2 m, 5 m, 10 m, and 20 m for 34 VES locations to measure the ground potential as and when required.

Another 44 VES stations MN/2 spacing changed from 0.5m, 1m, 3m, 5m, 8m, 10m, 20m, 30m and 40m to study the vertical variation of resistivity in the survey area.

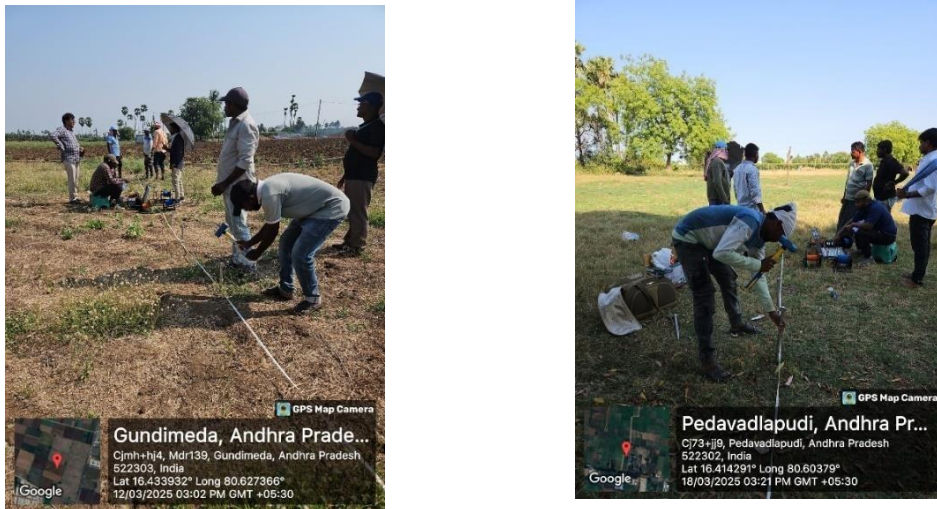


Figure 9.1.3.2 Vertical Electrical Sounding field photos in Ves 4 and VES 15

9.1.3.3 Shallow Seismic Refraction Survey

Shallow seismic refraction survey was carried out using multi-channel wireless seismograph with a weight-drop signal source having 170–210 kg adjusting capacity. Initially, the seismograph was deployed in both forward and reverse configurations at Mellampudi village (VES-31) to evaluate penetration depth. It was later arranged in a single direction for subsequent measurements. Following rainfall, a decrease in penetration depth was observed. To address this, the setup was modified to a split configuration—placing the source at the center, with 12 geophones positioned toward the north/east and the remaining 12 geophones oriented toward the south/west. Further the array was extended up to 30 channels on the basis of availability of area in the terrain.



Figure 9.1.3.3 Seismic refraction survey field photos Seismic point near Ves 9 and Seismic point

9.1.4 Statistical Details

- Number of soundings (VES) – 78 nos. (15.46 Lkm)
- Resistivity profiling (line Km)- 20.11 Lkm
- Seismic Refraction survey (line Km)- 12.75 Lkm

9.1.5 Data Processing

The VES data were analyzed using IPI2Win software, which generated four-layer curves with total thicknesses ranging from 12 m to 88 m. Resistivity profiling data were plotted as a linear graph in Microsoft Excel, and the apparent resistivity (ρ_a) values were calculated using the equation:

$$\rho_a = K^*(V/I)$$

where:

- **K** = Geometric factor
- **V** = Potential difference (voltage)
- **I** = Current

$$K = ((AB/2 + MN/2) * (AB/2 - MN/2) * 3.14) / MN.$$

In the **seismic refraction survey**, seismograms were plotted using **MATLAB** software, and **first arrival times** were picked from the plots. A **seismic hodograph**—a graph of offset distance versus first arrival (P-Wave) time was then constructed to determine the velocities of individual layers. Though surface waves such as love waves were also observed with delayed time of arrival, with characteristic low velocity, it is not considered for the estimation of thickness and depth.

Seismic refraction analysis is based on **acoustic impedance contrasts** (velocity $\times$ density) between subsurface layers. According to **IS 15681:2006 – Geological Exploration by Geophysical Method (Seismic Refraction Code of Practice)**, the representative velocity ranges for various lithological units are given in table no. 9.1.5.1.

Table 9.1.5.1 The representative velocity ranges for various lithological units from IS 15681:2006 – Geological Exploration by Geophysical Method (Seismic Refraction Code of Practice)

Litho Unit	Velocity (m/s)
Soil	400 – 800
Sand (wet)	800 – 1200
Gravel zone with dry alluvium and sand	500 – 900
Gravel zone with wet alluvium and sand	1100 – 1600
Fractured rock (if present)	1800 – 3000
Hard rock	4000 – 5500

Using these velocity values, the lithological units of each layer can be inferred.

The **depth (d)** of each layer was calculated using the formula, Lowrie, W.

(2007):

$$d = (X_c/2) * \text{Sqrt}(v_2 - v_1 / v_2 + v_1)$$

where:

- **X_c** = Crossover distance obtained from the seismic hodograph
- **v₁ and v₂** = Velocities of adjacent layers

Table 9.1.5.2 Velocity ranges for various lithological units as per drilling data in Mangalagiri block

Litho unit	Velocity (m/s)
Soil	160- 600
Dry Alluvial Sand	460-800
Gravel with sand/ Mud	820-880
Saturated sand / Mud	900-1600
Compact clay / Mud	1700-3400

9.1.6 Interpretation of Geophysical data

9.1.6.1 Electrical Resistivity Profiling

In the Mangalagiri block, eight resistivity profiles were carried out along the east-west direction, following the block boundary. The traverses were spaced approximately 1 km apart, covering a total profile length of about 20.11-line kilometers (LKM). Data acquisition was conducted using Schlumberger array with twin electrode separations with $AB/2$ (L) 20 and 30 m respectively and Potential electrodes $MN/2$ (l) of 10 m maintaining station interval 10m.

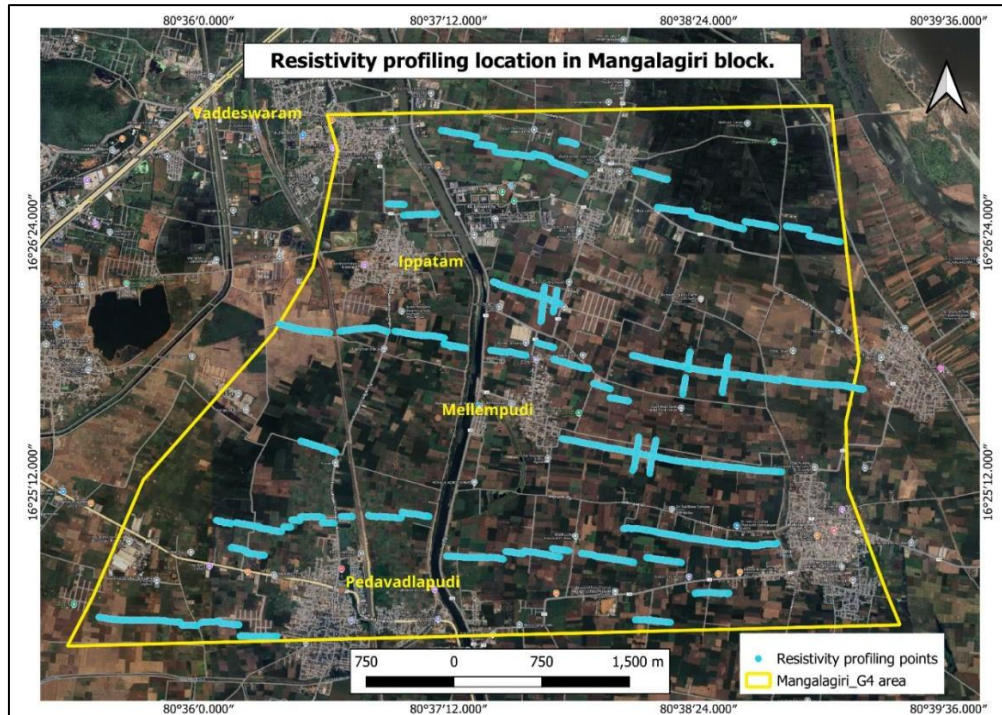


Figure 9.1.6.1.1 Profiling points in google earth imagery

Profile 1

The survey was conducted along the southernmost boundary, south of Pedavadlapudi and Nutakki, in the Mangalagiri block, using twin-electrode configurations with electrode separations (AB/2) of 20 m and 30 m. Over an east–west-oriented traverse of 2.11 km, spanning from 16°24'33.19"N, 80°35'31.31"E to 16°24'40.1"N, 80°38'32.7"E, the apparent resistivity values ranged from 2.20 to 33.05 $\Omega \cdot m$ for the 20 m separation and from 2.72 to 29.45 $\Omega \cdot m$ for the 30 m separation.

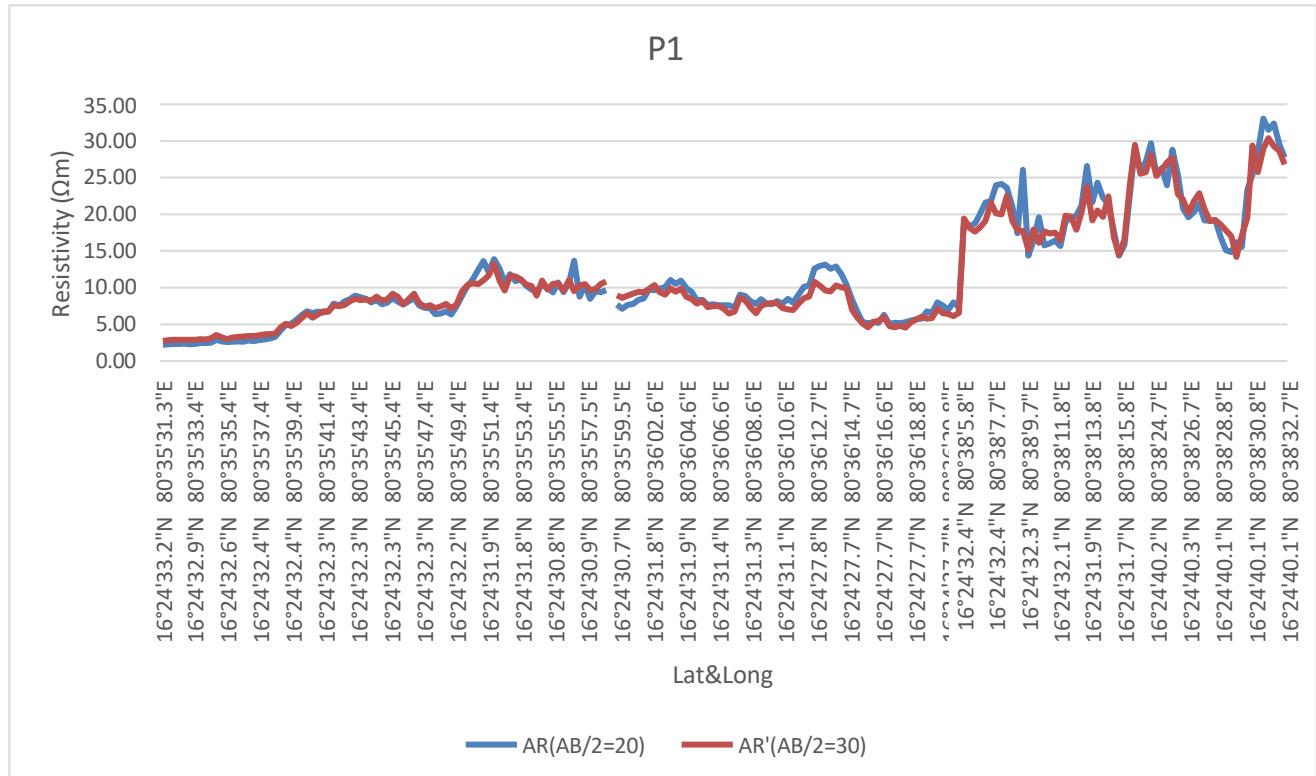


Figure 9.1.6.1.2 Graphical representation of Profile 1, showing resistivity versus latitude and longitude, with

AB/2 = 20 and 30.

Profile 2

This resistivity profile was conducted along east–west direction, approximately 700 m north of Profile-1 and to north of Pedavadlapudi Village. Measurements were carried out using twin-electrode configurations with electrode spacings (AB/2) of 20 m and 30 m. The apparent resistivity values obtained ranged from 6.38 to 39.88 Ωm for AB/2 = 20 m and from 6.10 to 32.21 Ωm for AB/2 = 30 m, covering a total survey length of approximately 2.21 km, spanning from 16°24'53.2"N, 80°36'9.4"E to 16°24'48.9"N, 80°38'19.0"E.

Profile 3

This resistivity profile was carried out along east–west direction, situated approximately 300 m north of Profile 2 and north of Pedavadlapudi Village. The line extended eastward in Mangalagiri Block toward Nutakki Village. Measurements were taken using twin-electrode configuration with electrode spacings (AB/2) as 20 m, 30 m, 40m and 50 m, covering a total distance of about 3.0 km (with 540 m surveyed at AB/2 = 50 m and AB/2 = 40m for one point). The apparent resistivity values ranged from 1.29 to 101.11 Ωm for AB/2 = 20 m, from 1.23 to 62.41 Ωm for AB/2 = 30 m and from 7.94 to 31.22 Ωm for AB/2 = 50 m, spanning from 16°25'01.1"N, 80°36'05.1"E to to 16°24'54.5"N,80°38'46.5"E.

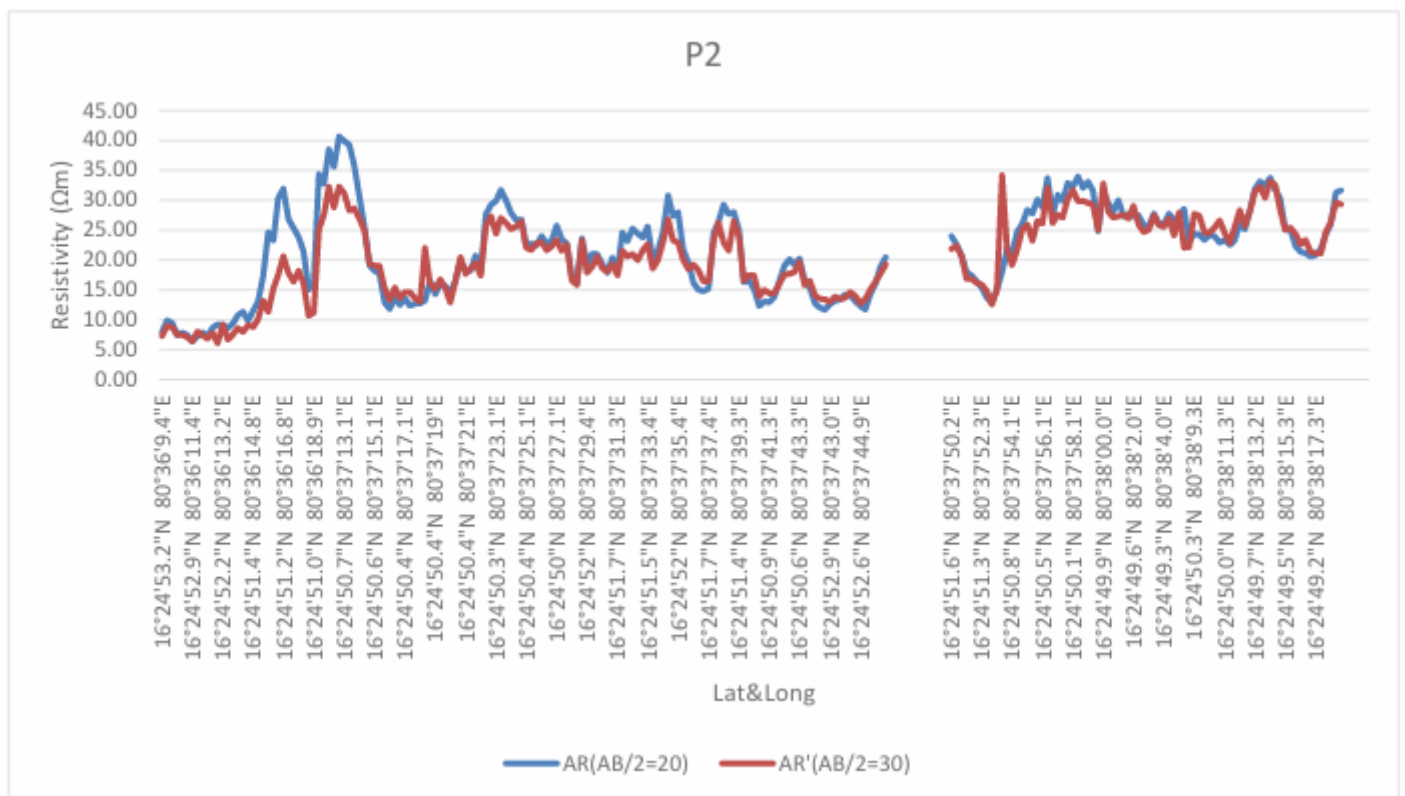


Figure 9.1.6.1.3 Graphical representation of Profile 2, showing resistivity versus latitude and longitude, with AB/2 = 20 and 30.

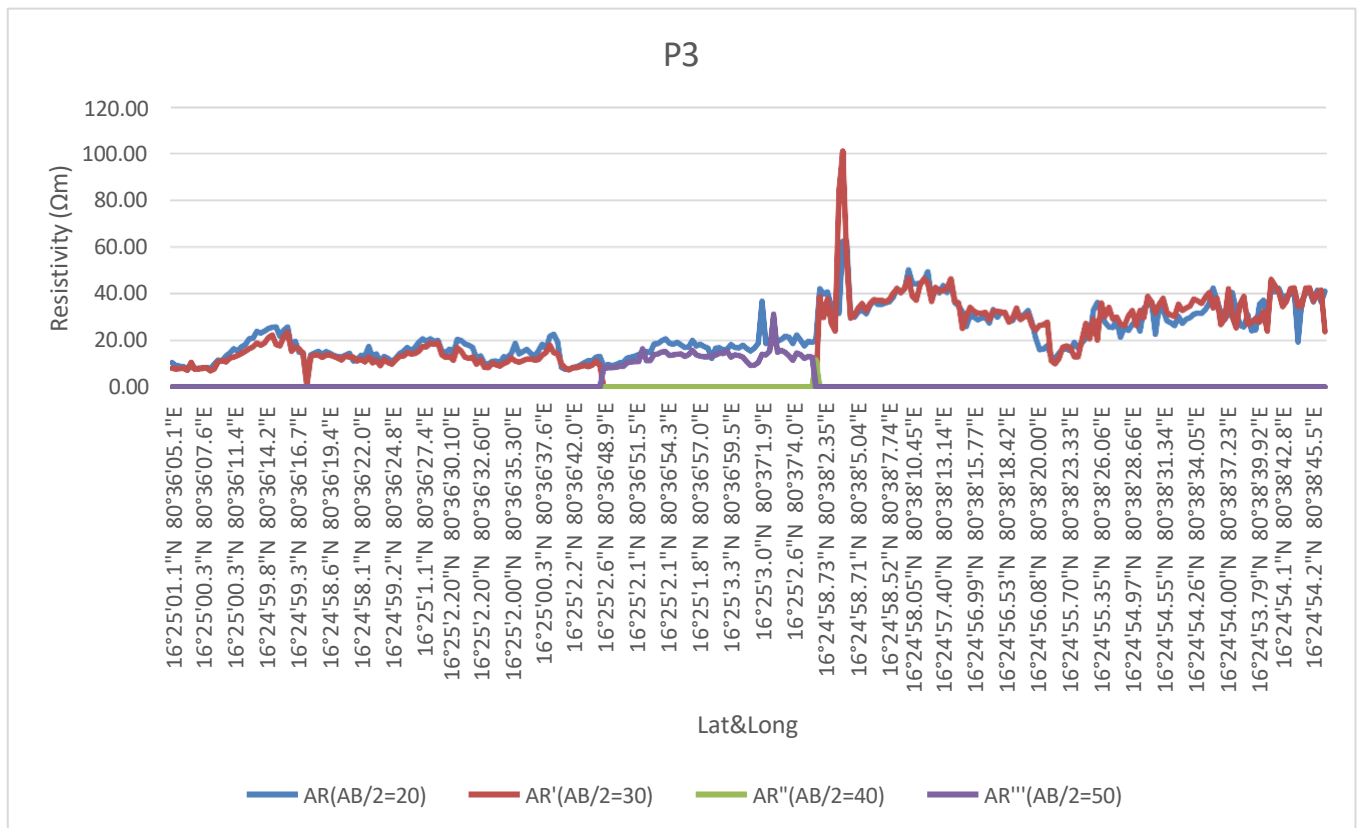
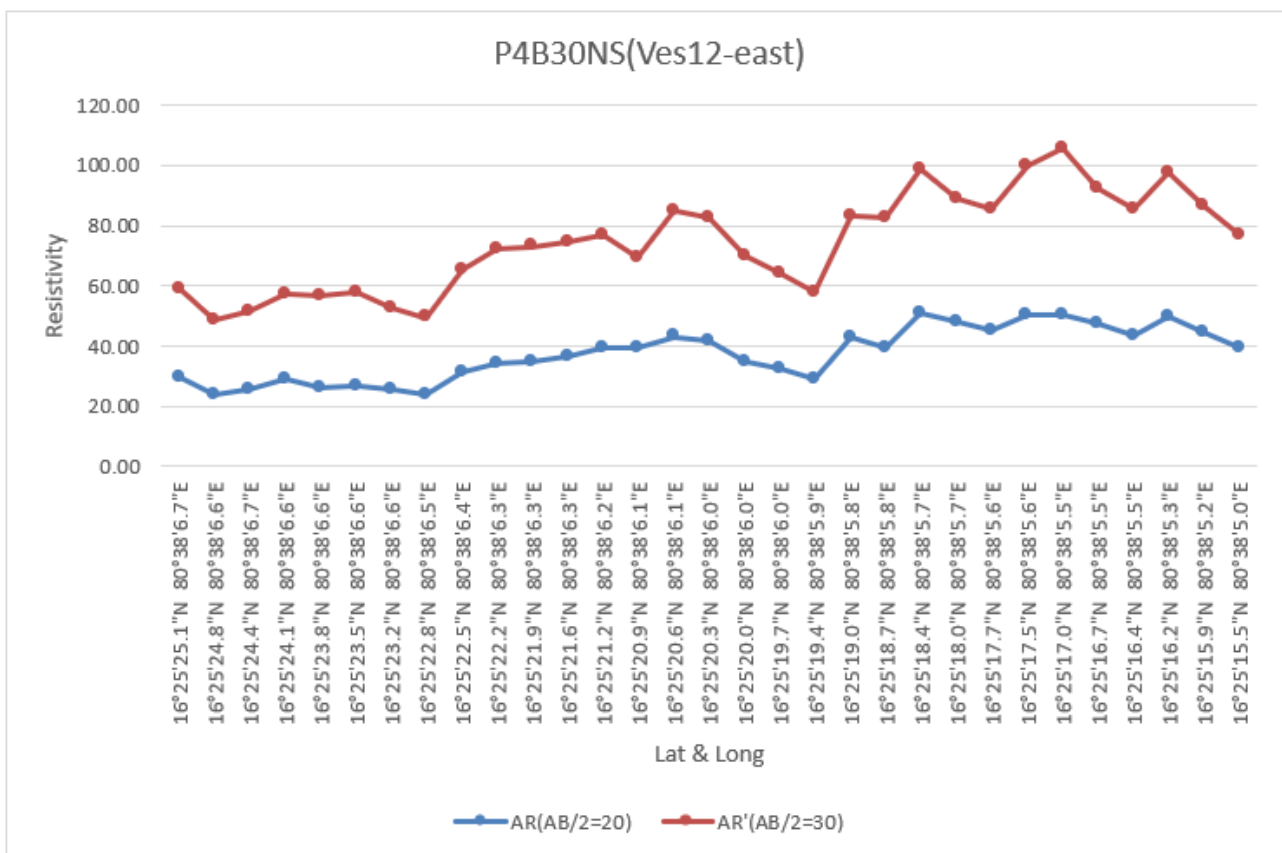
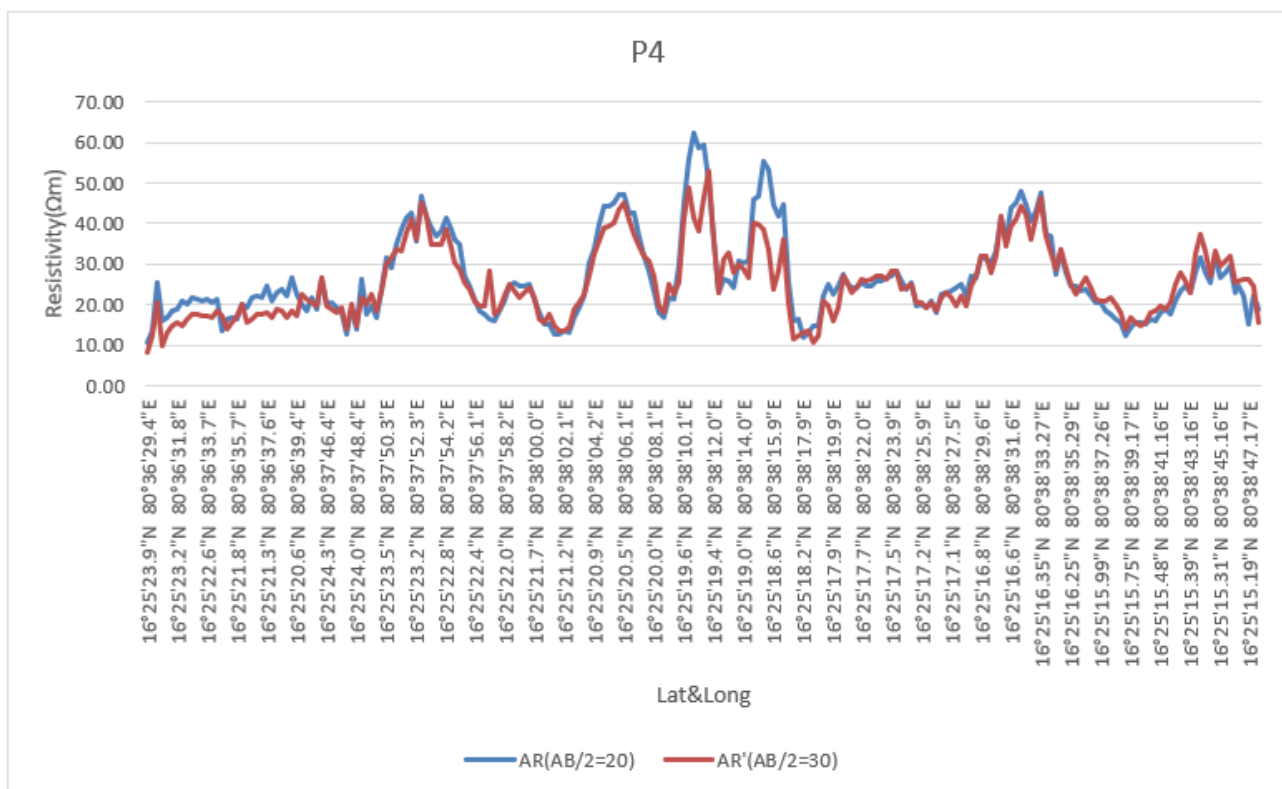


Figure 9.1.6.1.4 Graphical representation of Profile 3, showing resistivity versus latitude and longitude, with $AB/2 = 20, 30, 40$ and 50 .

Profile 4

This resistivity profile was carried out along east–west direction which is located approximately 700m north of Profile 3, using twin-electrode configuration with electrode spacings as $AB/2 = 20$ m and 30m. The apparent resistivity values ranged from 10.78 to 62.10 Ωm for $AB/2 = 20$ m and from 8.35 to 53.04 Ωm for $AB/2 = 30$ m, covering an east–west stretch of about 2.25 km, spanning from 16°25'23.9"N, 80°36'29.4"E to 16°25'15.05"N, 80°38'47.85"E. Among the six identified high-resistivity zones, two profiles designated as P4B30 and P4B44 were further surveyed in north–south direction.

- In **P4B30** profile, apparent resistivity values ranged from **23.84 $\Omega\cdot\text{m}$ to 50.62 Ωm** for $AB/2 = 20$ m, and from **24.64 Ωm to 55.50 Ωm** for $AB/2 = 30$ m.
- In **P4B44** profile, apparent resistivity values varied from **13.95 Ωm to 69.71 Ωm** for $AB/2 = 20$ m, and from **15.67 Ωm to 59.62 Ωm** for $AB/2 = 30$ m.



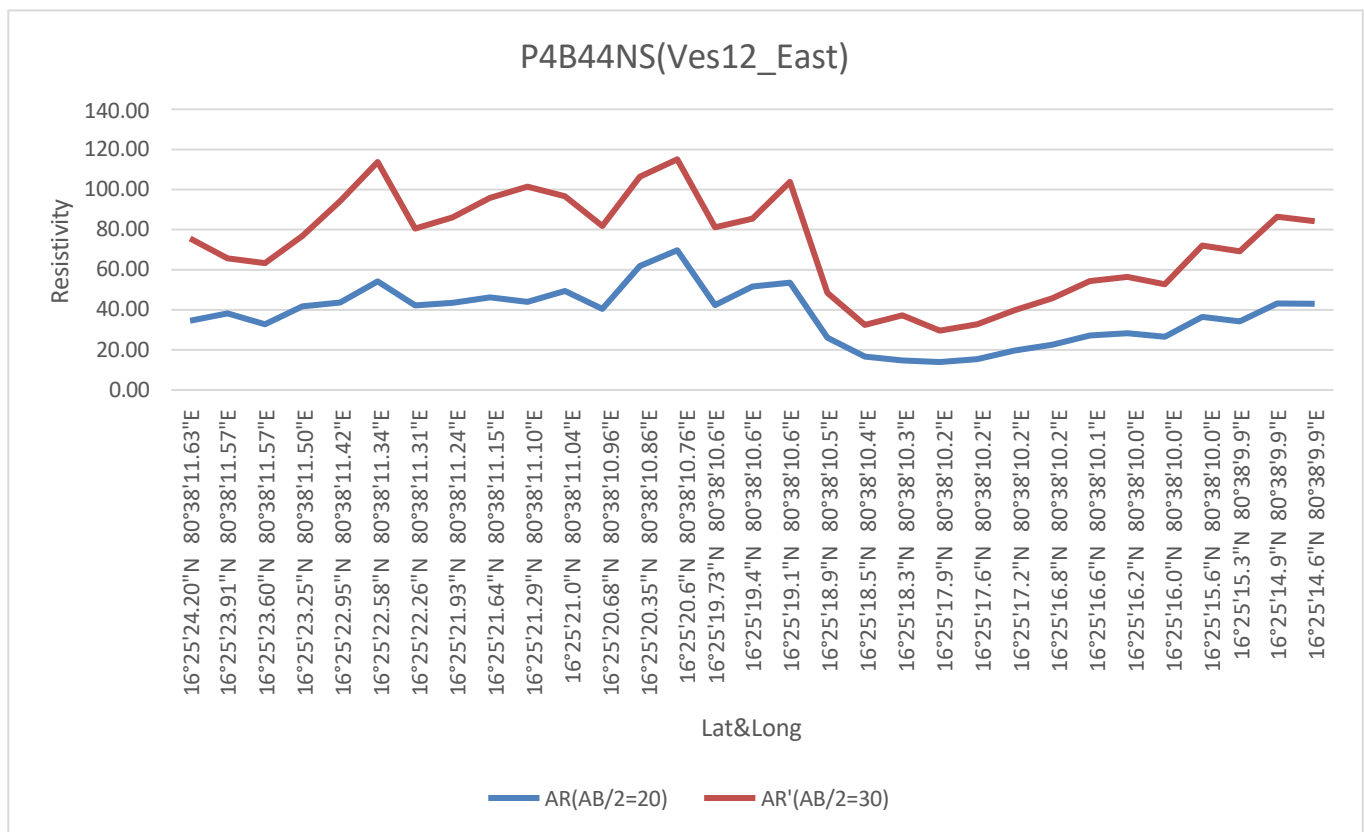


Figure 9.1.6.1.5 Graphical representation of Profile 4 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for AB/2 = 20m and 30m.

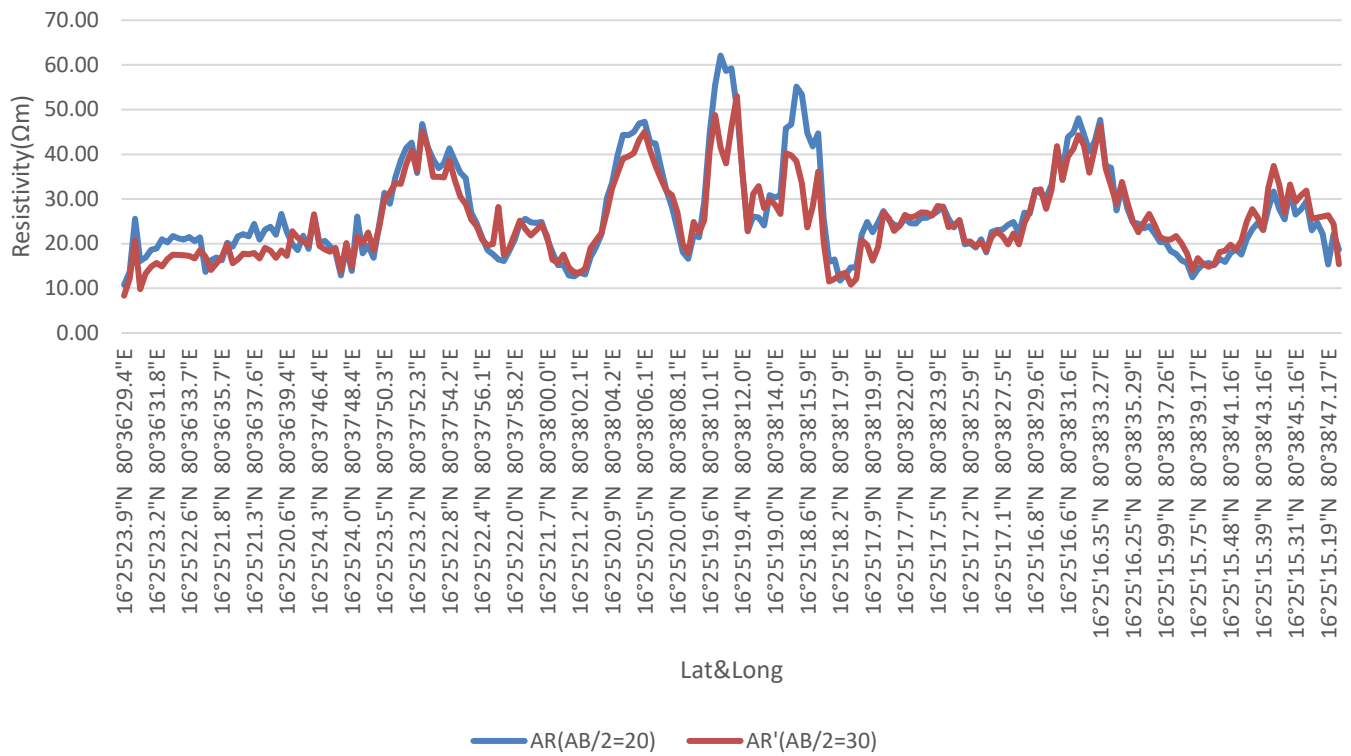
Profile 5

This resistivity profile was conducted along east–west direction, approximately 1.0 km north of Profile 4, in central part of survey area passing through Mellampudi Village. Measurements were taken using the twin-electrode configuration with electrode spacings (AB/2) as 20 m and 30 m. The apparent resistivity values ranged from 2.20 to 95.61 Ωm for AB/2 = 20 m and from 3.29 to 61.54 Ωm for AB/2 = 30 m, covering about 4.64 km in east–west direction, spanning from 16°25'57.6"N, 80°36'23.2"E to 16°25'38.9"N, 80°39'11.3"E.

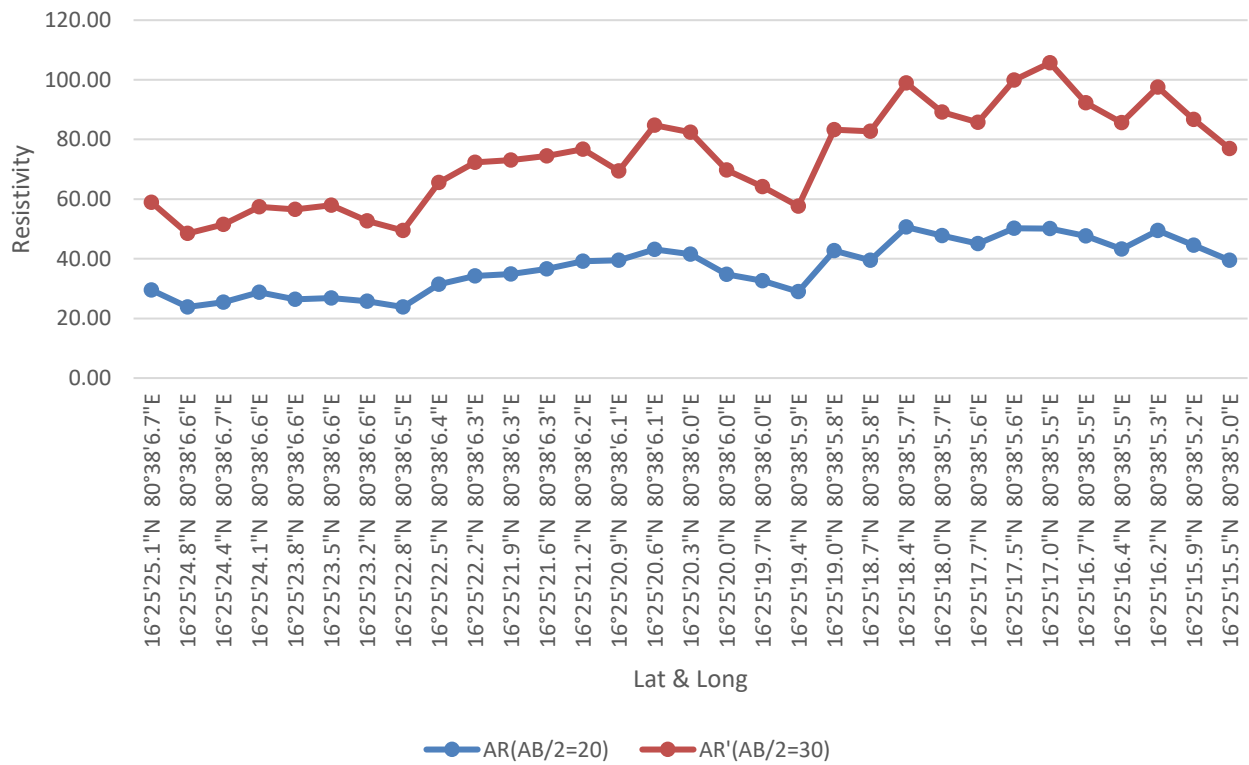
Among the identified high-resistivity zones, two additional profiles were conducted along north–south direction viz; **P28A24** (0.32 km length) and **P28E9** (0.33 km length).

- In **P28A24** profile, apparent resistivity values ranged from **28.07 Ωm to 84.82 Ωm** for AB/2 = 20 m, and from **27.41 Ωm to 62.30 Ωm** for AB/2 = 30 m.
- In **P28E9**, apparent resistivity varied from **31.7 Ωm to 55.6 Ωm** and for AB/2 = 20 m, the variation is **27.6 Ωm to 53.9 Ωm** for AB/2 = 30 m.

P4



P4B30NS(Ves12-east)



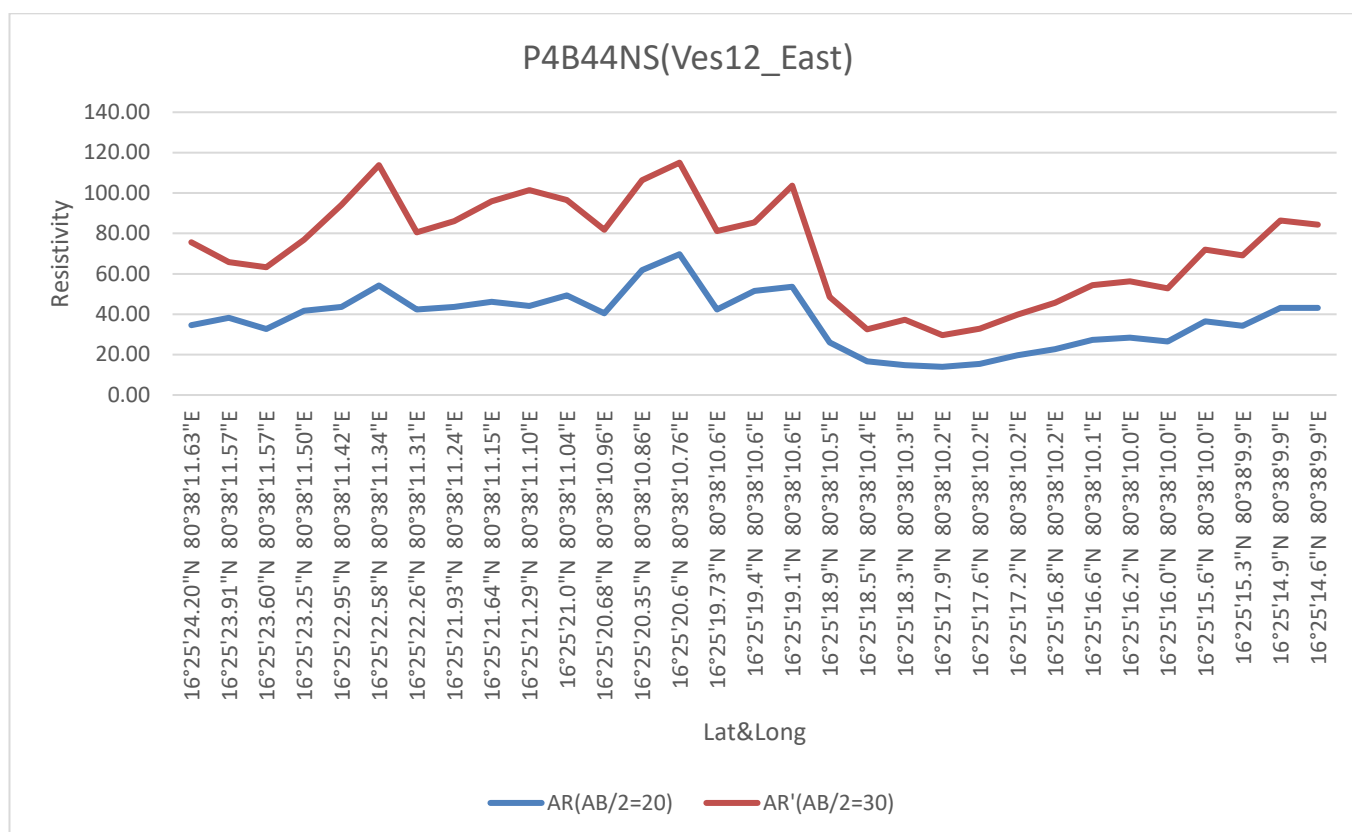


Figure 9.1.6.1.5 Graphical representation of Profile 4 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for AB/2 = 20m and 30m.

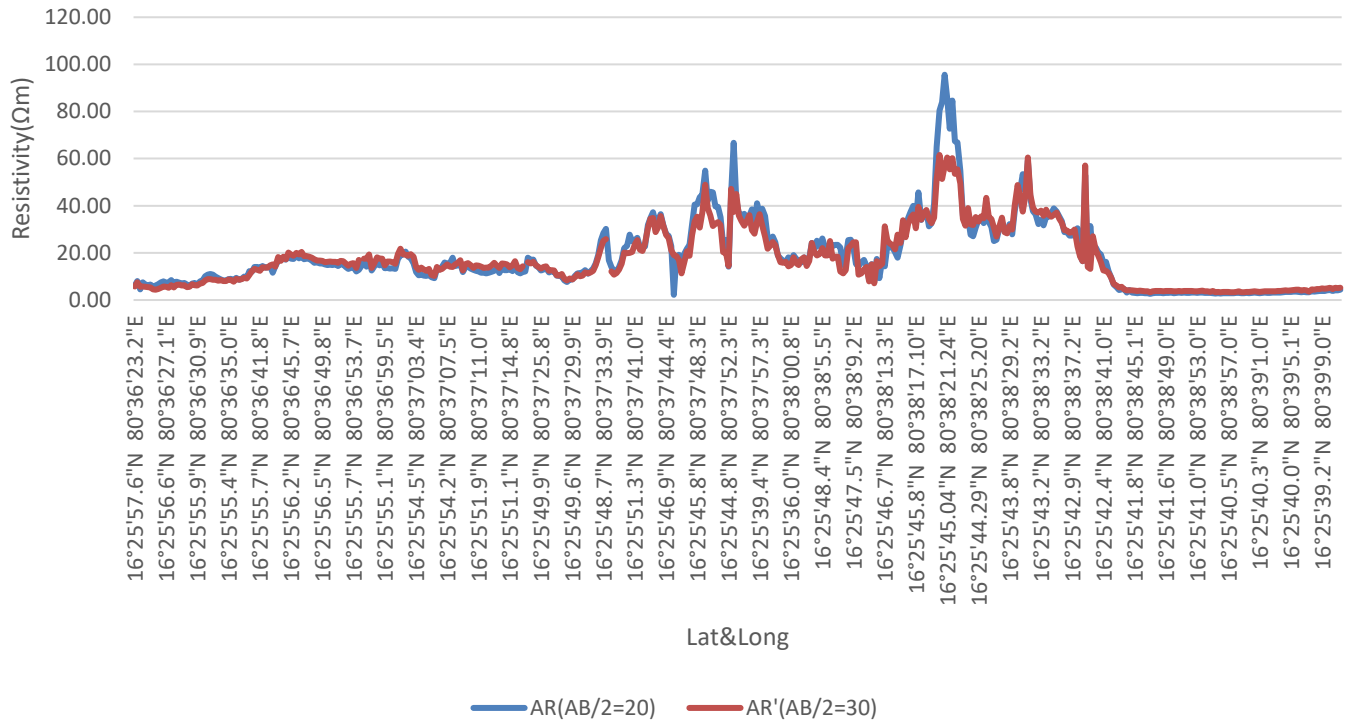
Profile 5

This resistivity profile was conducted along east–west direction, approximately 1.0 km north of Profile 4, in central part of survey area passing through Mellampudi Village. Measurements were taken using the twin-electrode configuration with electrode spacings (AB/2) as 20 m and 30 m. The apparent resistivity values ranged from 2.20 to 95.61 Ωm for AB/2 = 20 m and from 3.29 to 61.54 Ωm for AB/2 = 30 m, covering about 4.64 km in east–west direction, spanning from 16°25'57.6"N, 80°36'23.2"E to 16°25'38.9"N, 80°39'11.3"E.

Among the identified high-resistivity zones, two additional profiles were conducted along north–south direction viz; **P28A24** (0.32 km length) and **P28E9** (0.33 km length).

- In **P28A24** profile, apparent resistivity values ranged from **28.07 Ωm to 84.82 Ωm** for AB/2 = 20 m, and from **27.41 Ωm to 62.30 Ωm** for AB/2 = 30 m.
- In **P28E9**, apparent resistivity varied from **31.7 Ωm to 55.6 Ωm** and for AB/2 = 20 m, the variation is **27.6 Ωm to 53.9 Ωm** for AB/2 = 30 m.

P5



P28A24



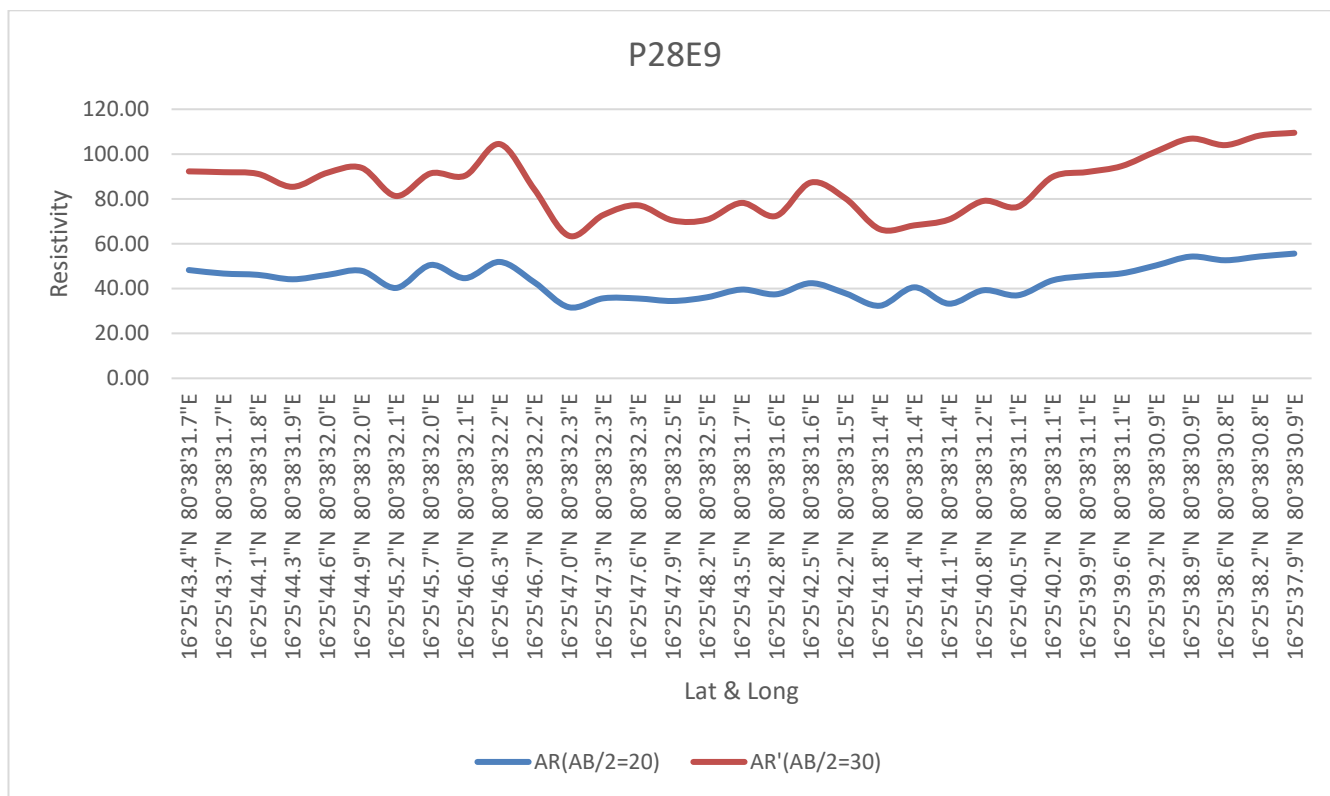


Figure 9.1.6.1.6 Graphical representation of Profile 5 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for AB/2 = 20 and 30.

Profile 6

This profile was conducted along the northern boundary of the survey area, with a traverse in the east–west direction, located approximately 1.8 km north of Profile 5 and passing through Gundimeda Village. Measurements were taken using a twin-electrode configuration with electrode spacings (AB/2) as 20 m and 30 m. The apparent resistivity values ranged from 2.10 to 54.23 Ωm for AB/2 = 20 m and from 2.71 to 49.00 Ωm for AB/2 = 30 m, along an east–west stretch of 3.28 km, spanning from 16°26'32.3"N, 80°36'54.5"E to 16°26'21.4"N, 80°39'4.7"E.

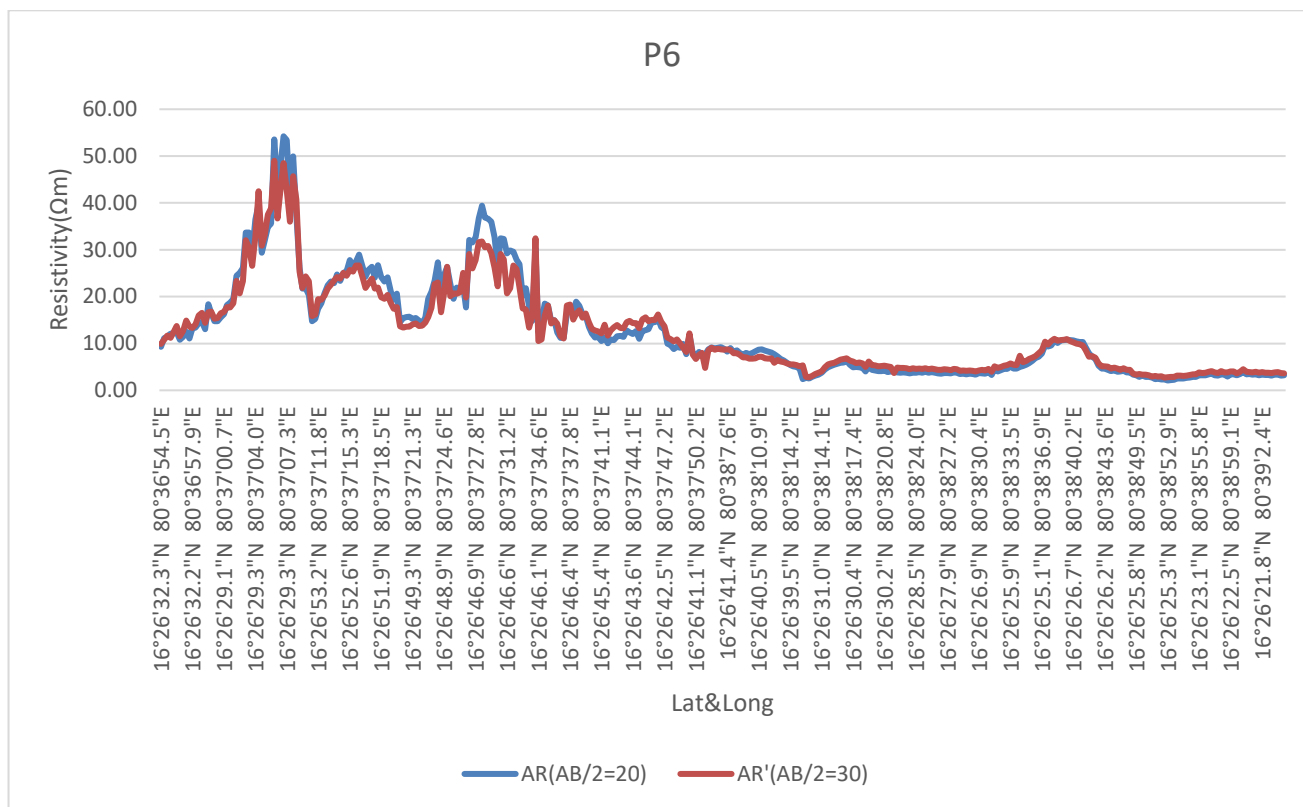


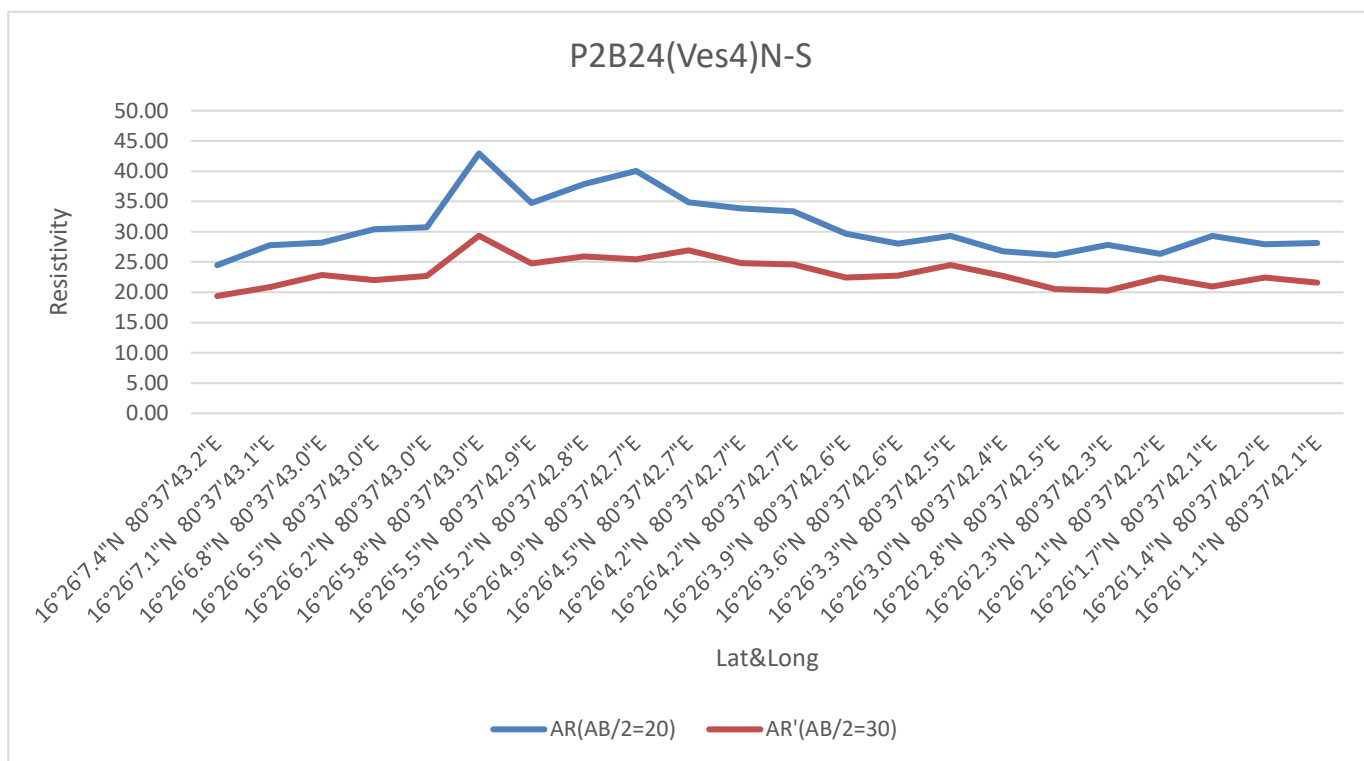
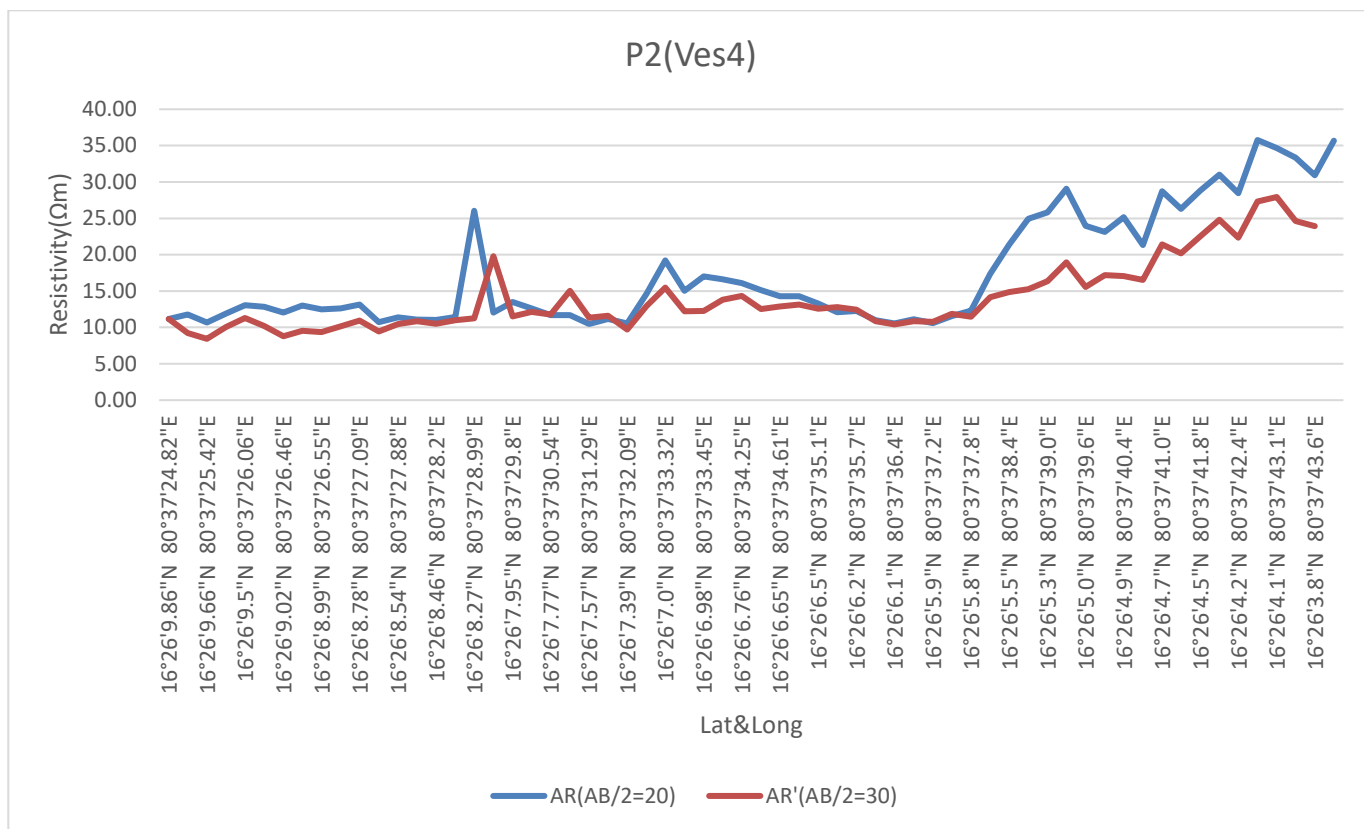
Figure 9.1.6.1.7 Graphical representation of Profile 6, showing resistivity versus latitude and longitude, with $AB/2 = 20$ and 30 .

Profile 7

This resistivity survey was conducted along 0.62 km east–west profile (VES4), located north of Mellampudi Village, at the centre of the Mangalagiri Block. Along this E–W profile, two zones of high resistivity were identified at locations P2B24 and P2B14. To investigate these anomalies further, additional resistivity surveys were carried out towards north–south direction over a stretch of approximately 0.22 km and 0.32 km, situated between Profiles 5 and 6. The survey extended from 16°26'9.85"N, 80°37'24.82"E to 16°26'3.59"N, 80°37'43.90"E. Measurements were taken using twin-electrode configuration with electrode spacings ($AB/2$) as 20 m and 30 m.

- In general, with in the survey area, apparent resistivity values ranged from **10.47 Ωm to 35.76 Ωm** for $AB/2 = 20$ m, and from **8.43 Ωm to 27.93 Ωm** for $AB/2 = 30$ m.
- In **P2B24 profile**, resistivity values varied from **24.47 Ωm to 42.93 Ωm** for $AB/2 = 20$ m, from **19.38 Ωm to 29.33 Ωm** for $AB/2 = 30$ m.
- In **P2B14 profile**, resistivity values ranged from **20.24 Ωm to 53.68 Ωm** for $AB/2 = 20$ m, and from **14.09 Ωm to 43.40 Ωm** for $AB/2 = 30$ m.

These results indicate notable resistivity highs at P2B24 and P2B14 locations within the surveyed area.



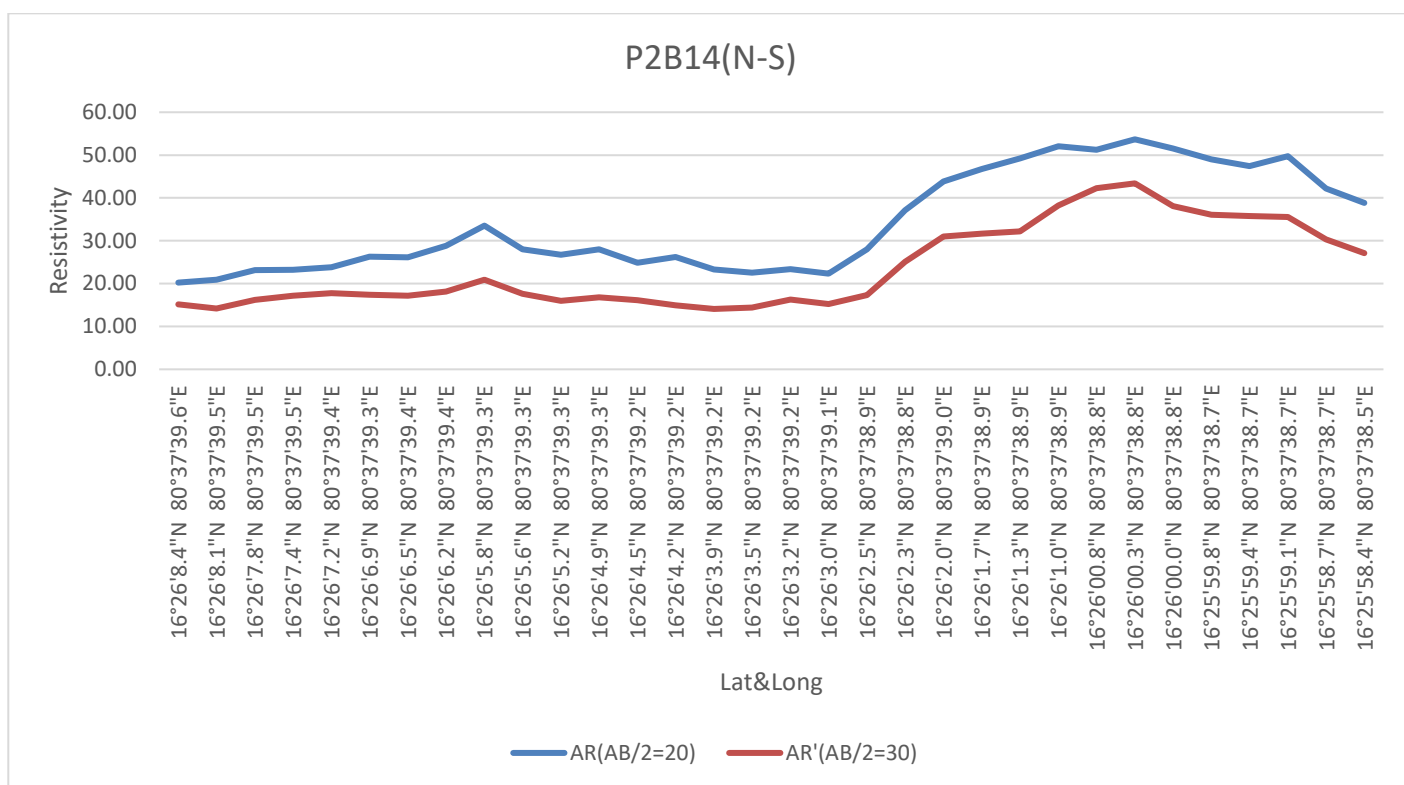


Figure 9.1.6.1.8 Graphical representation of Profile 7 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for AB/2 = 20 and 30.

Profile 8

This resistivity survey was carried out along 0.15 km east–west profile (VES2), located west of Gundimeda Village, towards northern part of Mangalagiri Block. Measurements were obtained using twin-electrode configuration with electrode spacings (AB/2) as 20 m and 30 m. The apparent resistivity values ranged from

3.57 to 3.99 Ωm for AB/2 = 20 m and from 4.35 to 4.86 Ωm for AB/2 = 30 m, spanning from 16°26'50.50"N, 80°37'44.40"E to 16°26'49.49"N, 80°37'48.72"E.

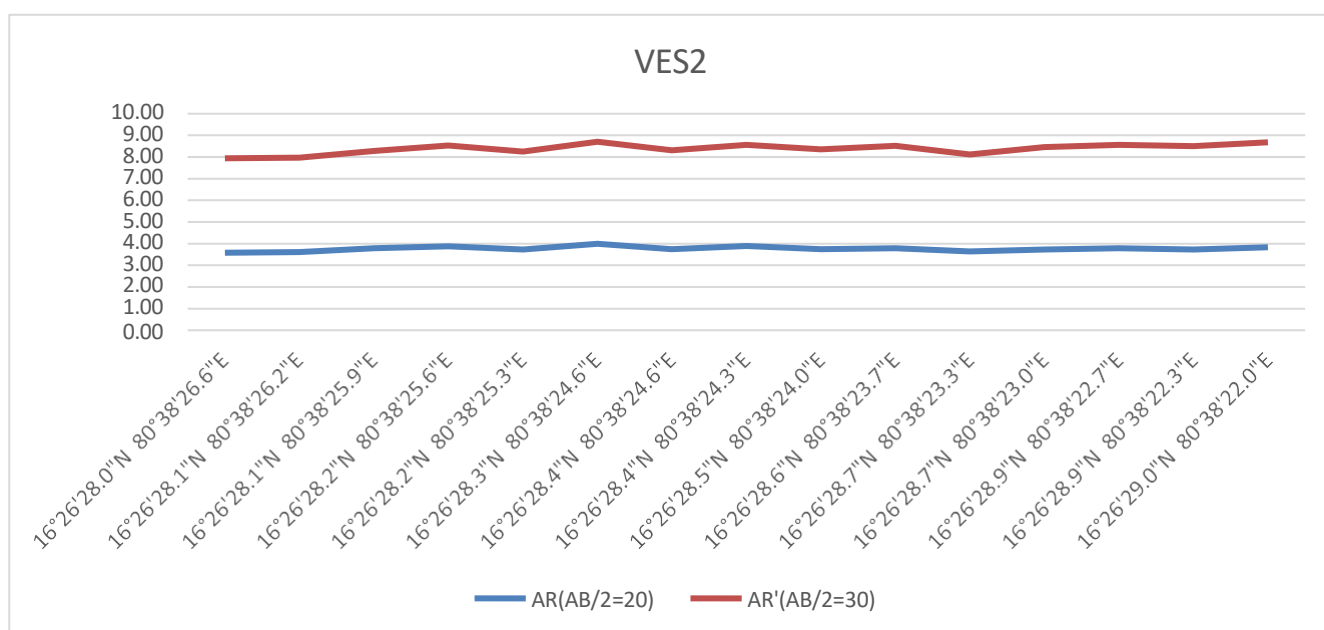


Figure 9.1.6.1.9 Graphical representation of Profile 8, showing resistivity versus latitude and longitude, with AB/2 = 20 and 30.

9.1.6.2 Vertical electrical soundings (VES):

This survey has been employed to observe the continuity of resistive zone and its persistence at depth to observe presence of gravels within the sub surface. Since the various textures of alluvium, sand and gravels are intercalated with in the sedimentary strata a qualitative and quantitative information attained can be utilized to initiate seismic survey based on resistivity, thickness and depth of different strata. A total of 78 Vertical Electrical Soundings (VES) were conducted across the Mangalagiri Block.

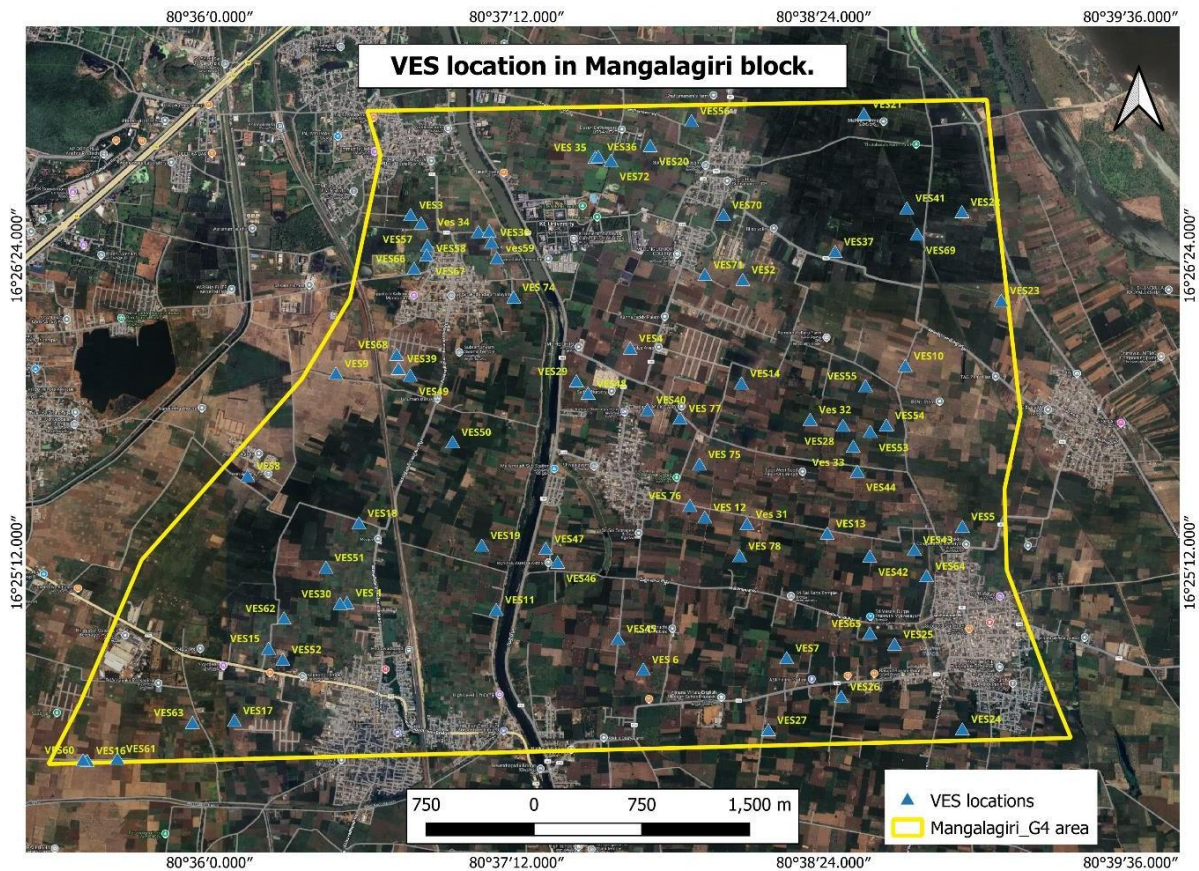


Figure 9.1.6.2.1 Total 78 resistivity sounding points in google earth imagery

VES 1

Resistivity sounding in Pedavadlapudi area towards N-S direction on a traverse with AB/2 as 200m at 16°25'2.20"N and 80°36'32.20"E. The apparent resistivity double log graph interpreted depicts five-layered strata and broadly manifest KH type curve. The lithology of subsurface layers begins with conductive top soil having thickness 1.87m and 4.62 Ωm resistivity. This layer is underlain a layer of resistivity 36.58 Ωm which extends down to 5.32m depth and is considered for conducting seismic survey near this locality. After this resistive layer a sudden decrease in resistivity is observed from third layer and is conductive compared to the present one with 20.74m thickness and 7.08 Ωm resistivity. Fourth layer below this has resistivity of 2.29 Ωm with thickness 104.5m.

Beneath this conductive layer of resistivity 9.09 Ωm persists at 130.6m depth.

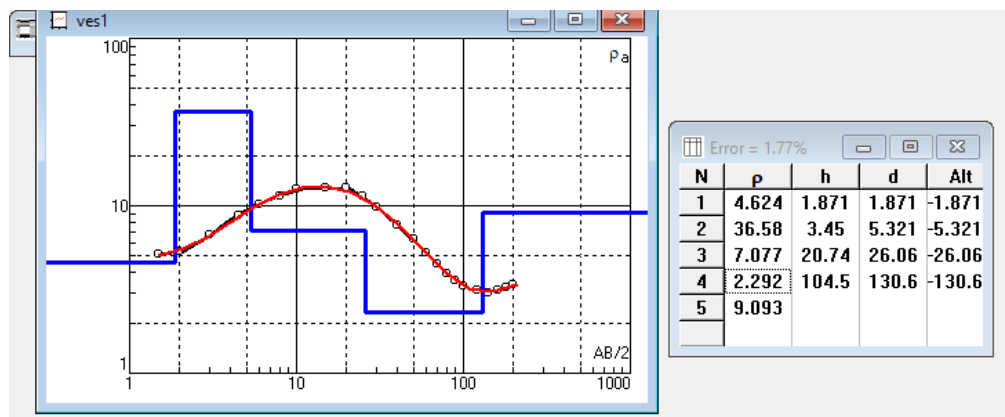


Figure 9.1.6.2.2: Graphical representation of VES 1.

VES 2

Resistivity sounding conducted near Gundimeda area towards N80°E-S80°W orientation on a traverse with AB/2 as 200m at 16°26'18.00"N, 80°38'5.00"E. The apparent resistivity double log graph interpreted depicts KH type curve. Top soil resistivity is 2.23 Ωm having thickness 0.77m. **Beneath this a thin layer of moderate resistivity 12.6 Ωm with thickness 7.89m is observed and is considered for conducting seismic survey near this locality.** Next layer with 55m thickness and resistivity 2.42 Ωm persists underneath this resistive zone. Beneath this resistivity of 5.78 Ωm existed at 63.3m depth.

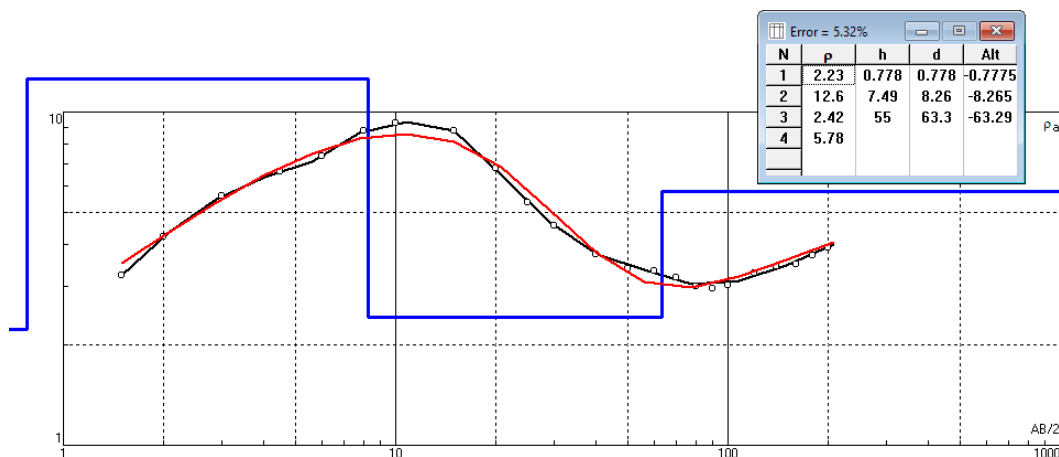


Figure 9.1.6.2.3: Graphical representation of VES 2.

VES 3

Resistivity sounding carried out towards south-eastern part of Vaddeswaram in N48°E-S48°W orientation on a traverse with AB/2 as 200m at latitude 16°26'33.20"N and longitude 80°36'47.10"E. The data manifests a four-layer lithology in the sub surface with A-type curve plotted in the double log graph. It comprises a conductive black cotton soil at top surface with resistivity of 1.76 Ωm which extends down to 4.72m depth, underlain by a less resistive layer having 17.26 m thickness and 4.32 Ωm resistivity. After the second layer steady increase in resistivity is observed. **Third layer is resistive with 38.8 Ωm resistivity and thickness of**

53.1m. This is considered for conducting seismic survey near this locality. Resistivity has further increased to 58.96 Ωm downward to base level. The steady increase in resistivity after 21.98m suggests presence of basement at 75.08m.

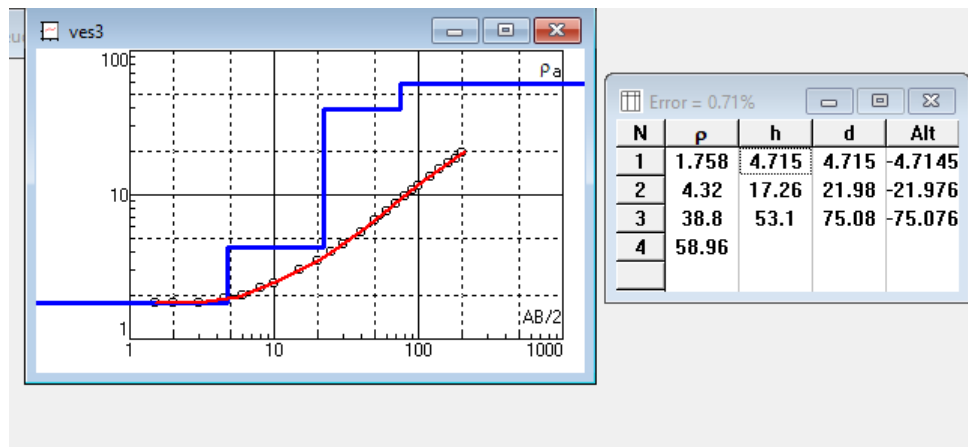


Figure 9.1.6.2.4: Graphical representation of VES 3.

VES 4

Resistivity sounding conducted near Mellampudi area along a traverse with AB/2 as 200m towards N25°E-S25°W orientation at 16°26'1.90"N, 80°37'38.60"E. Interpreted resistivity data by double log graph shows a six layers KH type curve. The subsurface sequence comprises 2.86m thick moderately resistive topsoil with resistivity 18.7 Ωm . **This layer is followed by 4.62m thick layer of 51.8 Ωm resistivity and is considered for conducting seismic survey at this locality.** Third layer is less resistive with 6.52 Ωm resistivity that extends down to 61m depth. Subsequent layer below it has 61.9m thickness having resistivity of 1.92 Ωm . This conductive layer is abruptly terminated at a depth of 123m having resistivity 152 Ωm .

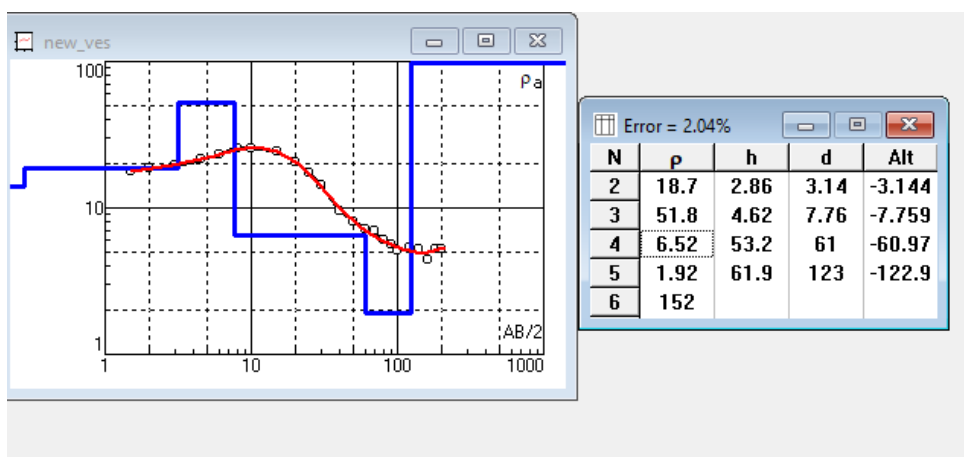


Figure 9.1.6.2.5: Graphical representation of VES 4.

VES 5

Resistivity sounding conducted towards north of Nuthakki with 90°E-W orientation and latitude 16°25'20.10"N and longitude 80°38'56.50"E reveals a five-layer AK-type curve. The lithology begins with a thin, 1.35 m, conductive topsoil having resistivity 5.24 Ωm underlain by a conductive layer with resistivity 7.59 Ωm and thickness 15.2 m. **This is followed by a resistive layer of 11 m thickness having 27.1 Ωm resistivity and is considered for conducting seismic survey in this area.** Again, resistivity has decreased to 4.75 Ωm in the fourth layer having 38.5m thickness. Beneath these strata a conductive layer with resistivity of 2.87 Ωm persisted at 66 m depth.

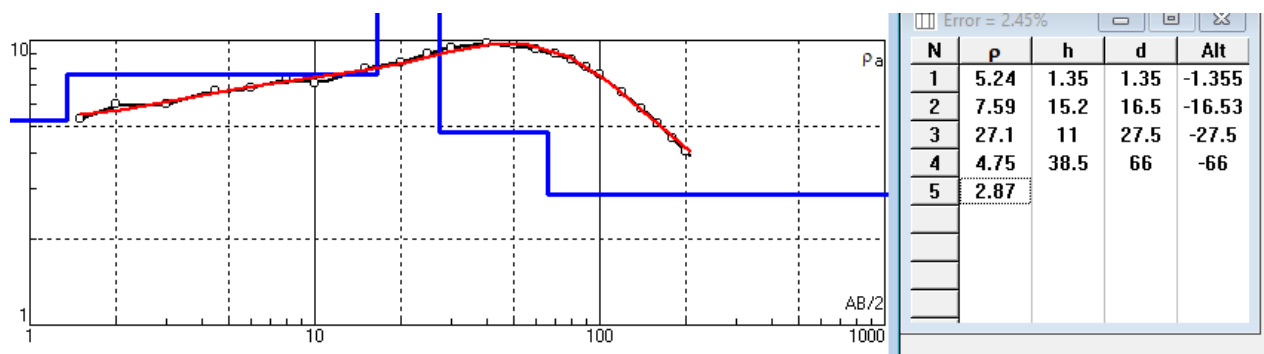


Figure 9.1.6.2.6: Graphical representation of VES 5.

VES 6

Resistivity sounding carried out towards west of Nutakki along N10°E orientation with AB/2 as 200m at latitude 16°24'46.60"N and longitude 80°37'41.70"E. The apparent resistivity curve indicates a five-layer AK-type graph. Lithology starts with a thin 1.36m topsoil of resistivity 5.21 Ωm . It is followed by 12.6 Ωm resistivity layer with 12.6 m thickness. **Beneath this lies a layer with 78.8 Ωm resistivity and 15.5m thickness and is considered for conducting seismic survey in this area.** Down to these strata a layer with 0.11 Ωm resistivity and 24.8m thickness persisted. A resistive layer of 20.3 Ωm resistivity existed below 54.2m depth.

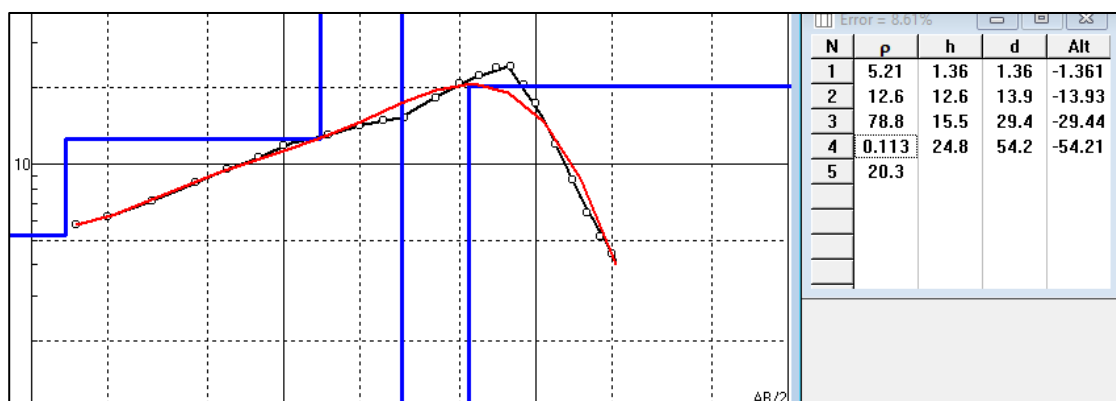


Figure 9.1.6.2.7: Graphical representation of VES 6.

VES 7

Resistivity sounding conducted towards west of Nuthakki along N7°W orientation on a traverse with AB/2 as 200m at 16°24'49.30"N and 80°38'15.30"E. The apparent resistivity curve is best fit to a seven-layer model which broadly manifested AKQ type curve with minor fluctuations in resistivity on different layers as shown in the table. A thin, 1.67m, conductive top soil of resistivity 5.94 Ωm overlying on a resistive layer of resistivity 82.8 Ωm with thickness 3.5m is delineated. Beneath this lies a thin conductive layer of resistivity 4.65 Ωm with thickness 0.597m is observed. Down to this 5.76m depth, **resistivity has increased abruptly to 65.1 Ωm . This high resistivity at depth can be tested by seismic studies for gravels.** Again, resistivity has decreased in the last three layers with resistivities 4.35 Ωm , 7.07 Ωm and 2.44 Ωm with thickness 2.06m, 46.1m and over the prevailing basement at 60.3m depth.

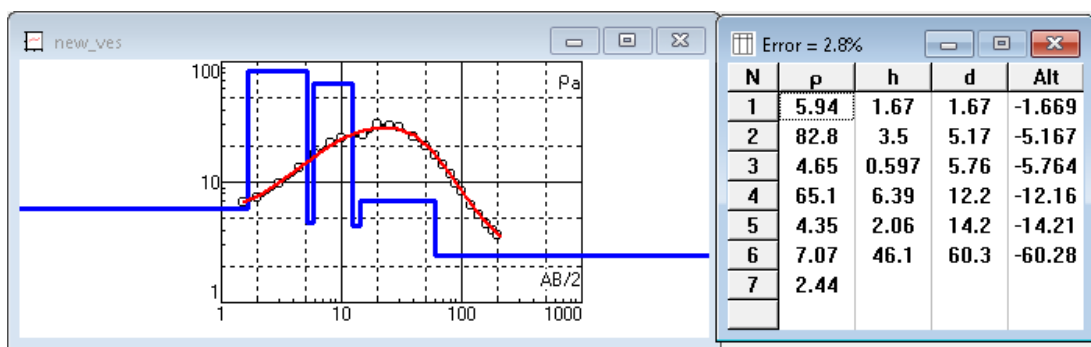


Figure 9.1.6.2.8: Graphical representation of VES 7.

VES 8

Resistivity sounding conducted in Athmakarur area towards 309°NW orientation with AB/2 as 200m at latitude 16°25'32.00"N and longitude 80°36'8.90"E. The interpreted apparent resistivity curve indicates HKA-type graph indicating minor fluctuations in resistivity at different depths. The subsurface lithology comprises 0.448m thin top soil with resistivity 9.93 Ωm manifesting comparatively high resistivity than the second layer which is underlain by a thin conductive layer of 3.14 m thickness with 2.03 Ωm resistivity. This is followed by a conductive layer with 6.8m thickness having resistivity 0.0262 Ωm . **Below these strata lies a resistive horizon with resistivity of 22 Ωm , extending below 0.539m depth worth testing by seismic survey.** Beneath this less resistive layer with 2.92 Ωm resistivity having 28.3 thickness is observed. The steady increase in resistivity from 7.26 Ωm to 45.9 Ωm after 32.5m and 32.7m depth suggests presence of a shallow weathered Khondalite basement.

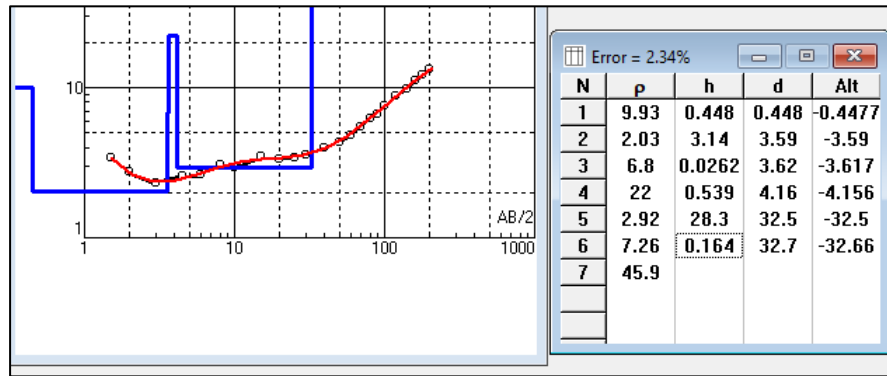


Figure 9.1.6.2.9: Graphical representation of VES 8.

VES 9

Resistivity sounding conducted near Ippatam 278°W orientation on a traverse with AB/2 as 200m at latitude 16°25'56.00"N and longitude 80°36'29.60"E. The interpreted resistivity data on a double log graph reveals a broad HKA-type apparent resistivity curve with minor fluctuations in resistivity at different depths. Interpretation depicts a seven layered subsurface. Lithology starts with a thin moderately resistive top layer having 0.49m thickness with resistivity 19.2 Ωm. This layer is underlain by a thin conductive layer of 0.167m thickness having resistivity 0.54 Ωm. There after resistivity increased in third and fourth layers to 10.2 Ωm and 19.1 Ωm with thickness 6.19m and 2.67m respectively. This variation is observed for delineation of gravel down to 9.52m depth by seismic survey in search of gravel. A sudden drop of resistivity can be seen in 5th layer having thickness 4.2m having resistivity 0.65 Ωm. Beneath this lies a thick moderately conductive stratum of resistivity 9.58 Ωm and thickness 50m. It is underlain by a highly resistive layer with resistivity 34.1 Ωm that persisted at 63.7m depth.

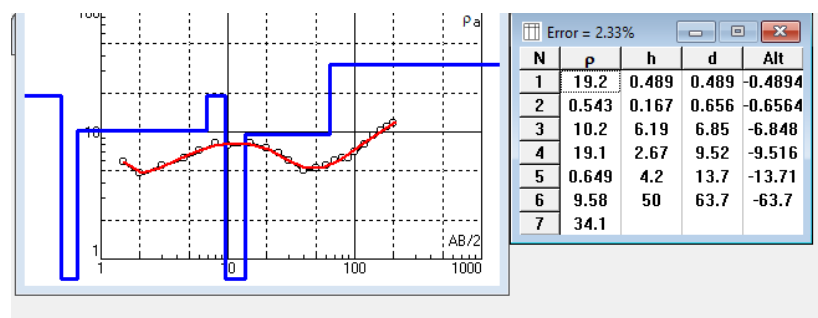


Figure 9.1.6.2.10: Graphical representation of VES 9.

VES 10

Resistivity sounding conducted towards north-west of Chiravur along 204°SW orientation at latitude 16°25'57.80"N and longitude 80°38'43.10"E along a traverse with AB/2 as 200m. This interpreted data indicates a five-layer HAK-type curve. From lithology, first two layers down to 1.268m depth, shows conductive topsoil with 2.47 Ωm and 0.86 Ωm resistivities. Next is also a conductive layer with resistivity 2 Ωm and thickness 6.9m. **There is a slight increase in resistivity to 7 Ωm in the massive 90.17m thick fourth layer. This variation is considered for seismic survey for delineating gravel zones down to 6.9m, if any, in the sub surface.** Resistivity has again decreased to 3.94 Ωm in the next layer which continues below 98.37m depth.

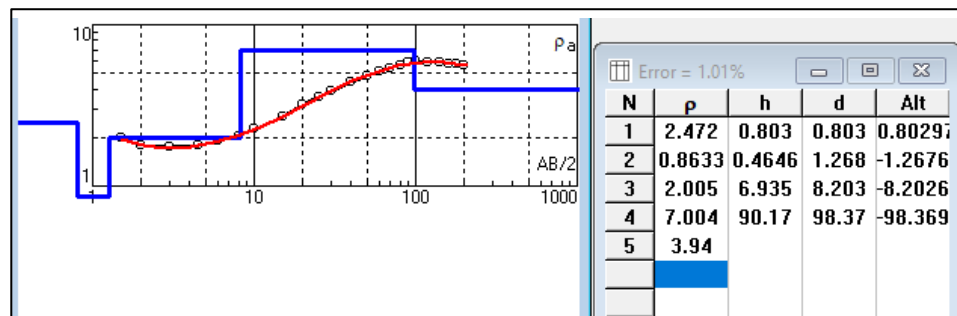


Figure 9.1.6.2.11: Graphical representation of VES 10.

VES 11

Resistivity sounding conducted north of Pedavadlapudi towards 20°N orientation on a traverse with AB/2 as 200m at latitude 16°25'0.60"N and longitude 80°37'7.20"E reveals a seven-layer subsurface with AKQ-type curve. The subsurface lithology begins with a thin moderately conductive top soil with 0.5m thickness and 7.475 Ωm resistivity. **Resistivity gradually increased in next two layers as 10.04 Ωm and 23.9 Ωm with thickness varying 3m and 15.53m respectively. This high resistivity zone is considered for conducting seismic survey in this locality.** Resistivity again decreased in the next two layers to 9.88 Ωm and 1.67 Ωm with its corresponding thickness 20.42m and 29.9m respectively. Down to this strata 34.27m thick moderately resistive layer with 14.87 Ωm resistivity is observed. Beneath this conductive layer of resistivity 0.47 Ωm existed at 103.8m depth.

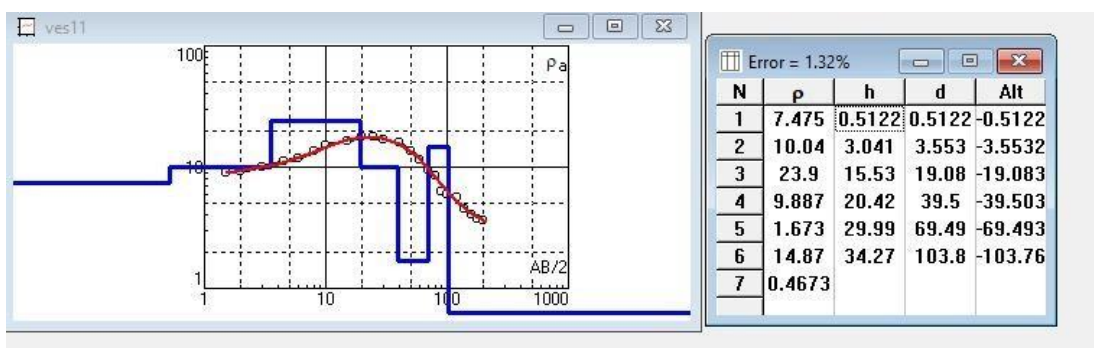


Figure 9.1.6.2.12: Graphical representation of VES 11.

VES 12

Resistivity sounding conducted towards east of Mellampudi along 101°E orientation on a traverse with AB/2 as 200m at latitude 16°25'22.30"N and longitude 80°37'56.10"E. Interpreted data indicates a five-layer AKQ-type apparent resistivity curve. The subsurface lithology begins with thin moderately resistive layer of top soil with 0.1m thickness and 13.09 Ωm resistivity. This layer is underlain by a thin conductive layer of 1.95m thickness and resistivity 5.31 Ωm . **Resistivity further increased to 35.38 Ωm in the third layer having thickness of 3.36m. This increase in resistivity is considered for seismic survey for gravel studies.** This layer is followed by a thick moderately conductive layer with 13.52 Ωm resistivity and thickness 41.57m. Underneath conductive layer of resistivity 3.55 Ωm persisted at 46.98m depth.

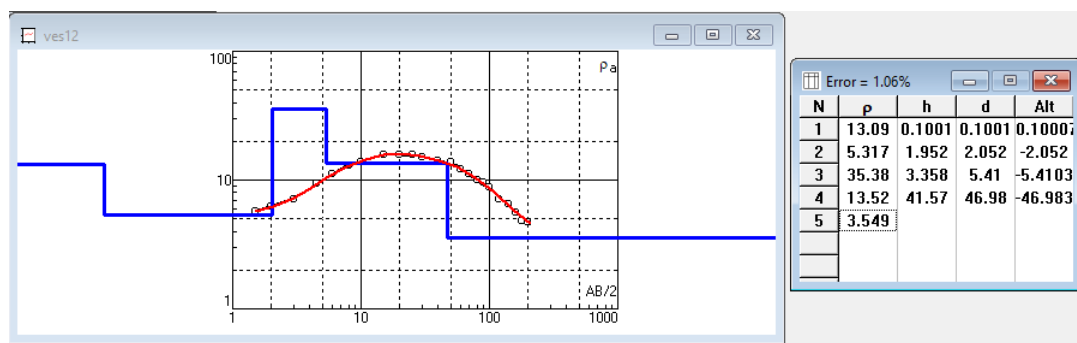


Figure 9.1.6.2.13: Graphical representation of VES 12.

VES 13

Resistivity sounding conducted north-west of Nuthakki towards 270°W orientation with AB/2 as 200m at latitude 16°25'18.50"N and longitude 80°38'24.80"E has been plotted in double log graph. This apparent resistivity curve demonstrates AKQ type curve which interprets as a conductive topsoil with 13.9 Ωm resistivity having 0.01 m thickness followed by two layers having 0.16m and 0.22m thickness with 5.75 Ωm and 0.65 Ωm resistivity. **Further downwards two litho units have 2.76 m and 4.39 m thickness with resistivity 14.9 Ωm and 85.4 Ωm respectively. This high resistivity zone can be considered for seismic survey in tracing gravel zones.** 6th layer is a conductive in nature with 4.37 Ωm resistivity and 53.8m thickness. Underneath highly conductive layer of resistivity 3.16 Ωm persists at 61.4m depth.

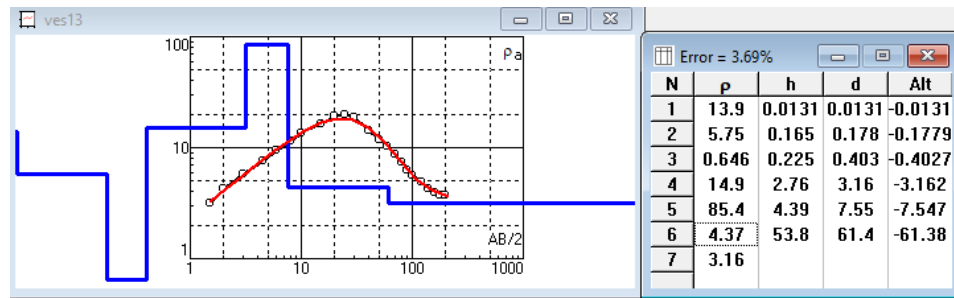


Figure 9.1.6.2.14: Graphical representation of VES 13.

VES 14

Resistivity sounding carried out in north-east of Mellampudi with 10°N orientation on traverse with AB/2 as 200m at latitude 16°25'53.70"N and longitude 80°38'4.70"E. The data indicates eight-layer AKQ-type resistivity curve. First three layers in the subsurface are represents topsoil with 0.02m, 0.09m & 0.15m thickness with resistivities 13.1 Ω m, 244 Ω m & 0.58 Ω m respectively. **Fourth layer 2.98m thickness is a resistive one with 66.4 Ω m resistivity which may be considered for seismic survey in identifying gravel zones at shallow depth.** Overlying this a highly conductive layer of 0.2m thickness with resistivity 2.24 Ω m has been interpreted. **Below this lies a resistive layer of 4.99m thickness with 130 Ω m resistivity is also considered for tracing gravel zones.** Next layer is a thick conductive layer of 34.1m thickness having 3.56 Ω m resistivity. Underneath highly conductive layer of resistivity 1.92 Ω m persisted at 42.5m depth.

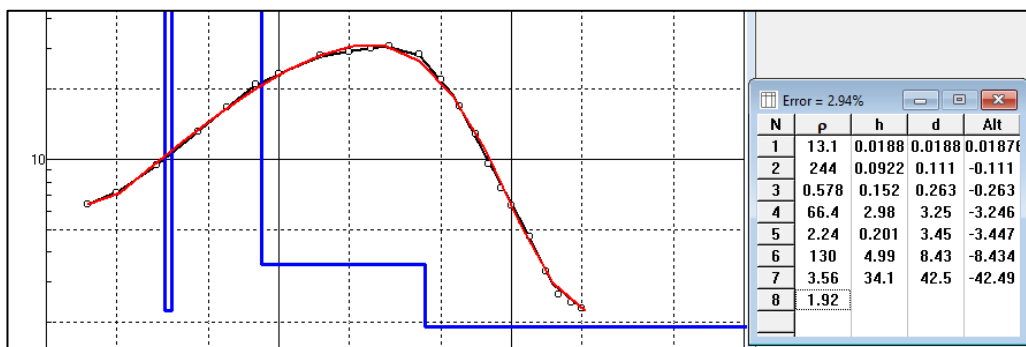


Figure 9.1.6.2.15: Graphical representation of VES 14.

VES 15

Resistivity sounding carried out towards north-east of Mellampudi on a traverse with AB/2 as 200m with 101°E orientation at latitude 16°24'51.5"N and longitude 80°36'13.8"E. The apparent resistivity curve is five-layered model of HKH double log graph. First two layers in the subsurface is soil with 15.2 Ωm and 2.23 Ωm resistivities which extends down to 0.98m depth. **There is a slight increase in resistivity up to 10.7 Ωm in the third layer having thickness 16.9m. This is considered for conducting seismic survey for delineating gravels in the sub surface.** Followed by this a thick, 107m, conductive layer with 2.15 Ωm resistivity is observed. This overlies on a moderately conductive layer with 11.1 Ωm resistivity which persists at 125m depth.

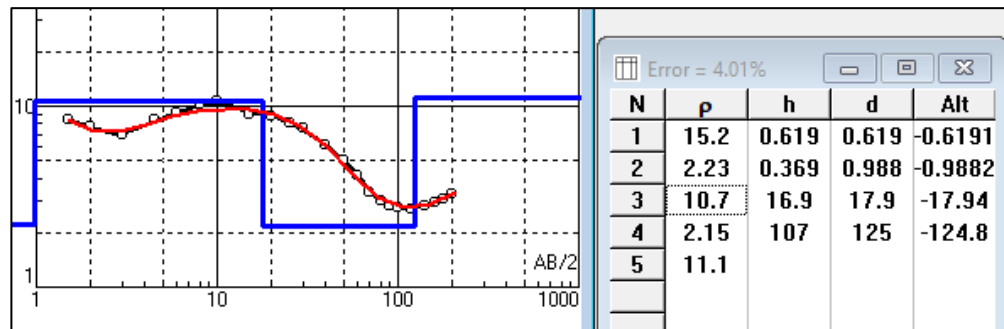


Figure 9.1.6.2.16: Graphical representation of VES 15.

VES 16

Resistivity sounding conducted in south-western part of Pedavadlapudi towards 268°W orientation at latitude 16°24'25.2"N and longitude 80°35'31.3"E on a traverse with AB/2 as 200m. The data plotted as apparent resistivity curve indicates six-layer HKA-type graph. The subsurface strata comprise a thin 0.78m conductive layer with resistivity of 1.599 Ωm . This is followed by two conductive layers of thickness 1.69m and 9.12m with resistivities 0.94 Ωm and 1.46 Ωm respectively. **Beneath these layers, lies a moderately resistive horizon with resistivity of 10.58 Ωm with 13.29m thickness. This probably indicates a sand or gravel bed and is considered for seismic survey at this locality.** Fifth layer is again a conductive layer of 59.44m thickness with 4.9 Ωm resistivity. Resistivity steadily increased after 84.33m depth with an interpreted value of 35.53 Ωm ,

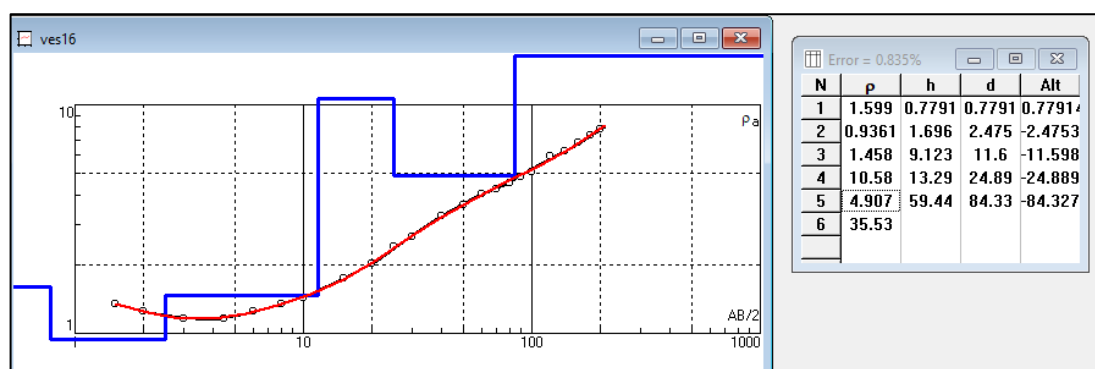


Figure 9.1.6.2.17: Graphical representation of VES 16.

VES 17

Resistivity sounding conducted towards west of Pedavadlapudi along 20°NE orientation with latitude 16°24'34.60"N and longitude 80°36'5.80"E on a traverse with AB/2 as 200m. The data interpreted shows eight-layer AKH-type curve. First two layers in the subsurface represents topsoil of 2.06m and 0.2m thickness with resistivities 4.72 Ω m and 6.18 Ω m respectively. Third layer with 0.48m thickness is conductive with 1.53 Ω m resistivity. This stratum is found to be overlying on a resistive layer of 2.78m thickness with resistivity 24.3 Ω m. Below this lies a conductive layer having 3.89m thickness and resistivity 2.83 Ω m. Beneath this a thick resistive layer with 17.7m having resistivity 20.5 Ω m is observed. This overlies on a thick conductive layer having 38.4m thickness with 0.71 Ω m resistivity. The underlying stratum of resistivity 97.6 Ω m persisted at 65.5m depth. **Fourth and sixth layers with moderately high resistive zones are considered for seismic survey with a possibility of tracing gravels.**

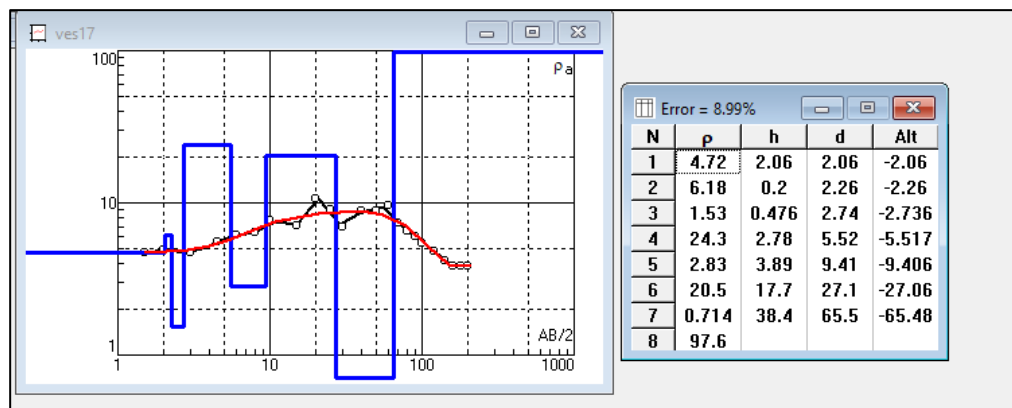


Figure 9.1.6.2.18: Graphical representation of VES 17.

VES 18

Resistivity sounding conducted north of Pedavadlapudi on a traverse with AB/2 as 200m towards N10°E orientation at latitude 16°25'20.90"N and longitude 80°36'35.00"E. Interpreted data indicates eight-layer AKH-type curve with fluctuations in resistivity. First two layers of the subsurface strata represents topsoil with 0.71m and 0.29m thickness having resistivities 3.88 Ω m & 1.39 Ω m. There is a sharp rise in resistivity up to 22.4 Ω m in the next layer having 5.68m thickness. Resistivity raised in fourth layer to 74.8 Ω m with 3.37m thickness. **This may indicate sand or gravel zone.** This layer is overlying on a highly conductive layer with 0.72 Ω m resistivity and 2.86m thickness. Resistivity has increased sharply to 79.3 Ω m in sixth layer with 2.26m thickness. **This may again indicate sand or gravel zone** which is overlying on a thick conductive layer with 1.09 Ω m resistivity and 57.5m thickness. Underlying this a layer of resistivity 155 Ω m persists at 72.6m that may indicate the basement probably weathered Khondalite. **The high resistive zones are considered for seismic survey for confirmation of gravels.**

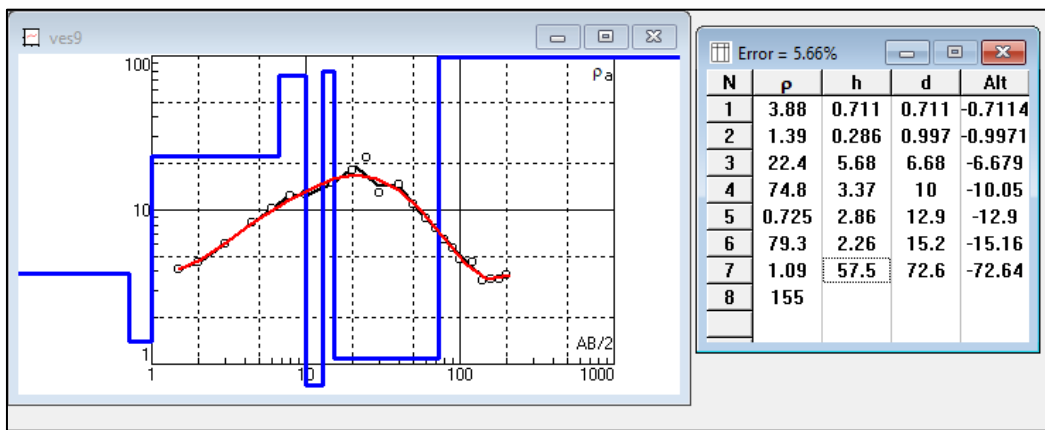


Figure 9.1.6.2.19: Graphical representation of VES 18

VES 19

Resistivity sounding conducted in NE of Pedavadlapudi area towards N100°E orientation at latitude 16°25'15.70"N and longitude 80°37'3.80"E on a traverse with AB/2 as 200m. The interpreted data indicates a six-layer AKQ-type graph. Lithology of topsoil which continues up to 1.2m depth with 12.1 Ωm and 1.7 Ωm resistivities. **Layer 3 & 4 shows similar resistivity of 24.5 Ωm up to 25.9m depth. These resistive zones are the criteria to be considered for seismic survey as it may highlight the presence of sand/gravel at this depth.** A conductive layer with 2.67 Ωm resistivity and 38.8m thickness lies below this. Next layer is with 3.87 Ωm resistivity which persists below 64.7m depth.

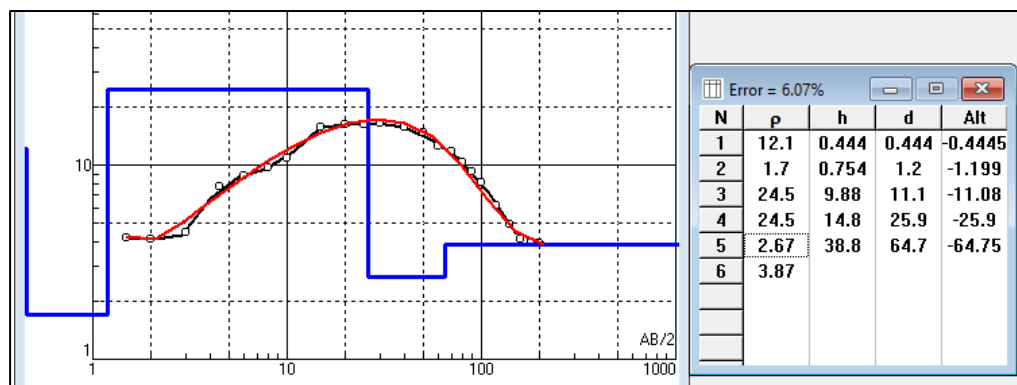


Figure 9.1.6.2.20: Graphical representation of VES 19

VES 20

Resistivity sounding conducted towards west of Gundimeda along N10°E orientation at latitude 16°26'49.40"N and longitude 80°37'43.30"E on a traverse with AB/2 as 200m. This data plotted on a double log graph indicates AKH-type curve. Interpreted subsurface lithology shows conductive topsoil up to 1.12m depth with 3.31 Ωm and 2.07 Ωm resistivity. **There is a sharp rise in resistivity to 83.6 Ωm in 1.3m thick third layer. This stratum may indicate the presence of gravel and is considered for conducting seismic survey in this area.** Hereafter an abrupt decrease in resistivity up to 3.99 Ωm with 3.5m thickness is interpreted. Fifth layer is a resistive one with 18.4 Ωm resistivity and 24.1m thickness. Again, resistivity has decreased to 1.8 Ωm representing a conductive layer of

6.4m thickness. Beneath this is a massive 55.5m thick layer of resistivity 16.4 Ωm underlain by 4.94 Ωm resistivity stratum at 92m depth.

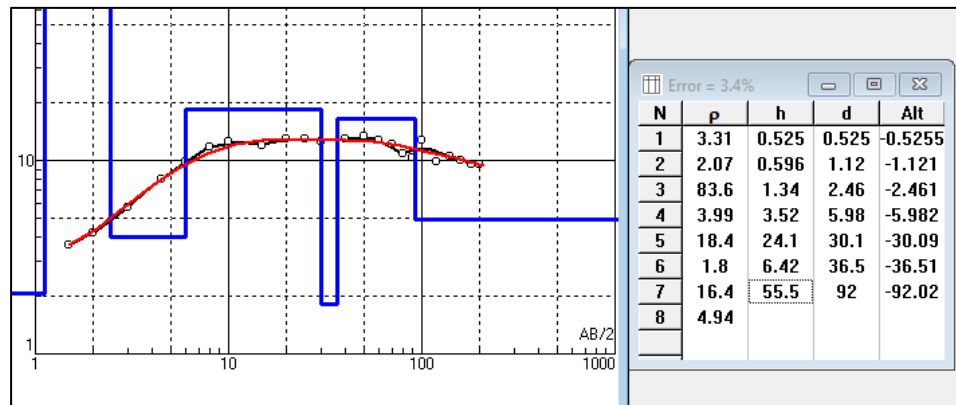


Figure 9.1.6.2.21: Graphical representation of VES 20

VES 21

Resistivity sounding conducted towards Northern part of Gundimeda and north-eastern part of Mangalagiri survey block along 140°SE orientation at latitude 16°26'56.80"N and longitude 80°38'33.40"E on a traverse with AB/2 as 200m. This apparent resistivity curve indicates a five-layer A-type curve. Subsurface lithology comprises 4.55m conductive layer of resistivity 2.53 Ωm . This is followed by a conductive layer of 4.77 m thickness with resistivity 3.93 Ωm . Beneath these layers lies a conductive layer with resistivity of 1.9 Ωm having 8.73 m thickness. Below this stratum persists 93.5m layer which has moderate resistivity of 10.3 Ωm . Beneath this exists a moderately conductive layer with 10.8 Ωm resistivity at 112m depth.

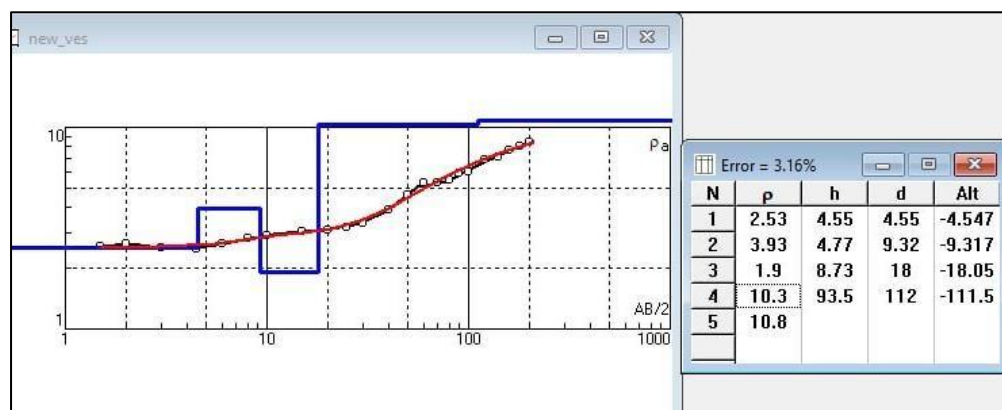


Figure 9.1.6.2.22: Graphical representation of VES 21

VES 22

Resistivity sounding conducted east of Gundimeda along S291°W orientation at latitude 16°26'33.90"N and longitude 80°38'56.40"E on a traverse with AB/2 as 200m. Interpreted data reveals a five-layer A-type curve. Subsurface lithology begins with a conductive top layer of 0.49m thickness having resistivity 4.09 Ω m. This is underlain by another conductive layer with 1.49 m thickness having 1.55 Ω m resistivity. Below this, a thick conductive layer with resistivity 2.4 Ω m extends down to 12.75m depth. Beneath this lies a zone with resistivity 9.47 Ω m and 64.25m thickness, underlain by a resistive layer with 32.65 Ω m resistivity which continues below 77m depth.

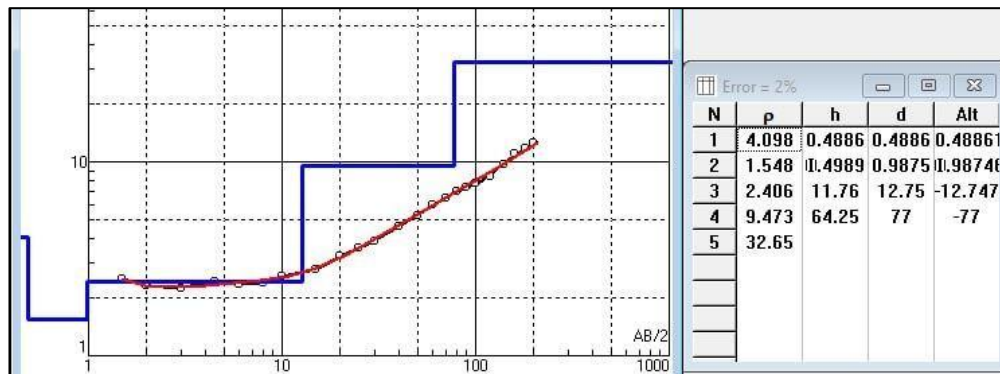


Figure 9.1.6.2.23: Graphical representation of VES 22

VES 23

Resistivity sounding conducted towards south-east of Gundimeda along 162°S orientation on a traverse with AB/2 as 200m located at latitude 16°26'13.10"N and longitude 80°39'5.60"E. This data reveals eight-layer AHA-type curve. First layer exhibits resistivity of 6.22 Ω m and thickness 0.25 m. This overlies on a layer of resistivity 2.45 Ω m with thickness 3.29 m. Beneath this, a third conductive layer with resistivity 0.34 Ω m extends to a depth of 4.2 m. **Below this stratum resistivity has increased sharply in the fourth layer with 70.6 Ω m having thickness 1.21m. This stratum can be considered for detection of sand/gravels by seismic survey.** Below this lies a layer of resistivity 0.73 Ω m with thickness 5.31m. The sixth layer is having 42.1 Ω m resistivity and 37.3m thickness overlying on a conductive layer of 30.8m thickness and 3.79 Ω m resistivity. A layer of resistivity 0.41 Ω m persisted below 78.8m depth.

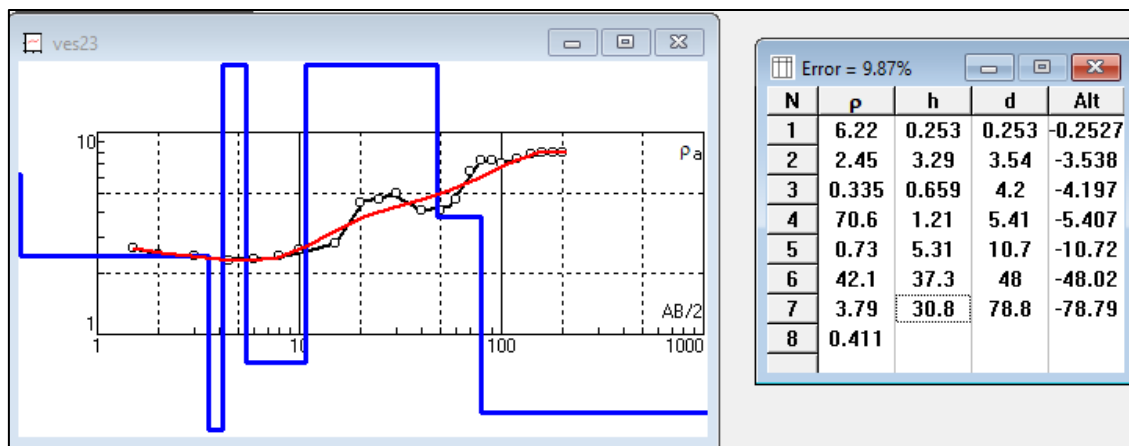


Figure 9.1.6.2.24: Graphical representation of VES 23

VES 24

Resistivity sounding conducted towards south of Nutakki village along 93°E orientation at latitude 16°24'32.60"N and longitude 80°38'56.50"E on a traverse with AB/2 as 190m. This is south eastern part of Mangalagiri block. The resistivity data plotted on a double log graph indicates a four-layer AK-type curve with a background resistivity of 3.69 Ωm of thickness 0.84m as the top soil cover. This is overlying on a resistive layer of resistivity 59.1 Ωm with thickness of 22.4 m. **This stratum can be tested for sand/gravel occurrence by seismic survey.** Beneath this lies a thick resistive layer of resistivity 22.4 Ωm having thickness 65.7m. A conductive layer of resistivity 1.14 Ωm persisted below 88.9m depth.

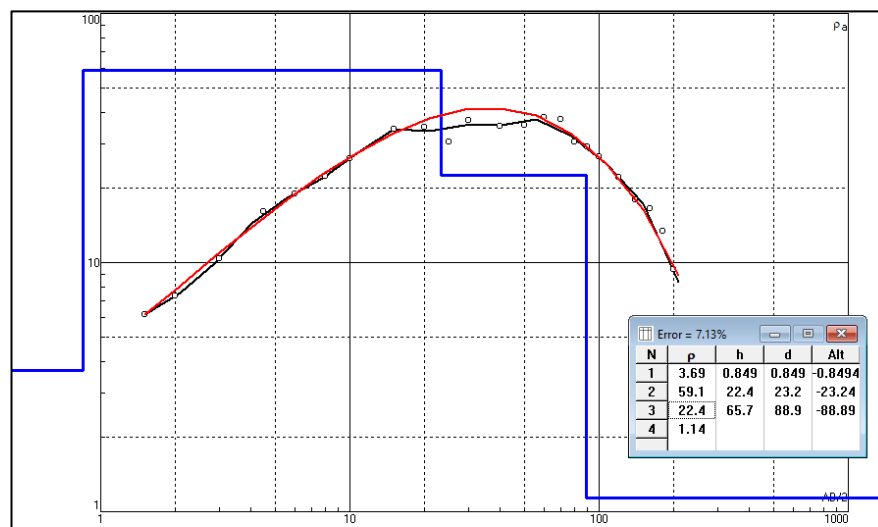


Figure 9.1.6.2.25: Graphical representation of VES 24

VES 25

Resistivity sounding carried out towards west of Nutakki along 90°E orientation at latitude 16°24'52.50"N and longitude 80°38'40.60"E on a traverse with AB/2 as 200m. The interpreted apparent resistivity curve indicates a seven-layer HKQ-type curve. Subsurface lithology starts with a conductive 2.37 Ωm resistivity layer with 0.64m thickness followed by a **resistive 360 Ωm stratum with 2.07m thickness which may indicate sand or gravel.**

Below this a resistive layer with 153 Ωm resistivity and 0.73m thickness may be suitable for conducting seismic survey to check the possibility of sand/gravel zone. A gradual decrease in resistivity can be seen after 3.4m depth. Next two layers are moderately conductive layer with 15.7 Ωm and 11.2 Ωm resistivity with 1.36m and 11.2m thickness respectively. Next layer below is having 5.6 Ωm resistivity and 63.6m thickness. An underlying conductive layer with 1.8 Ωm resistivity persisted below 88.6m depth.

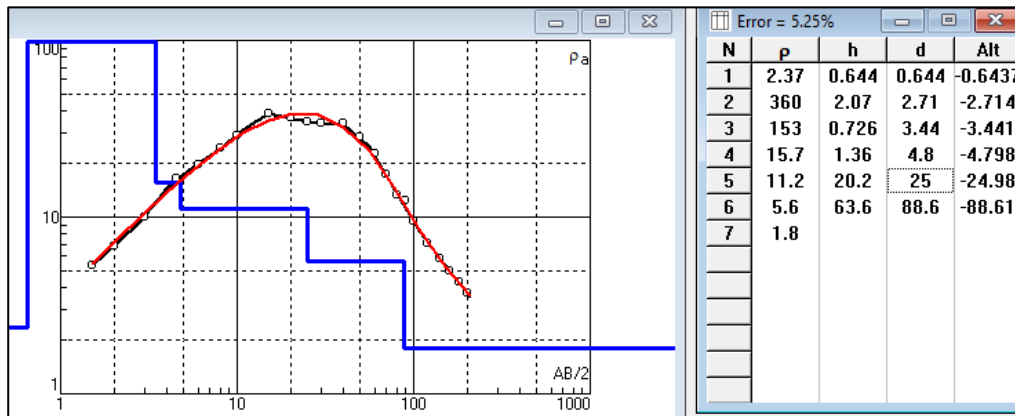


Figure 9.1.6.2.26: Graphical representation of VES 25

VES 26

Resistivity sounding conducted towards west of Nutakki village along N94°E orientation at latitude 16°24'40.20"N and longitude 80°38'28.10"E on a traverse with AB/2 as 200m. The interpreted data indicates five-layer AKQ-type graph. Lithology starts with a topsoil cover having 2.1m thickness soil with 4.22 Ωm resistivity **overlying on layer of resistivity 93.2 Ωm with thickness 4.07 m which may indicate sand or gravel zone. Hence this zone can be considered for seismic survey to delineate sand/gravels by its characteristic velocity.** Beneath this lies a thick moderately conductive layer of resistivity 14.5 Ωm and thickness 33.8m. Fourth layer is a thick conductive layer with 1.55 Ωm resistivity having 89.5m thickness. Underneath layer with resistivity 63.8 Ωm persisted at 129m depth.

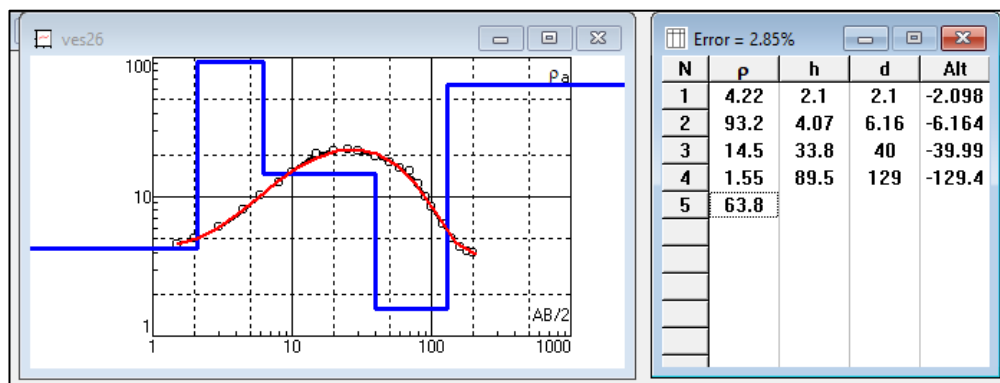


Figure 9.1.6.2.27: Graphical representation of VES 26

VES 27

Resistivity sounding conducted towards west of Nutakki village along 272°W orientation on a traverse with AB/2 as 200m at latitude 16°24'32.40"N and longitude 80°38'11.00"E. The data indicate a six-layer AKQ-type curve. Lithology of the subsurface layer begins with a conductive top soil with 0.52m thickness and 4.99 Ωm resistivity. This layer is followed by a moderately conductive layer with resistivity 14.3 Ωm that extends down to 1.56m depth. **This stratum can be considered to undertake seismic survey in this area.** The third layer is conductive with 0.97m thickness and 4.04 Ωm resistivity. Fourth layer represents highly resistive layer of 9.99m thickness and 120 Ωm resistivity followed by a conductive layer of resistivity 0.953 Ωm and thickness 61.3m. **This resistive zone can be considered for seismic survey.** Underlying layer with resistivity 63.8 Ωm persisted at 73.8m depth.

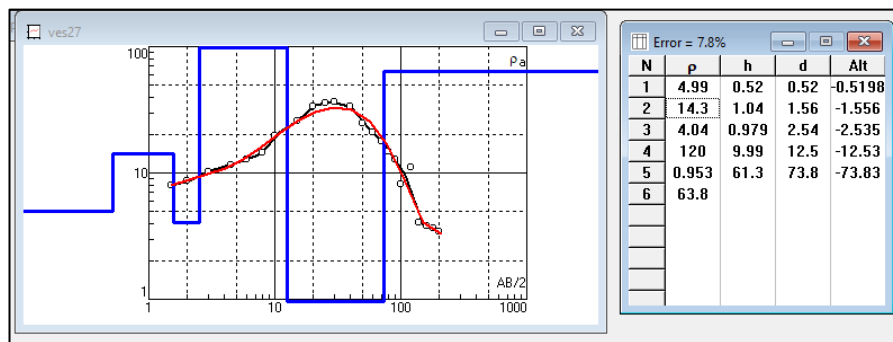


Figure 9.1.6.2.28: Graphical representation of VES 27

VES 28

Resistivity sounding conducted towards north of Mellampudi village along N15°E orientation on a traverse with AB/2 as 200m at latitude 16°25'54.20"N and longitude 80°37'26.00"E. The apparent resistivity graph indicates a six-layer AKQ-type curve. First stratum of the subsurface represents soil with 3.78m thickness and 4.26 Ωm resistivity underlain by a moderately conductive layer of 18.2 Ωm resistivity having 0.32m thickness. **Third layer is resistive with 44.3 Ωm resistivity and 9.79m thickness which is considered for conducting seismic survey at this locality.** This layer is followed by 17.7m thickness stratum with resistivity 1.46 Ωm . Underneath layer is 54.1m thickness with resistivity 23.1 Ωm . Beneath this a conductive layer with resistivity 0.4 Ωm persisted at 85.7m depth.

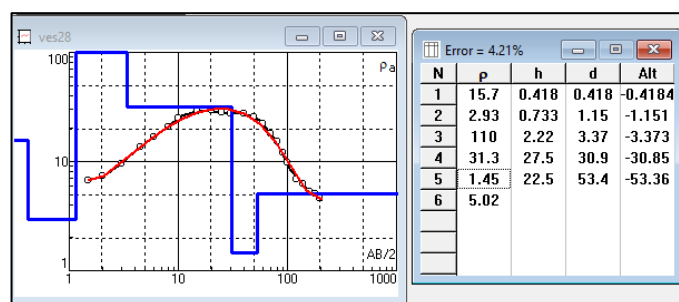


Figure 9.1.6.2.29: Graphical representation of VES 28

VES 29

Resistivity sounding conducted towards north of Mellampudi village along N15°E orientation on a traverse with AB/2 as 200m at latitude 16°25'54.20"N and longitude 80°37'26.00"E. The apparent resistivity graph indicates a six-layer AKQ-type curve. First stratum of the subsurface represents soil with 3.78m thickness and 4.26 Ωm resistivity underlain by a moderately conductive layer of 18.2 Ωm resistivity and 0.32m thickness. **Third layer is with 44.3 Ωm resistivity and 9.79m thickness which is considered for conducting seismic survey at this locality.** This is followed by 17.7m thickness stratum with 1.46 Ωm resistivity. Next layer is of 54.1m thickness with 23.1 Ωm resistivity. Underlying stratum is with 0.4 Ωm resistivity that persisted 85.7m depth.

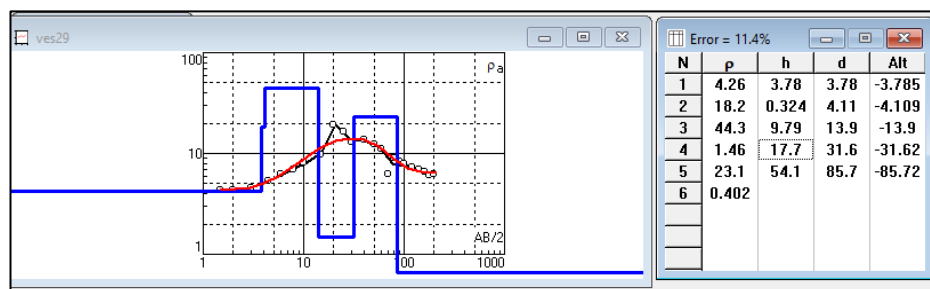


Figure 9.1.6.2.30: Graphical representation of VES 29

VES 30

Resistivity sounding conducted towards Pedavadlapudi village near VES1 location on a traverse with AB/2 as 200m along N12°E orientation at latitude 16°25'2.00"N and longitude 80°36'30.60"E. The apparent resistivity double log graph indicates five-layer KQ-type curve. Subsurface lithology starts with top soil having thickness 0.96m with 4.02 Ωm resistivity. This is underlain by a stratum of resistivity 38.4 Ωm with 5.38m thickness. **Second and third layers are comparatively resistive that can be considered for conducting seismic survey in this locality.** Third layer is moderately resistive with 16.34 Ωm resistivity and 17.96m thickness. This layer is followed by a comparatively conductive layer of 3.11 Ωm resistivity with 55.38m thickness. Underneath stratum is of 3.29 Ωm resistivity at 79.68m depth.

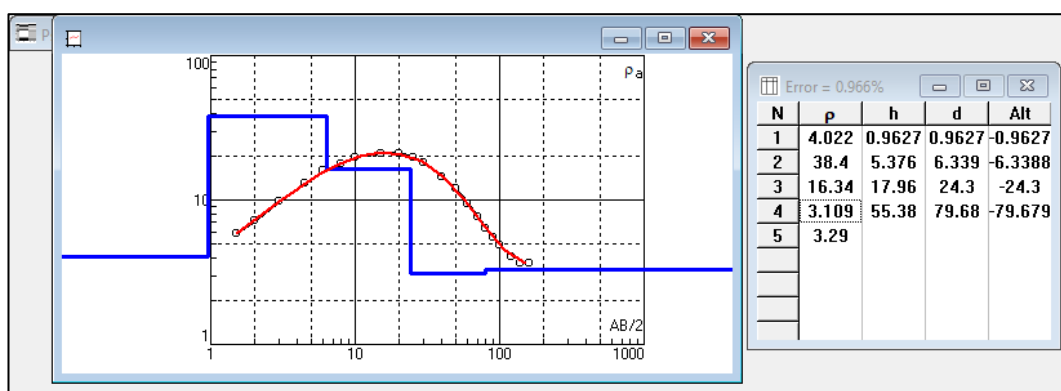


Figure 9.1.6.2.31: Graphical representation of VES 30

VES 31

Resistivity sounding conducted towards east of Mellampudi and eastern side of VES12 site along a traverse in N-S orientation on a traverse with AB/2 as 200m at latitude 16°25'20.70"N and longitude 80°38'6.00"E. The apparent resistivity double log graph indicates a six-layer AKQ-type curve. First layer in the subsurface represents resistive top soil of 34.65 Ωm resistivity with 0.09m thickness underlain by a moderately conductive layer of resistivity 10.17 Ωm with 1.21m thickness. **Third layer is comparatively having high resistivity with 136.4 Ωm and thickness 6.51m. This zone considered for seismic survey for searching gravel.** This is followed by a stratum of 24.77 Ωm resistivity with 39.78m thickness. Next layer is of 3.88 Ωm resistivity and 84.87m thickness. Beneath this a conductive layer with resistivity 5.17 Ωm persisted at 132.5m depth.

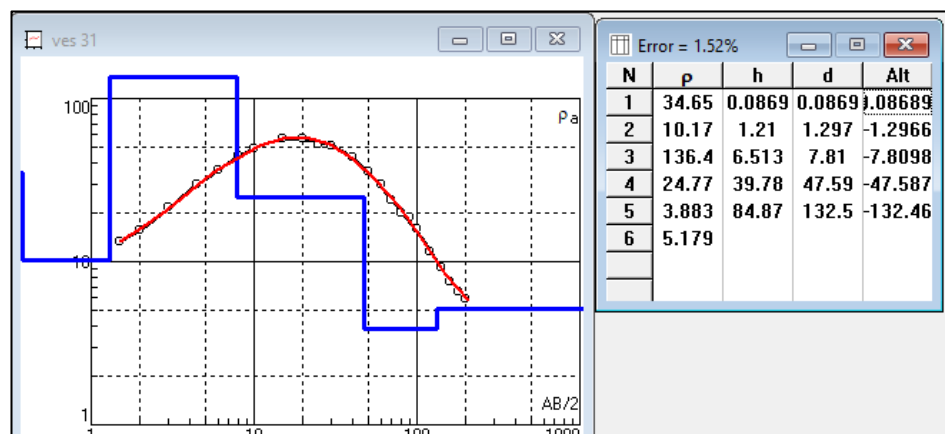


Figure 9.1.6.2.32: Graphical representation of VES 31

VES 32

Resistivity sounding conducted towards north west of Nutakki near VES 28 site along a traverse with AB/2 as 200m E-W orientation at latitude 16°25'45.19"N and longitude 80°38'20.80"E. This section with high resistivity as manifested in profile P6W24 is also considered for laying this traverse. Apparent resistivity double log graph at this location indicates a seven-layer AKQ-type curve. First two layers of this subsurface lithology represents topsoil with thickness 0.28m and 0.87m with resistivities of 3.81 Ωm and 28.8 Ωm respectively. **Next layer is showing resistivity 186 Ωm with 6.17m thickness. This stratum is considered for seismic survey for delineating sand/gravel.** Beneath this sudden decrease in resistivity of 2.15 Ωm manifests a conductive layer having 1.99m thickness. This is followed by 23.1 Ωm resistivity layer with 26.5m thickness. This layer is underlain by a thick conductive layer of 1.39 Ωm resistivity and 72.3m thickness. Beneath this weathered Khondalite basement with resistivity 139 Ωm persisted at 108m depth.

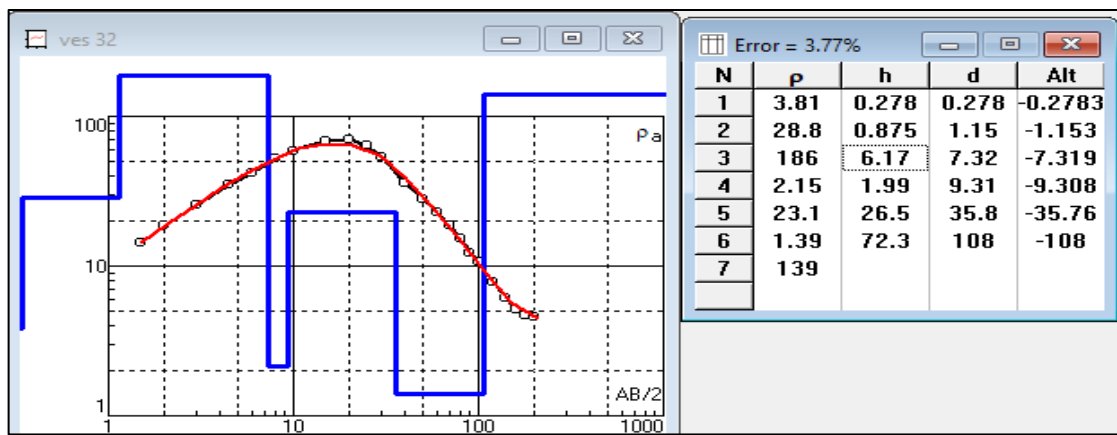


Figure 9.1.6.2.33: Graphical representation of VES 32

VES 33

Resistivity sounding conducted towards north west of Nutakki and South eastern side of VES 28 at latitude 16°25'38.90"N and longitude 80°38'30.90"E on a traverse with AB/2 as 200m along E-W orientation. This traverse falls in a high resistive zone in resistivity profile of P28E9S14. The apparent resistivity double log graph indicates a five-layer AKQ-type curve. First two layers of the subsurface lithology represents topsoil down to 1.45m depth with resistivities 6 Ωm and 11.3 Ωm. **Next layer is showing high resistivity of 192 Ωm with 4.2m thickness. This zone is of importance to conduct seismic survey at this locality.** This is underlain by a thick moderately conductive 13.3 Ωm resistivity layer with 40.4m thickness. Underlying layer with 3.95Ωm resistivity persisted below 45.8m depth.

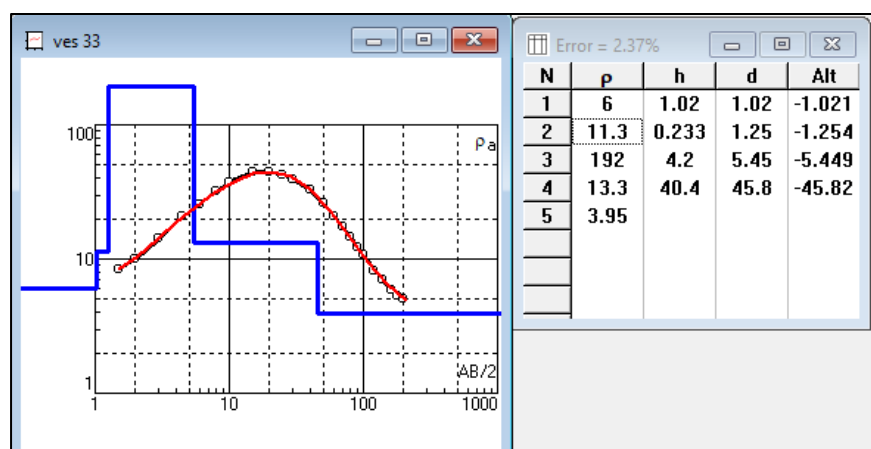


Figure 9.1.6.2.34: Graphical representation of VES 33

VES 34

Resistivity sounding conducted towards north of Ippatam village along a traverse with AB/2 as 200m in E-W orientation at latitude 16°26'29.20"N and longitude 80°37'3.00"E. The apparent resistivity double log graph indicates a seven-layer AKQ-type curve. Top layer of the subsurface sequence represents conductive soil with 1.32m thickness and 6.55 Ωm resistivity. **This is underlain by a resistive stratum of 111 Ωm resistivity with 0.45m**

thickness. This can be considered for conducting seismic survey in this area. Third layer is also resistive with 45.5 Ωm resistivity and 9.02m thickness. This layer is followed by a conductive stratum with 9.9 Ωm resistivity and 13m thickness. Next layer with 15.1m thickness and 45.4 Ωm resistivity is observed below this stratum. Beneath this layer a thick 58.8m conductive layer with 3.74 Ωm resistivity persists. An underlying highly resistive layer with resistivity 269 Ωm extends below 97.7m depth indicating probably Khondalite basement.

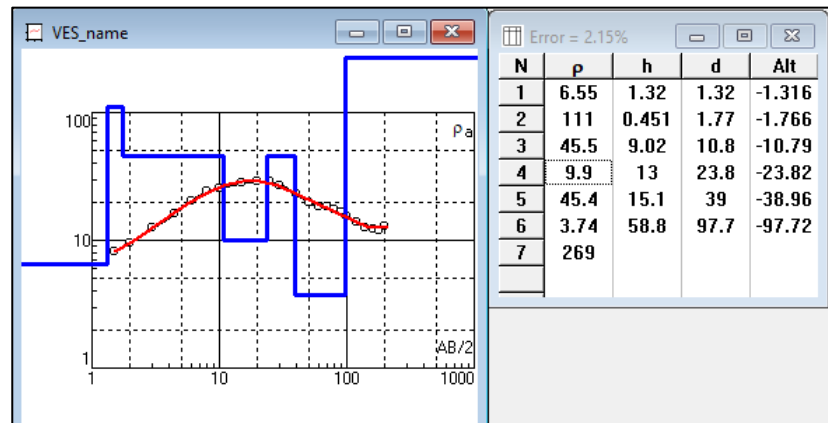


Figure 9.1.6.2.35: Graphical representation of VES 34

VES-35

Resistivity sounding conducted in Vaddeshwaram area, near K.L. University, along a traverse in N-S orientation at latitude 16°26'46.66"N and longitude 80°37'30.4"E with AB/2 as 119m. The apparent resistivity double log graph indicates a seven-layer AKQ-type curve. First layer in the subsurface sequence represents a conductive soil having 0.98m thickness and 6.12 Ωm resistivity underlain by a resistive stratum of 114 Ωm resistivity and 1.98m thickness. Third layer is with 29.8 Ωm resistivity and 9.64m thickness. This is followed by a conductive layer of 1.35 Ωm resistivity having 13.1m thickness. Beneath this 36.2m thick layer with 16.2 Ωm resistivity is identified. Underneath, highly conductive layer with 0.72 Ωm resistivity at a depth of 62m is detected.

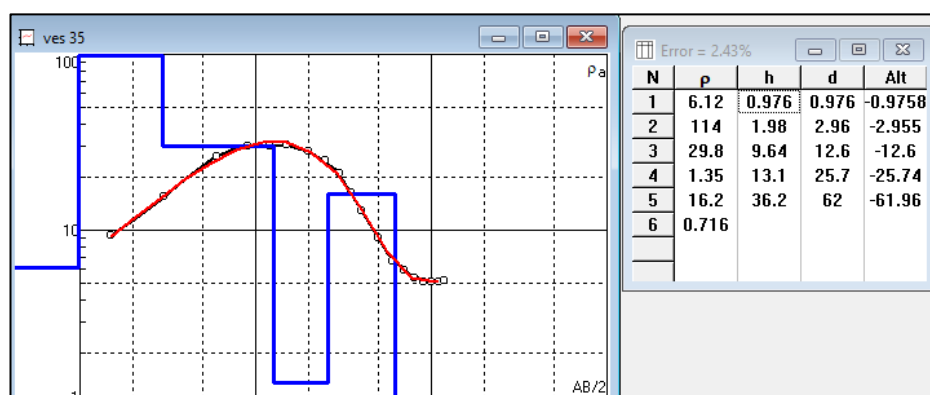


Figure 9.1.6.2.36: Graphical representation of VES 35

VES 36

Resistivity sounding conducted in Vaddeshwaram area, near K.L. University, along a traverse with AB/2 as 90m in E-W orientation at latitude 16°26'46.84"N and longitude 80°37'31.11"E. The apparent resistivity double log graph indicates a six-layer AKQ-type curve. First layer in the subsurface represents conductive soil with 0.62m thickness and 3.31 Ωm resistivity. **This is underlain 205 Ωm resistivity layer having 1.12m thickness. Third layer is with 109 Ωm resistivity and 2.56m thickness. This zone is considered for seismic survey which has high order of resistivity variations in search of Sand/Gravel.** This is followed by a highly conductive, 1.72 Ωm , resistivity stratum with 3.21m thickness. In the next layer 37.8m thickness and 4 Ωm resistivity is detected. Beneath this moderately conductive layer with resistivity of 11.8 Ωm persists at 45.3m depth.

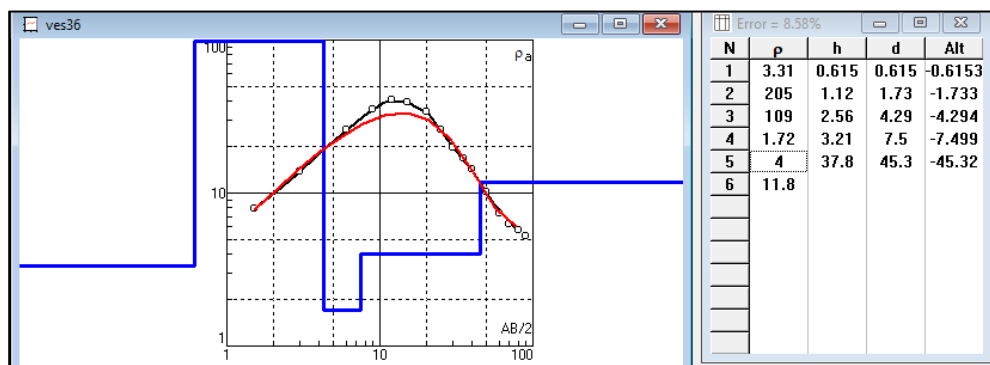


Figure 9.1.6.2.37: Graphical representation of VES 36

VES 37

Resistivity sounding conducted in Gundimeda area along a traverse of AB/2 110m towards NW-SE orientation at latitude 16°26'46.84"N and longitude 80°37'31.11"E. The apparent resistivity double log graph indicates a six-layer HKA-type curve. First two layers in the subsurface represents conductive soil with 5.21 Ωm and 1.89 Ωm resistivity having 0.70m and 1.35m thickness respectively. Third layer is again conductive with 3.15 Ωm resistivity and 6.3m thickness **followed by a moderately resistive stratum with 14.7 Ωm resistivity and 12.9m thickness. This zone is considered for seismic survey due to high order of resistivity.** Again, resistivity is found to be decreasing in the next stratum to 2.1 Ωm having 37.84m thickness. Underneath stratum with resistivity 112 Ωm extends from 59.1m depth.

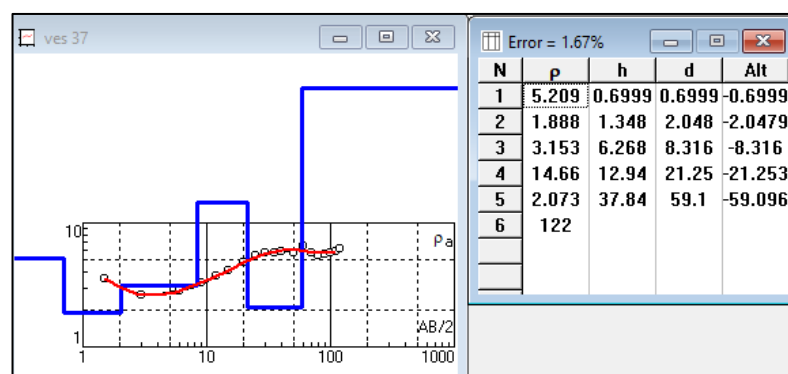


Figure 9.1.6.2.38: Graphical representation of VES 37

VES 38

Resistivity sounding conducted in Vaddeshwaram area, along a traverse with AB/2 as 140m along N-S orientation at latitude 16°26'26.77"N and longitude 80°37'6.07"E. The apparent resistivity double log graph indicates a six-layer AKQ-type curve. First layer is highly conductive with 2.75 Ωm resistivity and 0.35m thickness in the top surface. Beneath this with 16.1 Ωm resistivity and 10.5m thickness stratum followed by a resistive layer of 50.5 Ωm resistivity with 5.95m thickness. This zone is considered for seismic survey with its high order of resistivity. Again, resistivity is found to be decreasing in the next stratum as 7.19 Ωm having 53.6m thickness. Beneath this conductive layer with resistivity 7.89 Ωm persists at 70.4m depth.

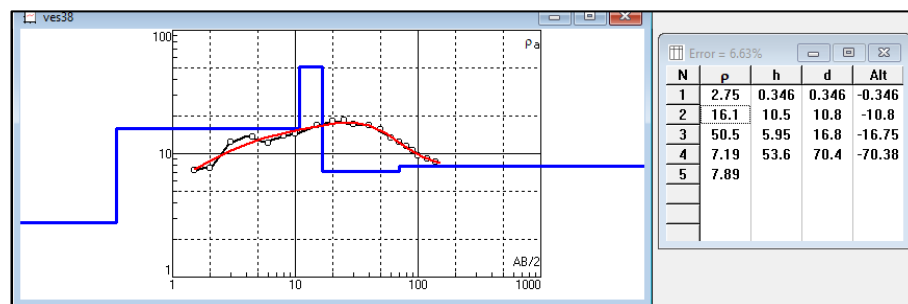


Figure 9.1.6.2.39: Graphical representation of VES 38

VES 39

Resistivity sounding conducted in Ippatam area along a traverse with AB/2 as 140m towards E-W orientation at latitude 16°25'57.12"N and longitude 80°36'44.25"E. The apparent resistivity double log graph indicates a ten-layer HAKQ-type curve. First 3 layers of the subsurface sequence represents soil upto 1.37m depth with 79.43 Ωm , 4.77 Ωm & 68.06 Ωm resistivities. Resistivity has gradually increased in the next two layers with 51.13 Ωm and 73.93 Ωm . Thickness of these two layers are 5.25m & 1.2m with its high order of resistivity. This zone can be considered for seismic survey for delineating sand/gravel. In the 7th layer sudden drop in resistivity to 4.85 Ωm is detected with thickness 11.17m. Down to this layer with 19.62 Ωm resistivity having 20.28m thickness is observed. Beneath this lies a conductive stratum with 3.74 Ωm resistivity and 38.82m thickness. A resistive layer with resistivity 26.38 Ωm persisted below 81.05m depth.

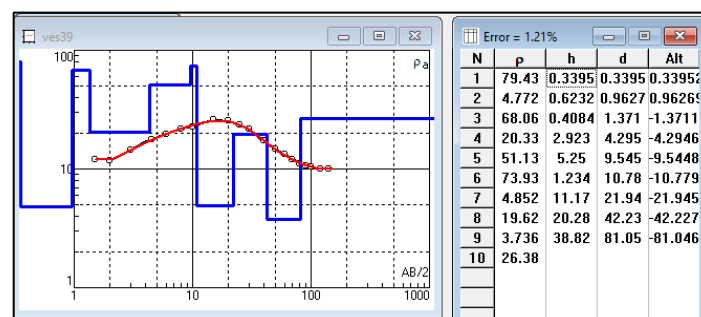


Figure 9.1.6.2.40: Graphical representation of VES 39

VES 40

Resistivity sounding conducted towards west of Mellempudi, along E-W orientation on a traverse with AB/2 as 100m at latitude 16°25'47.49"N and longitude 80°37'42.65"E. The apparent resistivity double log graph indicates five-layer AKQ-type strata. First layer in the subsurface represents soil with 0.25m thickness having resistivity 1.23 Ωm . **A sharp increase in resistivity with 135 Ωm can be observed in the second layer having 2.6m thickness. This zone is considered for seismic survey.** A sharp decrease in resistivity with resistivity 0.16 Ωm is observed in the next layer with thickness of 0.47m. Thick conductive layer lies below this stratum with 5.46 Ωm resistivity and 68.4m thickness. Fifth layer is also conductive with 1.76 Ωm resistivity which continues below 71.8m depth.

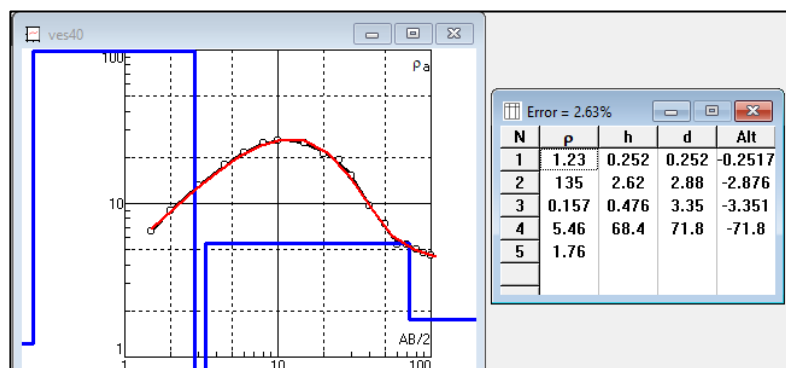


Figure 9.1.6.2.41: Graphical representation of VES 40

VES 41

Resistivity sounding conducted in Cherravuru towards N-S orientation at latitude 16°26'34.77"N and longitude 80°38'43.46"E with AB/2 as 200m. The apparent resistivity double log graph indicates a nine-layers HKA-type curve. From this data it is interpreted that first 3 layers up to 1.62m depth represents conductive soil with 2.18 Ωm , 0.78 Ωm and 0.85 Ωm resistivity respectively. Next two layers are also conductive in nature with 6.62 Ωm and 2.12 Ωm resistivity and 2.69m & 4.31m thickness. 6th layer is having a thickness of 20.2m and 5.47 Ωm resistivity. **It is followed by a thick moderately resistive layer with 22.4 Ωm resistivity and 36.7m thickness. This zone is considered for seismic survey so as to make clarity in lithology for identifying Gravel.** Beneath this stratum resistivity has decreased to 1.64 Ωm with 31.3m thickness. This is underlain by a resistive layer of 29.6 Ωm resistivity that continued down to 96.8m depth.

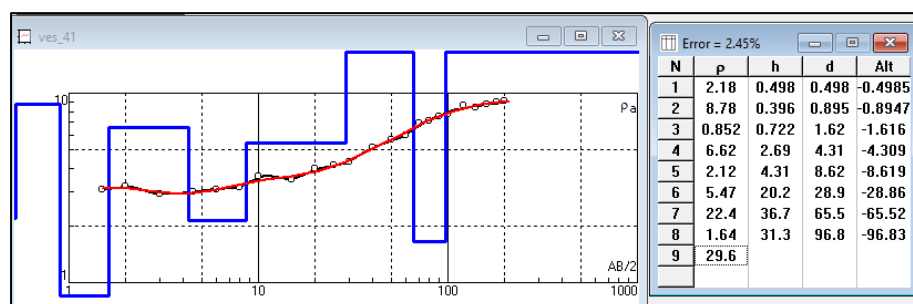


Figure 9.1.6.2.42: Graphical representation of VES 41

VES42

Resistivity sounding conducted in Nautakki Village towards N-S orientation on a traverse with AB/2 as 220m at latitude 16°25'13.13"N and longitude 80°38'34.78"E. The apparent resistivity double log graph indicates a five-layer AKQ-type curve. Subsurface lithology starts with a moderately resistive topsoil having 15.9 Ωm resistivity and 0.36m thickness followed by a conductive layer of 2.15 Ωm resistivity having 0.47m thickness. **Beneath this stratum a sharp increase of resistivity to 231 Ωm having 3.28m thickness is observed. This zone is considered for seismic survey.** It is underlain by a thick conductive layer with 76.7m thickness and 4.06 Ωm resistivity. Down to this a conductive layer with 2.46 Ωm resistivity persists at 80.8m depth.

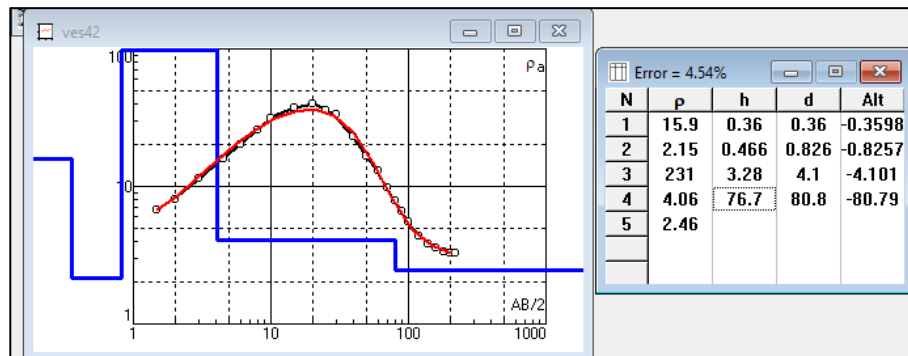


Figure 9.1.6.2.43: Graphical representation of VES 42

VES 43

Resistivity sounding conducted in Nautakki Village along N-S orientation at latitude 16°25'14.68"N and longitude 80°38'45.24"E on a traverse with AB/2 as 348m. The apparent resistivity double log graph indicates a six-layer AKQ-type curve. First two layers represents topsoil with resistivity 6.54 Ωm and 2.94 Ωm having thickness 0.55m and 1m respectively. **Third layer is highly resistive with 91.93 Ωm resistivity and 5.64m thickness. This zone is considered for seismic survey.** Followed by this a thick moderately conductive layer of resistivity 11.74 Ωm having thickness 45.12m is observed. Next layer is 165.7m thick and less resistive with 2.50 Ωm resistivity. A conductive layer with 5.4 Ωm resistivity persisted below 218.1m depth. It is probably a weathered Khondalite from the nature of apparent resistivity curve.

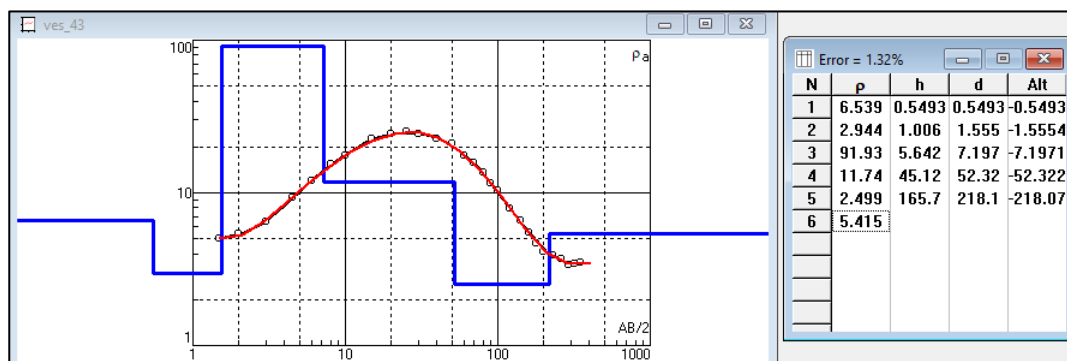


Figure 9.1.6.2.44: Graphical representation of VES 43

VES 44

Resistivity sounding conducted towards North of Nautakki Village along E-W orientation on a traverse with AB/2 as 135m at latitude 16°25'33"N and longitude 80°38'31.89"E. The apparent resistivity data plotted in double log graph indicates a six-layer AKQ. First layer in the subsurface represents soil with 46.34 Ωm resistivity and 0.3m thickness followed by a conductive layer with 3.24 Ωm resistivity and 0.7m thickness. **There is a sharp rise in resistivity to 138.8 Ωm in the next layer with 3.27m thickness. This zone is considered for seismic survey studies as it may reflect gravel zones due to high resistivity nature of the subsurface.** Resistivity decreased to 3.99 Ωm further downward in the next layer having 1.94m thickness. **This is underlain by a resistive layer with 30.93 Ωm resistivity and 15.8m thickness which can be considered for seismic studies to explore gravel zones.** Next layer is again a conductive layer with 2.31 Ωm resistivity and 50.9m thickness. Further downwards a resistive layer with 114.3 Ωm resistivity persists at 72.96m depth.

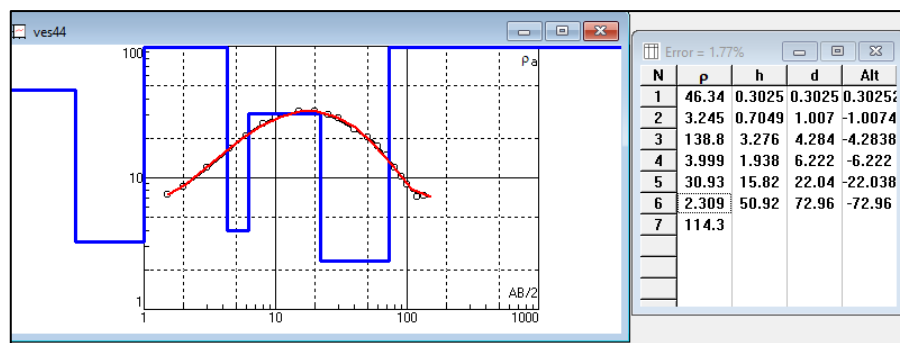


Figure 9.1.6.2.45: Graphical representation of VES 44

VES 45

Resistivity sounding conducted near Nutakki Village along N-S orientation on a traverse with AB/2 as 260m at latitude 16°24'53.78"N and longitude 80°37'35.74"E. The apparent resistivity data indicates a seven-layer AKQ-type double log graph. First two layers in the topsoil with 5.74 Ωm and 2.66 Ωm resistivity extends down to 1.87m depth. **Third layer is resistive with 176 Ωm resistivity and 1.31m thickness followed by 1.17m a thickness stratum with 27 Ωm thickness. These resistive layers are referred for seismic studies for identification of gravel.** Next layer is having 40.5m thickness which is moderately resistive with 13.5 Ωm resistivity which may be a continuation of the previous stratum. This is underlain by a highly conductive 0.83 Ωm resistivity stratum having 24.7m thickness. Conductive strata with 3.45 Ωm resistivity persisted below 69.5m depth.

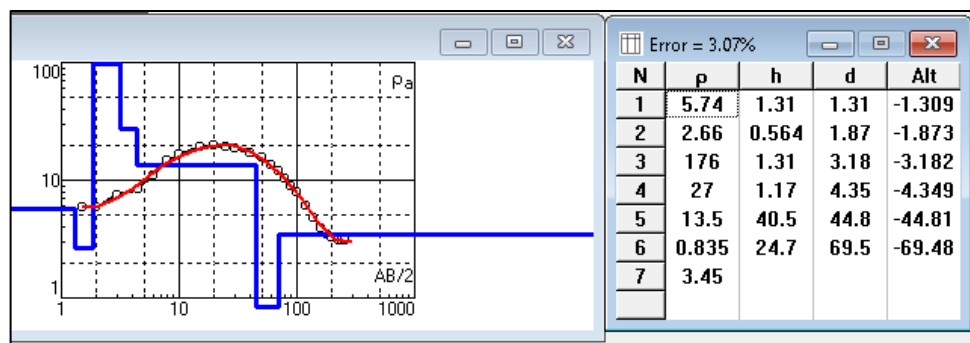


Figure 9.1.6.2.46: Graphical representation of VES 45

VES46

Resistivity sounding conducted towards Nutakki Village along N-S orientation on a traverse with AB/2 as 260m at latitude 16°25'11.7"N and longitude 80°37'21.6"E. The apparent resistivity double log graph indicates a five-layer AKQ-type curve. Subsurface lithology starts with a conductive topsoil having 4.79 Ωm resistivity and 1.31m thickness followed by **a thick resistive layer of 19.82 Ωm resistivity and 33.62m thickness. This resistive nature of the stratum is considered for seismic exploration to study gravel deposition in this subsurface.** Further, resistivity has decreased to 5.65 Ωm in the third layer having 32.55m thickness. Fourth layer is highly conductive with 0.32 Ωm resistivity and 13.16m thickness underlain by a stratum with 9.78 Ωm resistivity at 80.63m depth.

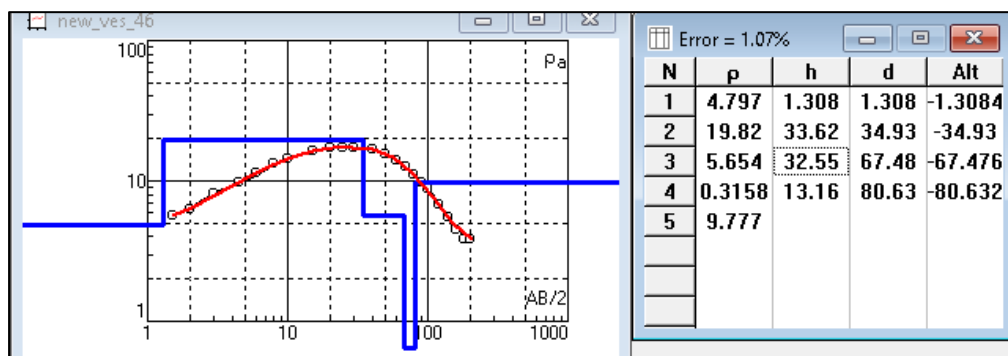


Figure 9.1.6.2.47: Graphical representation of VES 46

VES47

Resistivity sounding conducted towards Mellempudi Village along N-S orientation on a traverse with AB/2 as 160m at latitude 16°25'14.93"N and longitude 80°37'18.79"E. The apparent resistivity double log graph indicates a five-layer AKQH-type curve which starts with 4.57 Ωm resistivity in the topsoil with 1.55m thickness followed by **a resistive layer of 32.65 Ωm resistivity and 4m thickness. Next, a moderately resistive layer with 12.9 Ωm resistivity and 17.7m thickness persists. This resistive nature of the strata is considered for seismic exploration to study gravels.** This layer is underlain by highly conductive layer with 0.95 Ωm resistivity and 8.66m thickness. Fifth layer is also a conductive stratum with 1.94 Ωm resistivity and 13.37m thickness. Beneath this 4.92 Ωm resistivity persists below 45.3m

depth which may indicate probably a weathered Khondalite from the nature of the apparent resistivity curve.

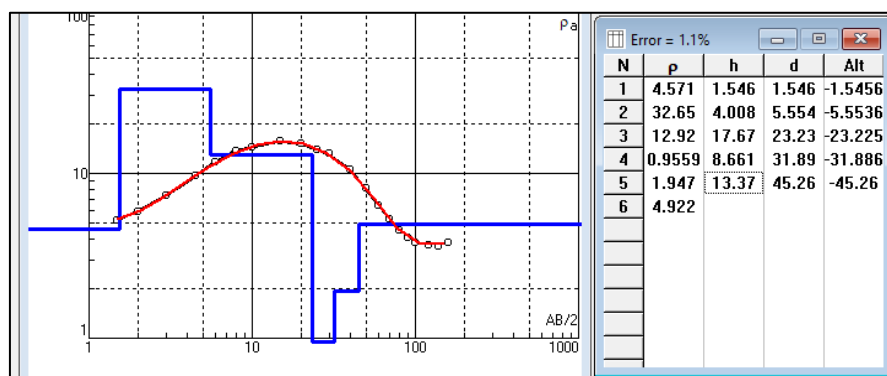


Figure 9.1.6.2.48: Graphical representation of VES 47

VES48

Resistivity sounding conducted towards Mellempudi Village along E-W orientation on a traverse with AB/2 as 190m at latitude 16°25'51.31"N and longitude 80°37'28.74"E. The apparent resistivity double log graph indicates a seven-layer HKQ-type curve. First two layers of the subsurface strata has 1.63m depth having resistivities 11.6 Ωm at the top and 3.04 Ωm below it. **Third layer is resistive with 25.43 Ωm resistivity and 0.22m thickness followed by a conductive layer of 1.91 Ωm resistivity and 1.27m thickness. Next is a moderately resistive layer with 14.5 Ωm resistivity and 4.34m thickness which may indicate sand/ gravel presence. This is underlain by 5.29m thick resistive layer of 18.75 Ωm resistivity which may indicate the presence of a sand/gravel bed. Beneath this 5.21 Ωm resistivity persists below 12.75m depth and its thickness cannot be estimated due to limitation in extending the traverse.**

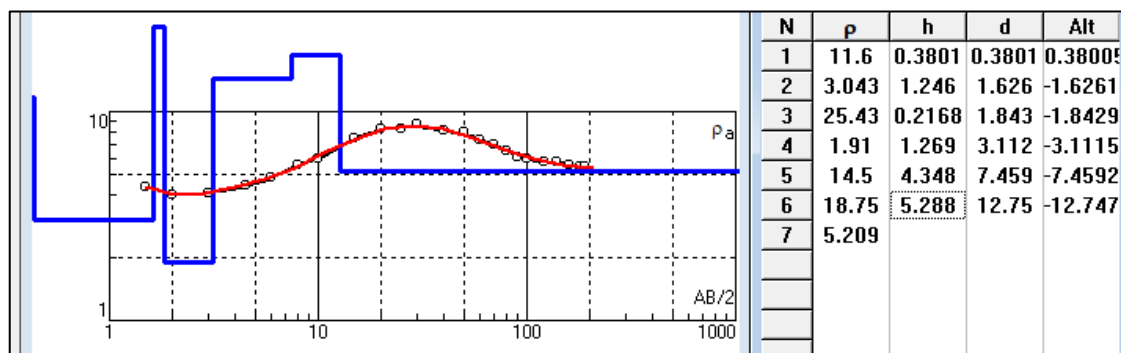


Figure 9.1.6.2.49: Graphical representation of VES 48

VES 49

Resistivity sounding conducted towards Ippatam Village along E-W orientation on a traverse with AB/2 as 220m at latitude 16°25'55.54"N and longitude 80°36'47.04"E. The apparent resistivity double log graph indicates a six-layer AKH-type curve. Lithology starts with 0.99m thick topsoil with 2.81 Ωm resistivity followed by 2.67m thick conductive layer with 4.68 Ωm resistivity. A sharp increase in resistivity to 99.4 Ωm can be observed in the third layer with 7.18m thickness. Again, resistivity has sharply decreased to 1.04 Ωm representing a highly conductive layer of 12.4m thickness. This layer is underlain by a resistive layer of 76 Ωm resistivity and 63.6m

thick stratum. A conductive layer with $3.05 \Omega\text{m}$ resistivity persists below 86.8m depth. **High resistivity in third- and fifth-layer point towards existence of sand/gravel zones which can be confirmed by seismic survey**

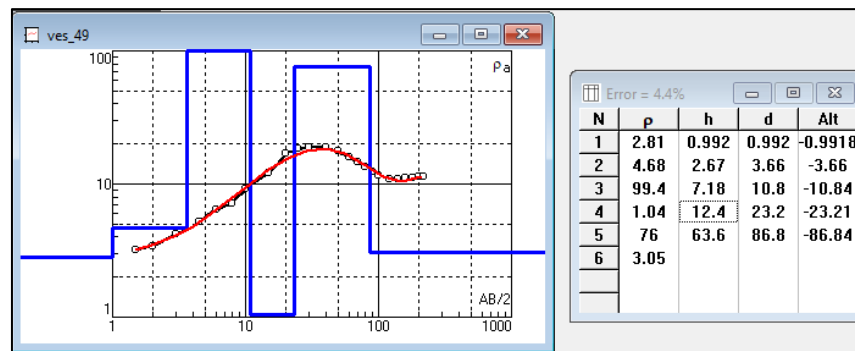


Figure 9.1.6.2.50: Graphical representation of VES 49

VES 50

Resistivity sounding conducted towards Pedavadlapudi Village on a traverse with AB/2 as 200m along SE-NW orientation at latitude $16^{\circ}25'39.89''\text{N}$ and longitude $80^{\circ}36'56.97''\text{E}$. The apparent resistivity double log graph indicates a seven-layer AKQ-type curve which starts with topsoil 0.75m thickness and $6.38 \Omega\text{m}$ resistivity. **This is followed by 3.54m thick resistive layer of $80.5 \Omega\text{m}$ resistivity. This high resistive zone can be considered for seismic studies.** Decrease in resistivity to $4.77 \Omega\text{m}$ is observed in the next layer with 2.13m thickness. Resistivity has increased to $19 \Omega\text{m}$ representing a resistive layer of 11.4m thickness. This layer is underlain by a conductive layer with $2.84 \Omega\text{m}$ resistivity and 6.12m thickness. Next is a thick, 50.5m, stratum with $5.17 \Omega\text{m}$ resistivity. Beneath this $6.38 \Omega\text{m}$ resistivity persists at 74.4m depth.

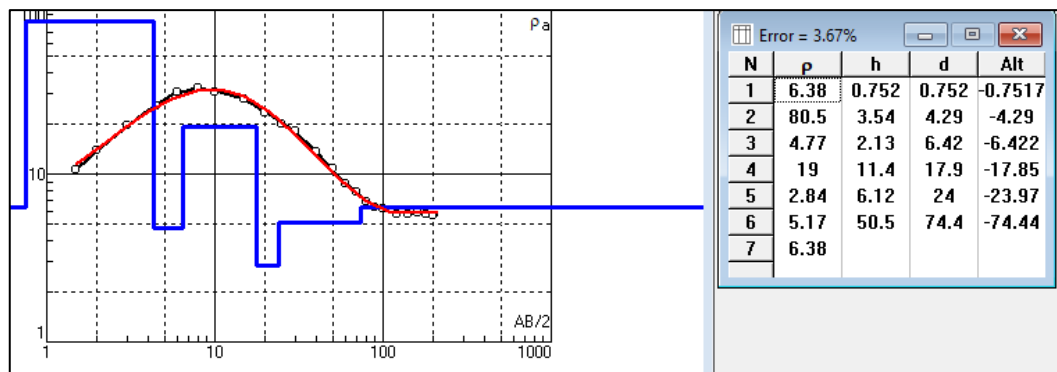


Figure 9.1.6.2.51: Graphical representation of VES 50

VES 51

Resistivity sounding conducted towards northern side of Pedavadlapudi Village on a traverse with AB/2 as 340m along E-W orientation at latitude $16^{\circ}25'10.5''\text{N}$ and longitude $80^{\circ}36'27.27''\text{E}$. The apparent resistivity double log graph indicates a five-layer AKH-type curve. The subsurface stratum begins with conductive top soil having 1.53m thickness and $4.41 \Omega\text{m}$ resistivity which overlain on a thin, 3.45m, layer with $32.08 \Omega\text{m}$ resistivity. Next layer is moderately resistive with $14.26 \Omega\text{m}$ resistivity and 14.42m thickness. These high resistive zones are considered

for seismic studies. Resistivity has decreased to 2.55 Ωm in 4th layer which has 104.9m thickness. Beneath this stratum 22.53 Ωm resistivity persists at 124.3m depth. This may indicate weathered Khondalite basement as inferred from the nature of apparent resistivity graph.

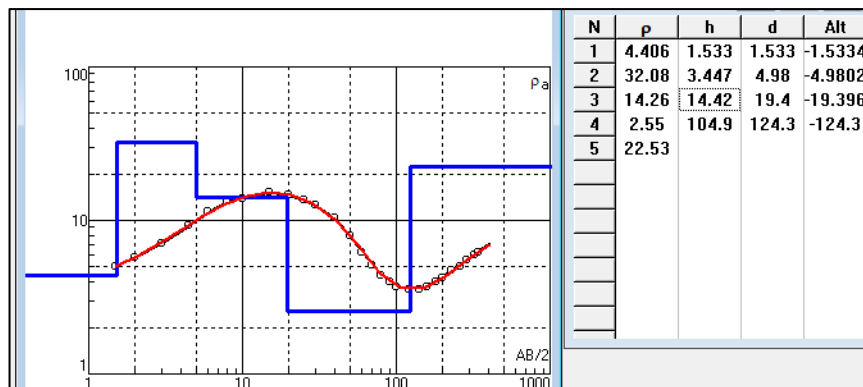


Figure 9.1.6.2.52: Graphical representation of VES 51

VES 52

Resistivity sounding conducted in Pedavadlapudi Village towards N-S orientation on a traverse with AB/2 as 260m at latitude 16°25'10.5"N and longitude 80°36'27.27"E. The apparent resistivity double log graph indicates a ten-layer AKQH-type lithology. First two layers in the subsurface represents topsoil upto 1.43m depth with 5.39 Ωm and 6.42 Ωm resistivities. **From third layer resistivity has increased sharply to 68.5 Ωm with 1.5m thickness. This may indicate a sand/gravel zone which can be confirmed from seismic survey.** Resistivity has decreased to 14.39 Ωm and 9.91 Ωm with its thickness varied to 0.57m and 4.02m downwards on next successive layers. Next layer with 27.5 Ωm resistivity and 2.8m thickness is detected. This is followed by moderately resistive stratum with 16.8 Ωm resistivity and 12m thickness which may be a continuation of the sand/gravel zone. This layer is underlain by a thick, 33.3m, conductive layer with 1.8 Ωm resistivity. Next layer is also a thick, 95.8 m, conductive zone with 3.6 Ωm resistivity. It is underlain by a moderately resistive layer with 15.08 Ωm resistivity at 149.6m depth.

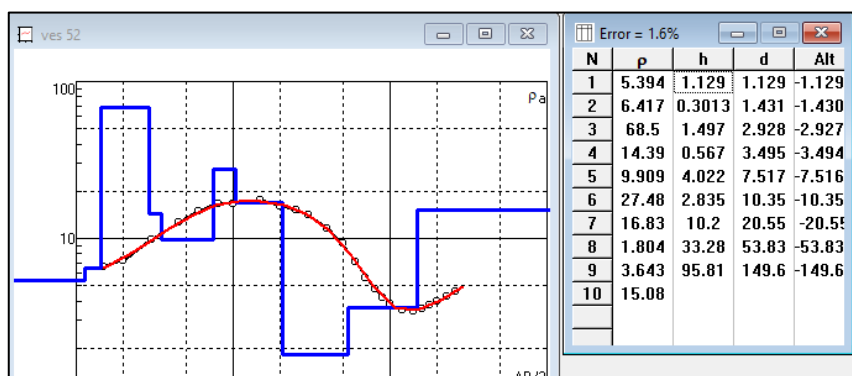


Figure 9.1.6.2.53: Graphical representation of VES 52

VES 53

Resistivity sounding conducted near Nutakki Village on a traverse with AB/2 as 260m along E-W orientation at latitude 16°25'42.34"N and longitude 80°38'34.89"E. The apparent resistivity double log graph indicates a nine-layer AKQ-type curve. **First three layers in the subsurface**

lithology represents topsoil up to 2.15m with resistivities 2.61 Ωm , 141 Ωm and 22.8 Ωm successively. Next layer is highly resistive layer with 88.7 Ωm resistivity and 4.94m thickness. This stratum may be considered for sand/gravel studies by seismic survey. After this layer resistivity gradually decreased in successive two layers as 8.5 Ωm and 2.78 Ωm with thickness varying from 1.93m to 11.8 m respectively. 7th layer is moderately resistive with 12.5 Ωm resistivity and 36.4m thickness. This fluctuation in resistivity may indicate sand/gravel zone, followed by a thick, 32.4m, and highly conductive stratum with 0.55 Ωm resistivity. Highly resistive layer with 189 Ωm resistivity persists below 89.7m depth which may indicate a weathered Khondalite basement from the nature of resistivity curve.

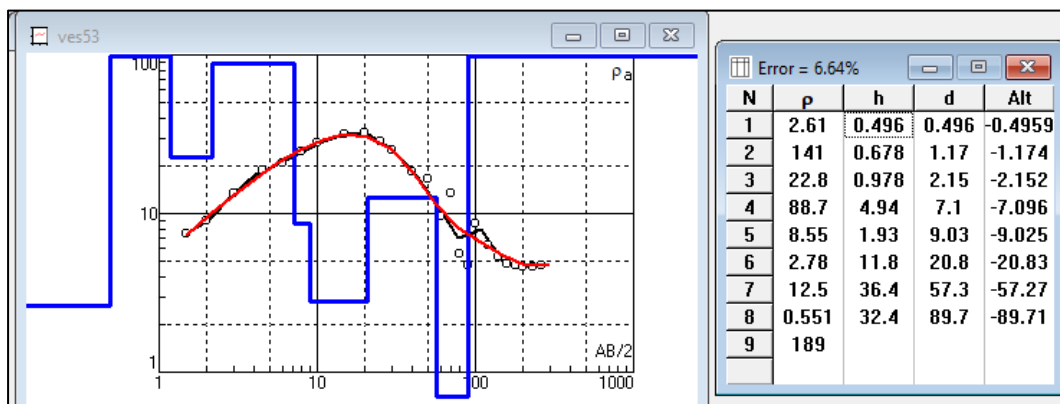


Figure 9.1.6.2.54: Graphical representation of VES 53

VES 54

Resistivity sounding conducted near Nutakki Village towards N-S orientation on a traverse with AB/2 as 200m at latitude 16°25'43.87"N and longitude 80°38'38.65"E. The apparent resistivity double log graph indicates eight-layer AKQ-type curve. Up to 0.99m depth from the subsurface represents topsoil with 29.4 Ωm & 2.17 Ωm resistivities successively. **Resistivity has increased to 45.8 Ωm in third layer with thickness 4.2m which may correspond to sand/gravel and is worth examining by seismic survey.** Resistivity has decreased to 6 Ωm representing a moderately conductive layer with 15.4m thickness. This layer is underlain by 12m thick moderately resistive layer having 14.2 Ωm resistivity. Next is a highly conductive layer of resistivity 1.97 Ωm with 10.8m thickness followed by a thick, 27.2m, stratum having 9.09 Ωm resistivity. Conductive layer of 2.47 Ωm resistivity continues below 70.5m depth.

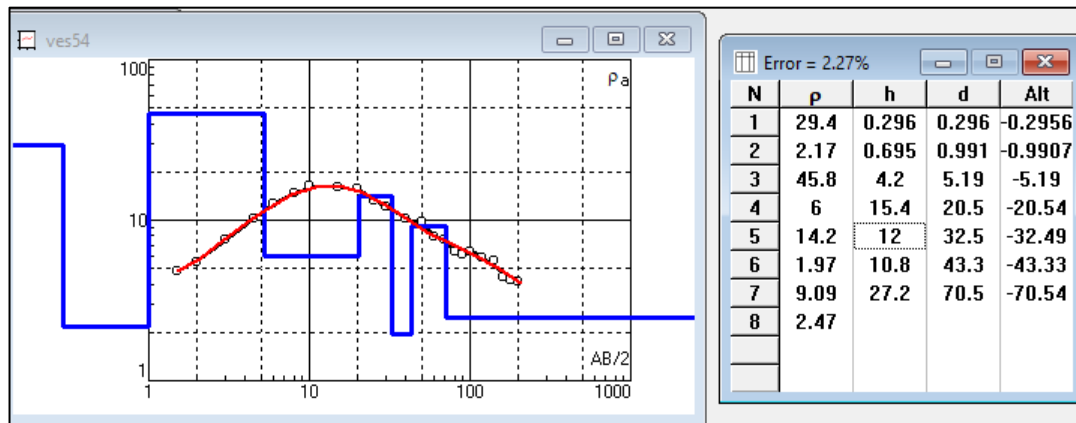


Figure 9.1.6.2.55: Graphical representation of VES 54

VES 55

Resistivity sounding conducted towards North of Nutakki Village on a traverse with AB/2 as 160m along E-W orientation at latitude 16°25'53.06"N and longitude 80°38'33.80"E. The apparent resistivity double log graph indicates a six-layer AKH-type curve. Subsurface lithology starts with 1.71m thick topsoil with 3.21 Ωm resistivity which overlies on a stratum of **5.71m thickness and 43.2 Ωm resistivity which is worth studying by seismic survey for Sand/Gravel deposits**. In the 3rd layer resistivity has decreased sharply to 0.14 Ωm representing a highly conductive stratum of 2.11m thickness followed by a resistive layer of 36.3 Ωm resistivity and 17.5m thickness. **This zone is important for sand/ gravel investigation by seismic survey**. Again, sharp decrease in resistivity is observed in the next layer with thickness 46.4m and resistivity 0.19 Ωm. Resistivity layer of 34.5 Ωm continues below 73.6 m depth which may indicate weathered Khondalite basement.

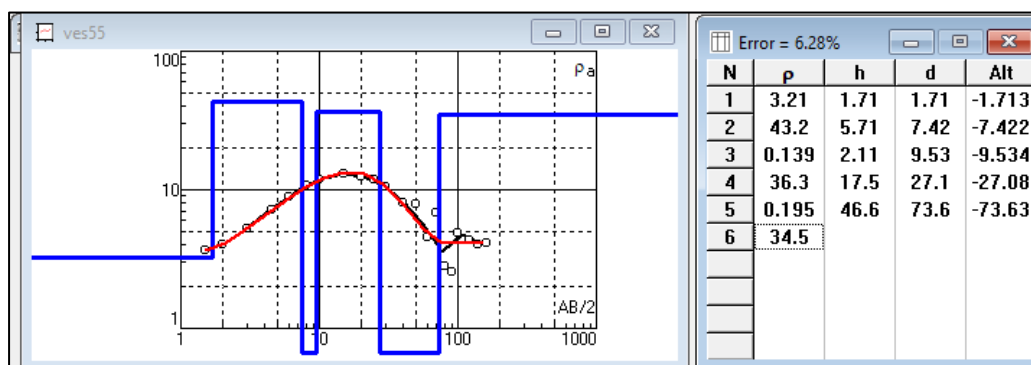


Figure 9.1.6.2.56: Graphical representation of VES 55

VES 56

Resistivity sounding conducted near Nutakki Village on a traverse with AB/2 as 120m towards N-S orientation at latitude 16°26'55.26"N and longitude 80°37'52.98"E. The apparent resistivity double log graph indicates eight-layer AKH-type curve. Down to 1.56m depth in the subsurface lithology represents topsoil with 4.25 Ωm and 1.18 Ωm resistivity. Beneath this stratum resistivity has increased in third layer to 27.3 Ωm having 1.35m thickness. Resistivity has again decreased

to $0.41 \Omega\text{m}$ representing a conductive layer with 0.4m thickness. This stratum is underlain by 6.41m thick resistive layer with $20.9 \Omega\text{m}$ resistivity indicating a sand or gravel zone. Next is a highly conductive, $0.63 \Omega\text{m}$, layer with 13.8m thickness followed by 15.1m thick layer having $19.1 \Omega\text{m}$ resistivity. **These alternative high resistive zones are worth examining for sand/gravel by seismic survey.** A highly resistive layer of $223 \Omega\text{m}$ resistivity continues below 38.6m depth which may corresponds to Khondalite basement.

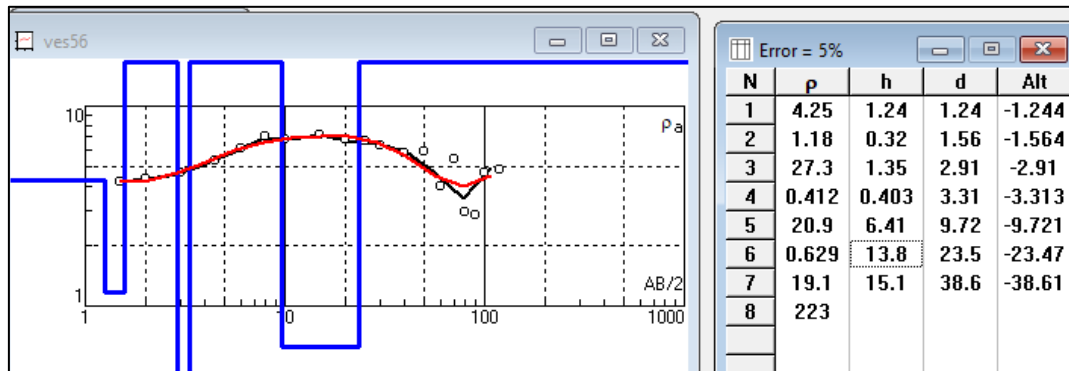


Figure 9.1.6.2.57: Graphical representation of VES 56

VES 57

Resistivity sounding conducted in Vaddeswaram area on a traverse with AB/2 as 200m towards N-S orientation at latitude $16^{\circ}26'31.23''\text{N}$ and longitude $80^{\circ}36'49.59''\text{E}$. The apparent resistivity double log graph indicates a five-layer HA-type curve. Subsurface lithology starts with conductive topsoil with $2.67 \Omega\text{m}$ resistivity and 1.03m thickness followed by a conductive layer with $1.54 \Omega\text{m}$ resistivity and 5.76m thickness. Resistivity gradually increased down to this layer. 3rd layer is conductive with $2.6 \Omega\text{m}$ resistivity and 11.08m thickness followed by a moderately conductive layer having $10.8 \Omega\text{m}$ resistivity and 39.57m thickness which may indicate a sandy horizon. A highly resistive layer with $77.37 \Omega\text{m}$ continues below 57.44m depth which may correspond to Khondalite basement.

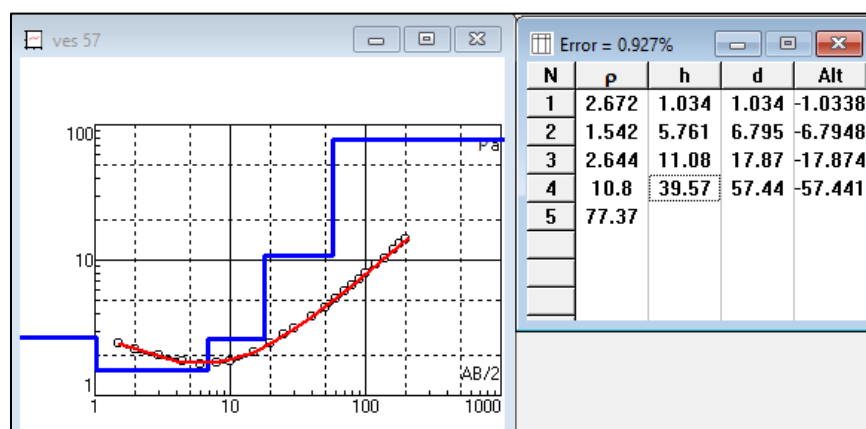


Figure 9.1.6.2.58: Graphical representation of VES 57

VES 58

Resistivity sounding conducted in Ippatam area on a traverse with AB/2 as 180m towards N-S orientation with latitude 16°26'25.96"N and longitude 80°36'51.08"E. The apparent resistivity double log graph indicates eight-layer AKH-type curve. First three layers in the subsurface indicates topsoil with 6.69 Ω m, 12.78 Ω m and 4.47 Ω m resistivities up to 1.79m depth. **Next layer is with 29.69 Ω m resistivity and 2.53m thickness. This zone may be tested for gravel occurrence by seismic survey.** Followed by this stratum a conductive layer with 7.37 Ω m resistivity and 1.65m thickness is observed. Resistivity increased on next layer to 13.77 Ω m. Beneath this a conductive 5.27 Ω m layer of 22.82m thickness is interpreted. A moderately resistive layer with 17.59 Ω m resistivity continues after 43.37m depth which may indicate weathered Khondalite.

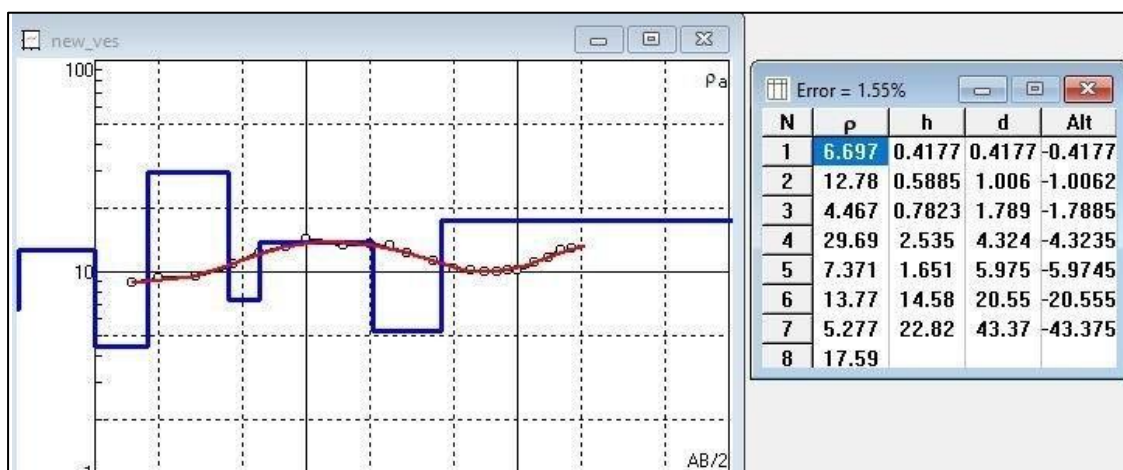


Figure 9.1.6.2.59: Graphical representation of VES 58

VES 59

Resistivity sounding conducted in Ippattam area towards E-W orientation on a traverse with AB/2 as 160m at latitude 16°26'23.07"N and longitude 80°37'7.38"E. The apparent resistivity double log graph indicates a six-layer AKH-type curve which starts with 1.55 m thick topsoil layer having 4.62 Ω m resistivity which is followed by 1.37m thick resistive layer of 52.25 Ω m resistivity. A sharp decrease in resistivity to 8.76 Ω ·m. can be observed in the next layer with 4.27m thickness. Beneath this stratum resistivity has sharply increased to 42.96 Ω m representing a highly resistive layer of 10.37m thickness **which can be investigated by seismic survey for gravel zone.** It is underlain by a conductive layer with 3.96 Ω ·m. resistivity and 60.92m thickness. Resistive layer with 70.41 Ω m resistivity persisted below 78.48m depth which may indicate a weathered Khondalite basement.

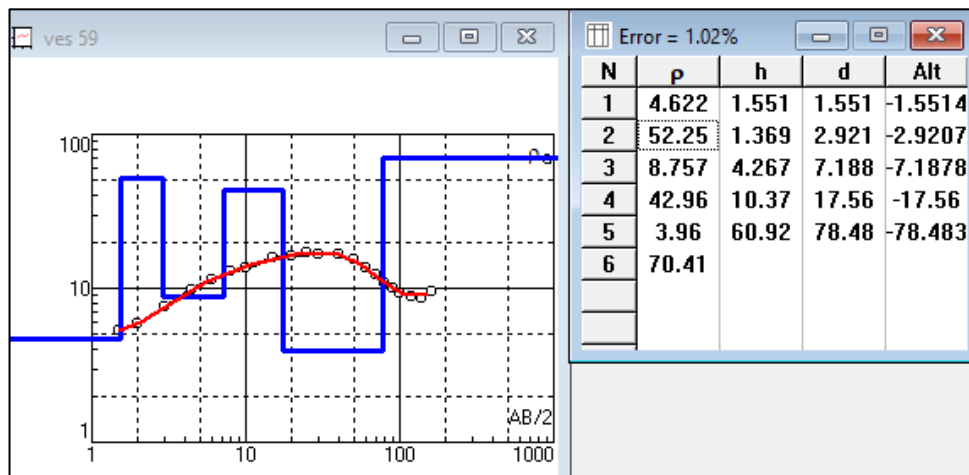


Figure 9.1.6.2.60: Graphical representation of VES 59

VES 60

Resistivity sounding conducted in Pedavadlapudi area on a traverse with AB/2 as 290m along E-W orientation at latitude 16°24'25.34"N and longitude 80°35'30.30"E. The apparent resistivity double log graph indicates a seven-layer A -type curve. Subsurface lithology starts with topsoil layer of 1.16m thickness and 1.25 Ωm resistivity. Underlying layer is conductive with 1.3 Ωm resistivity and 4.77m thickness. In next layer, resistivity increased to 3.15 Ωm with 17.73m thickness followed by 18.7m thick stratum of 9.51 Ωm resistivity. Down to this layer resistivity has gradually increased. In the next layer resistivity has decreased to 2.29 Ωm with 20.96m thickness followed by a thick resistive layer having 114.8m thickness and 33.3 Ωm resistivity. **The variations of resistivity in 4th and 6th layers need to be tested by seismic survey for gravel deposits.** Resistivity has again decreased to 2.08 Ωm in the next stratum which persists below 178.1m depth.

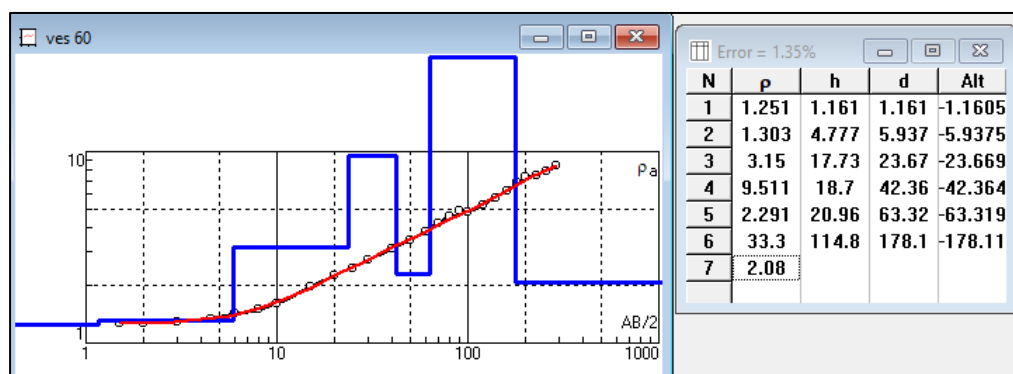


Figure 9.1.6.2.61: Graphical representation of VES 60

VES 61

Resistivity sounding conducted in Pedavadlapudi area towards E-W orientation on a traverse with AB/2 as 350m at latitude 16°24'25.70"N and longitude 80°35'38.37"E. The apparent resistivity double log graph represents a multi-layered subsurface sequence characterized by a complex AKA-type curve. This graph is reflecting a transition from highly conductive shallow sediments to a more resistive deep basement. Uppermost layer with 3.32m thickness typically indicates wet topsoil with 2.78 Ωm resistivity. Second layer is also conductive with 3.98 Ωm resistivity and 5.6m thickness. As we move deeper to third layer a slight rise in resistivity to 8.38 Ωm is observed which may indicate sandy layer with 24.9m thickness. Again, the resistivity has dropped to 3.4 Ωm in the next layer with 32.8m thickness. From layer 5 resistivity has again started increasing and it acts as a massive transition zone having 48m thickness indicating as the materials are becoming more consolidated. There is a sharp increase in resistivity to 92.3 Ωm in the next layer which continues below 215m depth indicating Khondalite basement.

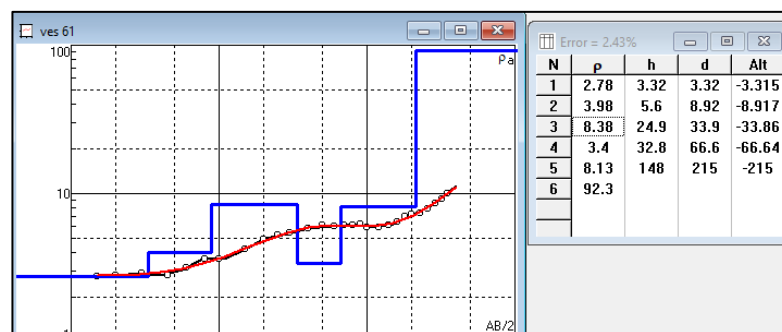


Figure 9.1.6.2.62: Graphical representation of VES 61

VES 62

Resistivity sounding conducted in Pedavadlapudi area towards E-W orientation on a traverse with AB/2 as 160m at latitude 16°24'58.61"N and longitude 80°36'17.43"E. The apparent resistivity double log graph represents a strata characterized by a complex AKH-type curve which illustrates high fluctuations in resistivity. The subsurface begins with a conductive topsoil with 3.86 Ωm resistivity extending to 1.89m depth. This layer is immediately underlain by a resistive layer of 28.64 Ωm resistivity having 2.06m thickness which may correspond to sand/gravel zone. Resistivity begins a significant decline through third and fourth layer with 12.11 Ωm and 1.94 Ωm having 13.96m and 62.47m as its thickness. **Second and third layer may correspond to sand/gravel zone which has to be confirmed by seismic survey.** This deep, low resistivity zone indicates a highly conductive medium. Next is also a conductive layer with 8.06 Ωm resistivity which continues below 80.4m depth probably indicating weathered Khondalite basement from the nature of the graph as it shows an upward trend.

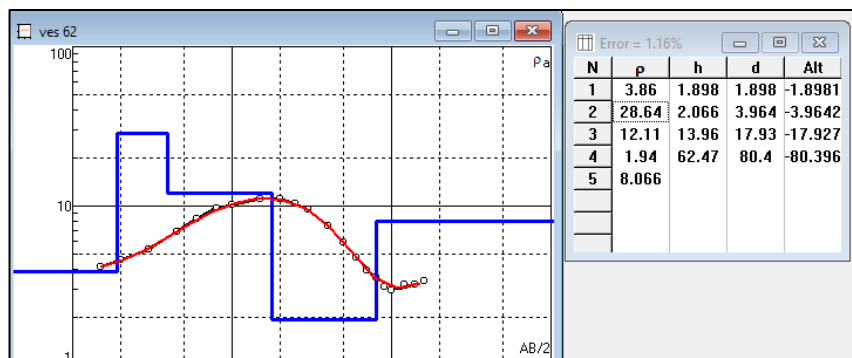


Figure 9.1.6.2.63: Graphical representation of VES 62

VES 63

Resistivity sounding conducted in Pedavadlapudi area towards E-W orientation along a traverse with AB/2 as 250m at latitude 16°24'34.10"N and longitude 80°35'55.96"E. The apparent resistivity double log graph represents a multi-layered subsurface sequence characterized by a complex AKAH-type curve, indicating significant lithological variations with depth. The strata begin with a relatively conductive topsoil of 4.5 Ωm resistivity with 1.68m thickness followed by more resistive, 37.5 Ωm , resistivity layer with 1.26m thickness. Beneath this, resistivity drops to 6.08 Ωm with 9.76m thickness. There after it has sharply increased to 97.8 Ωm in the next layer with 3.47m thickness. Next is a conductive zone with 3.99 Ωm resistivity and 26.1m thickness. Slightly increase in resistivity to 8.06 Ωm can be observed in the 6th layer with 7.49m thickness followed by a resistive stratum with 203 Ωm resistivity and 36.6m thickness. **Second and 4th layers comparatively high resistivity indicate presence of sand/gravel which need to be confirmed through seismic survey.** A very high resistive zone with 2027 $\Omega\cdot\text{m}$. resistivity has persisted below 86.4m depth which may indicate Khondalite basement.

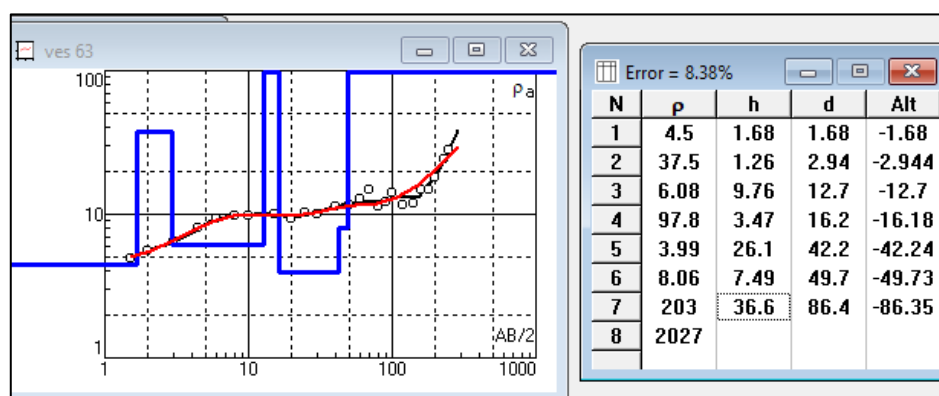


Figure 9.1.6.2.64: Graphical representation of VES 63

VES 64

Resistivity sounding conducted in Nutakki area towards E-W orientation along a traverse with AB/2 as 310m at latitude 16°25'8.53"N and longitude 80°38'48.10"E. The apparent resistivity double log graph consists eight distinct layers, characterized by AKH- type curve. The lithology begins with a conductive top soil of 1.19 Ωm resistivity having 0.5m thickness. Beneath this stratum a sharp peak in resistivity of 358 Ωm with 2.23m thickness is interpreted. This may correspond to a sand/gravel formation. Below this, resistivity drops to 6.54 Ωm - 5.84 Ωm level down to 7.62m depth. **Next is a resistive layer with 21.4 Ωm resistivity and 21.5m thickness which may indicate a sand/ gravel zon. This has to be checked by seismic survey.** A massive 169m thick conductive layer with 2.14 Ωm resistivity lies below this resistive zone marking a change in lithology. Again, a sharp rise resistance can be seen below 199m with 190 Ωm resistivity. This may indicate weathered Khondalite basement.

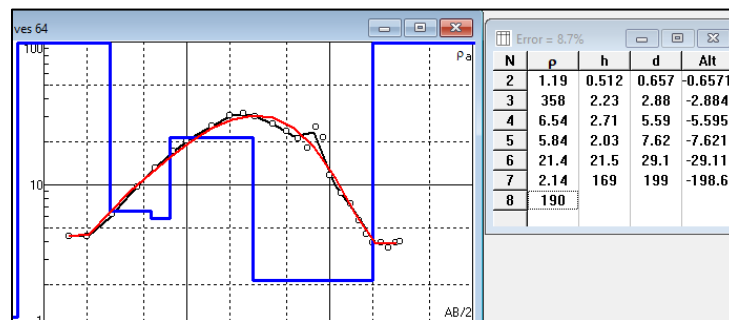


Figure 9.1.6.2.65: Graphical representation of VES 64

VES 65

Resistivity sounding conducted in Nutakki village on a traverse with AB/2 as 200m towards E-W orientation at latitude 16°24'55.06"N and longitude 80°38'34.81"E. The apparent resistivity double log graph indicates 5-layer sequence characterized by AKQ- type curve. The sub surface lithology begins with a relatively conductive topsoil of 5.27 Ωm resistivity having 2.1m thickness which immediately underlain by highly resistive, 2.35m thick, second layer with 312 Ωm resistivity. Below 4.45m, resistivity drops to 2.62 Ωm in 3rd layer representing highly conductive zone. This is followed by moderately resistive zone in layer 4 with 18.6 Ωm resistivity extending to a depth of 52m. **2nd and 4th layers indicate presence of sand or gravel which can be confirmed by seismic survey.** There is a sharp decline in resistance representing highly conductive layer with 0.12 Ωm resistivity which continued below 52m.

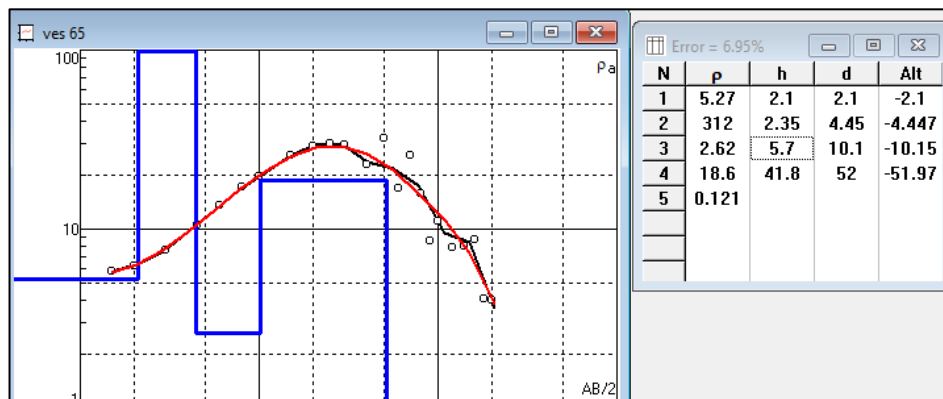


Figure 9.1.6.2.66: Graphical representation of VES 65

VES 66

Resistivity sounding conducted in Ippatam village along a traverse with AB/2 as 70m in E-W orientation at latitude 16°26'20.63"N and longitude 80°36'47.94"E. The apparent resistivity double log graph depicts a multi-layer subsurface sequence characterized by HKH- type curve. The first two layers of the sequence starts with topsoil 34.5 Ωm and 3.34 Ωm down to 0.5m depth. Beneath this strata resistivity rises in 3rd layer up to 11.6 Ωm with 2.24m thickness and in 4th layer with 39.1 Ωm resistivity having 4.21m thickness. A significant shift occurs in layer 5, where resistivity falls to 2.21 $\Omega\cdot\text{m}$. down to a depth of 12.6m. The profile then shows another resistivity increase to 33.4 Ωm in the next layer of 24.7m thickness. **4th and 6th layers may indicate sand/gravel which may be verified by seismic survey.** There after resistivity is plunging to 0.41 Ωm which continued below 37.3m.

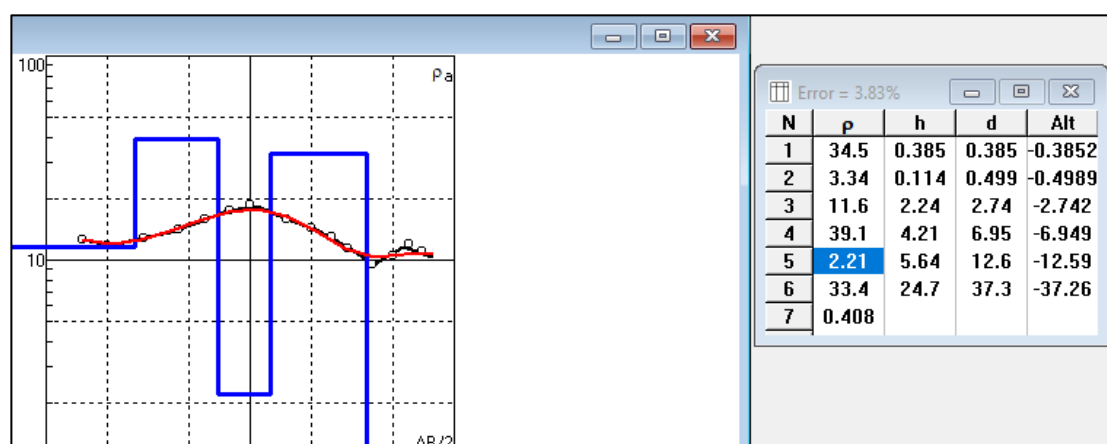


Figure 9.1.6.2.67: Graphical representation of VES 66

VES 67

Resistivity sounding conducted in Ippatam village along N-S orientation on a traverse with AB/2 as 100m at latitude 16°26'23.72"N and longitude 80°36'50.86"E. The apparent resistivity double log graph infers a multi-layer subsurface characterized by QK- type curve which illustrates a descending resistivity trend. The sequence starts with high resistivity topsoil with 95.7 Ωm

resistivity and 1.6m thickness followed by another resistive layer with 25.03 Ωm resistivity and 3.4m depth. The resistivity has again dropped to 15.38 Ωm in subsequent stratum with 2.11m thickness. Fourth layer with 30.65m thickness shows a slight increase in resistivity up to 19.35 Ωm . Next is a conductive layer with 7.4 Ωm resistivity and continues below 37.77m depth.

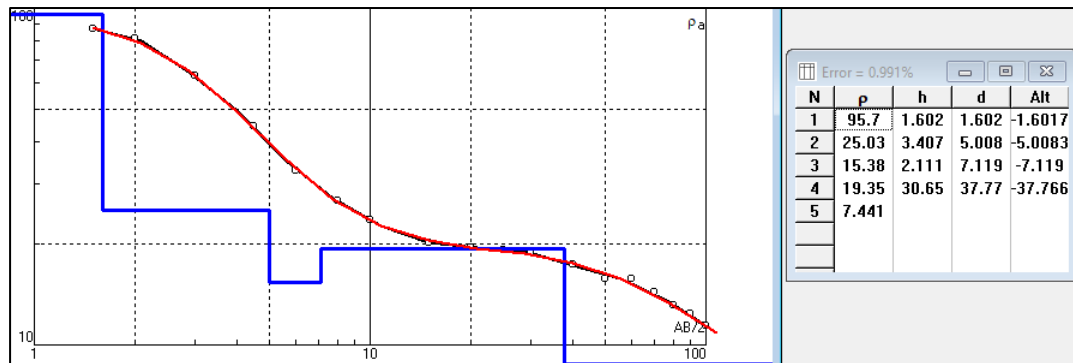


Figure 9.1.6.2.68: Graphical representation of VES 67

VES68

Resistivity sounding conducted towards south of Ippatam village along E-W orientation on a traverse of AB/2 as 135m at latitude 16°26'0.40"N and longitude 80°36'43.84"E. The apparent resistivity double log graph indicates a four-layer QH-type curve. The sub surface lithology starts with a high resistive topsoil having 170 Ωm resistivity and 0.35m thickness overlying on a resistive layer of 31.7 Ωm resistivity with 10.3m thickness. Beneath this lies a thick conductive layer of 5.52 Ωm resistivity and 32m thickness. This stratum is underlain by a layer of resistivity 20.2 Ωm which persists at 42.7m depth.

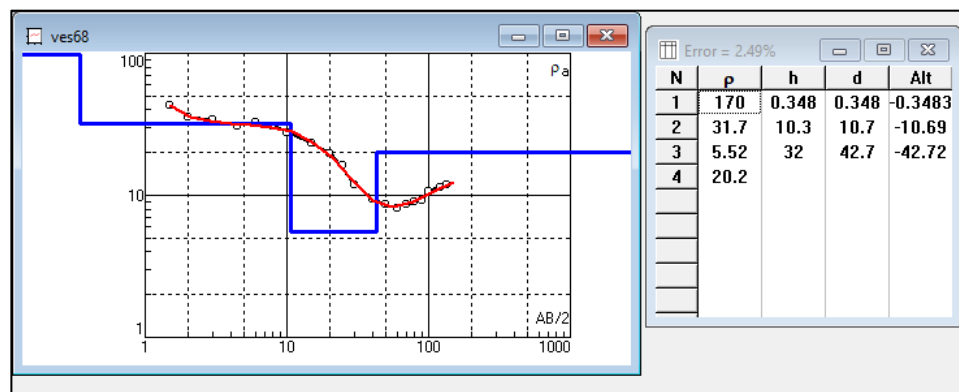


Figure 9.1.6.2.69: Graphical representation of VES 68

VES69

Resistivity sounding conducted in Ippatam village towards N-S orientation on a traverse with AB/2 as 180m at latitude 16°26'28.61"N and longitude 80°38'45.88"E. The apparent resistivity double log graph manifests a multi-layer subsurface sequence characterized by HHK- type curve. Lithology of these subsurface starts with a moderately conductive topsoil of 3.7 Ωm resistivity

with 1.26m thickness that drops to 1.43 Ωm in the very next layer with 1.7m thickness. This is immediately followed by a resistive layer of 12.7 Ωm resistivity with 1.75m thickness. **The possibility of gravel in this moderately resistive zone can be verified by seismic studies.** Below this a conductive layer with 1.76 Ωm resistivity and 2.8m thickness stratum persists which is underlain by a conductive layer of 2.46 Ωm resistivity and 6.56m thickness. **Layer 6 is having 12.5 Ωm resistivity over a massive 71m thick stratum which may corresponds to a sand/ gravel zone.** Next layer is again a conductive layer with 4.75 Ωm resistivity that persists below 85.2m depth.

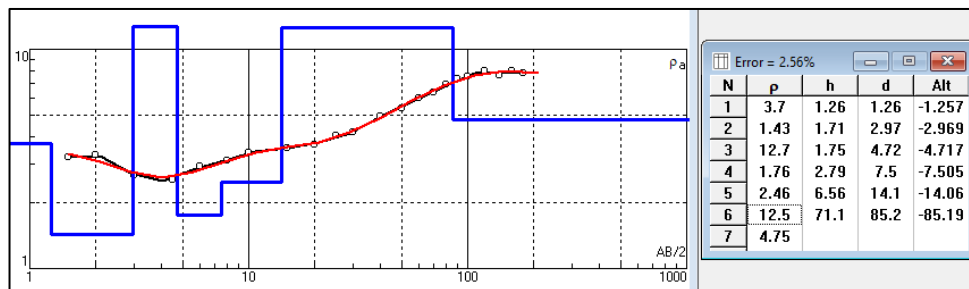


Figure 9.1.6.2.70: Graphical representation of VES 69

VES 70

Resistivity sounding conducted near Gundimeda village along N-S orientation on a traverse with AB/2 as 180m at latitude 16°26'33.20"N and longitude 80°38'0.50"E. The apparent resistivity double log graph is a multi-layered subsurface characterized by AKA- type curve. The lithology begins with a conductive surface layer of 1.61 Ωm resistivity with 1.75m thickness which is immediately followed by a sharp rise in resistivity of 15.2 Ωm having 0.48m thickness. The resistivity drops to 1.01 Ωm in the 1.19m thick 3rd layer. Layer 4 is conductive having 4.43 Ωm resistivity layer and 1.14m thickness. Layer 5 and 6 have thickness 21.1m & 51.9m with 2.82 Ωm and 3.09 Ωm resistivity. There is a sharp rise in resistivity to 19.5 Ωm which continues below 77.6m depth.

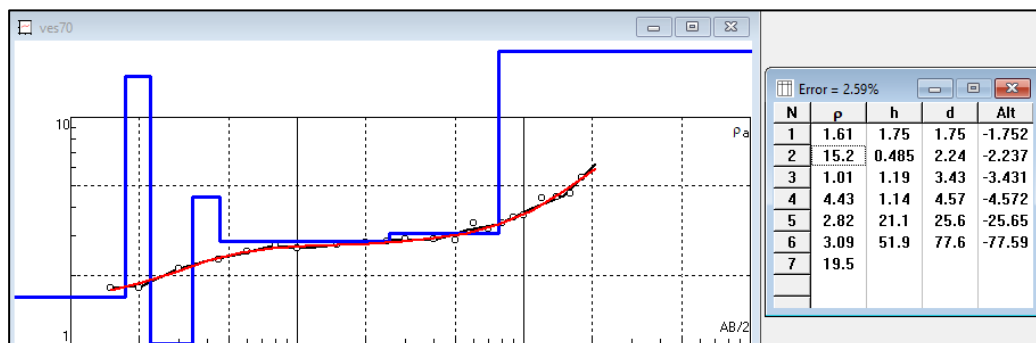


Figure 9.1.6.2.71: Graphical representation of VES 70

VES 71

Resistivity sounding conducted near Gundimeda village along E-W orientation on a traverse with AB/2 as 200m at latitude 16°26'19.18"N and longitude 80°37'56.10"E. The apparent resistivity double log graph shows a multi-layered subsurface characterized by AKH- type curve. The lithology starts with 4.81 Ωm resistivity pertaining to topsoil with 1.81m thickness followed by

a layer of 117 Ωm resistivity having 2.39m thickness which may corresponds to sand/gravel zone. Below 4.2m the resistivity significantly drops to 2.83 Ωm and 3.12 Ωm in two subsequent layers with 12m and 64.3m thickness down wards. **The profile then shows an increase in resistivity of 29.9 Ωm in 5th layer with 44m thickness which may corresponds to a sand or gravel horizon.** Next is a conductive layer with 1.66 Ωm resistivity which persists below 125m depth.

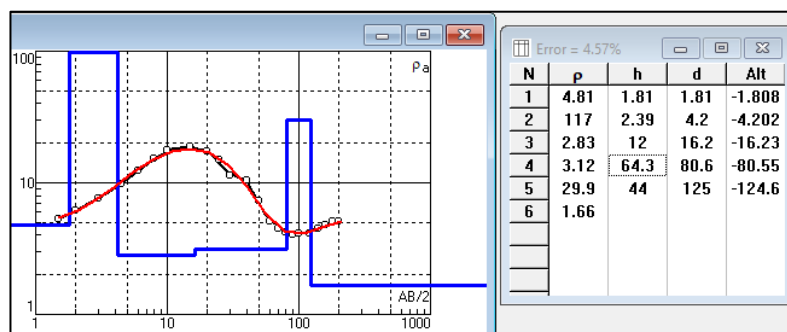


Figure 9.1.6.2.72: Graphical representation of VES 71

VES72

Resistivity sounding conducted in Vaddeswaram village towards N-S orientation on a traverse with AB/2 as 120m at latitude 16°26'45.92"N and longitude 80°37'34.10"E. The apparent resistivity double log graph depicts a multi-layer subsurface lithology characterized by QKH-type curve which illustrates a descending resistivity trend. The subsurface strata begin with a relatively resistive topsoil of 97.9 Ωm resistivity having 0.98m thickness. This is followed by a sharp drop in resistivity to 9.11 Ωm in the next layer with 0.75m thickness and in third layer subsequent rise of 64.3 Ωm resistivity with 1.72m thickness. **This may correspond to a sand or gravel zone which has to be verified with seismic survey.** Below this depth resistivity has decreased in next two layers as 11.6 Ωm and 2.19 Ωm representing conductive layers with 18m and 55.6m thickness. There is a sharp rise in resistivity to 138 Ωm which continues below 77m depth which may correspond to weathered Khondalite basement.

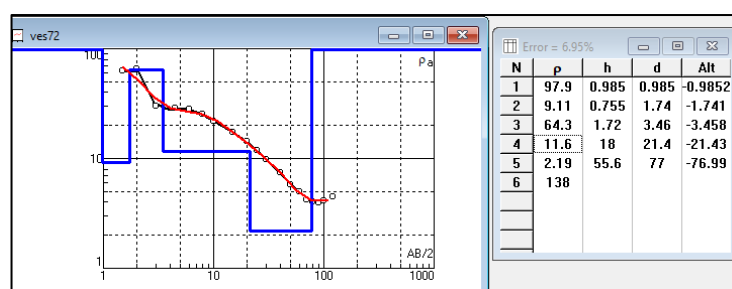


Figure 9.1.6.2.73: Graphical representation of VES 72

VES 73

Resistivity sounding conducted towards north of Ippatam village along E-W orientation on a traverse with AB/2 as 100m at latitude 16°26'29.39"N and longitude 80°37'5.56"E. The apparent resistivity double log graph indicates a four-layer AK-type curve. The sub surface lithology starts

with a conductive topsoil with 7.21 Ωm resistivity and 2.21m thickness overlying a resistive layer of 57.9 Ωm resistivity having 11.2m thickness **which may correspond to a sand or gravel zone**. Beneath this lies a thick conductive layer of 2.92 Ωm resistivity with thickness 34m. Resistive layer of resistivity 282 Ωm persisted below 47.5m depth which may indicate weathered Khondalite.

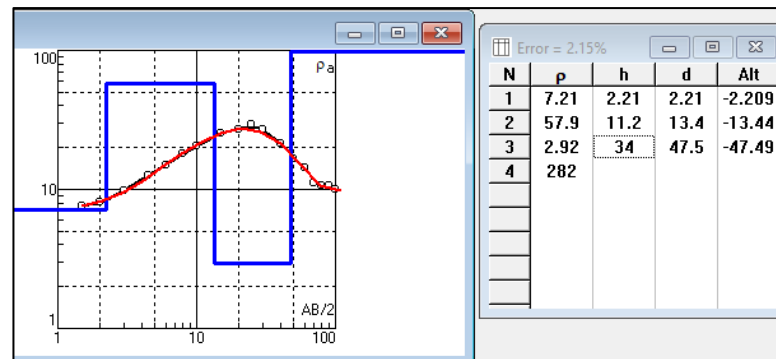


Figure 9.1.6.2.74: Graphical representation of VES 73

VES74

Resistivity sounding conducted towards east of Ippatam area in E-W orientation on a traverse with $AB/2$ as 200m at latitude 16°26'13.89"N and longitude 80°37'11.28"E. The apparent resistivity double log graph indicates multi-layered subsurface characterized by complex AKQ- type curve. The lithology starts with a relatively conductive topsoil of resistivity 3.31 Ωm and 8.28 Ωm up to 1.68m depth. Next stratum is also conductive with 2.67 Ωm resistivity having 1.91m thickness. A sharp increase of resistivity to 159 Ωm is observed in fourth layer with 2.49m thickness. This is followed by a decrease in resistivity to 0.911 Ωm . Beneath this strata resistivity increased to 120 Ωm with 143m thickness. Underlain by this a conductive layer of 0.3 Ωm with 56.8m thickness is interpreted. There is a slight rise in resistivity to 4.83 Ωm which persisted below

86.3m. **4th & 6th layers are having high resistivity which need to be tested for gravels by seismic survey.**

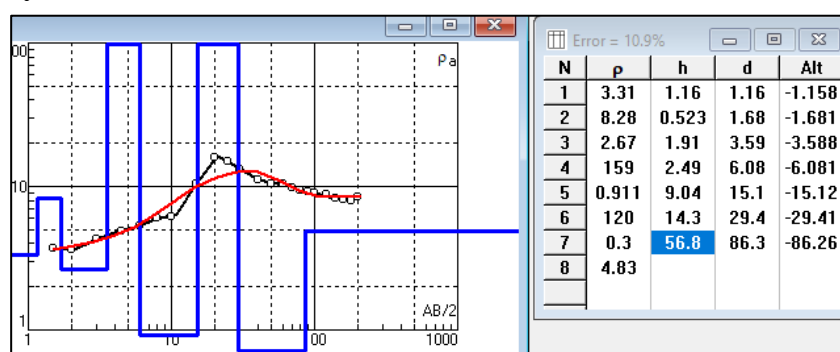


Figure 9.1.6.2.75: Graphical representation of VES 74

VES75

Resistivity sounding conducted near Mellampudi village on a traverse with $AB/2$ as 350m along E-W orientation at latitude 16°25'34.68"N and longitude 80°37'54.84"E. The resistivity double log graph depicts multi-layered subsurface characterized by AKH- type curve. The subsurface

lithology begins with conductive topsoil of $8.08 \Omega\text{m}$ resistivity with 1.19m thickness. **This is underlain by resistive layer of $214 \Omega\text{m}$ resistivity with 3.01m thickness which may corresponds to a sand/ gravel.** There after resistivity has decreased to $12.7 \Omega\text{m}$ with 33.6m thickness which may be a continuation of the above strata. This is followed by $2.28 \Omega\text{m}$ resistivity layer with 86.6m thickness. Next is also a conductive layer with $8.02 \Omega\text{m}$ resistivity which continues below 124m depth. This may indicate weathered Khondalite basement from the nature of the apparent resistivity graph.

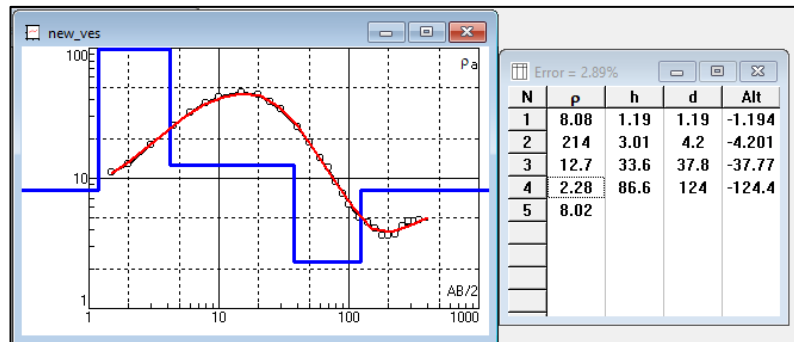


Figure 9.1.6.2.76: Graphical representation of VES 75

VES 76

Resistivity sounding conducted near Mellempudi village towards N-S orientation on a traverse with $AB/2$ 200m at latitude $16^{\circ}25'25.01''\text{N}$ and longitude $80^{\circ}37'52.60''\text{E}$. The apparent resistivity double log graph indicates a four-layer KQ-type curve. The lithology starts with a conductive topsoil having $4.9 \Omega\cdot\text{m}$. resistivity and 1.06m thickness **overlying a highly resistive layer of $109 \Omega\text{m}$ resistivity with 4.75m thickness which may reveal sandy/gravel horizon. This has to be verified by seismic survey.** Beneath this lies a thick conductive layer with $7.78 \Omega\text{m}$ resistivity having thickness 83.9m . Below this a highly conductive layer of resistivity $1.13 \Omega\text{m}$ persisted below 89.7m depth.

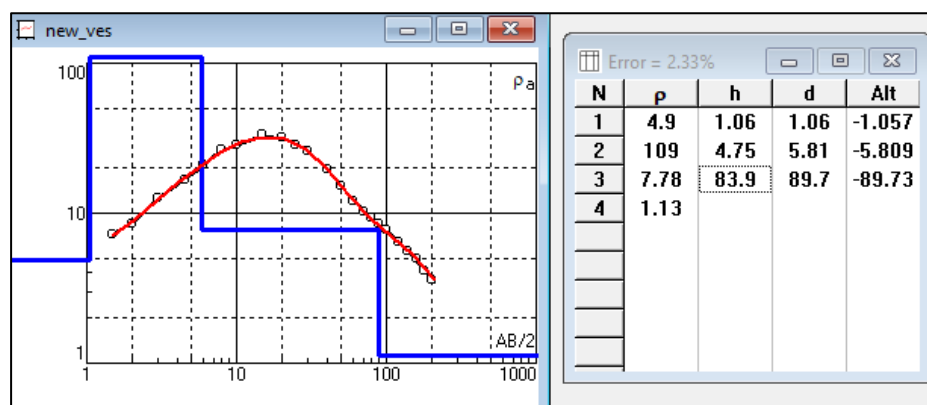


Figure 9.1.6.2.77: Graphical representation of VES 76

VES 77

Resistivity sounding conducted towards east of Ippatam village along a traverse with $AB/2$ as 350m in E-W orientation at latitude $16^{\circ}25'45.51''\text{N}$ and longitude $80^{\circ}37'50.29''\text{E}$. The apparent

resistivity double log graph depicts a multi-layer subsurface characterized by a complex AKQ-type curve. Lithology starts with two relatively conductive topsoil of resistivity 2.79 Ωm and 8.9 Ωm which continues down to 1.06m depth. This is followed by high resistivity in third layer with 99.3 Ωm having thickness 5.01m **which may correspond to a sand or gravel zone and need to be verified by seismic survey.** Beneath this zone, resistivity is fluctuating between conductive and resistive layers with 4.94m and 35.5m thickness having resistivity 1.86 Ωm . Both layers are separated by a moderately resistive 20.9 Ωm resistivity zone with 17.7m thickness. **These strata may correspond to a sand or gravel zone and has to be delineated by seismic studies.** Next layer is a massive moderately conductive 11.2 Ωm layer with 126m thickness. Again, resistivity has dropped significantly in the next layer to 0.13 Ωm suggesting a conductive layer which continues below 190m depth.

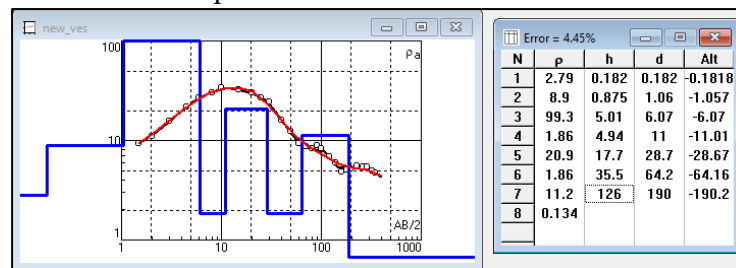


Figure 9.1.6.2.78: Graphical representation of VES 77

VES 78

Resistivity sounding conducted in Nutakki area towards N-S orientation along a traverse with AB/2 as 350m at latitude 16°25'13.21"N and longitude 80°38'4.28"E. The apparent resistivity double log graph shows a multi-layered subsurface characterized by a complex AKH- type curve. First two layers are of conductive in nature with 5.33 Ωm and 5.09 Ωm resistivity up to 1.21m depth. Next layer is resistive layer with 146 Ωm resistivity having 0.16m thickness. **Beneath this, 151 Ωm resistivity and 1.13m thickness stratum may indicate dry sand or gravel. These zones need to be tested by seismic survey.** Resistivity has gradually decreased in the next three layers with 24.4 Ωm , 10.8 Ωm and 0.97 Ωm down to 86.4m depth. Below these strata lies a resistive layer with 87.6 Ωm resistivity which continues up to 182m depth which may indicate the presence of weathered Khondalite basement.

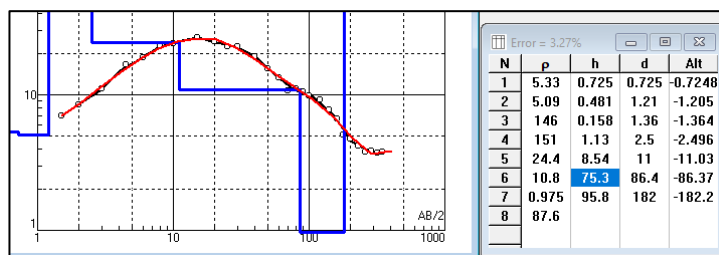


Figure 9.1.6.2.79: Graphical representation of VES 78

Highlights: Out of the 78 Vertical Electrical soundings conducted in the Mangalagiri Block, 69 locations exhibited K-type resistivity curves and were subsequently selected for seismic refraction surveys.

9.1.6.3 SEISMIC REFRACTION SURVEY

Seismic refraction survey was carried out across Mangalagiri block, covering a total area of 25.1 sq. km. Solar seismograph, an inhouse developed seismic refraction instrument, with an adjustable weight drop of 210 kg capacity as signal source is deployed for seismic exploration. Survey was conducted at 51 distinct locations, with approximately 123 shots. The survey focused on areas characterized by high-resistivity zones, which were previously delineated through resistivity profiling and VES. Data interpreted by observing the first arrival timing of P-wave (compressional wave) in millisecond accuracy and is further validated by observing lithology through drilling.

Since the seismic instrument is inhouse developed and is under **Govt. of India Patent claim** some factors is worth explaining while picking the first arrival to avoid confusion in reading the arrival time. In the instrument two operational options exist

1. First option: All the deployed geophone wireless recording sensors can be simultaneously switched on by wireless system, which is automatic and fitted in the machine, just the instant weight drop touches the impact plate to register the start time of signal propagation from the bottom of the plate. In this case the average arrival time for GP1 (2m between the impact plate to Geophone 1 position) in the first geophone is observed as 8 milliseconds (average) in the survey block.

Displayed in Seismogram Figure 9.1.6.3.1

2. Second option: Hand triggering unit attached to the system-This is used when the automatic system failed to work due to temperature shoot up in the survey area. While releasing the weight the hand trigger will be switched on simultaneously just before the weight touches the impact plate. Necessary corrections will be applied in milliseconds on arrival time among all first arrivals in registering the time. In first Geophone data (GP1) it is considered as 8milli seconds (average) for 2m distance from impact plate pertaining to top soil. Eg: Arrival time on GP1-66.962 milliseconds. Correction 58.962milliseconds has to be subtracted from all arrival times pertaining to GP1 to GP 30. In this case $66.92\text{ms} - 58.962\text{ms} = 8\text{ms}$ time for 2m (GP1)

Every seismogram data pertaining to 123 shots is read and shown in excel sheet with seismogram in Annexure 3.

Displayed in Seismogram Figure 9.1.6.3.2 and Annexure 3

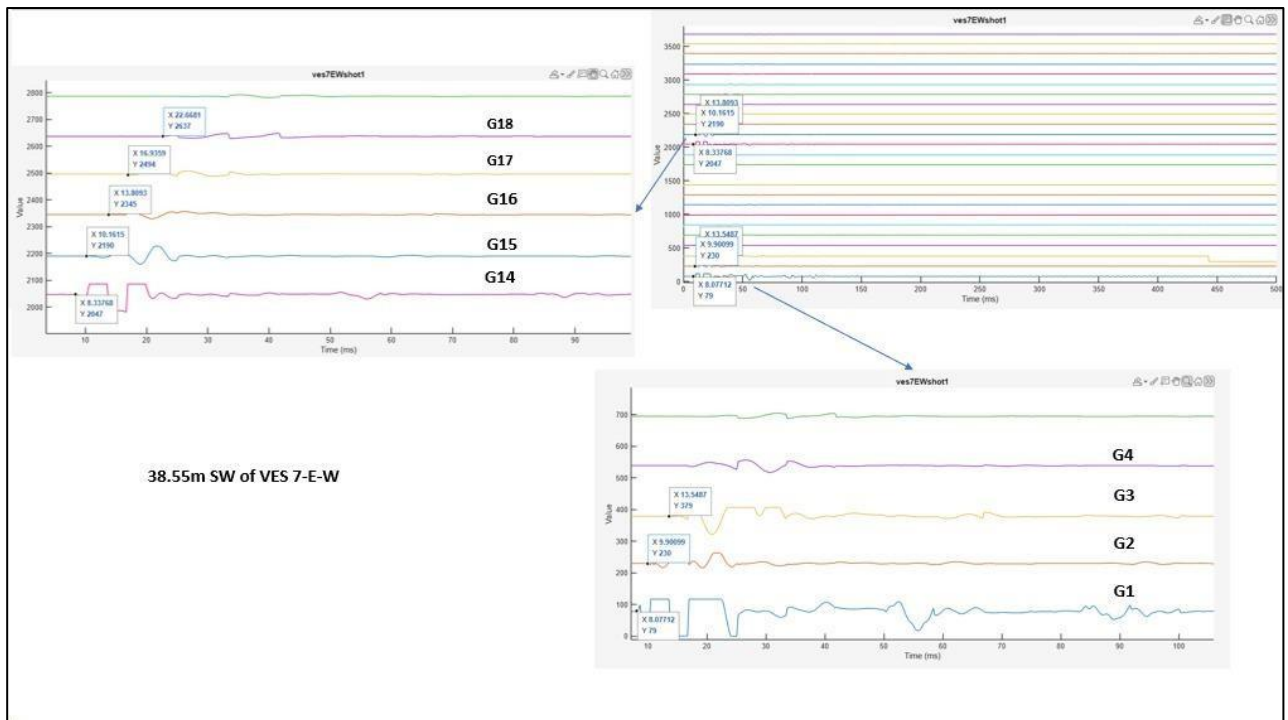


Figure 9.1.6.3.1 Seismogram of shot (split) 38.55m SW of VES 7-E W

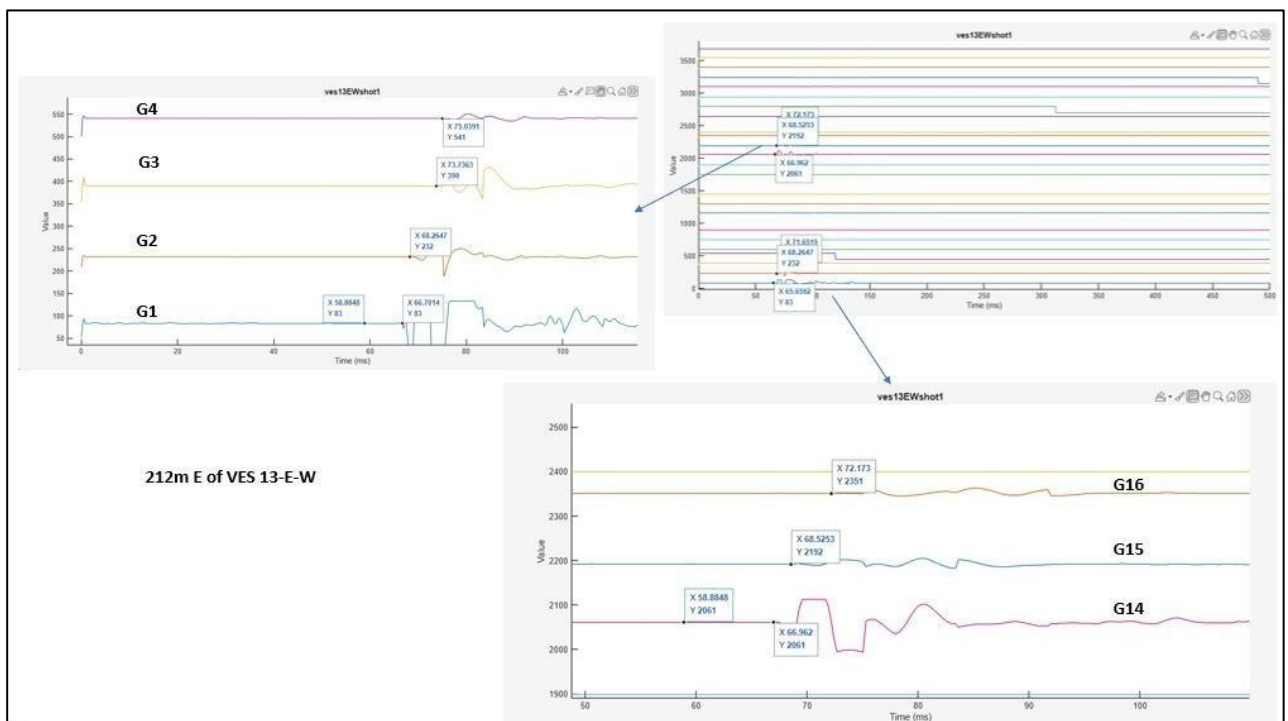


Figure 9.1.6.3.2 Seismogram of shot (split) 212m E of VES 13-E W

212m E of VES 13-E W					
Date:	07-06-2025	16°25'16.76"N	Date:	07-06-2025	16°25'16.76"N
Orientation:	EW	80°38'31.68"E	Orientation:	EW	80°38'31.68"E
GP	Distance (meter)	Pick time (mS)	GP	Distance (meter)	Pick time (mS)
13	55	116.9	14	2	66.9
12	50	115.9	15	5	68.2
10	45	109.9	16	10	74.7
9	40	91.7	17	15	
8	35	86.5	18	20	75.03
7	30		19	25	83.37
6	25		20	30	95.88
5	20		21	35	91.7
4	15	75.03	22	40	97.7
3	10	73.7	23	45	106.3
2	5	68.2	24	50	108.1
1	2	66.7	25	55	113.3

Table 9.1.6.3.1. seismic data sheet for shot 212m E of VES 13-E W.

38.55m SW of VES 7-E W					
Date:	03-06-2025	6°24'49.00"N	Date:	03-06-2025	6°24'49.00"N
Orientation:	EW	80°38'14.00"E	Orientation:	EW	80°38'14.00"E
GP	Distance (meter)	Pick time (mS)	GP	Distance (meter)	Pick time (mS)
13	55	48.9	1	2	8.33
12	50	45.85	14	2	8.33
10	45	45.07	15	5	10.16
9	40	36.7	16	10	13.8
8	35	34.3	17	15	16.67
7	30	30.22	18	20	22.6
6	25	25.2	19	25	25.7
5	20	20.5	20	30	31.5
4	15	16.4	21	35	33.3
3	10	13.5	22	40	38.8
2	5	9.6	23	45	49.5
			24	50	50.02
			25	55	52.1

Table 9.1.6.3.2. seismic data sheet for shot 38.55m SW of VES 7-E W.

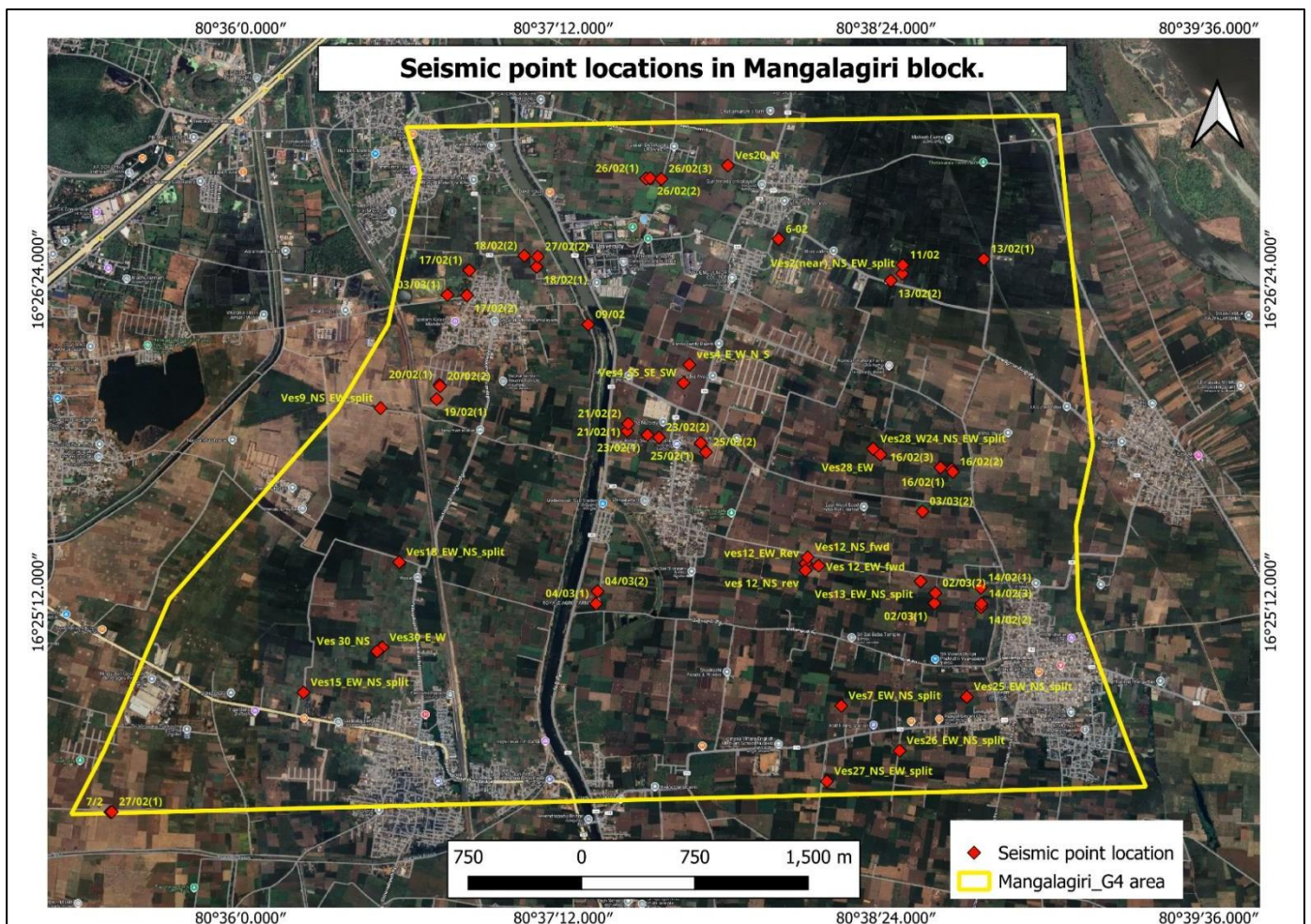


Figure 9.1.6.3.3 Seismic locations (51 nos) in google earth imagery

Seismic survey conducted in three locations towards northwest of survey area at Ippattam village. Based on the proximity of resistivity survey locations and its importance in identifying the occurrence of gravels at depth they are identified as 4m N of VES58 ($16^{\circ}26'26.08''\text{N}$, $80^{\circ}36'51.01''\text{E}$), 76m SE of VES66 ($16^{\circ}26'20.49''\text{N}$, $80^{\circ}36'50.47''\text{E}$), 53m W of VES66 ($16^{\circ}26'20.58''\text{N}$, $80^{\circ}36'46.12''\text{E}$)

- **4m N of VES58** ($16^{\circ}26'26.08''\text{N}$, $80^{\circ}36'51.01''\text{E}$)

Four seismic shots were conducted at this location, which are named as 245m SE of VES 3-N-D2-Shot 1(north direction), 245m SE of VES 3-S-D1-Shot 3(south direction), 245m SE of VES 3-E-D2-Shot 4(east direction) and 245m SE of VES 3-W-D1-Shot 5(west direction). The transect length of geophone array towards north, south, east and west directions are 105 m, 110 m, 80m and 120 m respectively.

- **245m SE of VES 3-N-D2-Shot 1**

Interpreted seismic data towards north with 105m traverse length

Table 9.1.6.3.3. Interpreted seismic data for shot 245 m SE of VES 3-N-D2-Shot 1.

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.243	Soil	333.3
0.24-4.14	3.898	Wet soil	375.0
4.14-15.05	10.917	Wet Alluvium & Sand	1537.3
15.05-29.96	14.907	Compact material-Granite?	5000.0
29.96-47.31	17.354	Wet Alluvium & Sand	1428.6
Below 47.31		Dry Alluvium	499.5

- **245m SE of VES 3-S-D1-Shot 3**

Interpreted seismic data towards south with 110m traverse length

Table 9.1.6.3.4. Interpreted seismic data for shot 245m SE of VES 3-S-D1-Shot 3.

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.427	Soil	333.3
0.42-2.07	1.651	Soil	230.7
2.07-5.89	3.821	Dry Alluvium & sand	587.9
5.89-9.33	3.438	Wet Alluvium & Sand	1000.0
Below 9.33		Dry Alluvium & sand	788.6

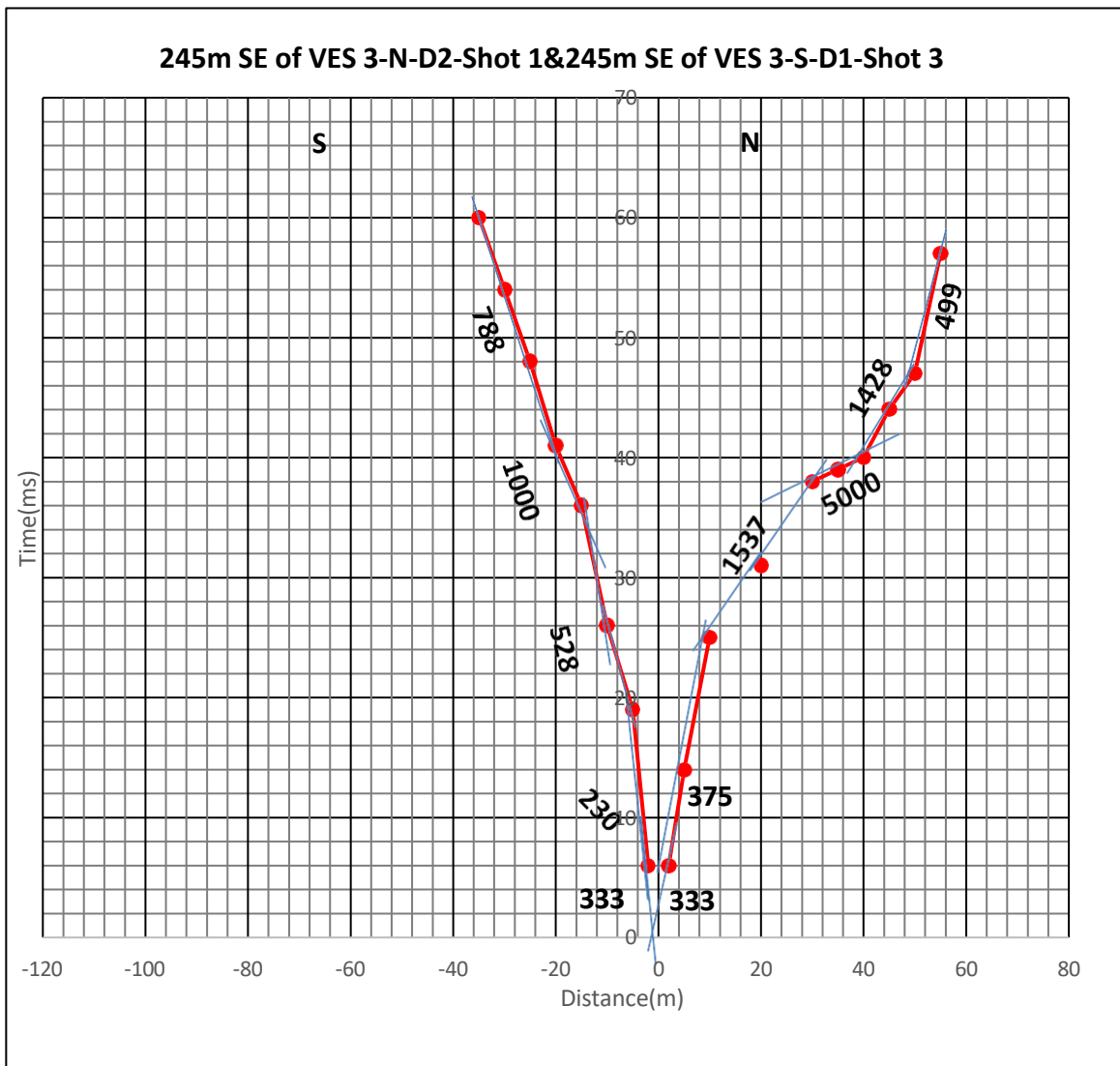


Figure 9.1.6.3.4 seismic hodograph of two shots 245m SE of VES 3-N-D2-Shot 1 and 245m SE of VES 3-S-D1-Shot 3

- **245m SE of VES 3-E-D2-Shot 4**

Interpreted seismic data towards east with 80m traverse length

Table 9.1.6.3.5. Interpreted seismic data for shot 245m SE of VES 3-E-D2-Shot 4.

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.241	Soil	333.33
0.24-1.49	1.251	Soil	374.53
1.49-5.83	4.332	Dry Alluvium and sand	624.61
5.83-14.92	9.097	Wet Alluvium & Sand	1250.00
Below 14.92		Dry Alluvium	384.32

Gravel not present. P-wave is indicated from 0–30 m geophone array and in rest of them, 35–45 m, surface waves recorded.

- **245m SE of VES 3-W-D1-Shot 5**

Interpreted seismic data towards west with 120m traverse length

Table 9.1.6.3.6. Interpreted seismic data for shot 245m SE of VES 3-W-D1-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.01	0.014	Soil	333.3
0.01-4.69	4.680	Soil	333.2
4.69-12.46	7.767	Lateritic soil	5050.5
12.46-21.3	8.839	Wet Alluvium & sand	1250.0
21.30-32.9	11.619	Dry alluvium	416.7
Below 32.9	Wet	Wet Clay& Sand	1666.7

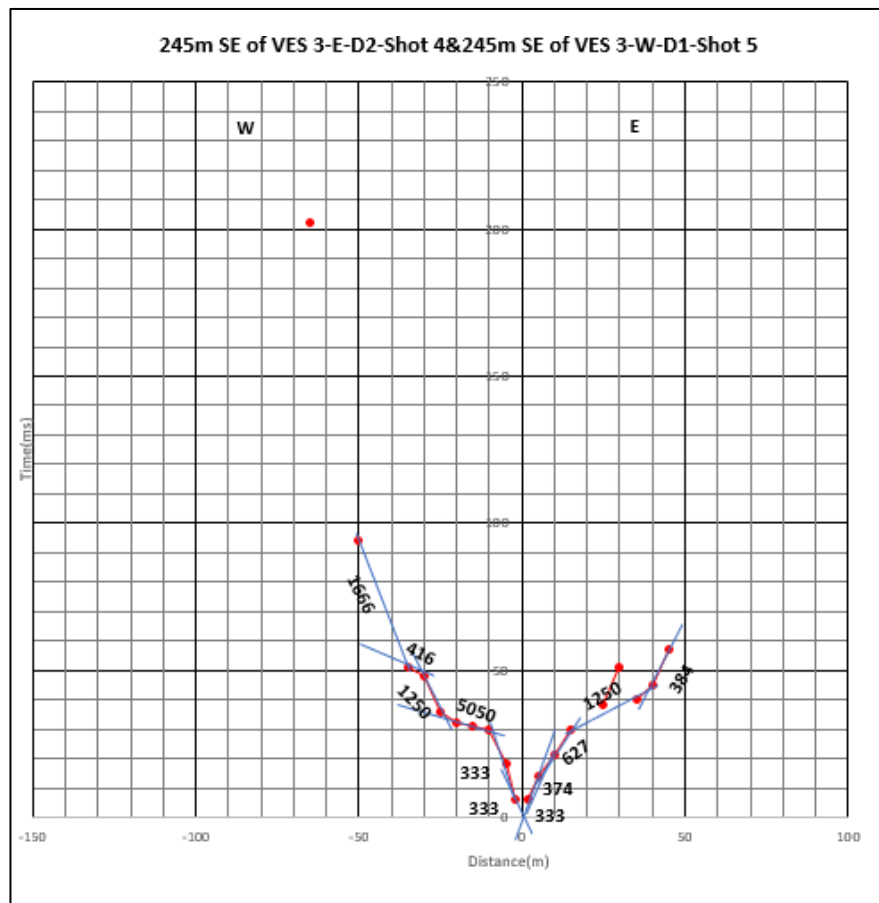


Figure 9.1.6.3.5 seismic hodograph of two shots 245m SE of VES 3-E-D2-Shot 4 and 245m SE of VES 3-W-D1-Shot 5

- **53m W of VES 66-E-D2 (16°26'20.58"N, 80°36'46.12"E)**

Seismic survey was conducted 53m W of VES 66-E-D2-Shot 2 towards northwest of Ippattam village at coordinates 16°26'20.58"N, 80°36'46.12"E. This was directed towards east with 95 m traverse length.

Interpreted seismic data table

Table 9.1.6.3.7. Interpreted seismic data for shot 53m W of VES 66-E-D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.64	0.646	Soil	333.333
0.64-4.09	3.447	Dry Alluvium&sand	811.993
4.09-14.18	10.095	Wet Alluvium &sand	1246.88
14.18-22.73	8.547	Dry Alluvium	624.22
22.73-42.31	19.580	Gravel/dry sand	834.725
Below 42.31		Dry Alluvium	200

A gravel bed /dry sand is present at 22.73m

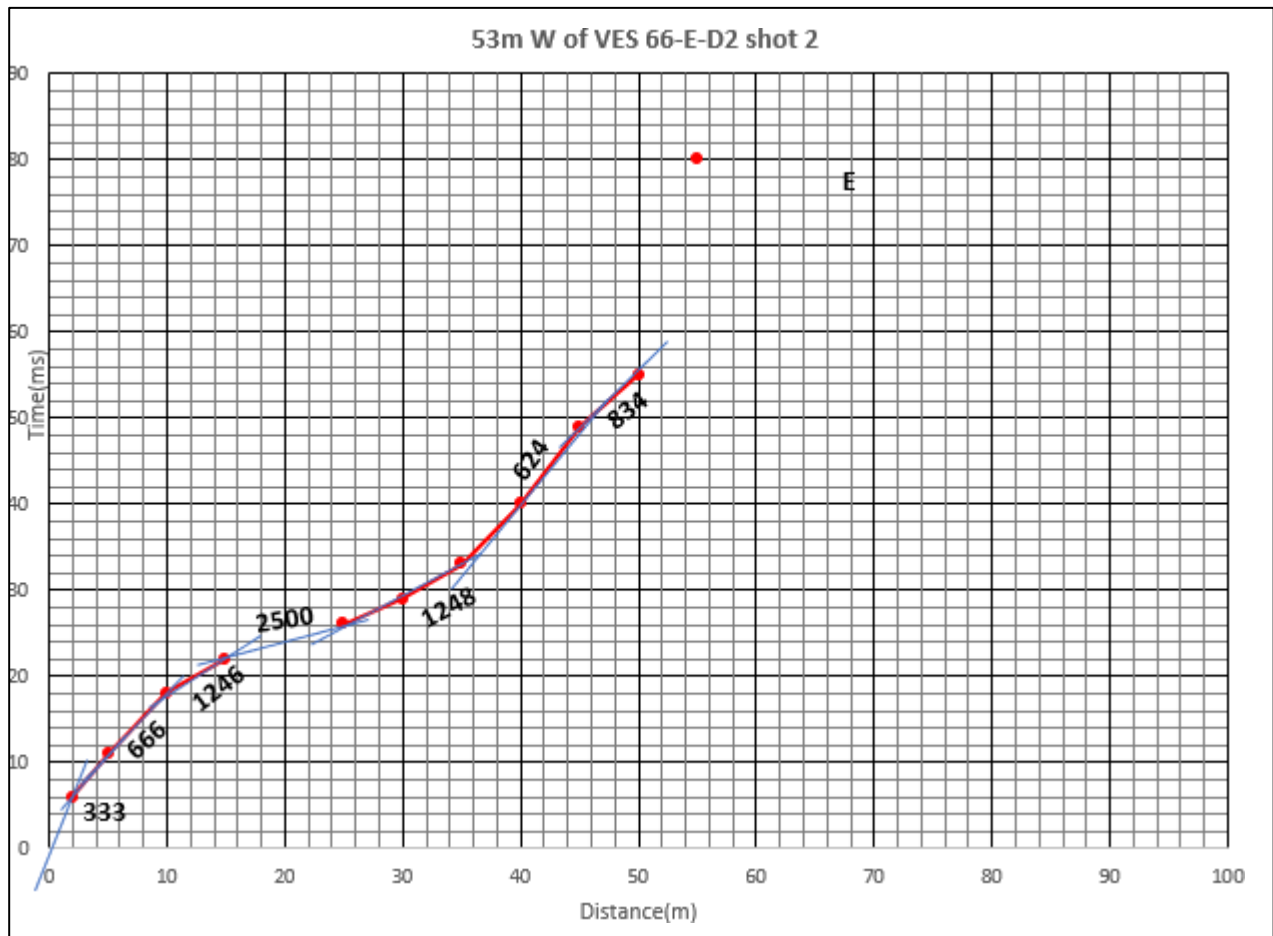


Figure 9.1.6.3.6 seismic hodograph of seismic shot 53m W of VES 66-E-D2 shot 2

- **76m SE of VES 66 (16°26'20.49"N, 80°36'50.47"E)**

Seismic survey conducted at two locations viz; 400m SE of VES 3-N-D2-Shot 6 towards north direction and 400m SE of VES 3-W-D1-Shot 7 towards west direction. These are west of Ippattam village

- **400m SE of VES 3-N-D2-Shot 6**

Interpreted seismic data towards north with 121 m traverse length

Table 9.1.6.3.8. Interpreted seismic data for shot 400m SE of VES 3-N-D2-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.63	0.632	Soil	333.3
0.63-5.45	4.826	Dry Alluvium & sand	777.3
5.45-5.70	0.247	Clay	1666.7
5.70-17.83	12.133	Clay	1664.8
17.83-31.12	13.285	Dry Alluvium & sand	624.6
31.12-51.75	20.635	Wet Alluvium & sand	1250.0
Below 51.75		Dry alluvium	370.1

Gravel not detected in these 7 layered strata. The P-wave is indicated from 0–50 m geophone array and in rest of them, 55-86 m, length surface waves recorded.

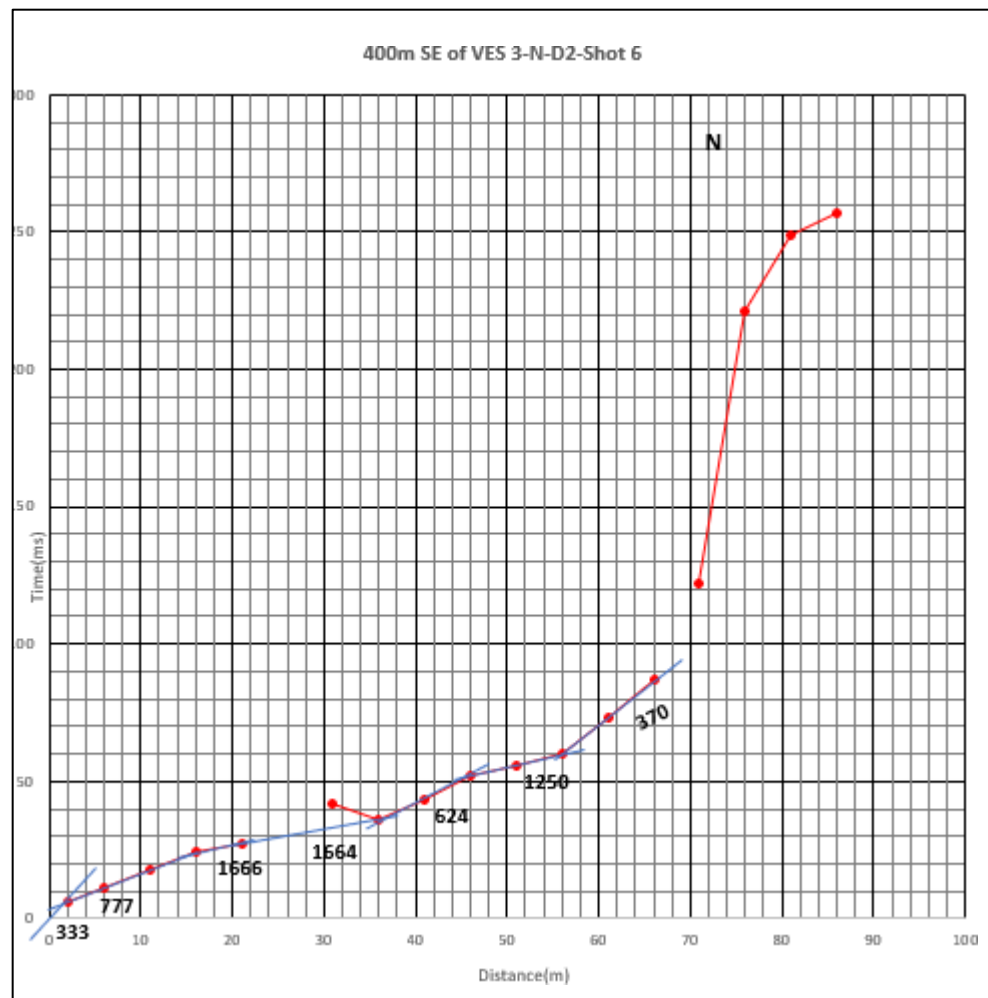


Figure 9.1.6.3.7 seismic hodograph of seismic shot 400m SE of VES 3-N-D2-Shot 6

400m SE of VES 3-W-D1-Shot 7

- Interpreted seismic data towards west with 120 m traverse length

Table 9.1.6.3.9. Interpreted seismic data for shot 400m SE of VES 3-W-D1-Shot 7

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.62	0.620	Soil	333.33
0.62-1.19	0.574	Dry Alluvium& sand	750
1.19-4.02	2.829	Gravel/dry sand	833
4.02-8.73	4.716	Wet Alluvium &sand	1109
8.73-19.34	10.607	Gravel/dry sand	833
Below 19.34		Lateritic soil	2500

Six-layer lithology with coarse sand at 0.62m depth and Gravel detected at 1.19 m depth.

P-wave is indicated from 0–35 m, and in rest of the geophones viz; 40-55 m surface waves recorded.

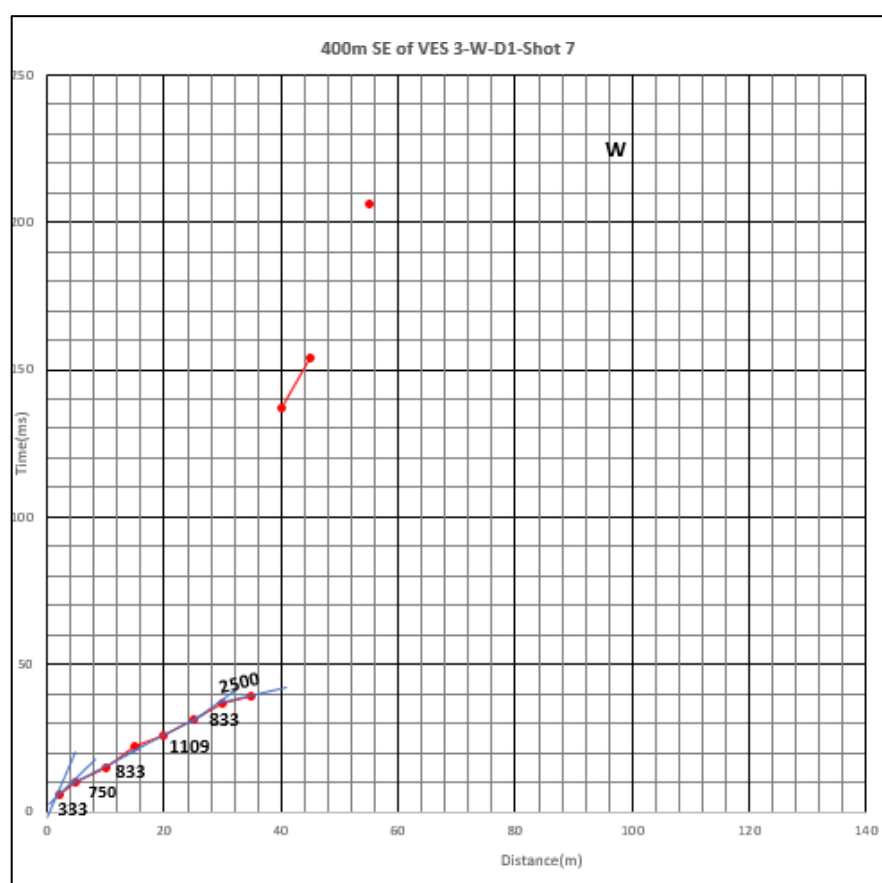


Figure 9.1.6.3.8 seismic hodograph of seismic shot 400m SE of VES 3-W-D1-Shot 7

Seismic survey conducted north east of Ippattam village at three locations which are identified as 3m N of VES 38(16°26'26.86"N, 80°37'6.03"E), 9.5m SW of VES 34(16°26'29.34"N, 80°37'3.29"E) and 23m E of VES 73(16°26'29.17"N, 80°37'6.30"E)

- **3m N of VES 38** (16°26'26.86"N, 80°37'6.03"E)

Three seismic shots were conducted at this location, named as 5m NW of VES 38-N-D1-Shot

1(north direction), 5m NW of VES 38-S-D2-Shot 2(south direction) and 5m NW of VES 38-E-D1-Shot 3(east direction). The stretch lengths for the north, south and east directions are 85 m, 120 m and 100 m respectively.

- **5m NW of VES 38-N-D1-Shot 1**

Interpreted seismic data towards north with traverse length 85m

Table 9.1.6.3.10. Interpreted seismic data for shot 5m NW of VES 38-N-D1-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.14	0.144	Soil	333.3
0.14-3.99	3.849	Dry Alluvium	319
Below 3.99		Wet Sand	1250

There is no evidence of gravel below in this 3-layer strata. The P-wave is indicated from 0–15 m geophone signals and the remaining 20-40 m represent surface waves.

- **5m NW of VES 38-S-D2-Shot 2**

Interpreted seismic data towards south with 120m traverse length.

Table 9.1.6.3.11. Interpreted seismic data for shot 5m NW of VES 38-S-D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.58	0.58	Soil	500
0.58-3.69	3.11	Dry Alluvium& sand	368
Below 3.69		Gravel/dry sand	833

Gravel or dry sand present below 3.69m. P-wave is indicated from 0 –15 m geophone signals and remaining 20-50 m represent surface waves.

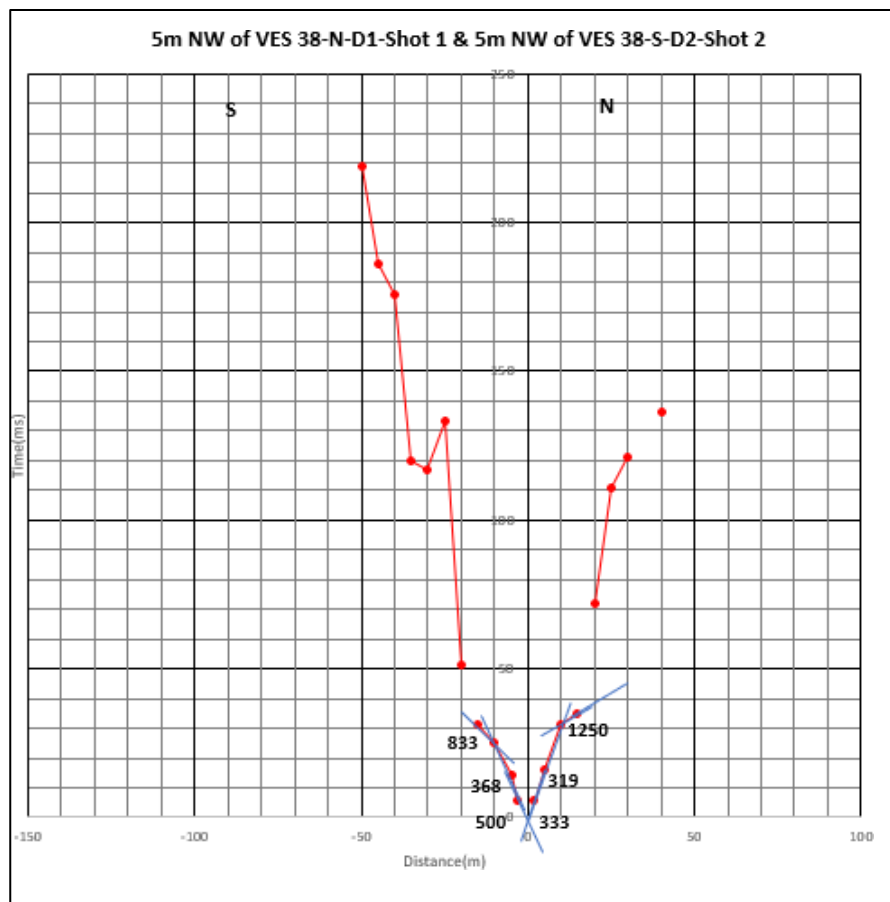


Figure 9.1.6.3.9 seismic hodograph of two 5m NW of VES 38-N-D1-Shot 1 and 5m NW of VES 38-S-D2-Shot 2

- **5m NW of VES 38-E-D1-Shot 3**

Interpreted seismic data towards east with a traverse length of 100m

Table 9.1.6.3.12. Interpreted seismic data for shot 5m NW of VES 38-E-D1-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.76	0.76	Soil	500
0.76-4.35	3.58	Dry Alluvium	291
Below 4.35		Dry Alluvium & sand	908

No gravel present in this 3-layer strata. P-wave is indicated from 0–20 m and in rest, 25-55 m, shows presence of surface waves.

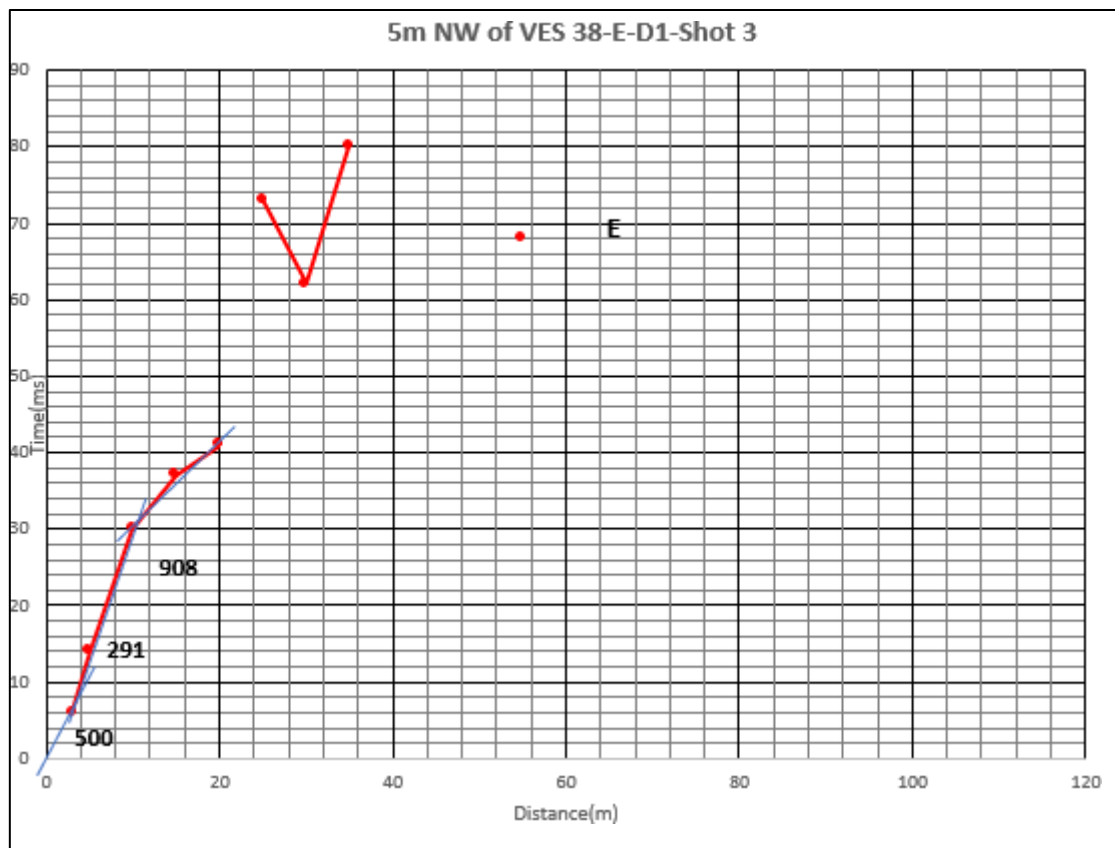


Figure 9.1.6.3.10 seismic hodograph of seismic shot 5m NW of VES 38-E-D1-Shot 3

- **9.5m SW of VES 34 (16°26'29.34"N, 80°37'3.29"E)**

Two seismic shots were conducted at this location, designated as 10m NE of VES 34-S-D1-Shot 4 towards south direction and 10m NE of VES 34-E-D2-Shot 5 along east direction. The traverse length towards south and east directions are 105 m and 138 m respectively.

- **10m NE of VES 34-S-D1-Shot 4**

Interpreted seismic data towards south with traverse length 105m

Table 9.1.6.3.13. Interpreted seismic data for shot 10m NE of VES 34-S-D1-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.37	0.378	Soil	333
0.37-1.72	1.346	Clay	250
1.72-4.82	3.117	Dry Alluvium	454
4.82-9.51	4.676	Dry sand	199
Below 9.51		Dry Alluvium	454

No indication of Gravels in the 5-layer sub surface. P-wave is indicated from 0–20 m geophone signals and from 25- 35 m presence of surface waves inferred.

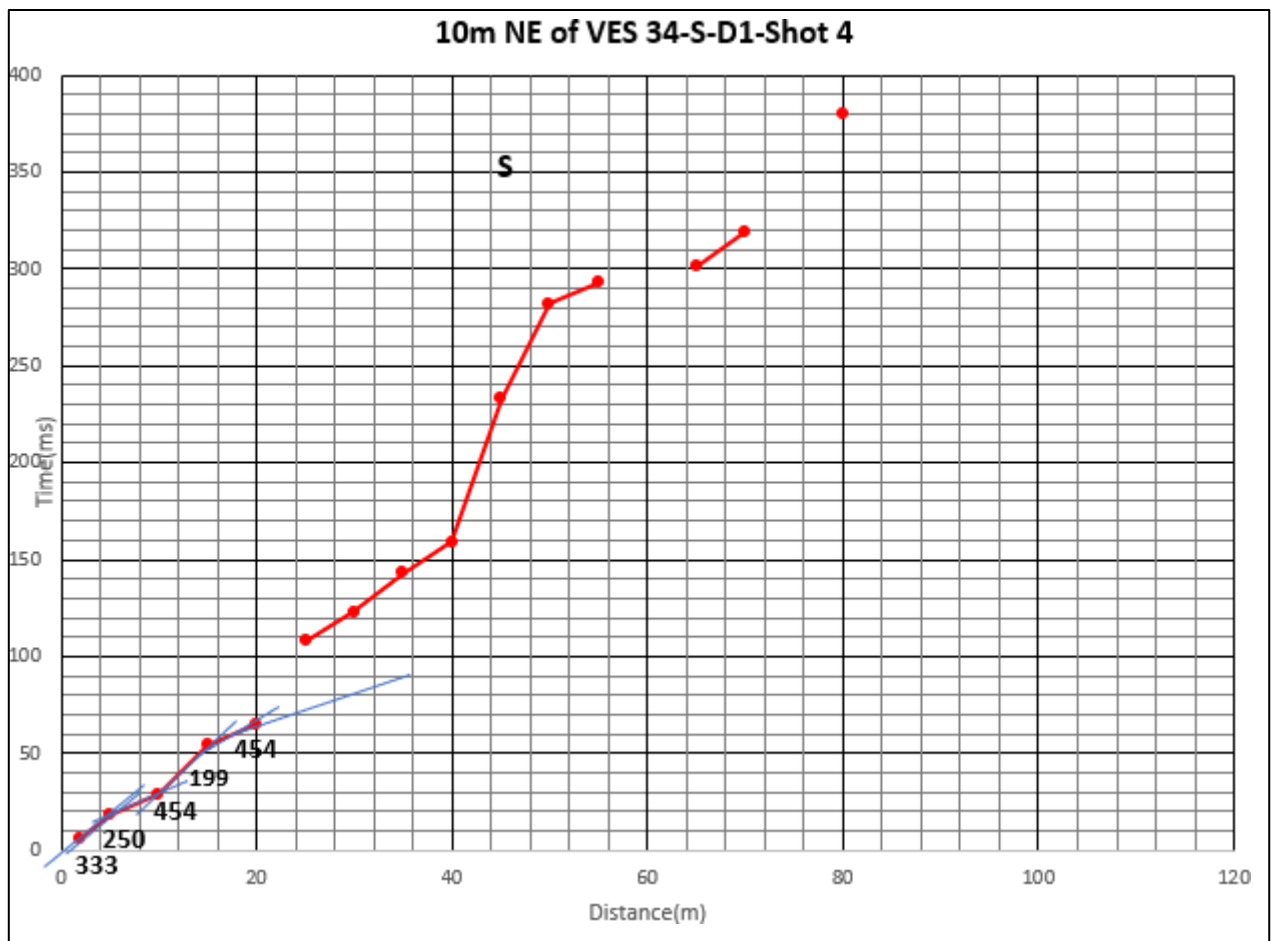


Figure 9.1.6.3.11 seismic hodograph of seismic shot 10m NE of VES 34-S-D1-Shot 4

- **10m NE of VES 34-E-D2-Shot 5**

Interpreted seismic data towards south with 105m traverse length.

Table 9.1.6.3.14. Interpreted seismic data for shot 10m NE of VES 34-E-D2-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.37	0.379	Soil	333
0.37-1.72	1.348	Dry Alluvium	249
1.72-4.43	2.710	Dry Alluvium	454
4.43-12.09	7.656	Gravel/Dry sand	832
Below 12.09		Dry Clay	217

A gravel bed is present below 4.43m with 7.6m thickness.

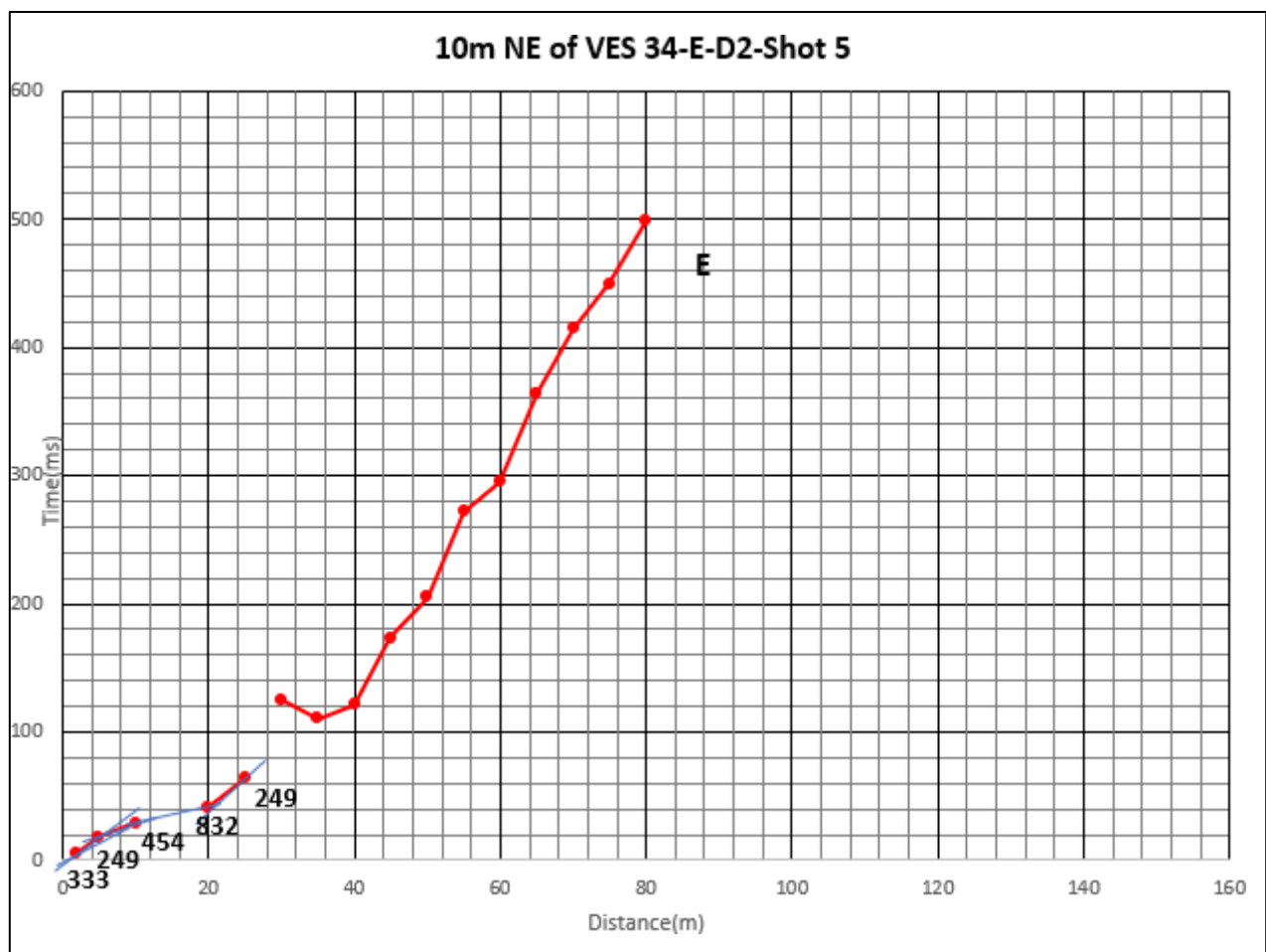


Figure 9.1.6.3.12 seismic hodograph of seismic shot 10m NE of VES 34-E-D2-Shot 5

- **23m E of VES 73 (16°26'29.17"N, 80°37'6.30"E)**

Two seismic shots were conducted at this location, designated as 80m N of VES 38/100m E of VES 34-S- D1-Shot 2(south direction) and 80m N of VES 38/100m E of VES 34-W- D1-Shot 3(west direction). The traverse lengths for the south and west directions are 88.5m and 89 m, respectively.

- **80m N of VES 38/100m E of VES 34-S- D1-Shot 2**

Interpreted seismic data towards south with traverse length 88.5m

Table 9.1.6.3.15. Interpreted seismic data for shot 80m N of VES 38/100m E of VES 34-S- D1-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.75	0.756	Soil	583
0.75-6.50	5.744	Dry Clay	399
Below 6.50		Lateritic soil	2500

No lithological evidence of gravel is observed. P-wave is indicated from 0–18.5 m, and in rest of traverse 23.5-78.5 m indicates surface waves.

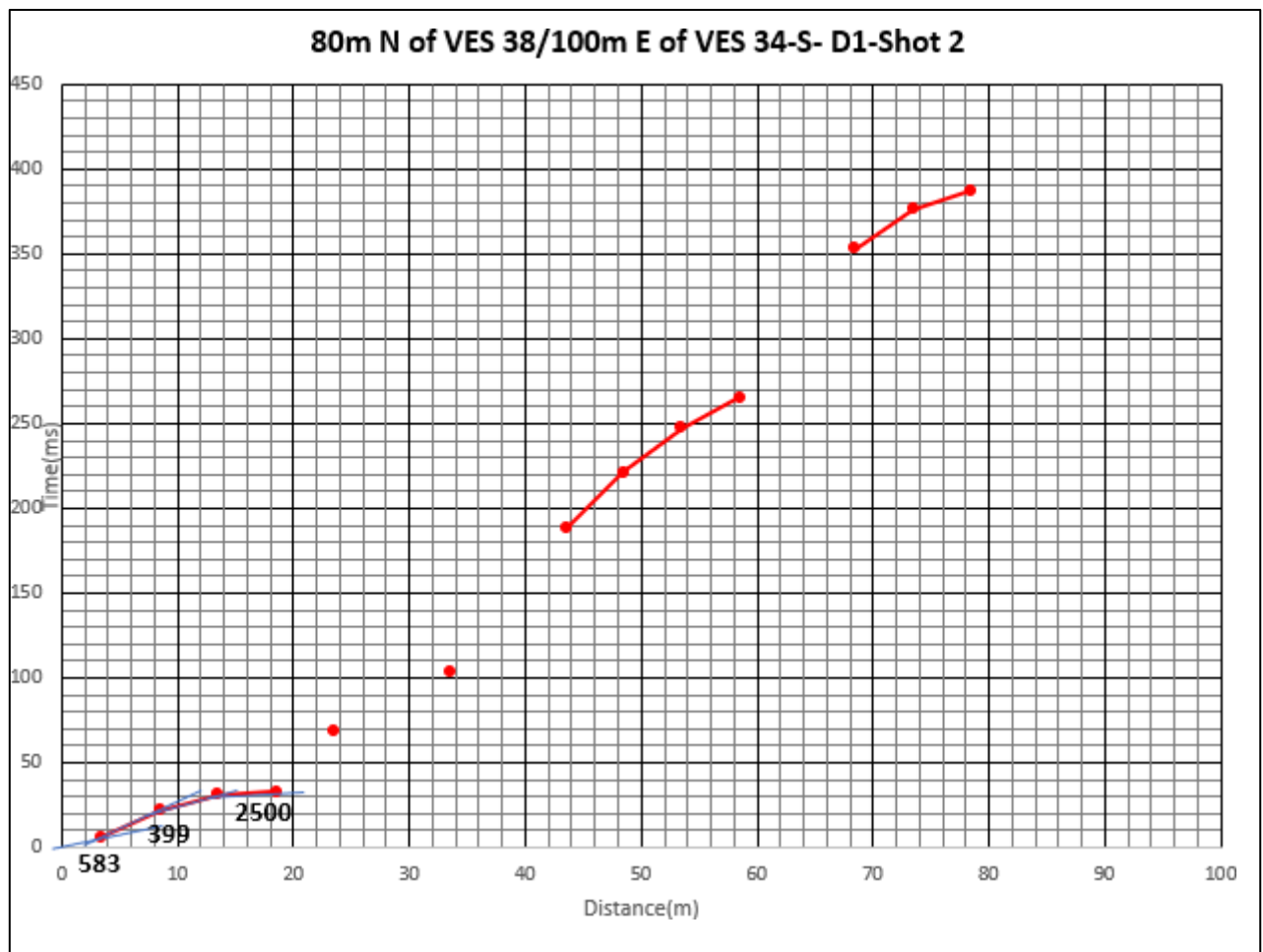


Figure 9.1.6.3.13 seismic hodograph of seismic shot 80m N of VES 38/100m E of VES 34-S-D1-Shot 2

- **80m N of VES 38/100m E of VES 34-W- D1-Shot 3**

Interpreted seismic data with 89m traverse length towards west.

Table 9.1.6.3.16. Interpreted seismic data for shot 80m N of VES 38/100m E of VES 34-W- D1-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.37	0.378	Soil	333
0.37-4.05	4.058	Dry Clay	250
Below 4.05		Lateritic soil	2427

No lithological evidence of gravel was observed in this 3-layer strata. The P-wave is indicated in 0–14 m geophones and up to 54m surface waves were recorded.

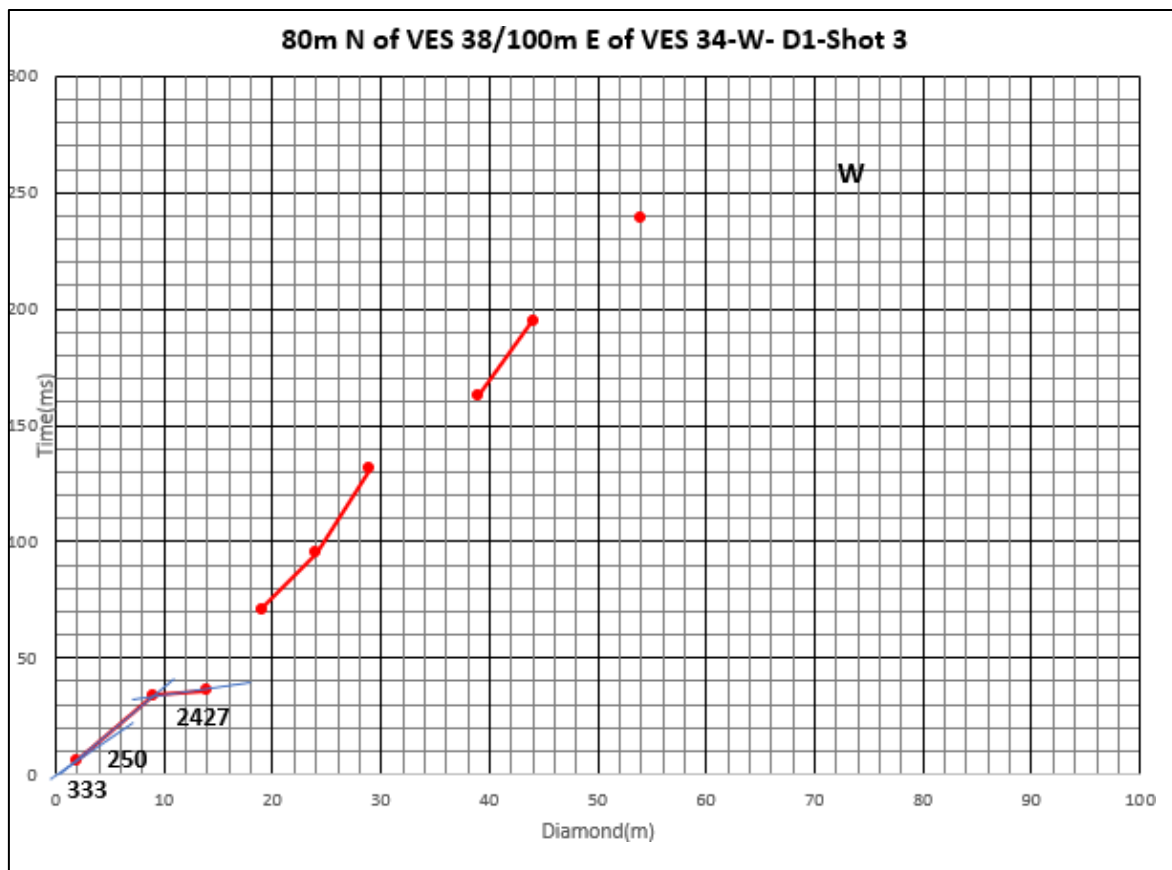


Figure 9.1.6.3.14 seismic hodograph of seismic shot 80m N of VES 38/100m E of VES 34-W-D1-Shot 3

Towards Northern Part of Survey area, at NW of Gudimeda village, Seismic survey conducted at three locations which are represented as 3.5m S of VES 35 (16°26'46.54"N, 80°37'30.43"E), 10m SE of VES36 (16°26'46.64"N, 80°37'31.35"E) and 18m N of VES 72 (16°26'46.45"N, 80°37'33.85"E)

- **3.5m S of VES 35 (16°26'46.54"N, 80°37'30.43"E)**

Three seismic shots were conducted at this location, designated as VES35-S-D2-Shot 1 (south direction), VES35-N-D2-Shot 3 (north direction) and VES35-W-D2-Shot 2 (west direction). The traverse length for the south, north and west directions are 100 m, 95 m and 90 m respectively.

- **VES35-N-D2-Shot 1**

Interpreted seismic data towards south with 100m traverse

Table 9.1.6.3.17. Interpreted seismic data for shot VES35-N-D2-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.429	Soil	333
0.42-2.10	1.677	Dry sand	229
2.10-12.50	10.402	Dry Alluvium & sand	605
12.50-28.52	16.020	Lateritic soil	3333
Below 28.52		Dry Alluvium	293

P-wave is recorded from 0–40 m geophones and rest of them from 50-65 m surface waves were registered.

- **VES35-S-D2-Shot 3**

Interpreted seismic data towards north with 95m traverse length.

Table 9.1.6.3.18. Interpreted seismic data for shot VES35-S-D2-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.30	0.307	Soil	333
0.30-3.70	3.399	Dry Clay	275
3.70-11.88	8.184	Dry sand/clay	749
11.88-28.05	16.162	Dry Clay	299
Below 28.05		Wet Sand saturated	1428

P-wave are indicated from 0–50 m Geophones and in 55-95 m surface waves are recorded.

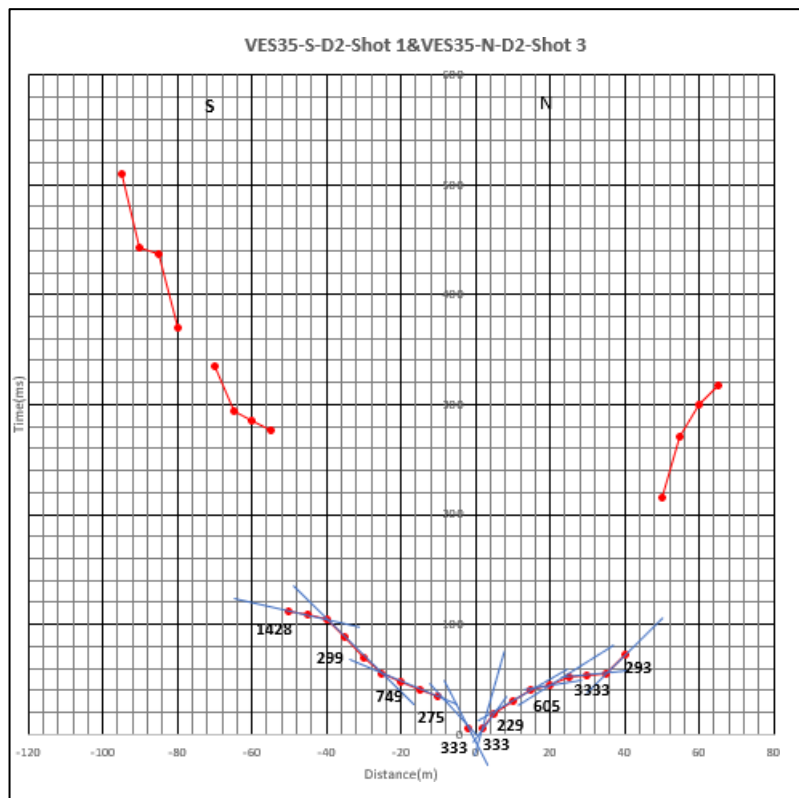


Figure 9.1.6.3.15 seismic hodograph of two shots VES 35-S-D2-Shot 1 and VES 35-N-D2-Shot 3

- **VES35-W-D2-Shot 2**

Interpreted seismic data towards west with 90m traverse length.

Table 9.1.6.3.19. Interpreted seismic data for shot VES35-W-D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.241	Soil	333
0.24-3.21	2.977	Dry Clay	296

3.21-8.59	5.379	Dry Alluvium & Sand	622
Below 8.59		Clay	199

P-wave is indicated from 0–20 m Geophones and from 25-90 m surface wave observed.

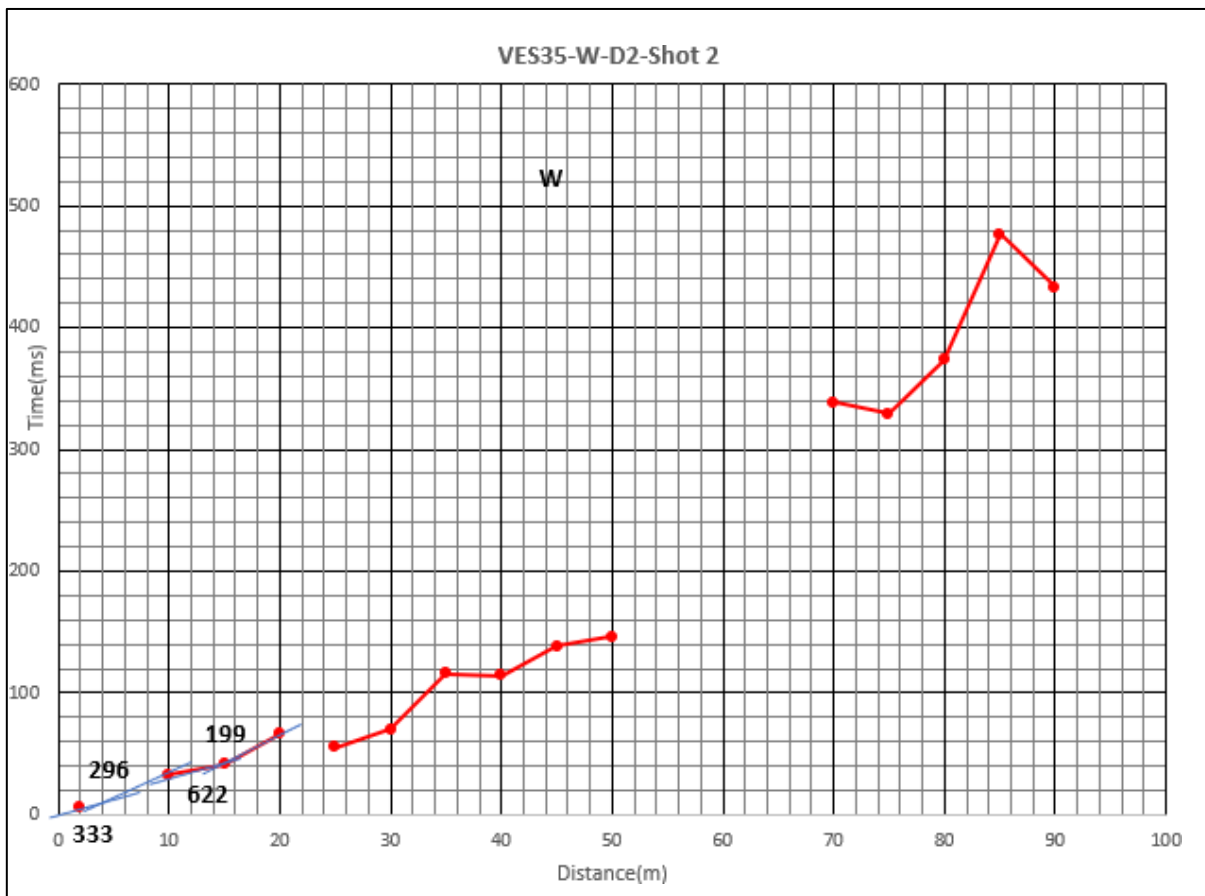


Figure 9.1.6.3.16 seismic hodograph of seismic shot VES 35-W-D2-Shot 2

- **10m SE of VES36 (16°26'46.64"N, 80°37'31.35"E)**

In this location 4 seismic shots were conducted. They are identified as 10m SE of VES36-N-D2-Shot 4, 10m SE of VES36-E-D1-Shot 5, 10m SE of VES36-W-D2-Shot 6 and 10m SE of VES36-S-D1-Shot 7. These shots are towards north, south, east and west directions with traverse length 100m, 55.4m, 75m and 90m

- **10m SE of VES36-N-D2-Shot 4**

Interpreted seismic data towards north with 100m traverse length.

Table 9.1.6.3.20. Interpreted seismic data for shot 10m SE of VES36-N-D2-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.20	0.209	Soil	333.333
0.20-1.20	0.993	Dry Clay	363.636
1.20-6.20	5.000	Dry Alluvium & sand	500
6.20-15.14	8.944	Gravel/dry sand	833.333

15.14-28.13	12.990	Wet Alluvium & Sand	1250
Below 28.13		Clay	625

Gravel bed is present at 6.2m depths below having 8.9m thickness

P-wave is indicated in 0–50 m geophone records and up to 95 m shows surface waves.

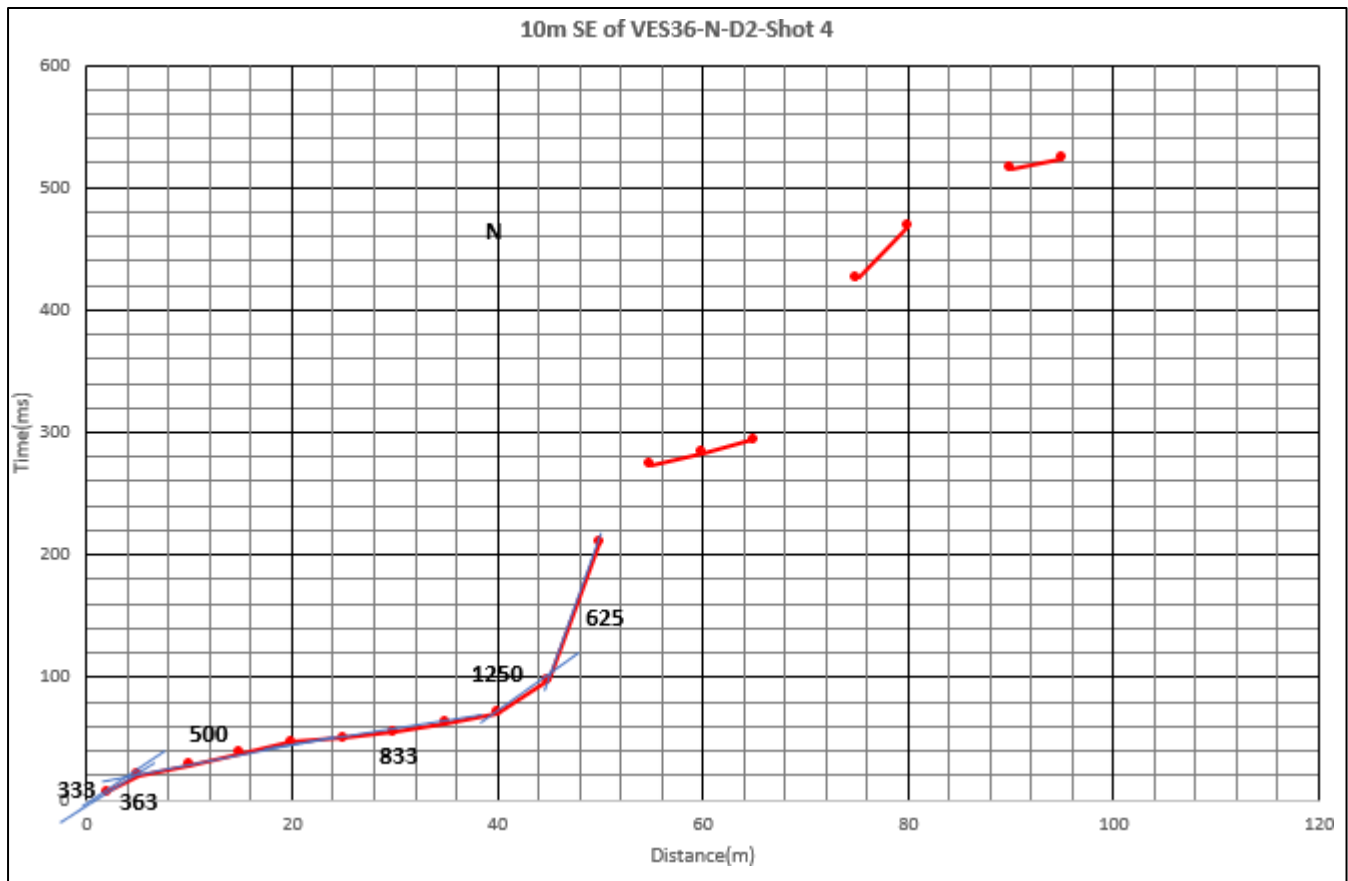


Figure 9.1.6.3.17 seismic hodograph of seismic shot 10m SE of VES 36-N-D2-Shot 4

- **10m SE of VES36-E-D1-Shot 5**

Interpreted seismic data towards east with a traverse length of 75m.

Table 9.1.6.3.21. Interpreted seismic data for shot 10m SE of VES36-E-D1-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.33	0.338	Soil	333.3
0.33-4.27	3.937	Dry Alluvium	419.1
4.27-9.8	5.610	Dry Alluvium	238.0
Below 9.8	9.607	Dry Alluvium & Sand	456.6

Gravel velocity not present in the 4-layer strata. P-wave is indicated in 0–25 m geophone signals and in rest of them 30-75 m surface waves recorded.

10m SE of VES36-W-D2-Shot 6

Interpreted seismic data towards west with a traverse of 90m length.

Table 9.1.6.3.22. Interpreted seismic data for shot 10m SE of VES36-W-D2-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-3.55	0.020	Soil	333.3
3.55-6.67	3.14	Wet Sandy clay	1000.0
6.67-15.94	9.319	Dry Alluvium & sand	713.8
15.94-29.05	13.117	Lateritic soil	2500.0
29.05-42.36	13.306	Dry Clay	333.3
42.36-61.81	19.451	Wet Alluvium & sand	1246.9

No gravel bed is present. P-wave is indicated in 0–40 m geophone signals and in rest of them 45-90 m surface waves recorded.

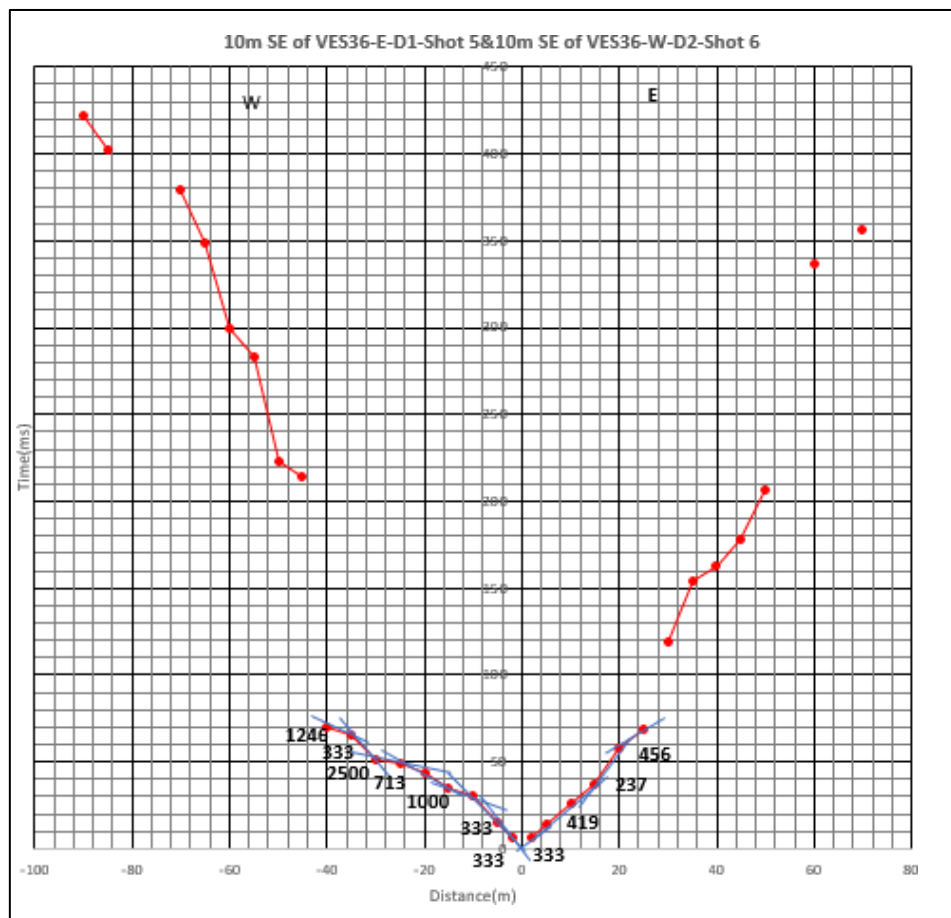


Figure 9.1.6.3.18 seismic hodograph of two shots 10m SE of VES 36-E-D1-Shot 5 and 10m SE of VES 36-W-D2-Shot 6

- **10m SE of VES36-S-D1-Shot 7**

Interpreted seismic data towards south with 55.4m traverse length.

Table 9.1.6.3.23. Interpreted seismic data for shot 10m SE of VES36-S-D1-Shot 7

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.427	Soil	333.3
0.42-1.97	1.552	Soil	230.6
1.97-6.92	4.946	Dry Alluvium & sand	519.7
6.92-13.43	6.512	Wet Alluvium & sand	1250.0
Below 13.43		Dry Alluvium & sand	526.0

Gravels not detected with its characteristic velocity in this 5-layer strata.

P-wave is indicated from 0–30.4 m geophones and in rest of them, 35.4-45.4 m, surface waves recorded.

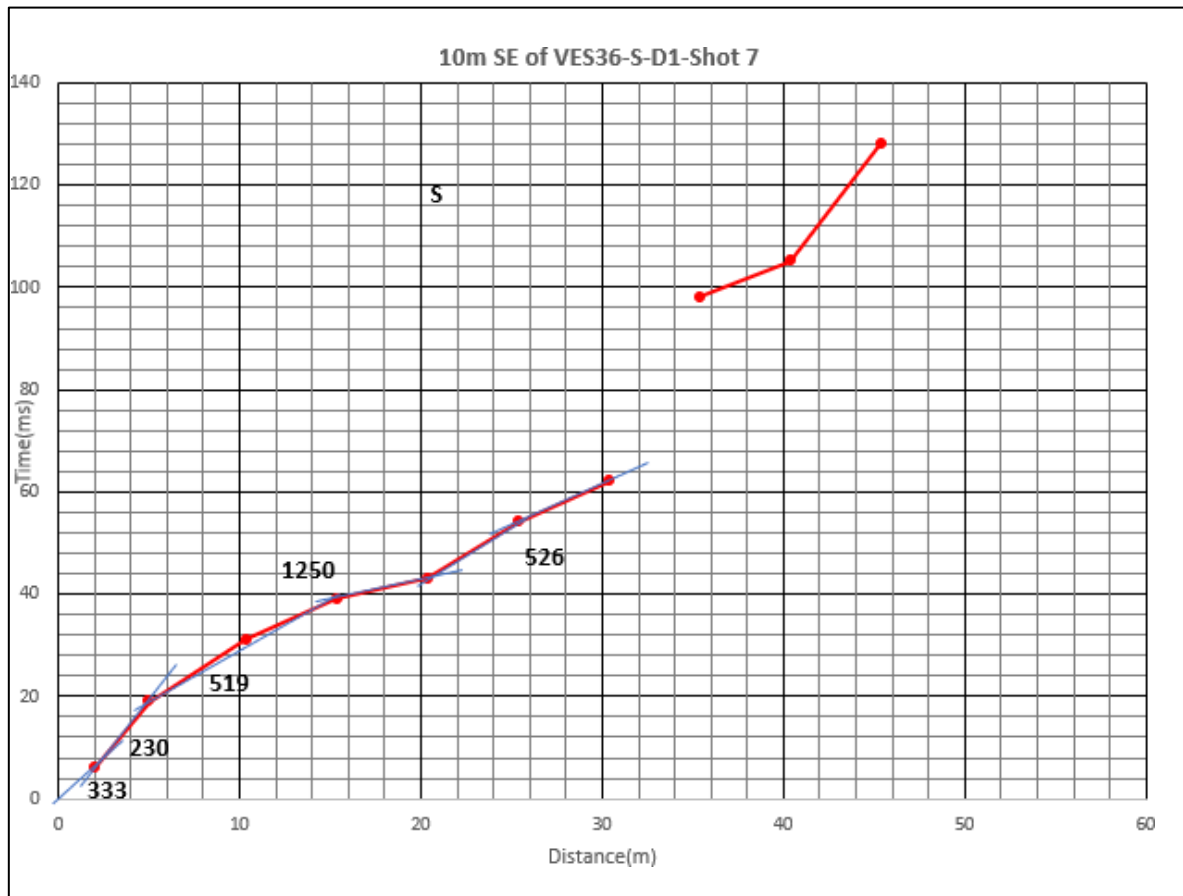


Figure 9.1.6.3.19 seismic hodograph of seismic shot 10m SE of VES 36-S-D1-Shot 7

- **18m N of VES 72 (16°26'46.45"N, 80°37'33.85"E)**

One seismic shot was recorded at this location towards western direction (20m NW of VES 72-W-D2- Shot 8) with a traverse of 100m length. Table shows interpreted seismic data

Table 9.1.6.3.24. Interpreted seismic data for shot 20m NW of VES 72-W-D2- Shot 8

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.25	0.258	Soil	333.3
0.25-4.54	4.288	Dry Clay	381.0
4.54-10.88	6.33	Lateritic soil	2500.0
10.8-18.6	7.74	Dry Alluvium	416.7
18.6-29	10.37	Wet Sand saturated	1666.7
Below 29		Dry Alluvium & sand	588.2

Gravels not detected with its characteristic velocity in this 6-layer strata.

P-wave is indicated from 0–40 m geophones and in rest of them, 45-100 m, surface waves recorded

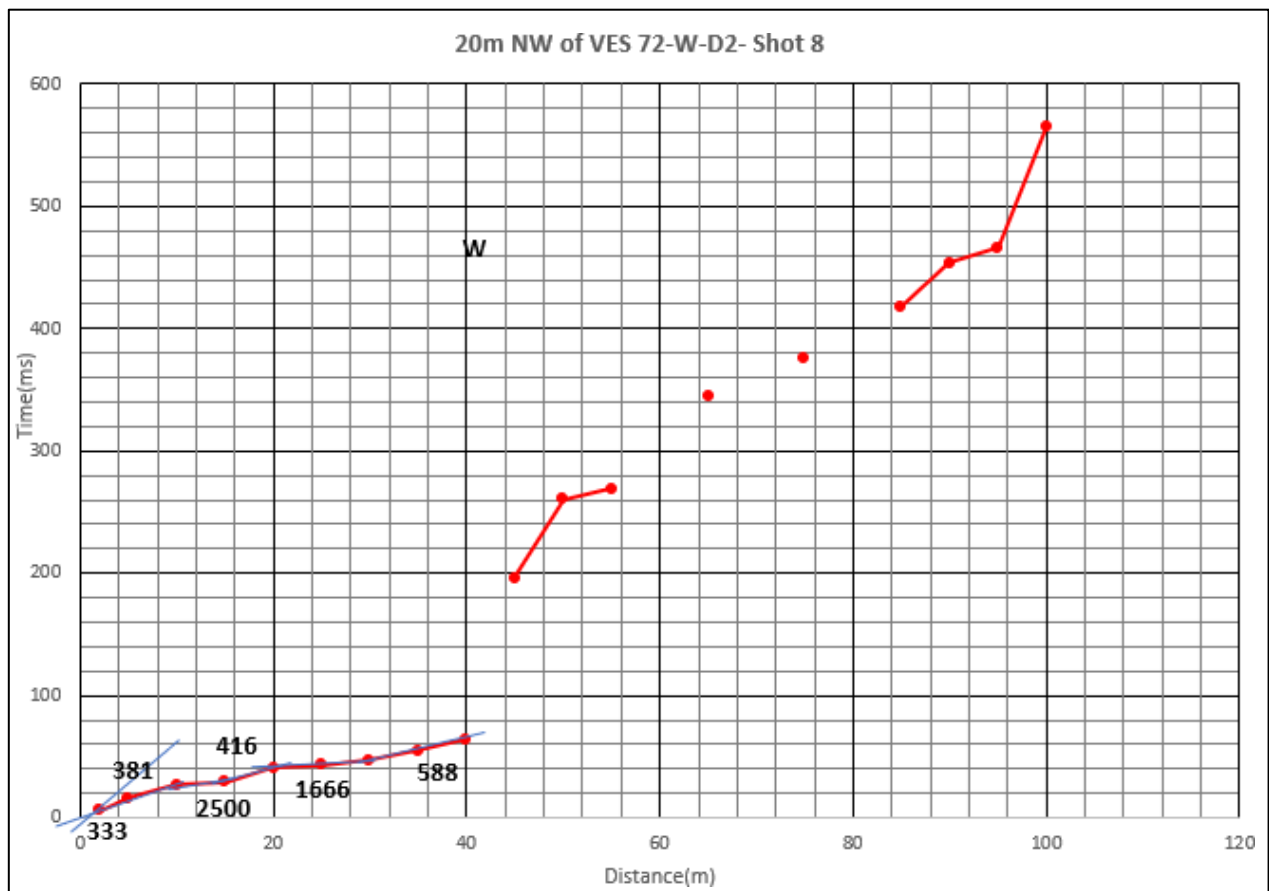


Figure 9.1.6.3.20 seismic hodograph of seismic shot 20m NW of VES 72-W-D2-Shot 8

VES 20-W (16°26'49.46"N, 80°37'48.69"E)

Seismic shot was conducted northwest of Gudimeda village at coordinates 16°26'49.46"N, 80°37'48.69"E. This was directed towards west with a traverse of 115m length. Interpreted lithology of 7 layers manifested in the table. No gravel bed detected.

Table 9.1.6.3.25. Interpreted seismic data for shot VES 20-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.76	0.770	Soil	333.89
0.76-6.03	5.267	Wet Alluvium & sand	1303.4
6.03-19.52	13.493	Lateritic soil	2304.15
19.52-32.96	13.436	Dry Alluvium & sand	585.995
32.96-58.65	25.692	Dry Alluvium & sand	953.516
58.65-95.75	37.098	Compact clay	1742.16
Below 95.75		Dry Alluvium & sand	505.051

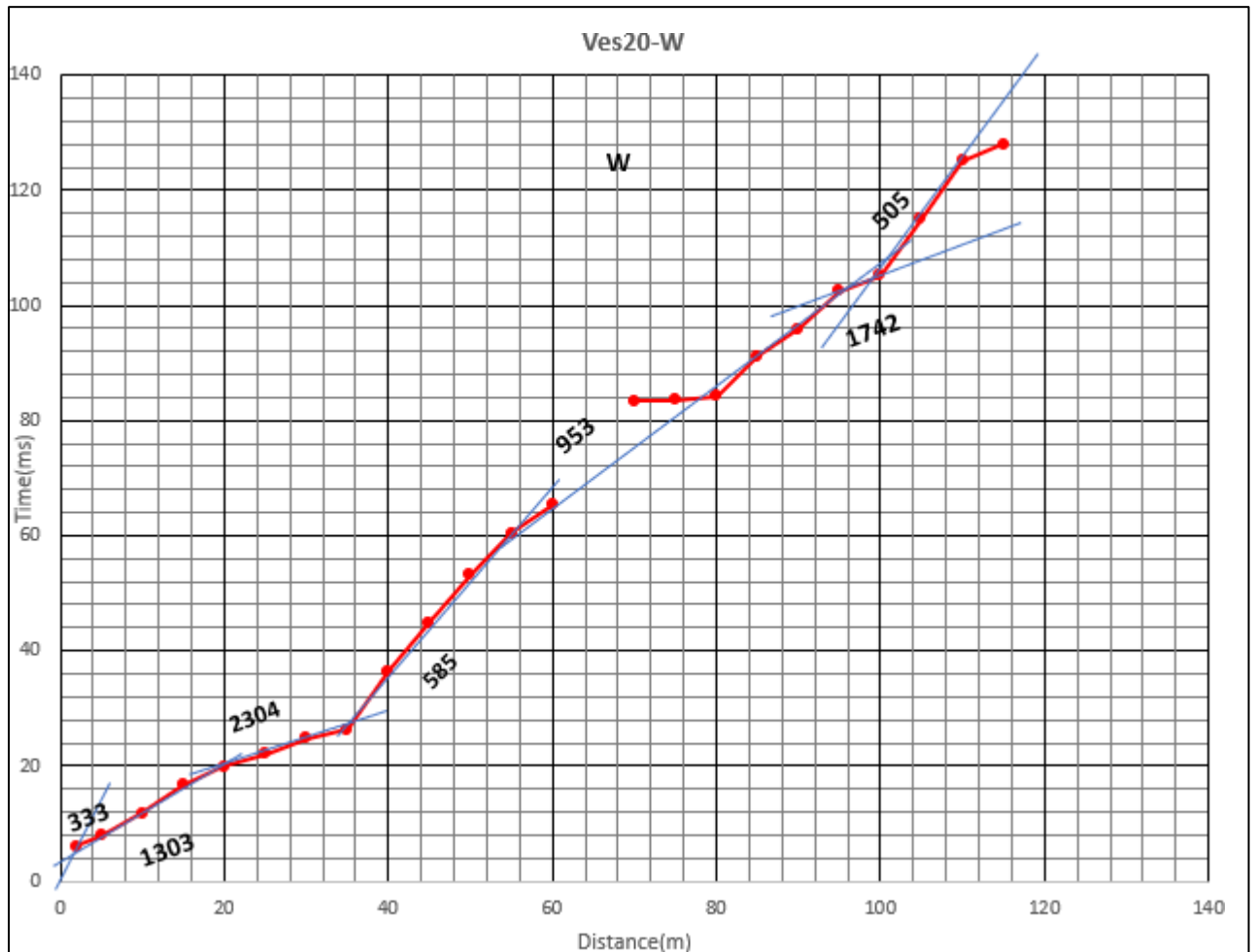


Figure 9.1.6.3.21 seismic hodograph of seismic shot VES 20-W

- **VES70_NE_SW_NW_SE** (16°26'33.05"N, 80°37'59.99"E)

The survey conducted in southern part of Gudimeda area at geographic coordinates 16°26'33.05"N, 80°37'59.99"E. seismic shots carried out in four directions: northeast (NE), southwest (SW), northwest (NW) and southeast (SE) directions covering transect lengths 115m, 130m, 69m and 95m respectively.

- **Northeastern direction-** Interpreted seismic data

Table 9.1.6.3.26. Interpreted seismic data for shot VES70_NE

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.447	Soil	333.3
0.44-1.69	1.250	Dry Alluvium & sand	500.0
1.69-5.02	3.324	Gravel/dry sand	833.3
Below 5.02		Soil	322.6

Three layers in the sedimentary region are identified as in table with gravel/dry sand delineated at a depth of 1.69m. The P-wave is indicated in 0–20m geophones and in remaining 25-40m recorded surface waves.

- **Southwestern direction-** Table shows interpreted seismic data

Table 9.1.6.3.27. Interpreted seismic data for shot VES70_SW

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.45	Soil	333.3
0.44-1.69	1.25	Dry Alluvium & sand	500.0
1.69-5.11	3.42	Gravel/dry sand	833.3
Below 5.11		Dry Clay	303.0

Interpreted seismic refraction data displays a 4-layer sequence with a gravel bed/dry sand at 1.69 depth. Up to 15m P-wave recorded. From 20-55 m surface waves were observed.

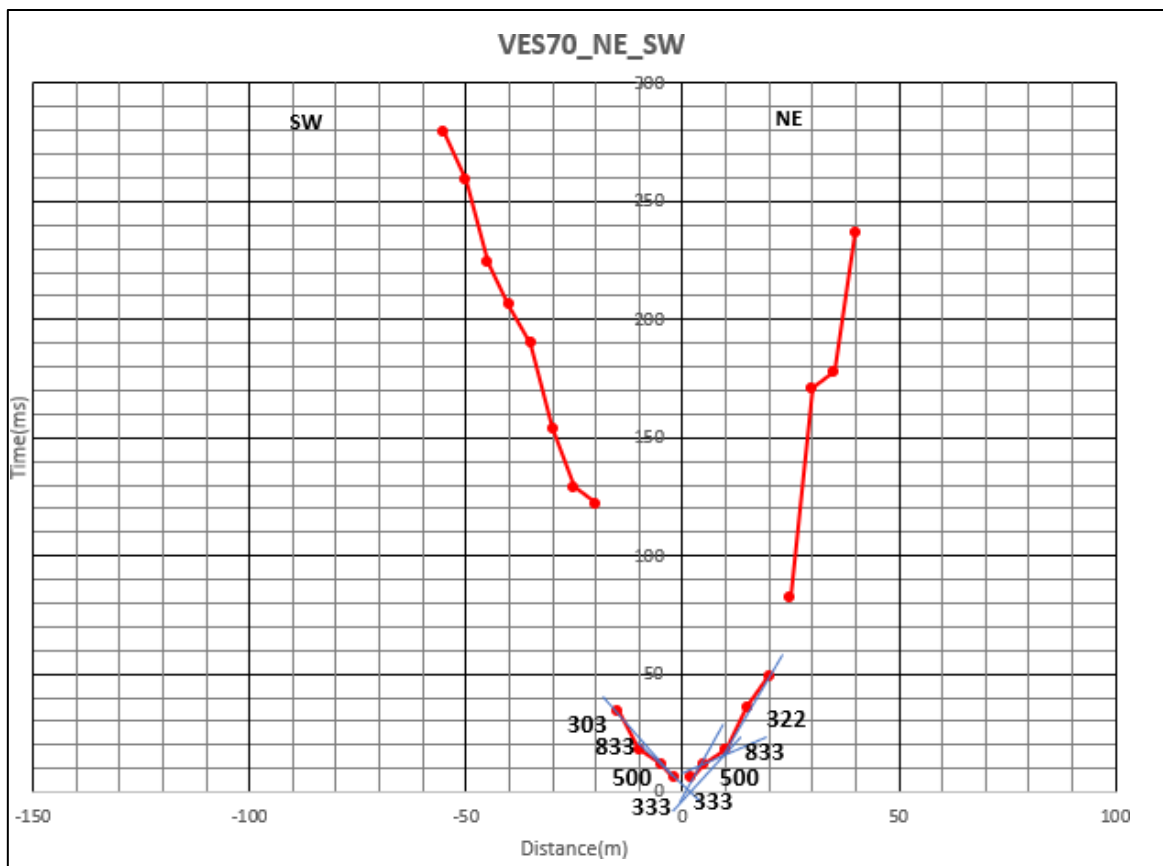


Figure 9.1.6.3.22 seismic hodograph of two shots VES 70-NE and VES 70-SW

- **Northwestern direction** – Table displays interpreted seismic data

Table 9.1.6.3.28. Interpreted seismic data for shot VES70_NW

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.43	Soil	333.3
0.42-1.92	1.50	Dry Clay	230.8
Below 1.92		Dry Alluvium & sand	487.8

P-wave signal is indicated from 0–25 m geophones and in remaining geophones, from 35-69 m, surface waves recorded.

- **Southeastern direction-** Table displays interpreted seismic data

Table 9.1.6.3.29. Interpreted seismic data for shot VES70_SE

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.447	Soil	333.3
Below 0.44		Dry Alluvium & sand	500.0

Gravel beds are not present in this 2-layer sedimentary set up. P-wave is indicated in geophones 0–5 m spread and in remaining geophones, up to 95 m length, surface waves recorded. Water accumulation/wet condition below second layer limited the propagation of p-wave and its attenuation. Hence in these

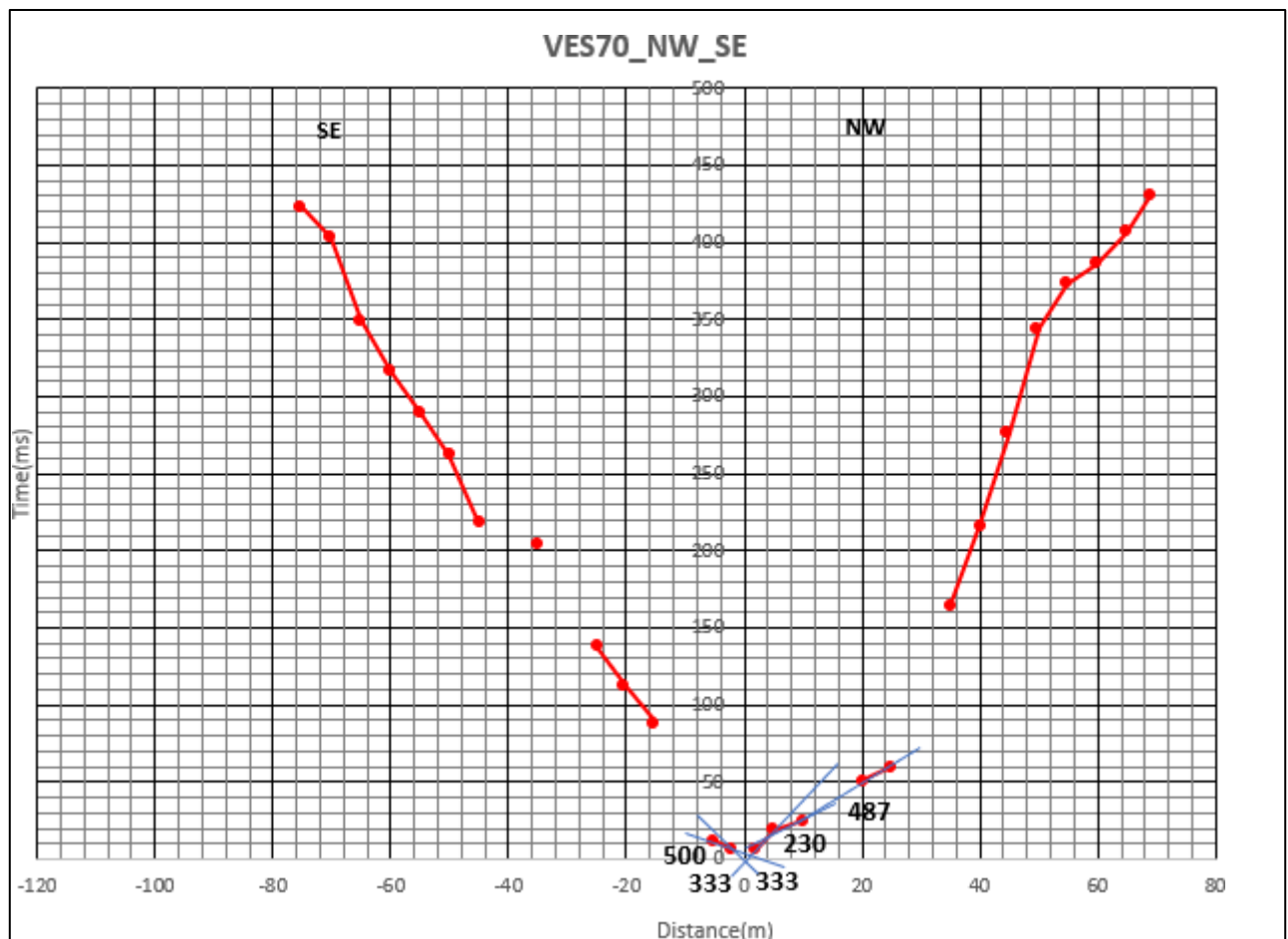


Figure 9.1.6.3.23 seismic hodograph of two shots VES 70-SE and VES 70-NW

North east of the block

A seismic survey was conducted northeast of the block at three locations in Gudimeda village: 88 m north of VES 37 (16°26'27.24"N, 80°38'27.70"E), 55 m southwest of VES 37 (16°26'23.77"N, 80°38'25.04"E), and 36 m north of VES 37 (16°26'25.36"N, 80°38'27.60"E)

- **88m N of VES 37 (16°26'27.24"N, 80°38'27.70"E)**

Three seismic shots were conducted at this location, designated as 88m N of VES 37-E-D2(east direction), 88m N of VES37-W-D1(west direction), 88m N of VES37-S-D1 (south direction). The traverses are towards east, west and south directions with length 60 m, 130 m, and 125 m respectively.

- **88m N of VES 37-E-D2**

Seismic shot towards east with a 60m traverse.

Table 9.1.6.3.30. Interpreted seismic data for shot 88m N of VES 37-E-D2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.243	Soil	333.3
0.42-1.49	1.250	Dry Alluvium	375
1.49-3.3	1.838	Dry Alluvium & sand	629
3.3-9.28	5.957	Dry Alluvium	476.2
9.28-15.79	6.512	Wet Sand	1000.0
Below 15.79		Dry Alluvium & sand	573.0

As in table lithology shows a 6-layer sequence with no characteristic gravel velocity.

- **88m N of VES37-W-D1**

Seismic shot towards west with a stretch of 130m

Table 9.1.6.3.31. Interpreted seismic data for shot 88m N of VES37-W-D1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.41	0.413	Soil	333.3
0.41-2.95	2.538	Dry sand/soil	470
2.95-5.6	2.652	Dry soil	277
5.6-14.6	9.061	Dry sand/soil	357
Below 14.6		Dry soil	111

As in table lithology shows a 5-layer sequence with no characteristic gravel velocity.

P-wave is indicated in geophones spread up to 0–25 m and in rest, from 30-75 m surface waves registered.

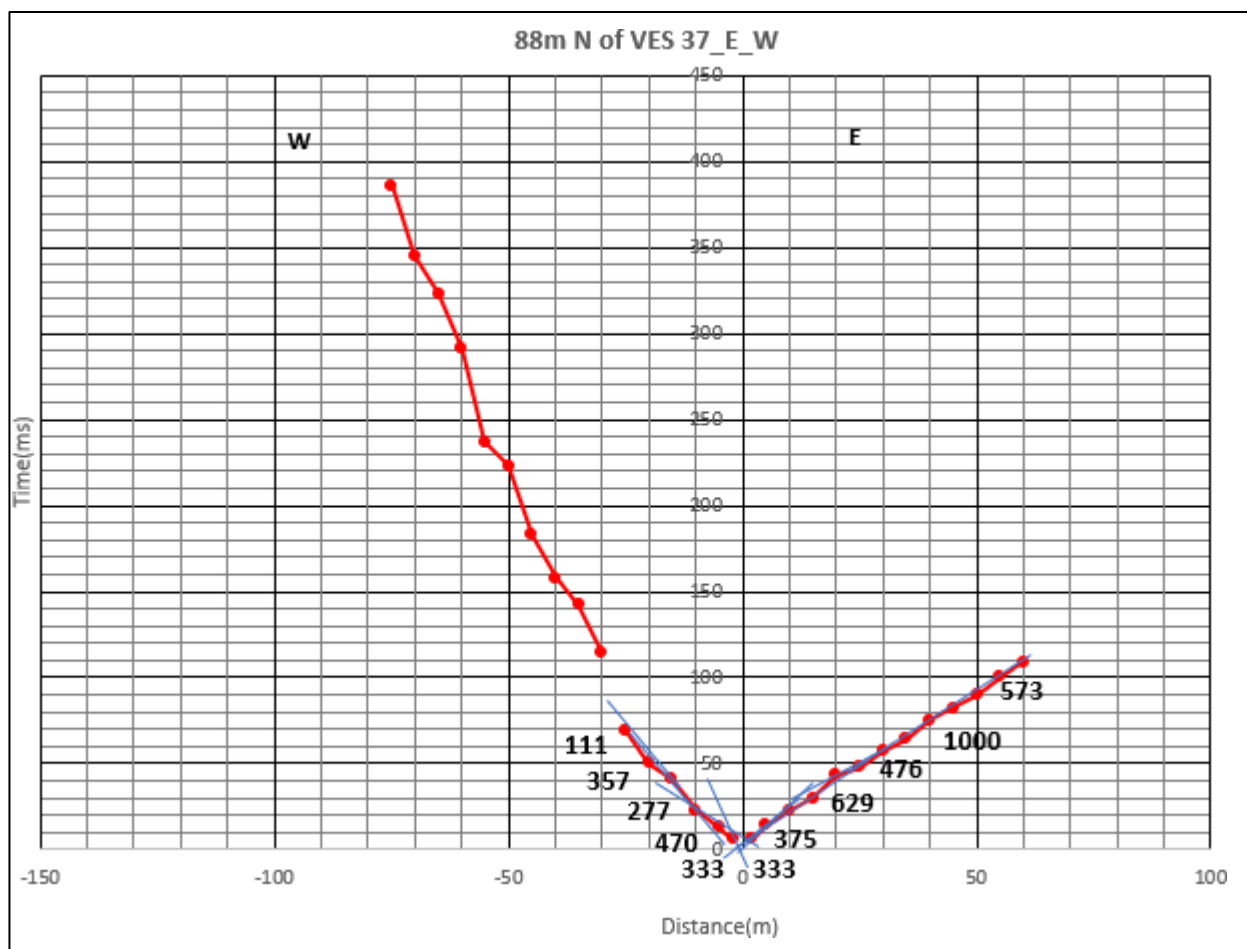


Figure 9.1.6.3.24 seismic hodograph of two shots 88m N of VES 37-E and 88m N of VES 37-W

- 88m N of VES37-S-D1

Seismic shot towards south with a traverse of 125m length.

Table 9.1.6.3.32. Interpreted seismic data for shot 88m N of VES37-S-D1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.02	0.0236	Soil	333.3
0.02-1.92	1.9028	Dry Alluvium	332.9
1.92-5.34	3.4170	Wet Sand/clay	1250
5.34-8.56	3.2250	Dry sand/Soil	454.1
8.56-17.6	9.0416	Dry Alluvium	312.4
17.6-28.2	10.6013	Wet Alluvium & Sand	998.0
Below 28.2		Dry Alluvium	331

Lithology shows a 7-layer configuration without gravel beds.

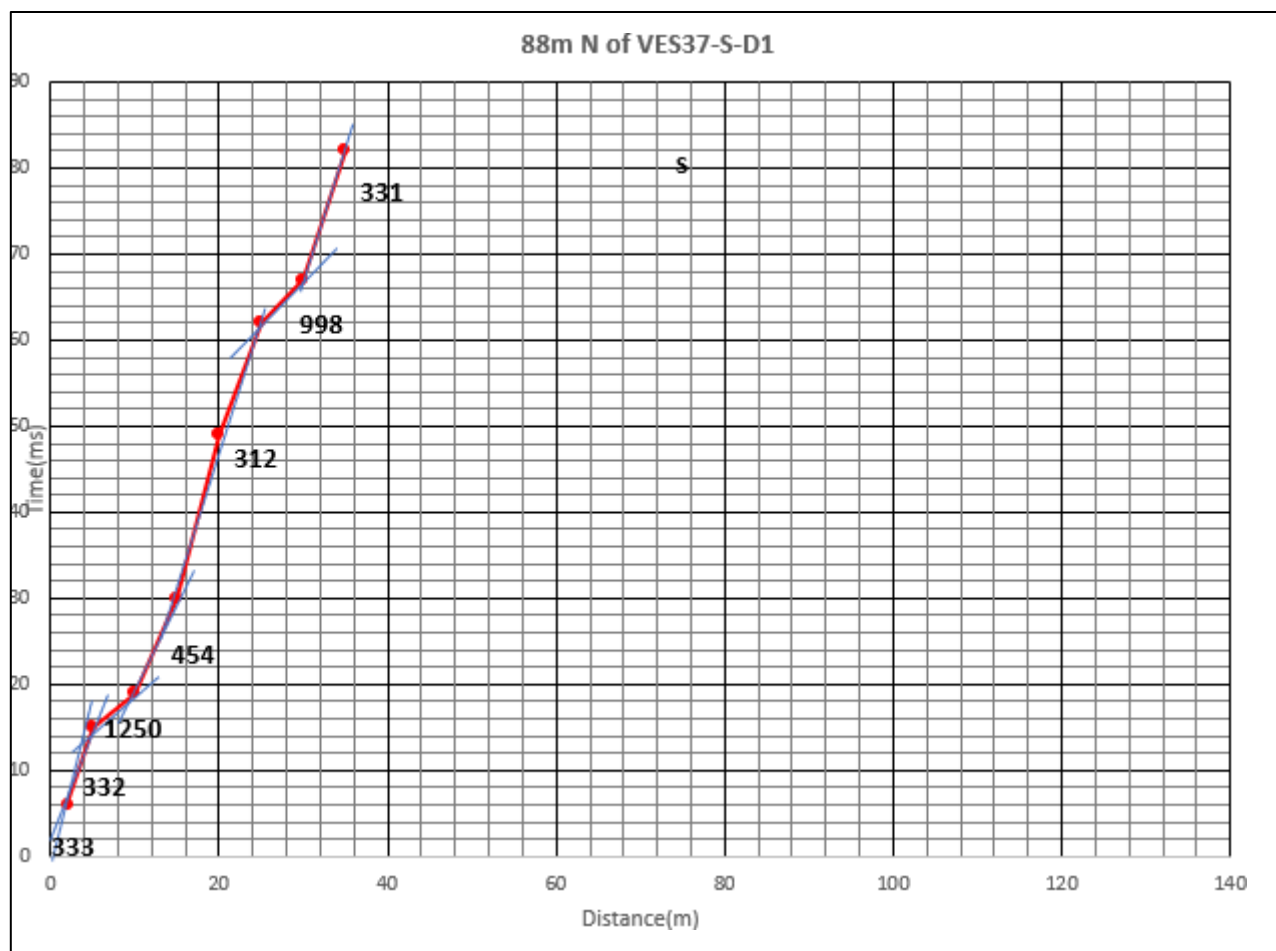


Figure 9.1.6.3.25 seismic hodograph of seismic shot 88m N of VES 37-S-D1

- **55m SW of VES 37** (16°26'23.77"N, 80°38'25.04"E)

The seismic shots were conducted at this location, designated as 55m SW of VES 37-NE-D1 (north eastern direction). The traverse length for north eastern directions 130 m. Table shows interpreted seismic data.

Table 9.1.6.3.33. Interpreted seismic data for shot 55m SW of VES 37-NE-D1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.243	Soil	333.3
0.24-1.49	1.250	Dry Alluvium	375.0
1.49-3.3	1.838	Dry Alluvium/Sand	625.0
3.3-10.6	7.276	Dry Alluvium/Sand	476.2
10.6-26.2	15.645	Dry Alluvium/Sand	769.2
Below 26.2	17.222	Dry Alluvium	185.2

As in table lithology shows a 7-layer sequence. P-wave is indicated from 0–40 m geophone spread and in remaining 45-65 m geophones surface waves registered.

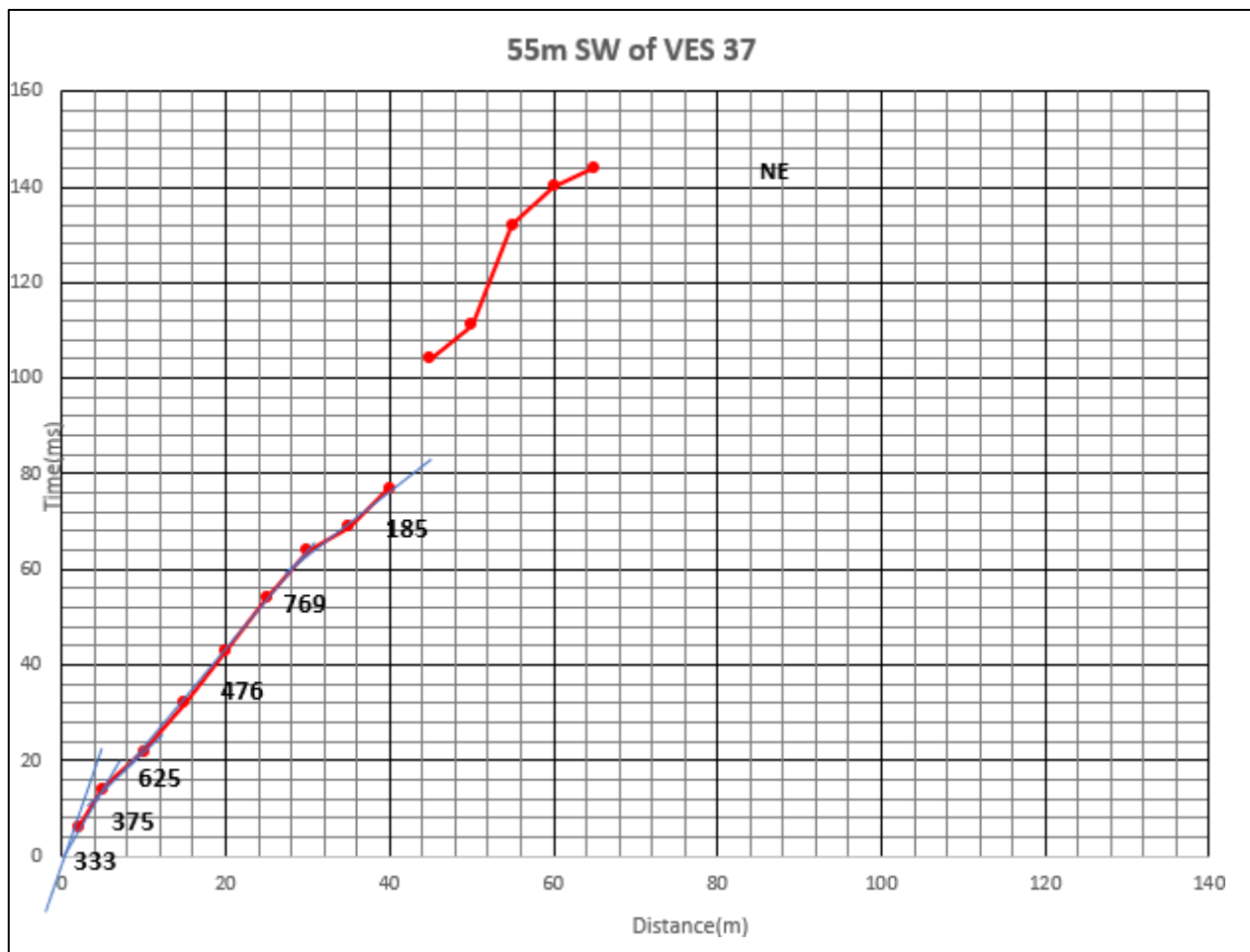


Figure 9.1.6.3.26 seismic hodograph of seismic shot 55m SW of VES 37

- **36m N of VES37** (16°26'25.36"N, 80°38'27.60"E)

Seismic survey was carried out at southeastern part of the Gundimeda area using split-spread configuration along both east–west (E–W) and north–south (N–S) directions. The main objective was to assess penetration of P-wave to identify subsurface configuration of lithology. Both E–W and N–S survey shots are conducted at same latitude and longitude viz; 16°24'49"N, 80°38'14"E on both directions.

Subsurface gravel detection results

Interpreted seismic data. East West spread towards east direction with 55m traverse length.

Table 9.1.6.3.34. Interpreted seismic data for shot 36m N of VES37-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.82	0.820	Soil	207.5
0.82-3.08	2.269	Wet Alluvium & Sand	1059.6
3.08-7.39	4.302	Dry Alluvium & Sand	697.8
7.39-11.49	4.106	Dry Alluvium	479.8
11.49-24.79	13.296	Dry Alluvium & Sand	595.9
Below 24.79		Wet Alluvium & Sand	1066.1

Lithology shows a 7-layer configuration with sand and clay

Seismic shot towards west direction: Interpreted seismic data with traverse length 55m.

Table 9.1.6.3.35. Interpreted seismic data for shot 36m N of VES37-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.6	0.604	Soil	620.9
0.6-3.75	3.152	Wet sandy clay	1335.6
3.75-12.03	8.277	Dry Alluvium/Sand	575.8
12.03-20.61	8.580	Wet clay	1474.9
20.61-30.82	10.216	Dry Alluvium/Sand	747.8
30.82-39.96	9.134	Dry Alluvium	492.1
Below 39.96		Dry Alluvium	376.2

Interpreted data displays 7-layer strata with wet and dry layers of sand. No gravels detected.

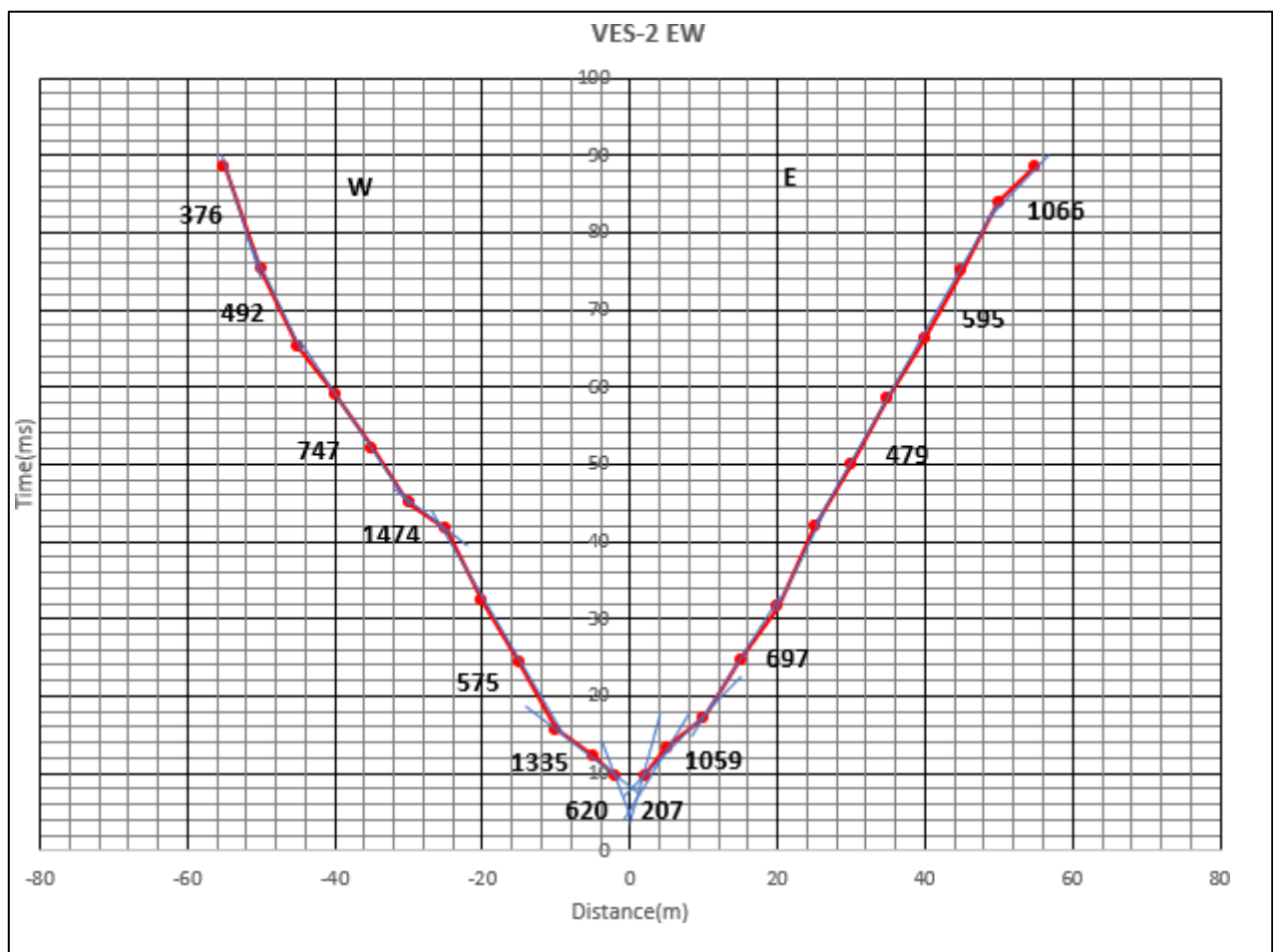


Figure 9.1.6.3.27 seismic hodograph of two shots 36m N of VES37 -E and 36m N of VES37 -W

North-South Spread.

Interpreted seismic data towards north with traverse length 55m

Table 9.1.6.3.36. Interpreted seismic data for shot 36m N of VES37-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.89	0.896	Soil	240.10
0.89-3.8	2.939	Lateritic soil	2191.78
3.8-9.2	5.441	Wet Alluvium & Sand	1066.10
9.2-18.2	9.010	Dry Clay/soil	330.91
18.2-28.1	9.870	Lateritic soil	3184.71
28.1-40.3	12.183	Dry Alluvium & Sand	738.55
40.3-52.6	12.301	Lateritic soil	2127.66
52.6-66.06	13.423	Wet Alluvium & Sand	959.69
Below 66.06		Lateritic soil	2020.2

Nine-layer sequence and the possibility of gravel not detected.

Southward Direction:

Interpreted seismic data. Traverse towards south with 55m length.

Table 9.1.6.3.37. Interpreted seismic data for shot 36m N of VES37-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.803	Soil	247.8
0.8-1.9	1.134	Wet Alluvium & Sand	1149.4
1.9-7.5	5.656	Wet Clay	1745.2
7.5-12.9	5.385	Dry Alluvium & Sand	479.8
12.9-18.9	5.962	Gravel & dry sand	871.8
18.9-27.4	8.531	Wet Alluvium & Sand	1199.0
27.4-33.4	6.022	Dry Alluvium & Sand	738.6
33.4-51.02	17.532	Gravel & dry sand	852.5
Below 51.02		Lateritic soil	2020

Gravel detected in this 9-layer sequence at 12.9m and 33.4m depth as in table.

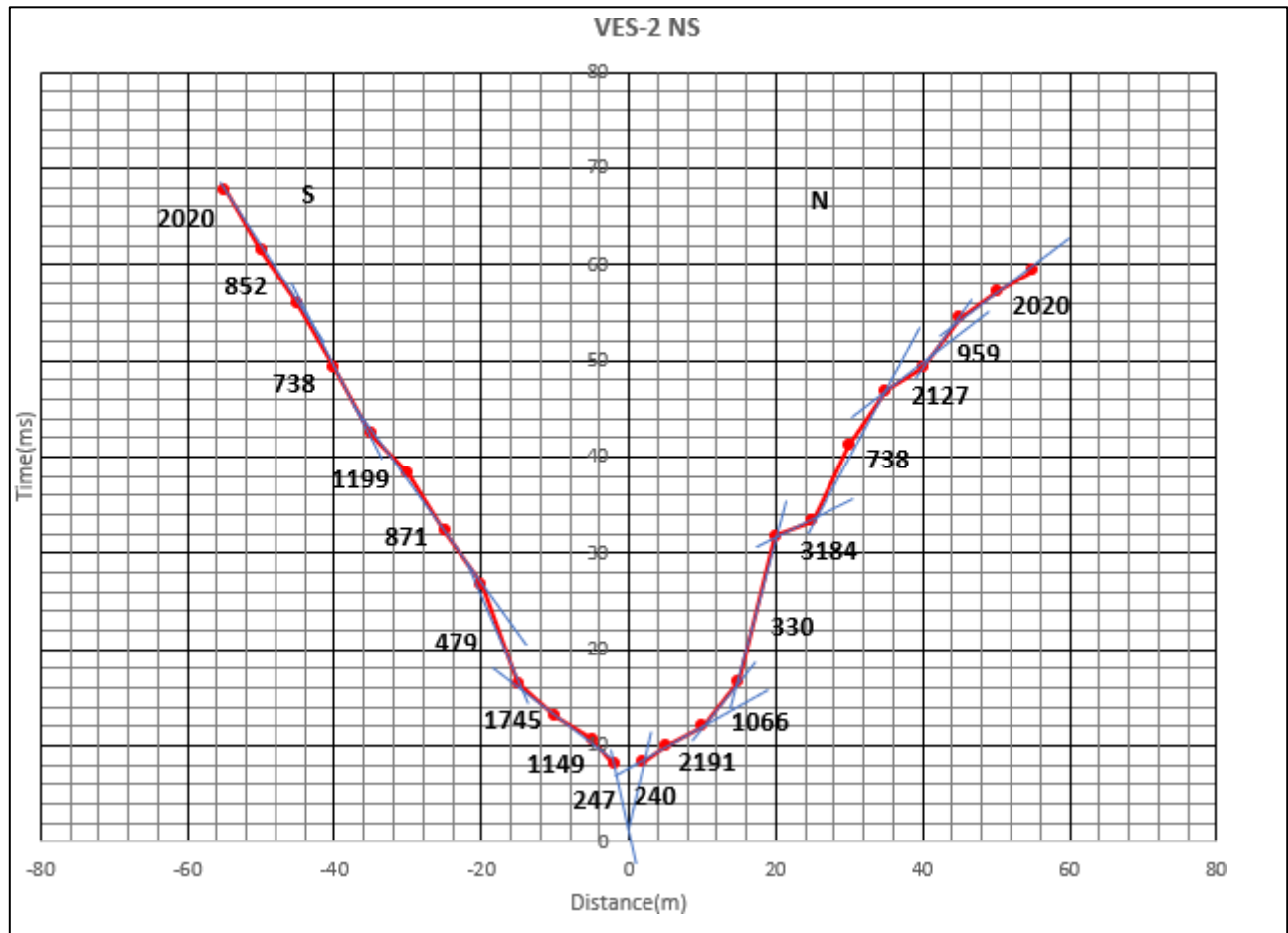


Figure 9.1.6.3.28 seismic hodograph of two shots 36m N of VES37 -N and 36m N of VES37 -S

North east of the block

Seismic survey conducted towards SE of Gudimeda village. The location named as VES69_NW_SE with latitude and longitude 16°26'28.58"N, 80°38'45.80"E.

- **VES69_NW_SE** (16°26'28.58"N, 80°38'45.80"E)

Two seismic shots were conducted at this location, designated as VES69-NW-D2 towards north west direction and VES69-SE towards south east direction. The traverse lengths for north-west and south-east directions are 120 m and 115 m respectively.

- **VES69-NW-D2**

Interpreted seismic data towards north-west direction

Table 9.1.6.3.38. Interpreted seismic data for shot VES69-NW-D2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.31	0.316	Soil	333.3
0.31-2.6	2.367	Dry Alluvium	272.7
2.6-6.9	4.282	Road material (Granite?)	5000.0
6.9-12.4	5.452	Dry Alluvium & Sand	769.2
12.4-19.8	7.409	Dry Alluvium	416.7
19.8-30.2	10.448	Dry Alluvium	200.0
Below 30.2		Dry Alluvium & Sand	576.9

Lithology shows 7 layer sequence with sand and clay without gravels

VES69-SE

Interpreted seismic data towards south east direction with a traverse of 115 m length

Table 9.1.6.3.39. Interpreted seismic data for shot VES69-SE

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.31	0.318	Soil	333.3
0.31-2.01	1.700	Dry Alluvium	272.0
2.01-10.93	8.915	Dry Alluvium & Sand	740.2
10.9-32.3	21.458	Lateritic soil	2272.7
32.3-57.5	25.208	Dry Alluvium	344.6
Below 57.59		Lateritic soil	2000.0

Seven layers with clay sand and Lateritic soil. No gravels identified.

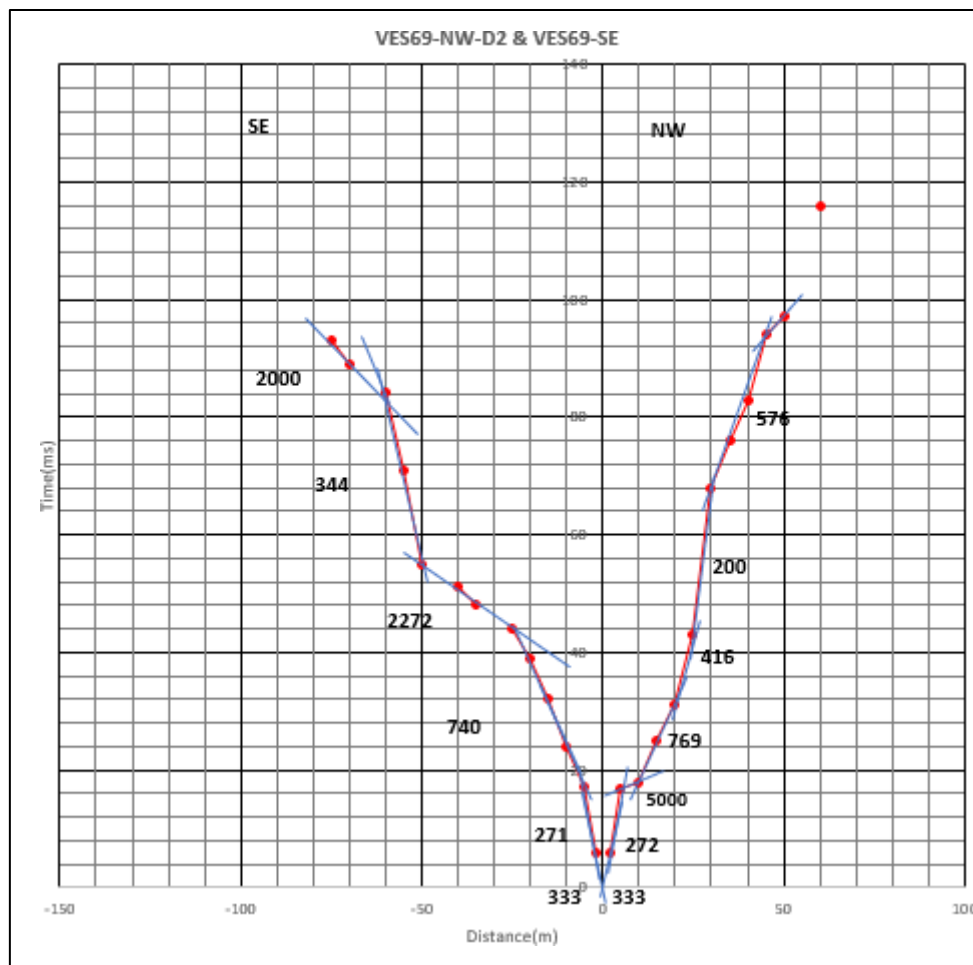


Figure 9.1.6.3.29 seismic hodograph of two shots VES 69-NW-D2 and VES 69-SE

Seismic survey conducted north west of the survey area identified as 184m E of VES 74 (16°26'14.01"N, 80°37'17.53"E) in Ippattam village. Seismic shot was conducted at this location towards east direction with 99.6 m traverse length. Interpreted seismic data

Table 9.1.6.3.40. Interpreted seismic data for shot 184m E of VES 74

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.61	0.616	Soil	333.3
0.61-1.74	1.131	Dry Alluvium	150.0
1.74-5.7	3.974	Dry Alluvium	227.3
5.74-9.8	4.167	Dry Alluvium	312.5
9.8-14.9	5.044	Dry Alluvium	250.0
Below 14.9	7.420	Dry Alluvium	199.2

There is no distinct gravel bed at this location.

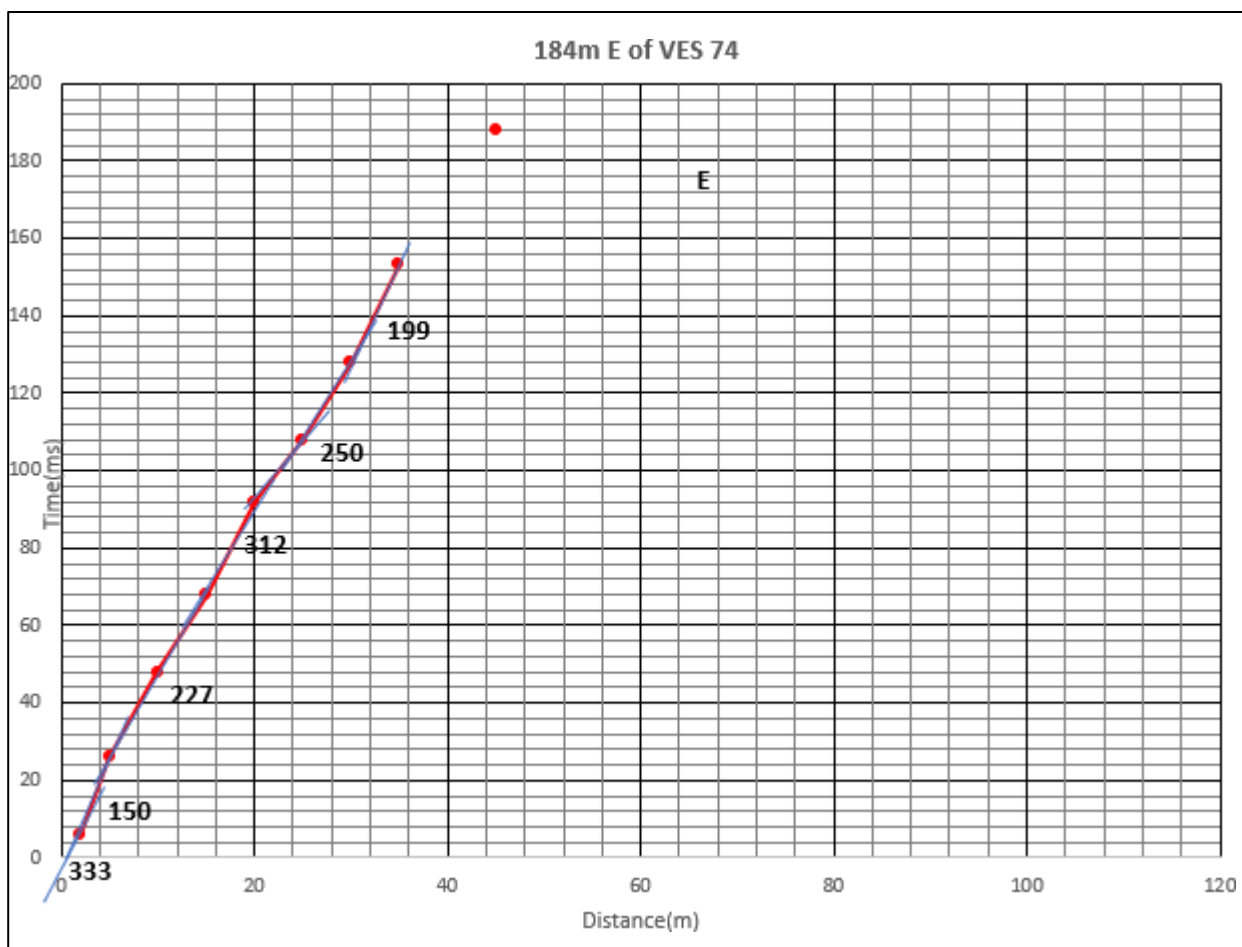


Figure 9.1.6.3.30 seismic hodograph of seismic shot 184m E of VES 74

Seismic survey conducted in the southwestern region of survey area at Ippattam village identified as 50m E of VES9. Split-spread configuration employed along east–west and north–south directions. The objective is to determine depth of penetration and to delineate subsurface lithology. Traverse lengths towards east, west, north and south directions are 60m, 40m, 57m and 59m respectively. The survey lines for E–W and N–S spreads were established at same coordinates 16°25'55.35"N, 80°36'31.2"E.

East–West Spread - Based on vertical electrical sounding (VES) results shallow-level transported material with moderate resistivity was observed. Interpreted seismic data is shown in table.

East direction:

Table 9.1.6.3.41. Interpreted seismic data for shot 50m E of VES9-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.67	0.67	Soil	427
Below 0.67		Wet Alluvium & Sand	1149

West direction:

Table 9.1.6.3.42. Interpreted seismic data for shot 50m E of VES9-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.67	0.67	Soil	427
Below 0.67		Wet Alluvium & Sand	1149

There is no distinct gravel bed at this location.

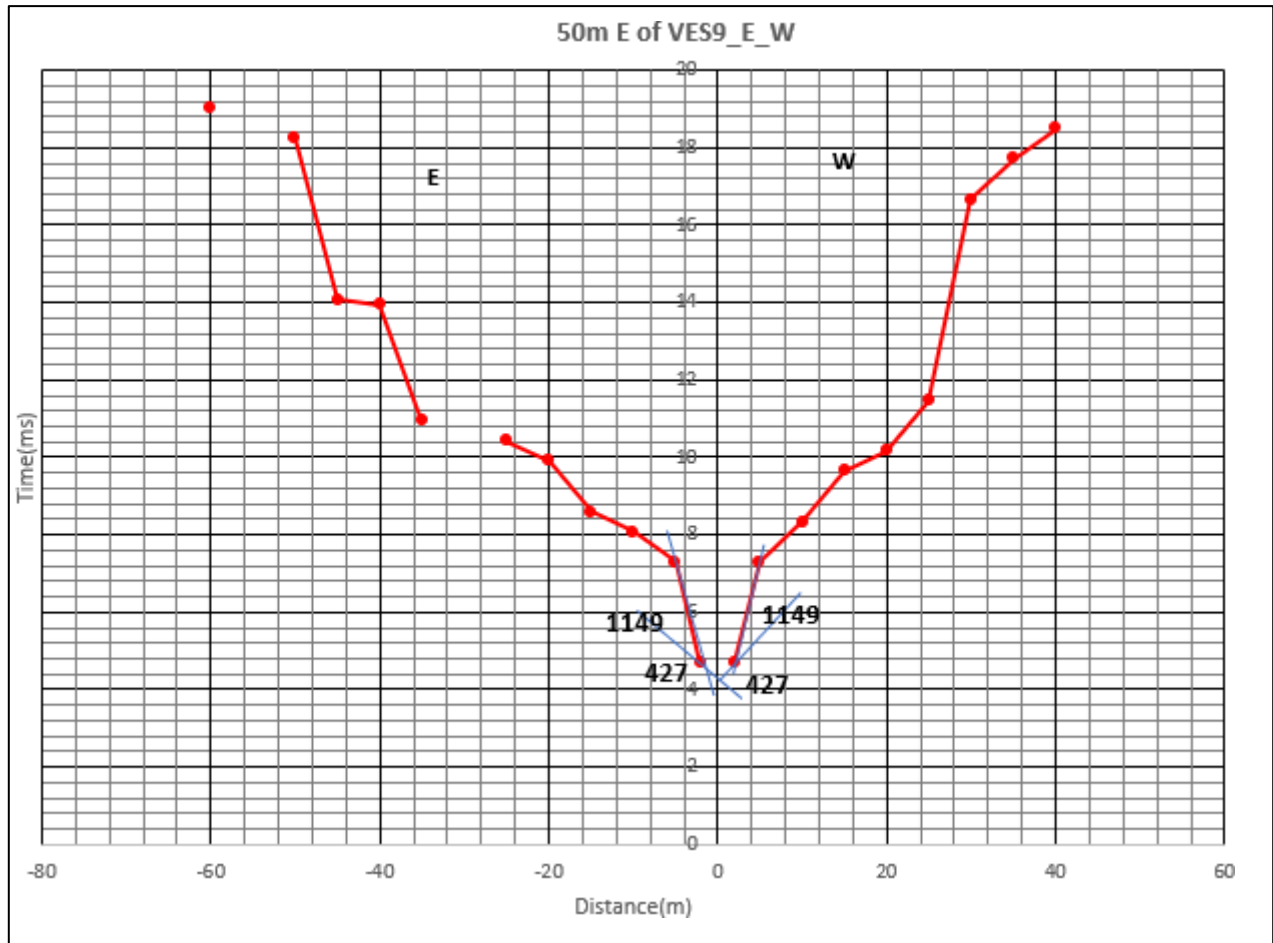


Figure 9.1.6.3.31 seismic hodograph of two shots 50m E of VES 9-E and 50m E of VES 9-W

North–South Spread

Northward Direction:

Table 9.1.6.3.43. Interpreted seismic data for shot 50m E of VES9-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.89	0.89	Soil	160
Below 0.89		Wet Alluvium & Sand	1474

Southward Direction:

Table 9.1.6.3.44. Interpreted seismic data for shot 50m E of VES9-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.92	0.92	Soil	150
Below 0.92		Wet Alluvium & Sand	2064

There is no distinct gravel bed at this location.

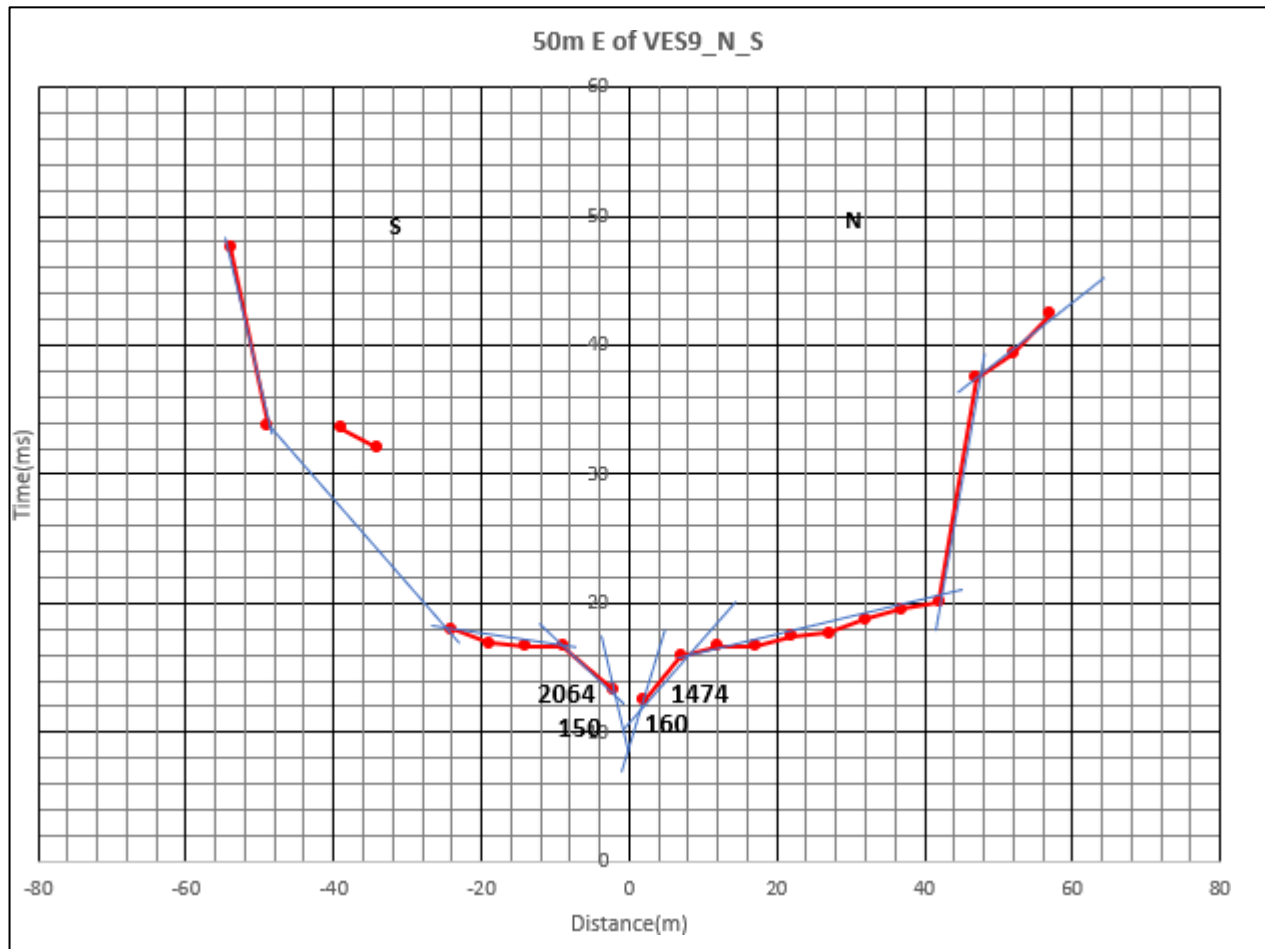


Figure 9.1.6.3.32 seismic hodograph of two shots 50m E of VES 9-N and 50m E of VES 9-S

Seismic survey conducted towards south of Ippattam village at three locations, named as 18m W of VES39(16°25'57.35"N, 80°36'43.71"E), 16m N of VES68(16°26'0.56"N, 80°36'44.33"E) and 20m S of VES68(16°26'0.24"N, 80°36'44.48"E).

- **18m W of VES39** (16°25'57.35"N, 80°36'43.71"E)

Four seismic shots were conducted at this location, designated as 19m W of VES 39-N-D2-Shot 1 towards north, 19m W of VES 39-S-D1-Shot towards south, 19m W of VES 39-E-D2-Shot 3 towards east and 19m W of VES 39-W-D1-Shot 4 towards west directions. The traverse lengths

for east, west, north and south directions are 105m, 100m, 105m and 90m, respectively

- **19m W of VES 39-N-D2-Shot 1**

Interpreted seismic data towards north on the traverse of 105m length.

Table 9.1.6.3.45. Interpreted seismic data for shot 19m W of VES 39-N-D2-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.64	0.642	Soil	333.3
0.64-3.6	2.961	Dry Alluvium & Sand	800.0
3.6-10.3	6.737	Wet Clay	1663.9
Below 10.3		Dry Alluvium & Sand	625.0

Lithology shows a 4-layer sequence with Alluvium and Clay

P-wave is indicated from 0–25 m geophone array, and in the rest of them, 30-45 m, surface waves indicated.

- **19m W of VES 39-S-D1-Shot 2**

Interpreted seismic data towards south on the traverse of 90m length

Table 9.1.6.3.46. Interpreted seismic data for shot 19m W of VES 39-S-D1-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.64	0.642	Soil	333.3
0.64-4.23	3.589	Dry Alluvium & Sand	800.0
4.2-10.47	6.240	Lateritic soil	2500.0
10.47-17.29	6.824	Dry Alluvium	454.5
17.29-23.8	6.522	Wet Alluvium & Sand	1246.9
Below 23.8		Dry Alluvium & Sand	713.3

Lithology shows 6 layers sequence with dry and wet Alluvium intercalated with sand. Thick Lateritic soil observed at 4,2m depth and no gravels detected up to 23.8m. P-wave is indicated from 0–40 m in geophone array and in rest of them, from 45-60 m, surface waves recorded.

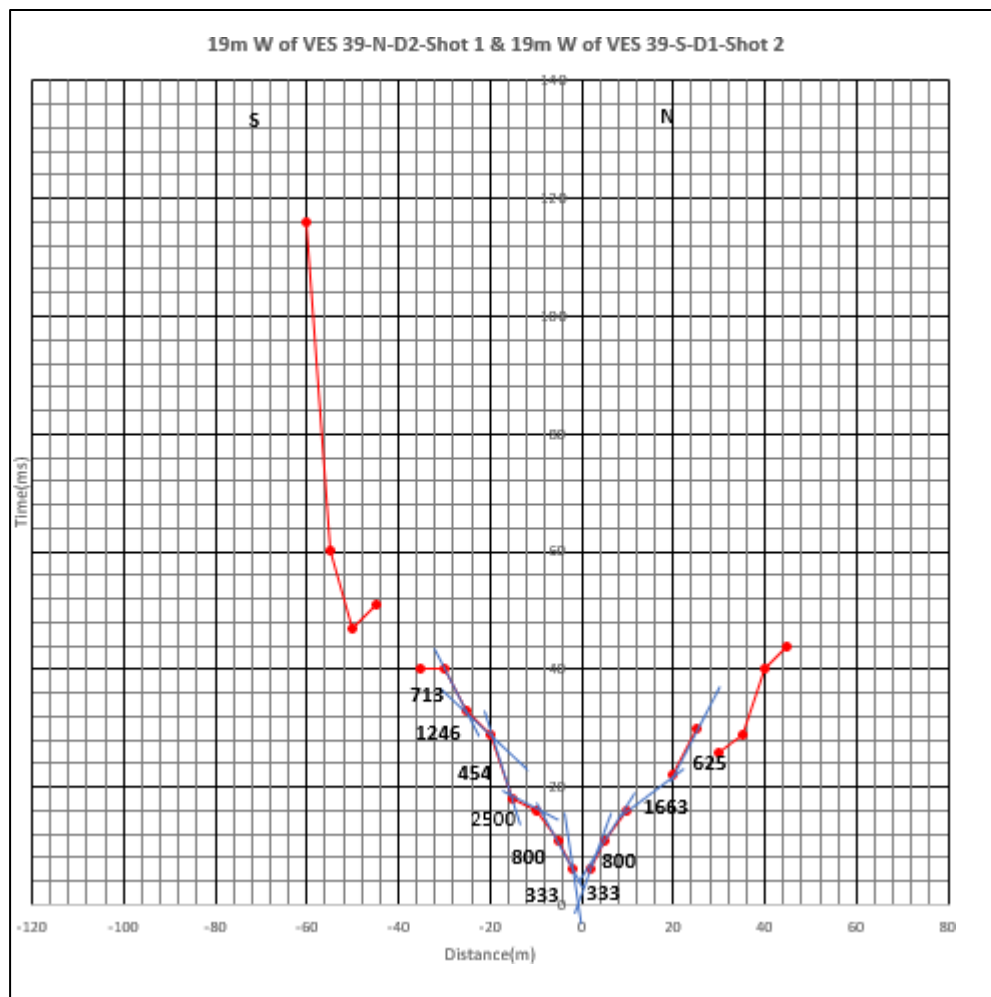


Figure 9.1.6.3.33 seismic hodograph of two shots 19m W of VES 39-N-D2-Shot 1 and 19m W of VES 39-S-D1-Shot 2

- 19m W of VES 39-E-D2-Shot 3**

Interpreted seismic data on the traverse with 105m length.

Table 9.1.6.3.47. Interpreted seismic data for shot 19m W of VES 39-E-D2-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.446	Soil	333.3
0.44-2.08	1.638	Dry alluvium & sand	499.2
2.08-4.48	2.402	Wet alluvium & sand	1250.0
4.48-15.34	10.861	Lateritic soil	2000.0
15.34-25.45	10.112	Dry alluvium & sand	624.2
25.45-38.45	12.996	Wet alluvium & sand	1250.0
Below 38.45		Dry alluvium & sand	624.6

Gravel bed not present in this 7-layer strata of the sub surface.

- **19m W of VES 39-W-D1-Shot 4**

Interpreted seismic data towards west on the traverse of 100m length.

Table 9.1.6.3.48. Interpreted seismic data for shot 19m W of VES 39-W-D1-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.446	Soil	333.3
0.44-2.08	1.638	Dry alluvium	499
2.08-4.48	2.402	Wet alluvium & sand	1250
Below 4.48		Lateritic soil	2000

Lithology of the sub surface shows 4-layer strata with a lateritic soil at 4.48 m depth.

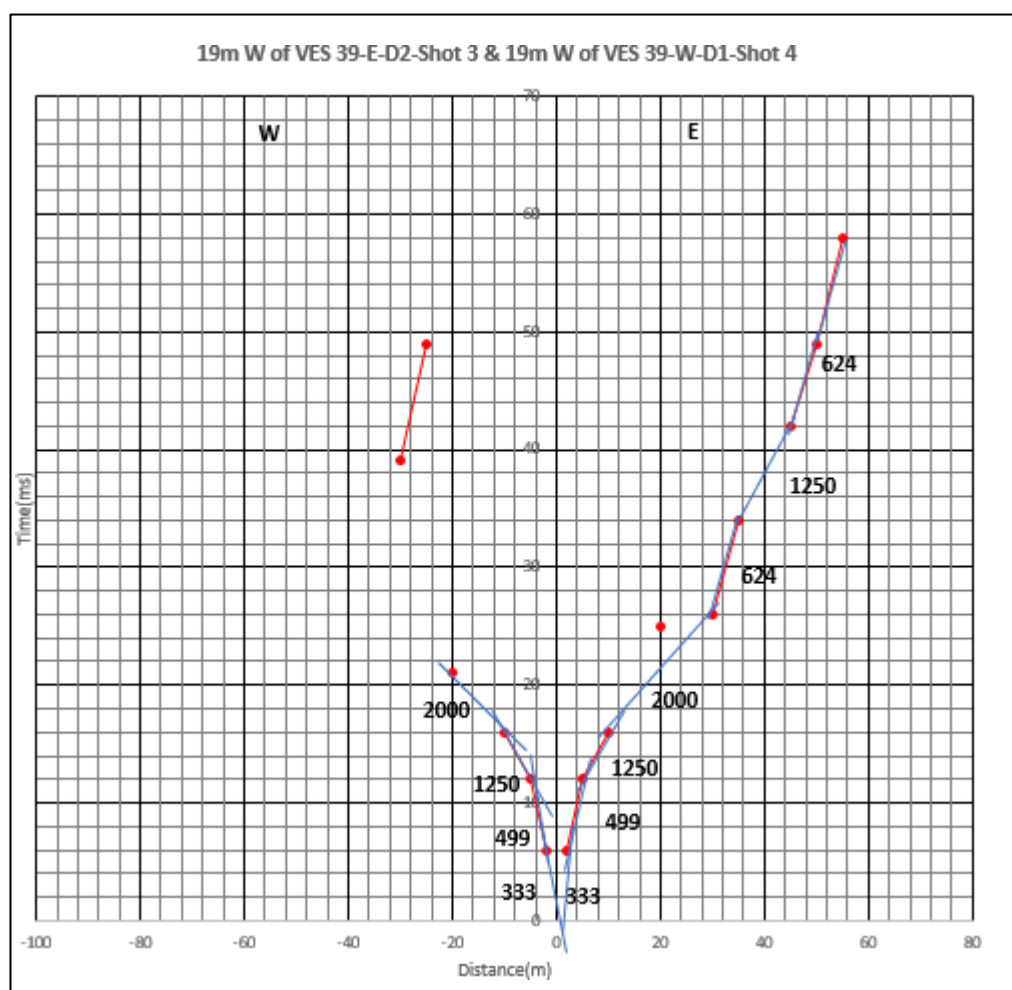


Figure 9.1.6.3.34 seismic hodograph of two shots 19m W of VES 39-E-D2-Shot 3 and 19m W of VES 39-W-D1-Shot 4

- **16m N of VES68 (16°26'0.56"N, 80°36'44.33"E)**

Three seismic shots were conducted at this location, designated as 15m NE of VES 68-E-D2-Shot 1(east direction), 15m NE of VES 68-W-D1-Shot 4(west direction) and 15m N of VES 68-S-D2-Shot 5(south direction). The traverse lengths for east, west and south directions are 120m, 90m, 105m and 105m respectively.

- **15m NE of VES 68-E-D2-Shot 1**

Interpreted seismic data towards east on the traverse of 120m length

Table 9.1.6.3.49. Interpreted seismic data for shot 15m NE of VES 68-E-D2-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.70	0.706	Soil	333.3
0.70-2.2	1.511	Wet Alluvium & Sand	996.7
2.2-7.3	5.130	Lateritic soil	2142.9
Below 7.3		Wet Alluvium & Sand	1250.0

There is no distinct gravel bed at this location. P-wave is indicated from 0–25 m geophone array and in rest of them, from 40-45 m, surface waves registered.

- **15m NE of VES 68-W-D1-Shot 4**

Interpreted seismic data towards west on the traverses of 90m length.

Table 9.1.6.3.50. Interpreted seismic data for shot 15m NE of VES 68-W-D1-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.53	0.535	Soil	333.3
0.53-2.36	1.834	Dry Alluvium & Sand	600.0
2.36-5.97	3.603	Lateritic soil	2000.0
5.97-13.04	7.071	Sand	1250.0
13.04-21.8	8.839	Dry Alluvium	416.7
Below 21.8		Wet Alluvium & Sand	1250.0

No gravel bed detected in this 6-layer sub surface up to 21.8m depth.

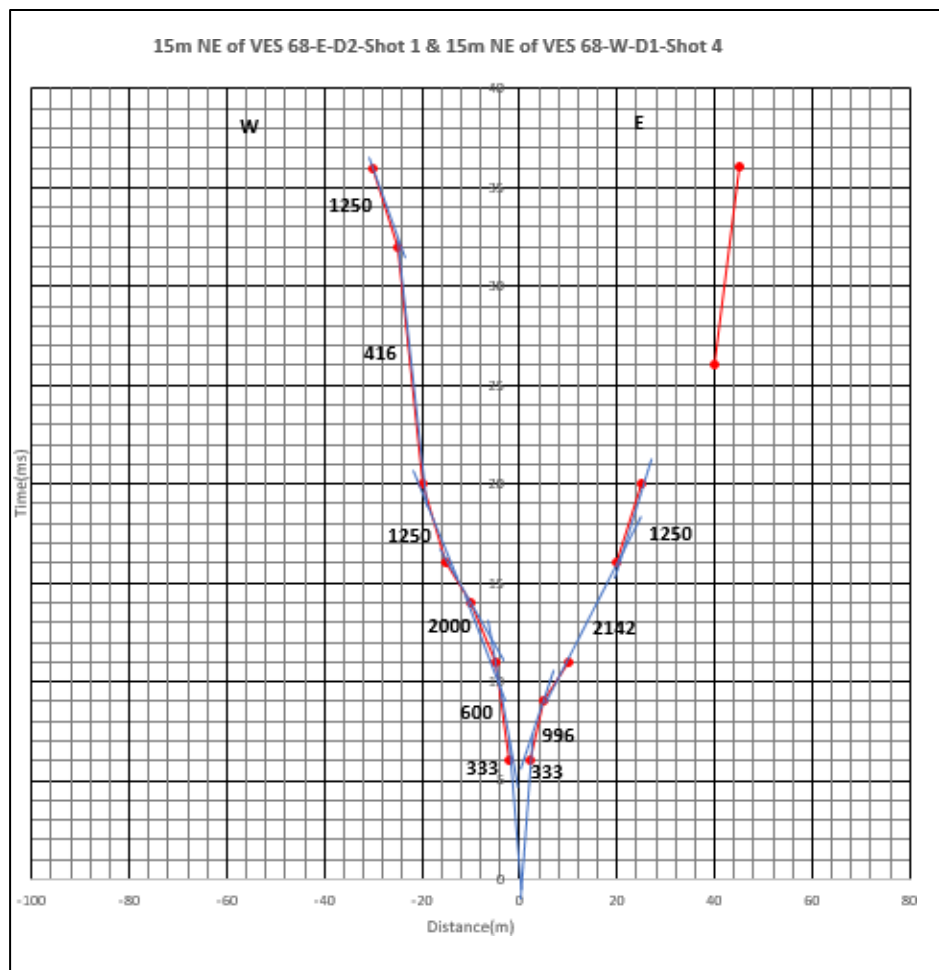


Figure 9.1.6.3.35 seismic hodograph of two shots 15m NE of VES 68-E-D2-Shot 1 and 15m NE of VES 68-W-D1-Shot 4

• **15m N of VES 68-S-D2-Shot 5**

Interpreted seismic data towards south on a traverse of 105m length.

Table 9.1.6.3.51. Interpreted seismic data for shot 15m N of VES 68-S-D2-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.73	0.739	Soil	333.3
0.73-4.7	3.969	Wet Alluvium & Sand	1134.8
4.7-10.52	5.813	Granite (road material)	5000.0
10.52-15.3	4.816	Wet Alluvium & Sand	1246.9
15.3-19.85	4.523	Lateritic soil	2000.0
Below 19.85		Wet Clay	1666.7

There is no distinct gravel bed at this location.

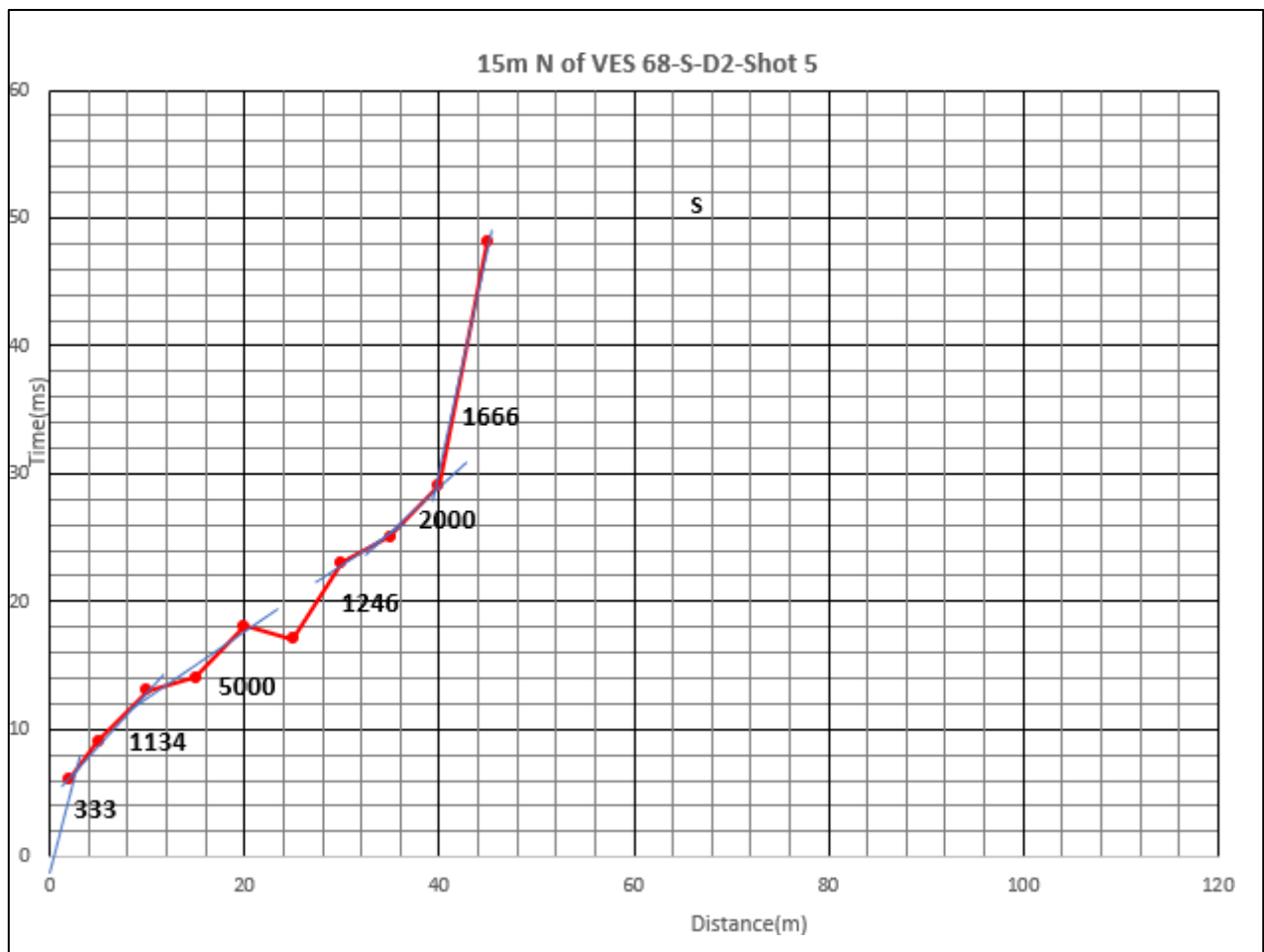


Figure 9.1.6.3.36 seismic hodograph of seismic shot 15m N of VES 68-S-D2-Shot 5

- **20m S of VES68 (16°26'0.24"N, 80°36'44.48"E)**

Seismic survey was conducted at this location, which is named as 93.22m N of VES 39-N-D2-Shot 7 towards north direction, on a traverse of 95m length. Refraction data is interpreted as below.

Table 9.1.6.3.52. Interpreted seismic data for shot 93.22m N of VES 39-N-D2-Shot 7

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.53	0.535	Soil	333.3
0.53-2.13	1.598	Dry Alluvium & Sand	600.0
2.13-7.72	5.590	Wet Alluvium & Sand	1428.6
Below 7.72		Granite (Road material)	5000.0

Gravel bed not detected in this 4-layer strata up to 7.72m depth. P-wave is indicated from 0–25 m geophone array and in the rest of them, 30-40 m, surface waves recorded.

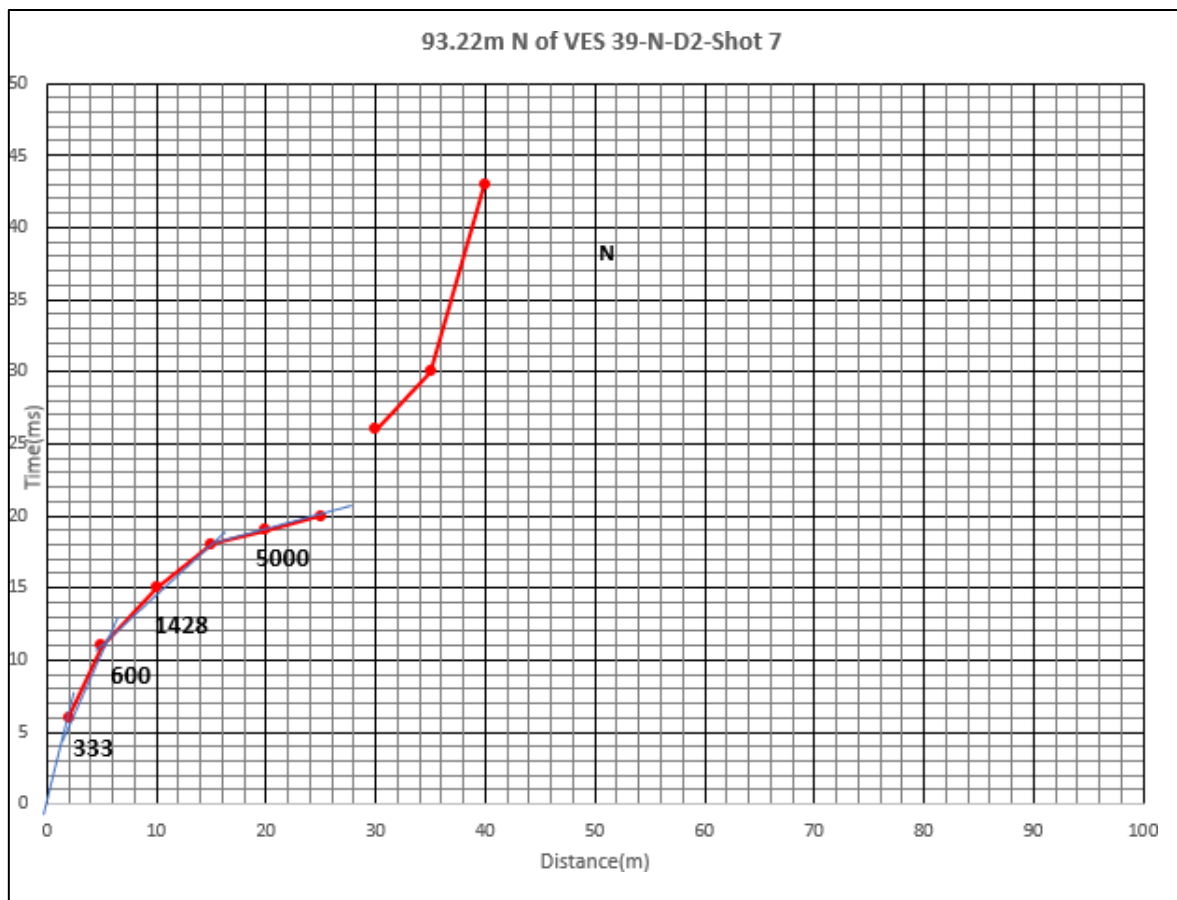


Figure 9.1.6.3.37 seismic hodograph of seismic shot 93.22m N of VES 39-N-D2-Shot 7

West of the block

Seismic survey conducted at four locations named as 70m W of VES 48(16°25'51.88"N, 80°37'26.47"E), 80m SW of VES48(16°25'50.27"N, 80°37'26.23"E), 82m SE of VES48(16°25'49.41"N, 80°37'30.75"E), 155m SE of VES48(16°25'48.83"N, 80°37'33.32"E) towards north west of Mellampudi village.

- **70m W of VES 48** (16°25'51.88"N, 80°37'26.47"E)

Three seismic surveys were conducted at this location which are designated as 70m S of VES29-E-D2-Shot 5(east direction), 70m S of VES29 W-D1-Shot 6(west direction) and 70m S VES29 S-D2-Shot 8(south direction). Traverse lengths for east, west and south directions are 102m, 85m and 75m respectively.

- **70m S of VES29-E-D2-Shot 5**

Interpreted seismic refraction data towards east with traverse length of 102m

Table 9.1.6.3.53. Interpreted seismic data for shot 70m S of VES29-E-D2-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.23	0.230	Soil	333.3
0.23-1.94	1.716	Dry Alluvium	299.7
1.94-4.75	2.804	Gravel/ dry sand	833.3
4.75-8.62	3.872	Dry Alluvium & Sand	434.6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
Below 8.62		Dry Alluvium & Sand	587.9

A gravel bed is present below 1.94m with 2.804m thickness with in this 5-layer sub surface. The P-wave is indicated from 0–30 m geophone array and in the rest of them, 40-70 m, shows presence of surface waves.

• **70m S of VES29 W-D1-Shot 6**

Interpreted seismic data towards west with a stretch of 85 m

Table 9.1.6.3.54. Interpreted seismic data for shot 70m S of VES29 W-D1-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.447	Soil	333.3
Below 0.44		Dry Alluvium	499.7

No gravel beds present. P-wave is indicated from 0–20 m geophone array and in rest of them from 30-80 m surface waves recorded. The terrain is accumulated water below the surface and the seismic signals attenuated.

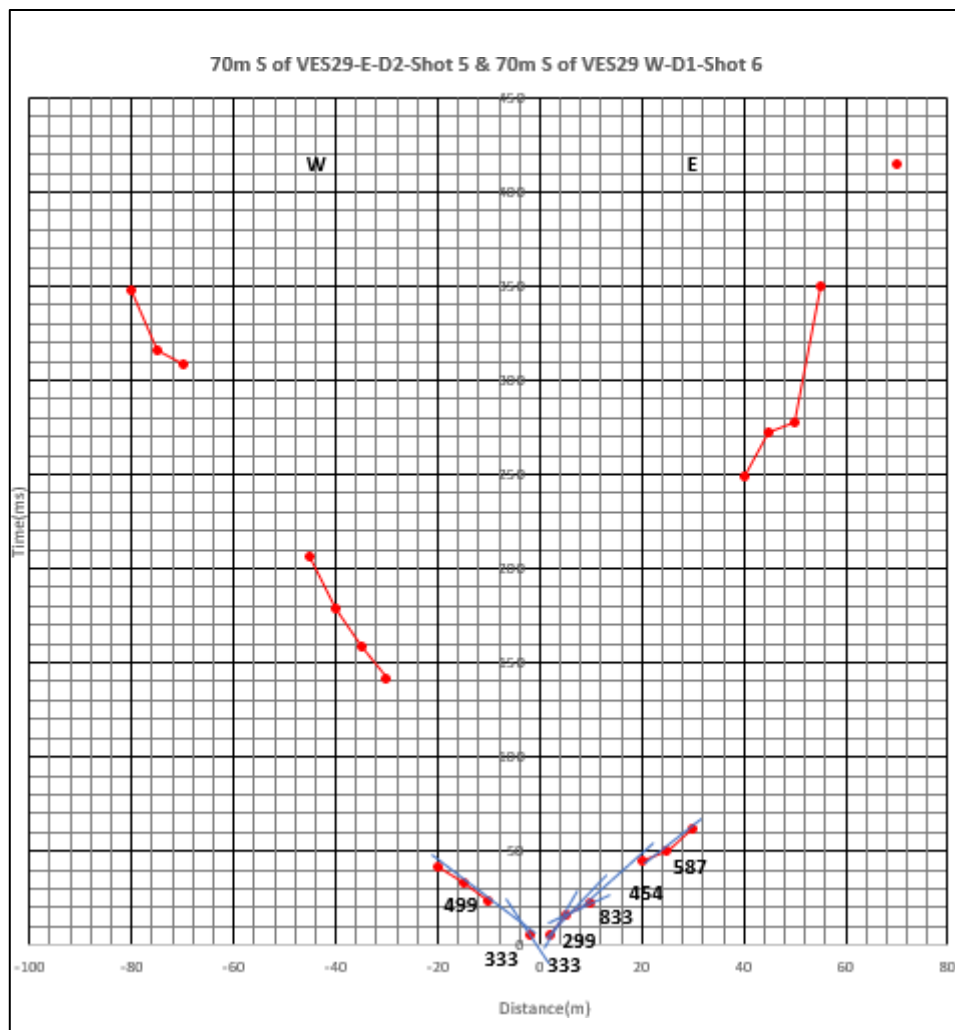


Figure 9.1.6.3.38 seismic hodograph of two shots 70m S of VES 29-E-D2-Shot 5 and 70m S of VES 29 W-D1-Shot 6

- **70m S VES29 S-D2-Shot 8**

Interpreted seismic data towards south with a stretch of 75m.

Table 9.1.6.3.55. Interpreted seismic data for shot 70m S VES29 S-D2-Shot 8

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-1.44	1.44	Soil	833.33
1.44-4.65	3.21	Dry Alluvium	416.67
4.65-15.5	10.86	Wet Sand	999.5
15.5-29.98	14.48	Dry Alluvium	312.3
Below 29.98		Compact clay	1666.7

Gravel beds are not present in this 5-layer sedimentary set up. P-wave is indicated in geophones 0–40 m spread and in remaining geophones, up to 70 m length, surface waves recorded.

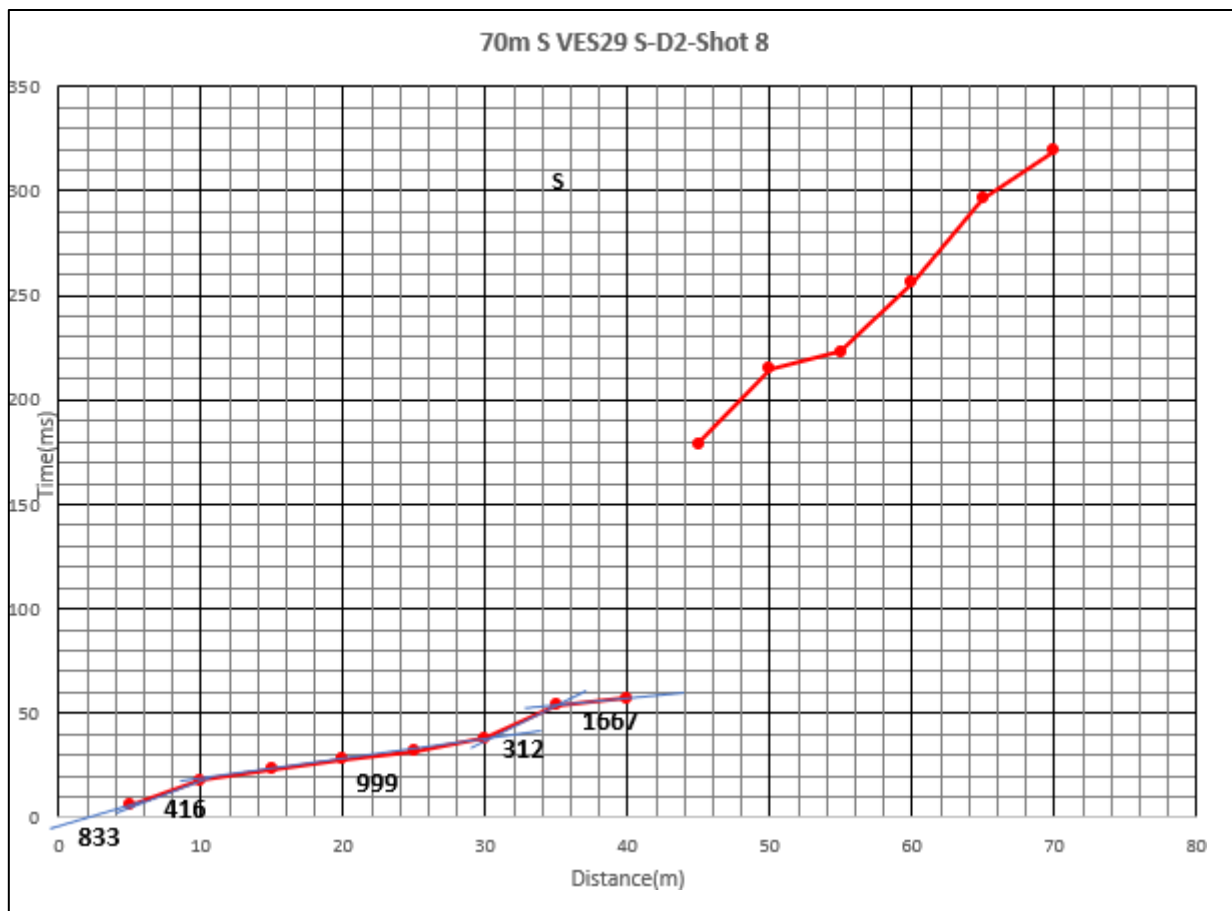


Figure 9.1.6.3.39 seismic hodograph of seismic shot 70m S VES 29-S-D2-Shot 8

• **80m SW of VES48 (16°25'50.27"N, 80°37'26.23"E)**

Four seismic shots were conducted at this location, designated as 85m SW of VES48-E-D1-Shot 1(east direction), 85m SW of VES48-W-D2-Shot 2(west direction), 85m SW of VES48-N-D1- Shot 3(north direction) and 85m SW of VES48-S-D2-Shot 4 (south direction).). The traverse lengths for east, west, north and south directions are 95m, 105m, 90m and 70 m respectively.

• **85m SW of VES48-E-D1-Shot 1**

Interpreted seismic data towards east with 95 m traverse length.

Table 9.1.6.3.56. Interpreted seismic data for shot 85m SW of VES48-E-D1-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.23	0.230	Soil	333.3
0.23-1.53	1.3	Dry Alluvium	299.7
Below 1.53		Dry Alluvium & Sand	526

As in table lithology shows a 3-layer sequence with no characteristic gravel velocity.

P-wave is indicated in geophones spread up to 0–25 m and in rest, from 30-55 m surface waves registered.

- **85m SW of VES48-W-D2-Shot 2**

Interpreted seismic data towards west with a stretch of 105m

Table 9.1.6.3.57. Interpreted seismic data for shot 85m SW of VES48-W-D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.46	0.462	Soil	333.3
0.46-5.32	4.860	Dry Alluvium & Sand	514.0
5.32-10.06	4.738	Gravel/ dry sand	831.9
Below 10.06		Wet Alluvium & sand	1111.1

Three layers in the sedimentary region are identified as in table with gravel/dry sand delineated at a depth of 5.32 m. The P-wave is indicated in 0–35m geophones and in remaining 40-90m recorded surface waves.

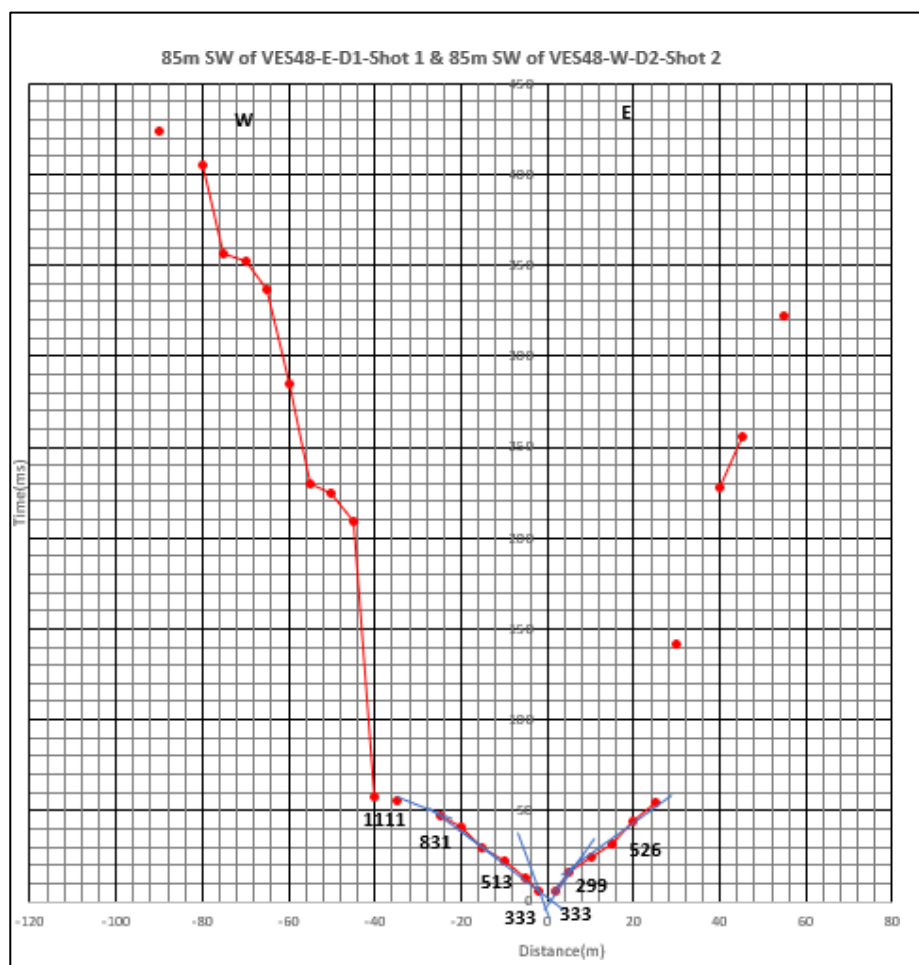


Figure 9.1.6.3.40 seismic hodograph of two shots 85m SW of VES 48-E-D1-Shot 1 and 85 m SW of VES 48-W-D2-Shot 2

- **85m SW of VES48-N-D1- Shot 3**

Interpreted seismic data towards north with 90 m traverse length (forward shot of 70m S VES29 S-D2-Shot 8).

Table 9.1.6.3.58. Interpreted seismic data for shot 85m SW of VES48-N-D1- Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.31	0.317	Soil	333.3
0.31-1.88	1.566	Dry sand	272.5
1.88-7.18	5.303	Dry Alluvium & Sand	624.6
7.18-16.38	9.199	Dry Alluvium & Sand	208.2
16.38-28.36	11.979	Lateritic soil	2500.0
Below 28.36		Dry sand	106.3

Six-layer sequence and the possibility of gravel not detected. The P-wave is indicated in 0–30m geophones and in remaining 40-55m recorded surface waves.

85m SW of VES48-S-D2-Shot 4

Interpreted seismic refraction data towards south on a traverse length of 70m

Table 9.1.6.3.59. Interpreted seismic data for shot 85m SW of VES48-S-D2-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.30	0.301	Soil	333.3
0.30-3.57	3.274	Dry Alluvium & Sand	399.8
3.57-9.7	6.127	Wet Alluvium & Sand	1000.0
9.7-15.6	5.963	Dry Alluvium & Sand	454.1
Below 15.6		Dry Alluvium & Sand	624.6

Gravel bed is not present in this sub surface which has 15.6m thickness.

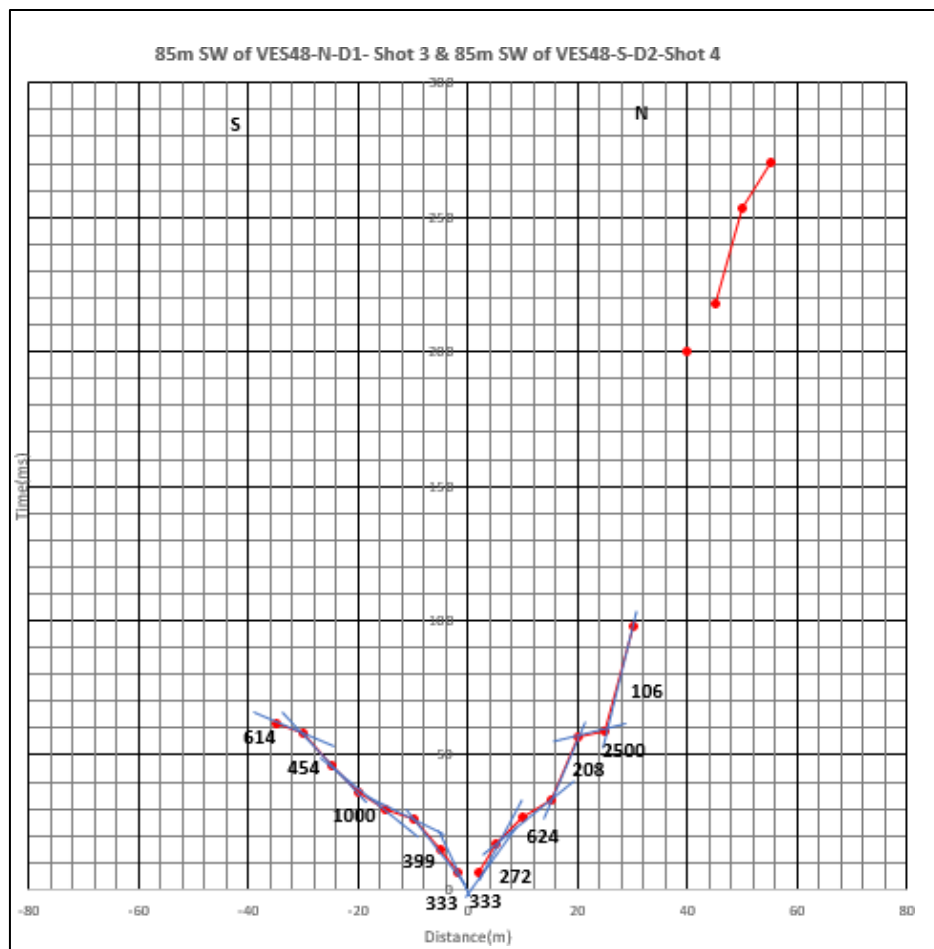


Figure 9.1.6.3.41 seismic hodograph of two shots 85m SW of VES 48-N-D1-Shot 3 and 85 m SW of VES 48-S-D2-Shot 4

- **82m SE of VES48 (16°25'49.41"N, 80°37'30.75"E)**

Four seismic shots were conducted at this location, designated as 84mSE VES48-E-D1-Shot 2(east direction), 84mSE VES48-W-D2-Shot 3(west direction), 84m SE VES48-N-D1-Shot 4(north direction), 84m SE VES 48-S-D2-Shot 5 (South direction). The stretch lengths for the east, west, north and south directions are 75m, 107m, 75m and 101.7 m, respectively.

- **84mSE VES48-E-D1-Shot 2**

Interpreted seismic refraction data towards east on a traverse of 75m. This is forward shot of 155mSE VES48-W-D2-Shot 8.

Table 9.1.6.3.60. Interpreted seismic data for shot 84mSE VES48-E-D1-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.31	0.31	Soil	333.3
0.31-0.88	0.57	Dry Alluvium	272
Below 0.88		Dry Alluvium	302

There is no distinct gravel bed up to a depth of 0.88m. P-wave is indicated in 0–15 m geophone array and in rest of them, 20-60 m, surface waves recorded. Sub surface water accumulated at depth.

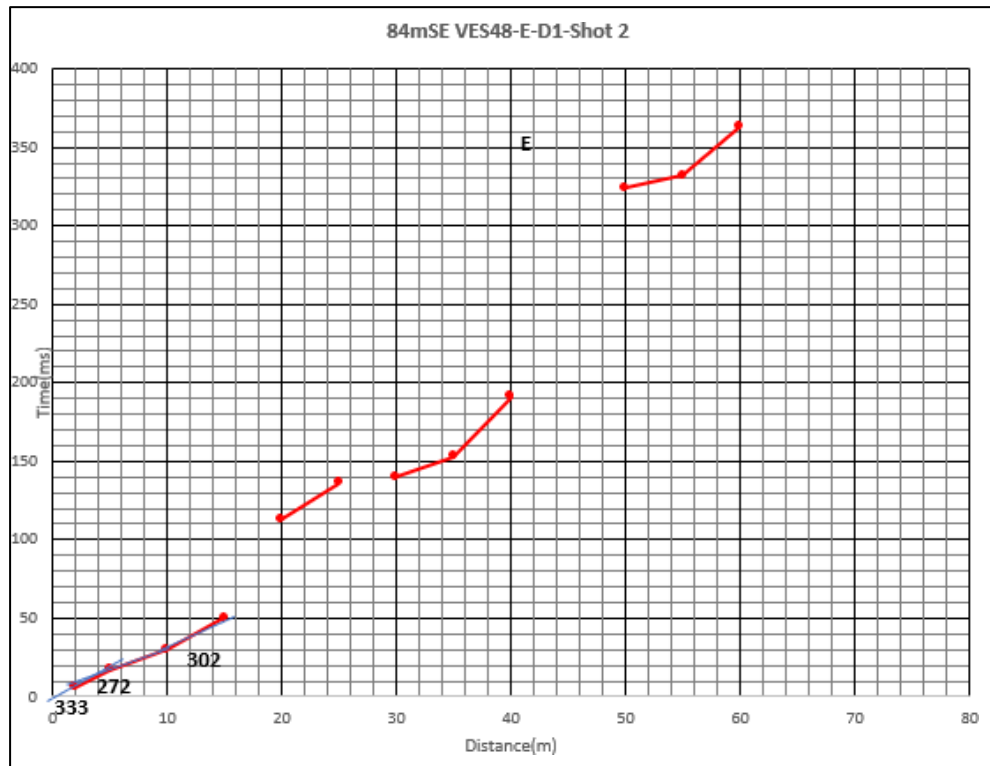


Figure 9.1.6.3.42 seismic hodograph of seismic shot 84m SE of VES 48-E-D1-Shot 2

- **84mSE VES48-W-D2-Shot 3**

Interpreted seismic data towards west direction with a traverse of 107m length.

Table 9.1.6.3.61. Interpreted seismic data for shot 84mSE VES48-W-D2-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.2	0.201	Soil	333.3
0.2-3.8	3.644	Dry Clay	307.5
3.8-8.5	4.689	Dry Alluvium & Sand	666.7
8.5-13.4	4.910	Sand	1250.0
13.4-22	8.884	Dry Alluvium & Sand	624.6
22-29	7.542	Wet Alluvium & Sand	999.0
29-44.7	14.863	Dry Alluvium & Sand	714.3
Below 44.7		Wet clay	1666.7

Gravel bed not present at this sub surface up to 44.7m depth.

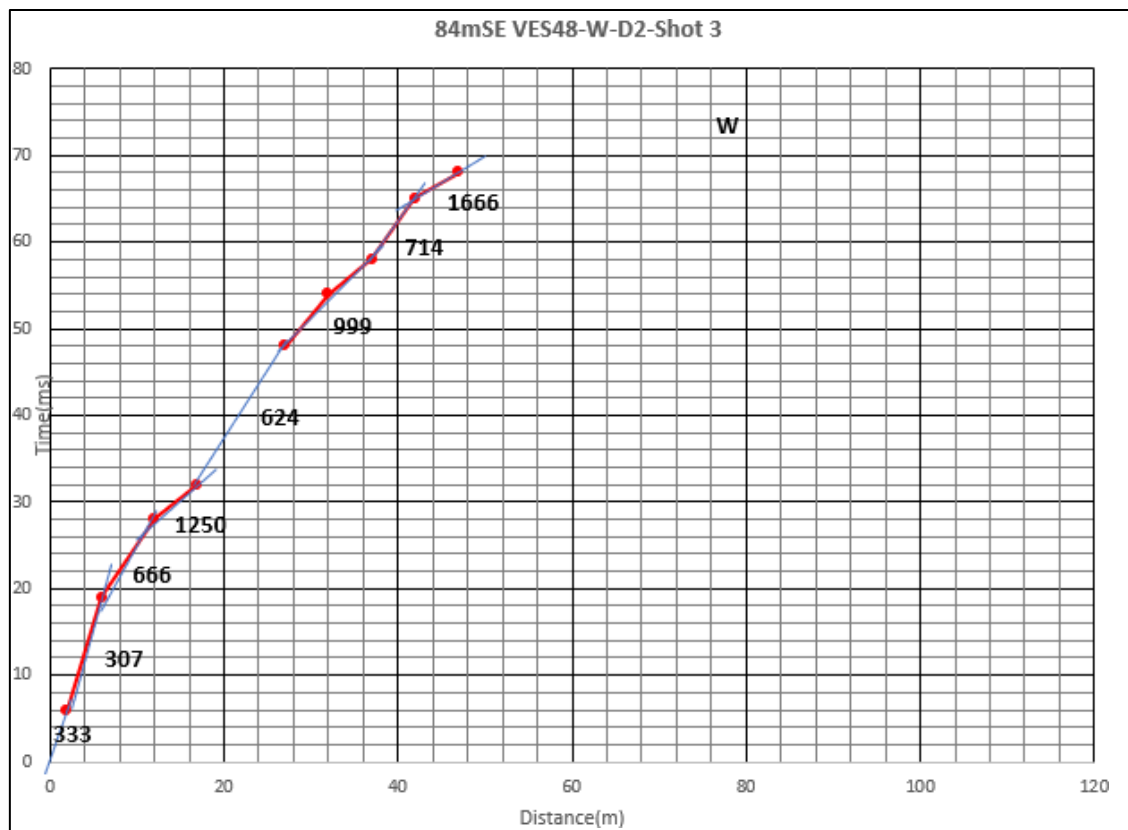


Figure 9.1.6.3.43 seismic hodograph of seismic shot 84m SE of VES 48-W-D2-Shot 3

- **84m SE of VES48-N-D1- Shot 4**

Interpreted seismic data. Traverse towards north with 90m length.

Table 9.1.6.3.62. Interpreted seismic data for shot 84m SE of VES48-N-D1- Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.01	0.014	Soil	333.3
0.01-3.95	3.943	Dry Alluvium	333.1
Below 3.95		Wet Alluvium & Sand	1428.5

There is no distinct gravel bed up to a depth of 3.95 m. P-wave is indicated from 0–20 m, and in rest of them, 25-65 m, surface waves recorded.

- **84m SE of VES48-S-D2-Shot 5**

Interpreted seismic refraction data towards south with a traverse of 70 m length.

Table 9.1.6.3.63. Interpreted seismic data for shot 84m SE of VES48-S-D2-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.41	0.145	Soil	335
0.41-3.6	3.479	Dry Alluvium	347
3.6-4.6	1.055	Wet Alluvium & Sand	1000
Below 4.6		Wet Alluvium & Sand	961

There is no distinct gravel bed up to a depth of 4.6 m. P-wave is indicated from 0–40 m geophone array and in the rest of them, 45-71.7m, surface recorded.

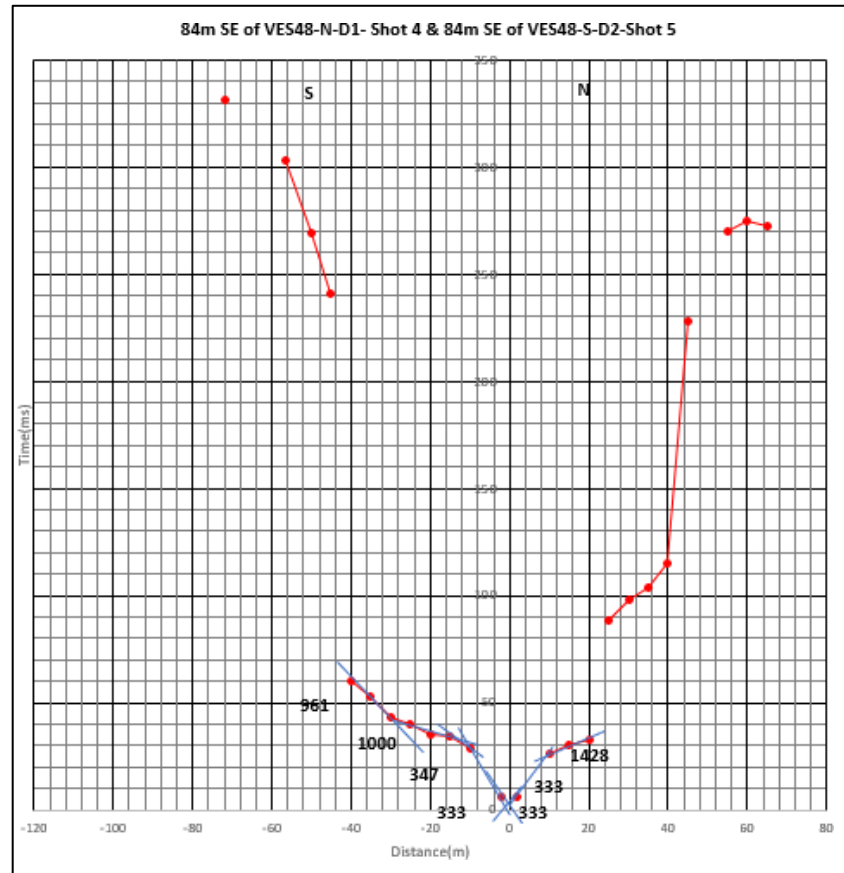


Figure 9.1.6.3.44 seismic hodograph of two shots 84m SE of VES 48-N-D1-Shot 4 and 84m SE of VES 48-S-D2-Shot 5

- **155m SE of VES48 (16°25'48.83"N, 80°37'33.32"E)**

Three seismic shots were conducted at this location, designated as 155m SE VES48-S-D2-Shot 6(South direction), 155m SE VES48-N-D1-Shot 7(north direction), 155mSE VES48-W-D2-Shot 8(west direction). Traverse lengths for west, north and south directions are 80 m, 69.5 m and 100 m respectively.

- **155m SE VES48-S-D2-Shot 6**

Interpreted seismic refraction data towards south on a traverse of 100 m length

Table 9.1.6.3.64. Interpreted seismic data for shot 155m SE VES48-S-D2-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.243	Soil	333.3
0.24-3.8	3.565	Dry Alluvium	296.1
3.8-10.16	6.360	Wet Alluvium & Sand	908.7
10.16-21.17	11.010	Lateritic soil	2142.9
Below 21.17		Khondalite?	4950.5

Gravel bed not present in this 5-layer subsurface up to 21.17m depth. P-wave is indicated from 0–40 m geophone array and in rest of the geophones, 50-95 m, surface waves recorded.

- **155m SE VES48-N-D1-Shot 7**

Interpreted seismic refraction data towards north on the traverse of 69.5 m length.

Table 9.1.6.3.65. Interpreted seismic data for shot 155m SE VES48-N-D1-Shot 7

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.58	0.584	Soil	500.0
0.58-5.14	4.564	Dry Alluvium	368.5
5.14-13.41	8.265	Dry Sand	165.4
13.41-22.7	9.304	Wet Alluvium & Sand	980.0
Below 22.7		Dry Alluvium	263.0

There is no distinct gravel bed up to a depth of 22.7 m. The P-wave is indicated from 0–29.5 m geophone array and in rest of the geophones 34.5-59.5m surface waves recorded.

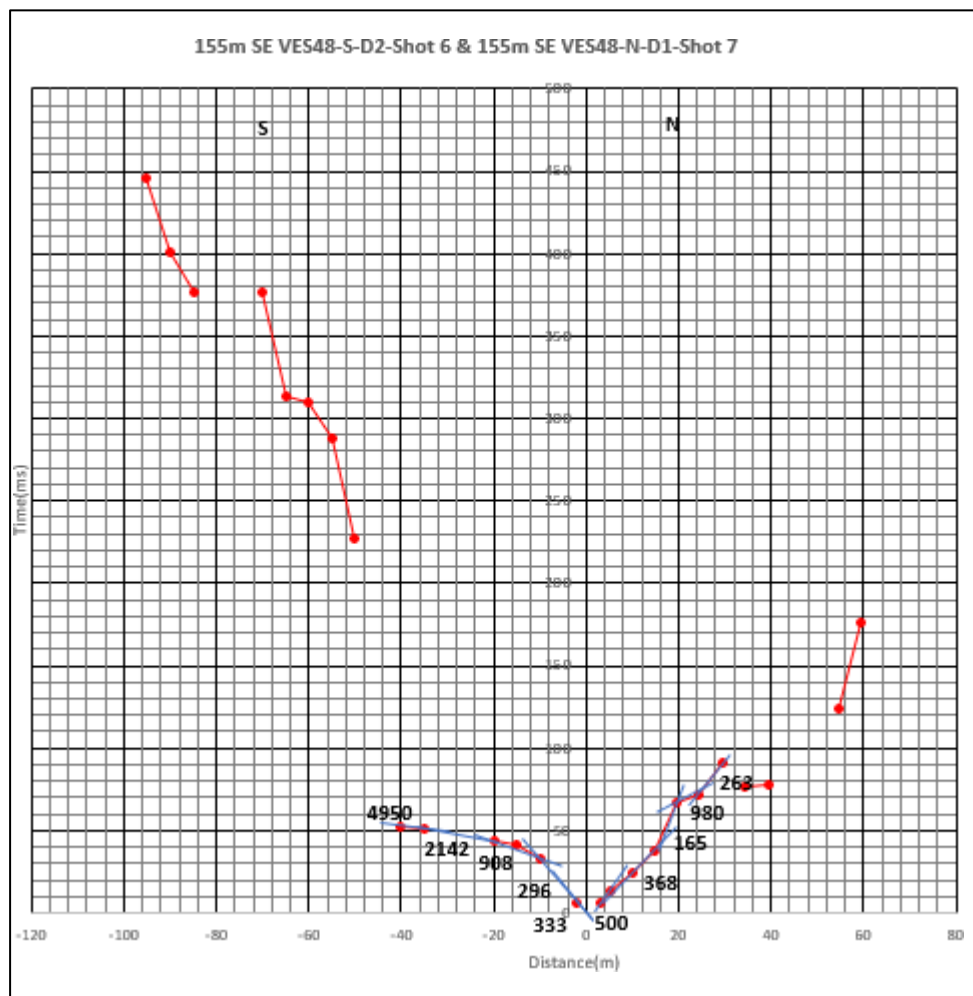


Figure 9.1.6.3.45 seismic hodograph of two shots 155m SE of VES 48-S-D2-Shot 6 and 155m SE of VES 48-N-D1-Shot 7

- **155mSE VES48-W-D2-Shot 8**

Interpreted seismic refraction data towards west on the traverse of 80 m length.

Table 9.1.6.3.66. Interpreted seismic data for shot 155mSE VES48-W-D2-Shot 8

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.68	0.686	Soil	333.3
0.68-3.04	2.354	Dry sand	119
Below 3.04		Lateritic soil	2000

There is no distinct gravel bed up to a depth of 3.04 m depth. P-wave is indicated from 0–25 m geophone array and in rest of geophones, 35-80 m array, surface waves recorded.

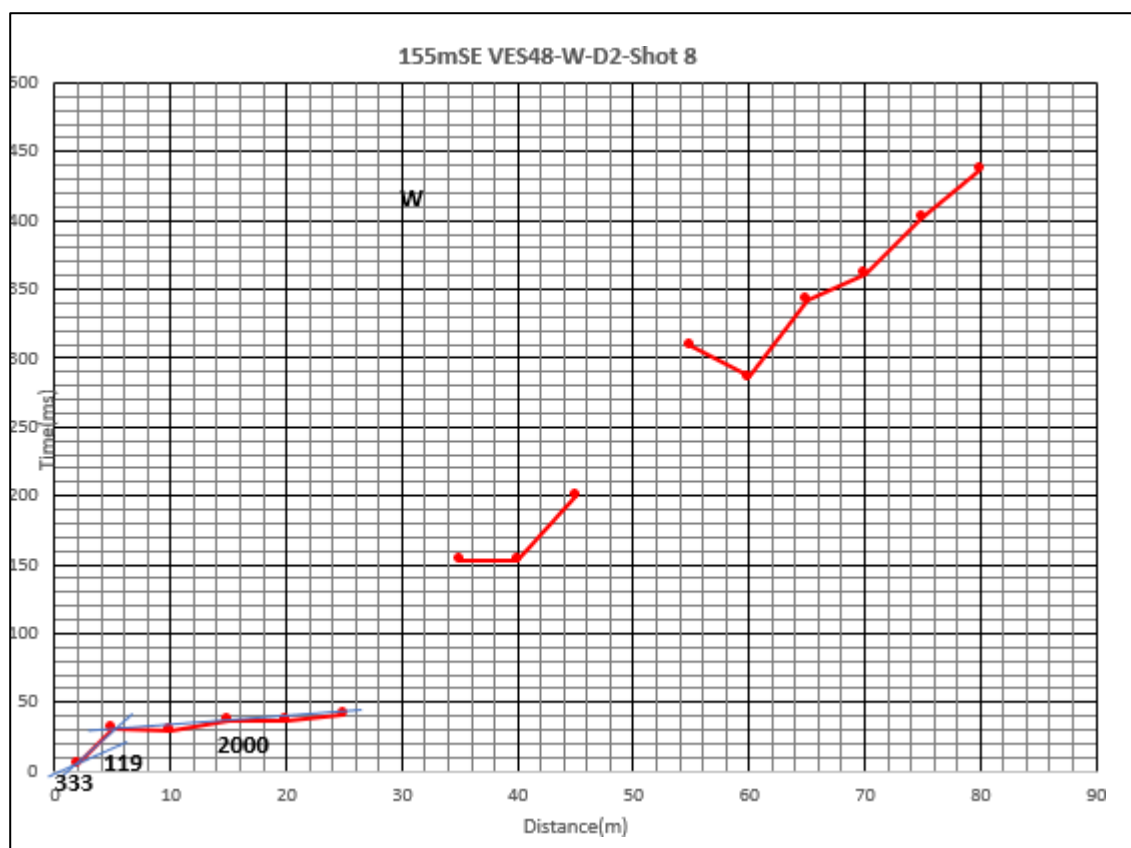


Figure 9.1.6.3.46 seismic hodograph of seismic shot 155m SE of VES 48-W-D2-Shot 8

Centre of the block

Seismic survey conducted at two locations which are named as 28m S of VES4(16°26'1.00"N, 80°37'38.79"E) and 108m N of VES4(16°26'5.05"N, 80°37'40.11"E) towards north of Mellampudi village.

- **28m S of VES4 (16°26'1.00"N, 80°37'38.79"E)**

Three seismic shots were conducted at this location, designated as southeastern spread, south western spread and south southern spread. The traverse lengths for south east, south west and south - south directions are 120m, 120m and 120m respectively.

- **Southeastern Spread** - interpreted seismic refraction data

Table 9.1.6.3.67. Interpreted seismic data for shot 28m S of VES4-SE

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.870	Soil	264.9
0.8-8.2	7.361	Wet Clay	1919.0
8.2-16.8	8.576	Dry Alluvium & Sand	570.1
16.8-27.6	10.887	Wet clay	1583.9
27.6-38.4	10.751	Gravel/ dry sand	859.8
38.4-54.4	15.982	Wet Alluvium & Sand	1250.0
54.4-73.8	19.443	Dry Alluvium & Sand	618.8
73.8-92.9	19.063	Wet clay	1515.2
92.9-118.3	25.414	Dry Alluvium & Sand	892.9
Below 118.3		Wet Alluvium & Sand	1886.8

Gravel zone is located at 27.6 m to 38.4 m depth in this 10 layered lithological set up.

- **Southwestern Spread** - interpreted seismic refraction data

Table 9.1.6.3.68. Interpreted seismic data for shot 28m S of VES4-SW

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.81	0.811	Soil	452.5
0.81-3.5	2.769	Lateritic soil	2191.8
3.5-8.8	5.243	Wet Alluvium & Sand	1162.8
8.8-15.5	6.720	Dry Alluvium & Sand	661.4
15.5-25.1	9.605	Wet Alluvium & Sand	1199.0
25.1-45.1	20.041	Dry Alluvium & Sand	749.6
45.1-58.3	13.140	Wet clay	1669.4
58.3-90.1	31.855	Lateritic soil	2136.8
90.1-116	26.755	Dry Alluvium & Sand	599.5
Below 116		Dry Alluvium	286.4

Gravel zone not detected in these 10 layered sub surfaces interpreted up to 116m depth.

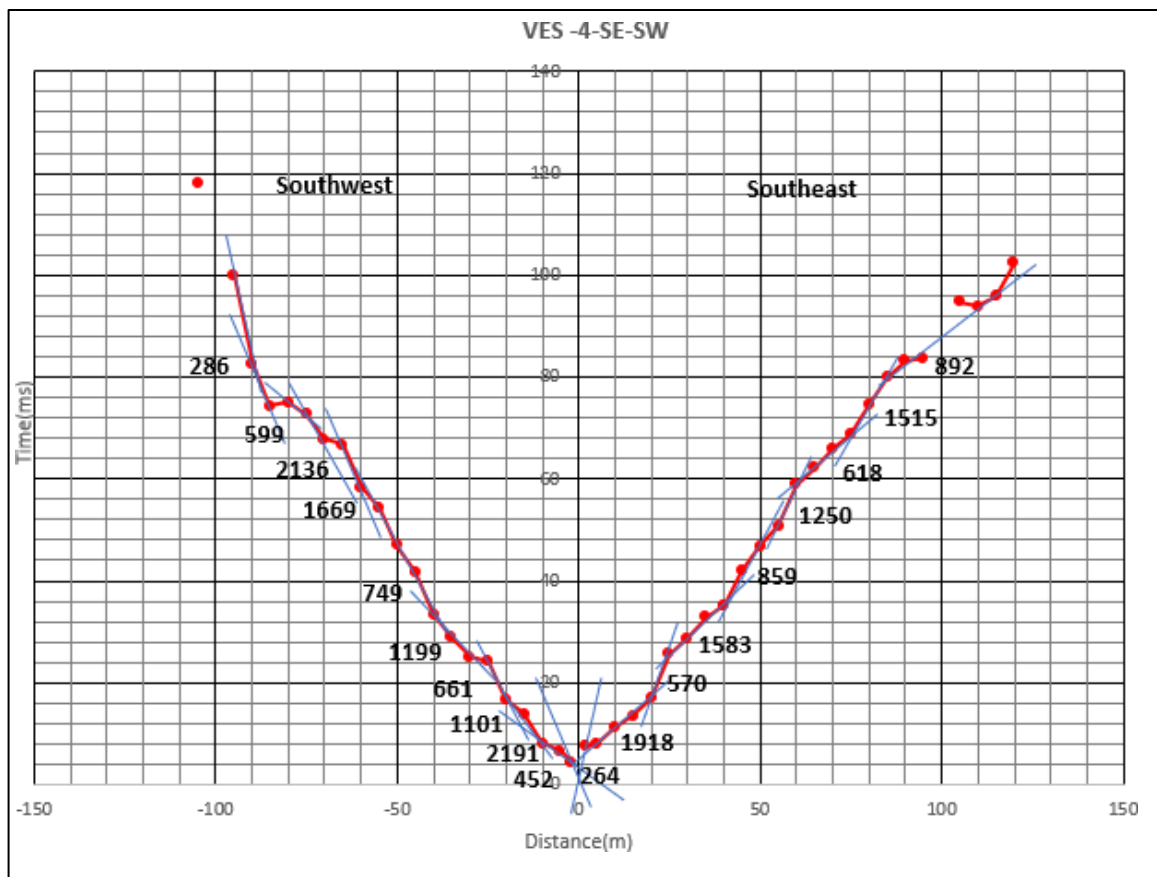


Figure 9.1.6.3.47 seismic hodograph of two shots 28m S of VES4 -SE and 28m S of VES4-SW

- **South-Southern Spread** - interpreted seismic refraction data

Table 9.1.6.3.69. Interpreted seismic data for shot 28m S of VES4-SS

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.78	0.787	Soil	232.83
0.78-3.8	3.020	Wet Alluvium&Sand	990.10
3.8-12.3	8.591	Lateritic soil	2127.66
12.3-26.8	14.452	Wet Alluvium&Sand	1301.24
26.8-44.5	17.673	Dry Alluvium	408.50
44.5-66.5	21.978	Wet Alluvium&Sand	983.28
66.5-101.2	34.722	Wet Clay	1599.36
Below 101.2		Dry Alluvium&Sand	558.66

Gravel not identified up to 101.2m depth in these 8 layered sub surfaces

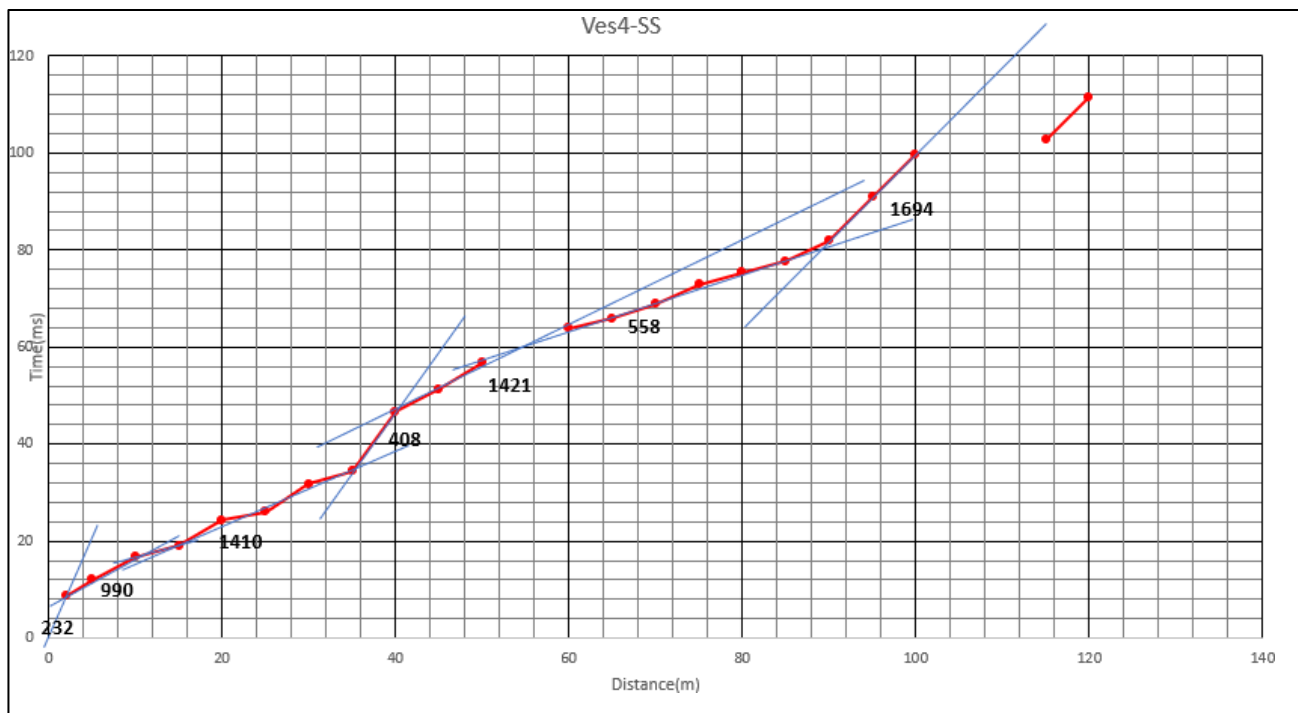


Figure 9.1.6.3.48 seismic hodograph of seismic shot 28m S of VES4-SS

- **108m N of VES4** (16°26'5.05"N, 80°37'40.11"E)

Seismic survey was conducted towards northern part of Mellampudi area and in multiple directions—with traverses north 122.2 m, south 120 m, east 120 m and west 120 m. The objective was to delineate the litho units for tracing gravel beds.

Spread towards east direction - interpreted seismic refraction data

Table 9.1.6.3.70. Interpreted seismic data for shot 108m N of VES4-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.02	0.02	Soil	256.4
0.02-7.7	7.69	Wet Alluvium & Sand	1336.4
7.7-15.35	7.65	Dry Alluvium & Sand	603.1
15.35-29.5	14.19	Wet Alluvium & Sand	1027.4
29.5-52.3	22.79	Lateritic Soil	2384.7
52.3-75.8	23.52	Dry Alluvium & Sand	639.4
Below 75.8		Lateritic Soil	2045.0

Gravel layer not identified in these 7 layered strata.

Western Spread

Table 9.1.6.3.71. Interpreted seismic data for shot 108m N of VES4-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.877	Soil	170.9
0.8-18.6	17.793	Wet Alluvium & Sand	1311.9
18.6-38.8	20.194	Dry Alluvium & Sand	537.6
38.8-62.63	23.768	Wet Alluvium & Sand	1428.6
Below 62.6		Dry Alluvium & Sand	609.8

Gravel layer not identified in these 5 layered strata.

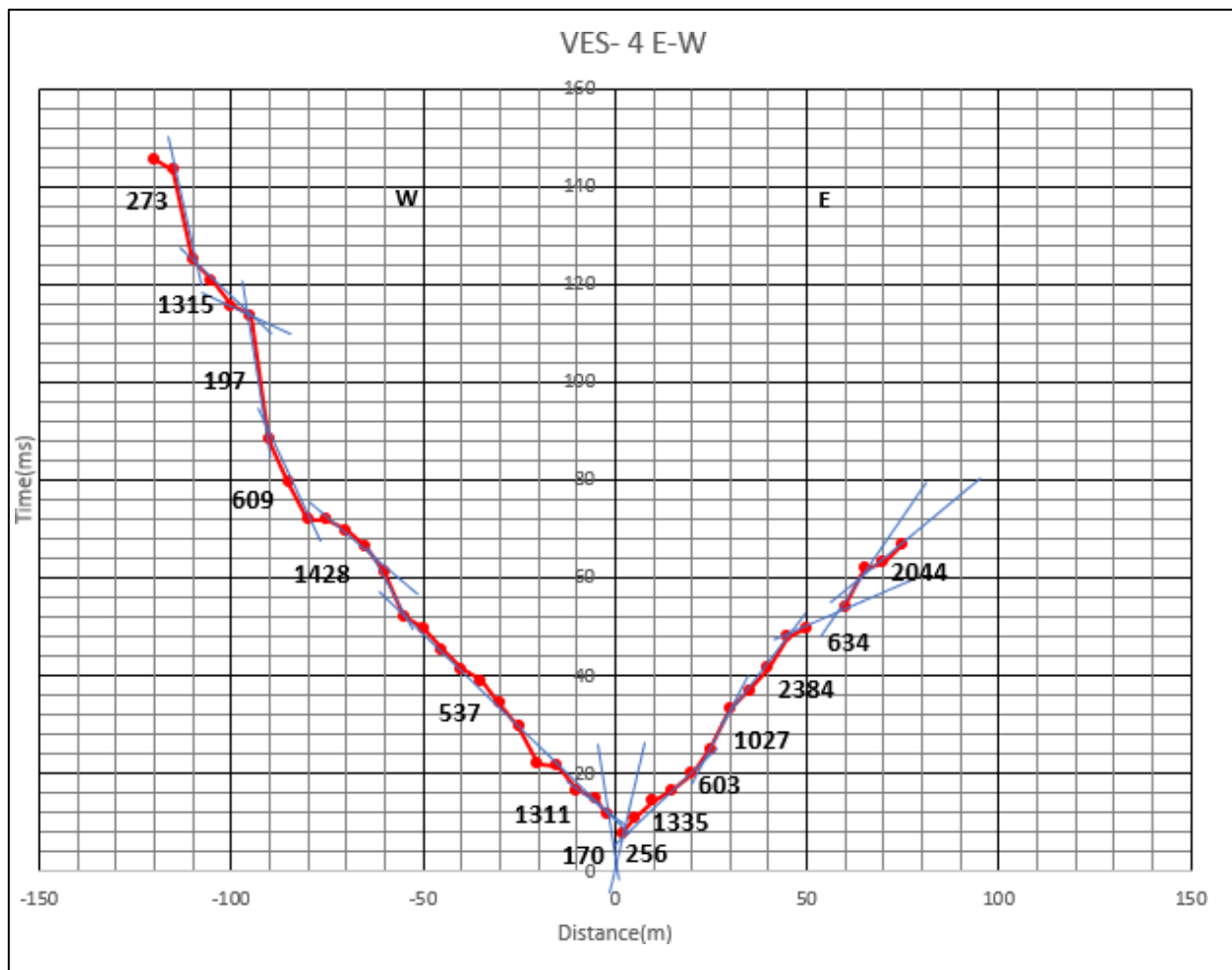


Figure 9.1.6.3.49 seismic hodograph of two shots 108m N of VES4 -E and 108m N of VES4 -W

Northern Spread

Table 9.1.6.3.72. Interpreted seismic data for shot 108m N of VES4-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.885	Soil	248.1
0.8-3.8	2.960	Lateritic soil	2046.0
3.8-16	12.156	Wet Alluvium & Sand	983.9
16-33.3	17.306	Lateritic soil	2136.8
33.3-51.1	17.867	Dry Alluvium & Sand	548.2
51.1-72.3	21.147	Wet Compact Clay	1693.0
Below 72.3		Dry Alluvium & Sand	685.9

Gravel not detected down to 72.3m subsurface with in its characteristic velocity range

Southern Spread- interpreted seismic refraction data

Table 9.1.6.3.73. Interpreted seismic data for shot 108m N of VES4-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.87	0.879	Soil	256.4
0.87-2.5	1.634	Wet Compact Clay	1993.9
2.5-4.74	2.234	Dry Alluvium & Sand	800.0
4.74-8.7	4.028	Wet Alluvium & Sand	1199.0
8.7-16.7	7.994	Dry Alluvium & Sand	662.3
16.7-29.2	12.504	Wet Alluvium & Sand	914.1
29.2-41.7	12.508	Dry Alluvium & Sand	548.2
Below 41.7		Gravel/ dry sand	834.3

Gravel bed is present below 41.7 m depth.

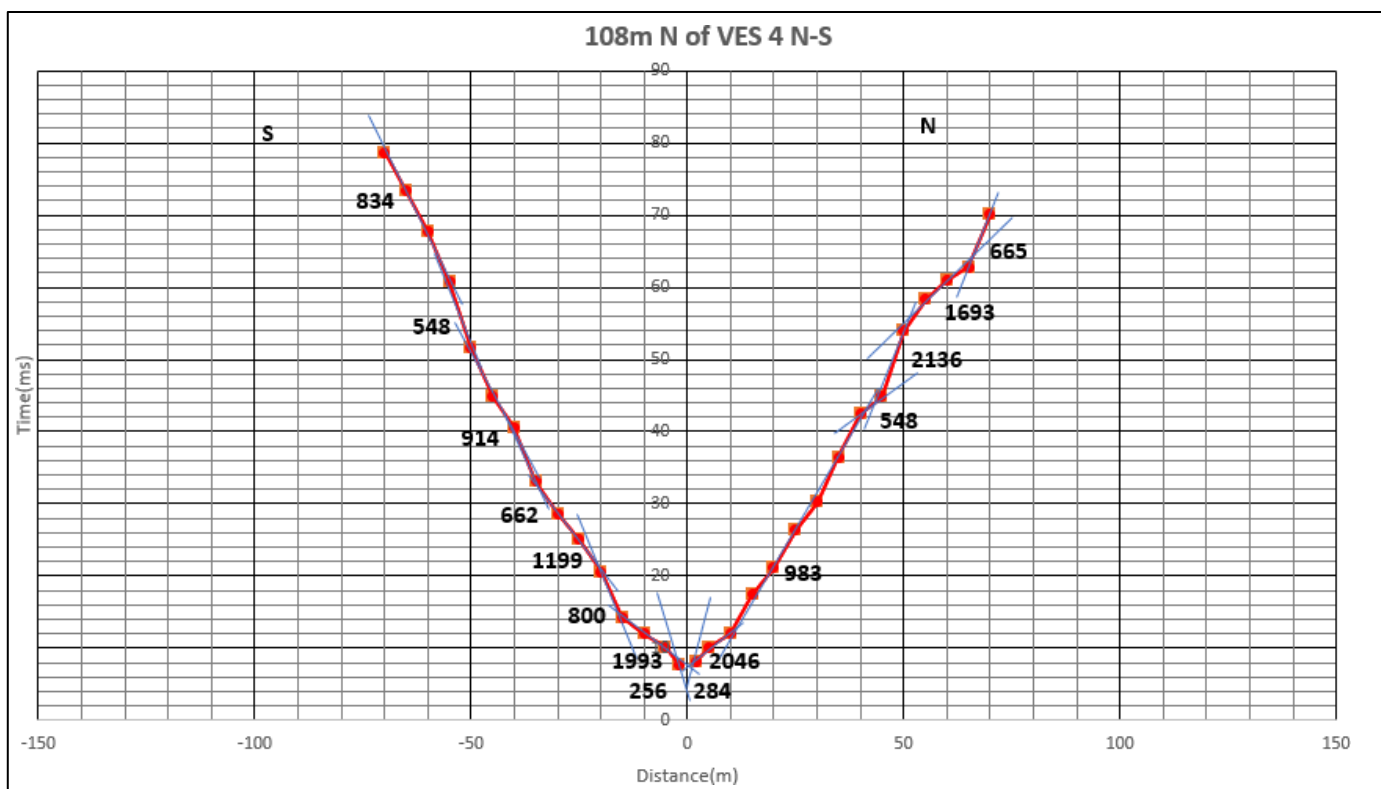


Figure 9.1.6.3.50 seismic hodograph of two shots 108m N of VES4 -N and 108m N of VES4 -S
 Seismic survey conducted centre of the area and towards north east of Mellampudi village at two locations. They are named as 2m N of VES40 at 16°25'47.58"N, 80°37'42.65"E, 71m SE of VES40 16°25'45.53"N, 80°37'43.80"E with respect to the latitude and longitude.

- **2m N of VES40 (16°25'47.58"N, 80°37'42.65"E)**

Three seismic shots were conducted at this location, designated as VES40-N-D1-Shot 1(north direction), VES40-W-D2-Shot 2(west direction) and VES40-E-D1-Shot 3 (east direction). The traverse lengths for the east, west and north directions are 80 m, 100m and 90.1 m, respectively.

- **VES40-N-D1-Shot 1**

Interpreted seismic refraction data towards north on the 90.1m traverse.

Table 9.1.6.3.74. Interpreted seismic data for shot VES40-N-D1-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.44	0.447	Soil	333.3
0.44-1.4	1.022	Dry Alluvium & Sand	500.0
Below 1.4	6.982	Dry clay	356.9

Gravel bed not present with in these sub-strata. Limited penetration and attenuation of P-wave due to water accumulation is observed. P-wave is indicated from 0–20 m, and in rest of geophones, 25–80.1 m, surface waves recorded.

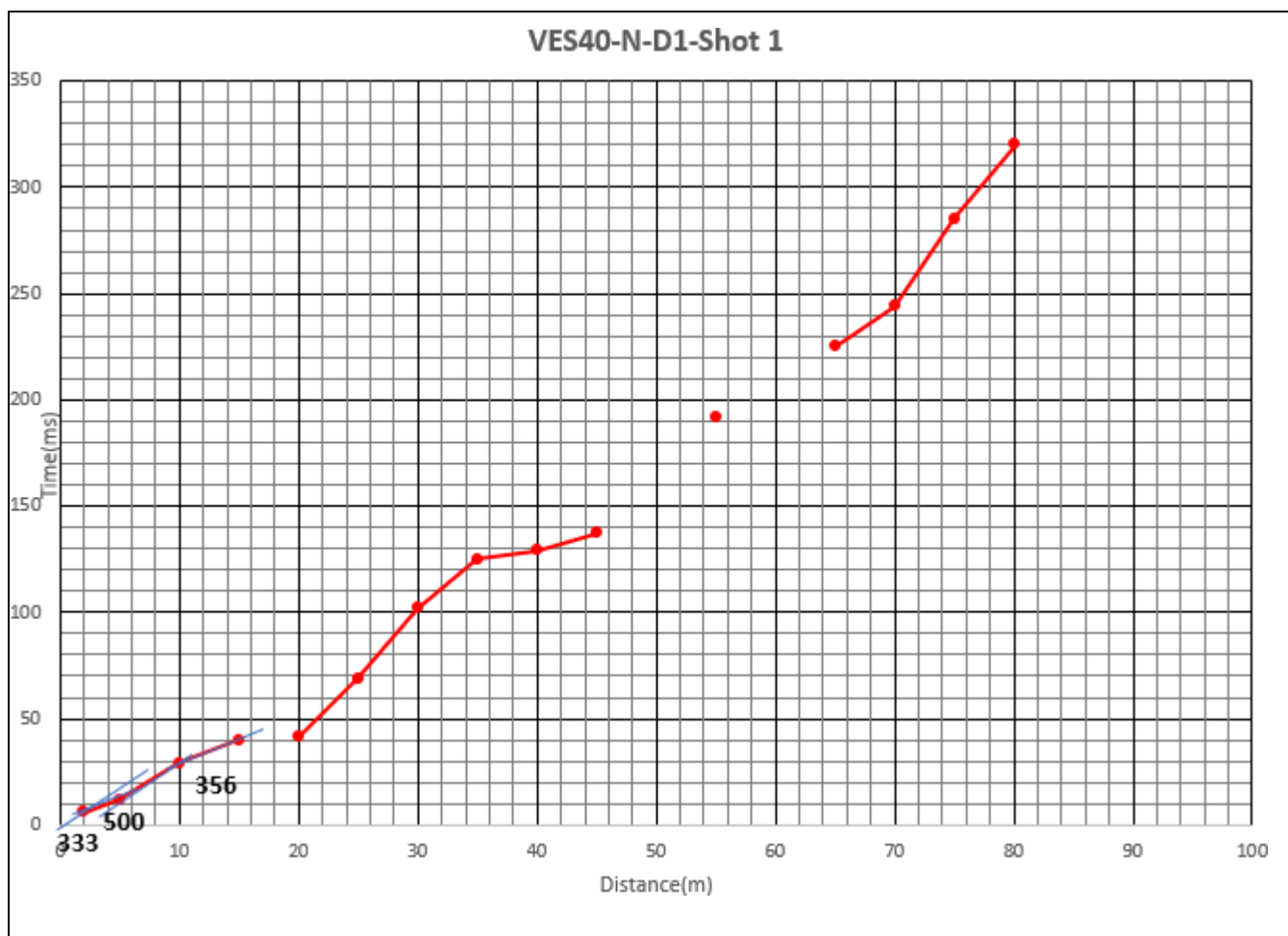


Figure 9.1.6.3.51 seismic hodograph of seismic shot VES 40-N-D1-Shot 1

- **VES40-W-D2-Shot 2** - Interpreted seismic refraction data on the traverse of 100m length.

Table 9.1.6.3.75. Interpreted seismic data for shot VES40-W-D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.53	0.535	Soil	333.3
0.53-1.93	1.403	Dry Alluvium & Sand	600.0
1.93-4.94	3.005	Dry Alluvium	312.5
4.94-12.5	7.612	Dry Alluvium & Sand	665.8
12.5-25.4	12.847	Lateritic Soil	2500.0
Below 25.4		Dry Alluvium	384.3

A gravel bed not present down to 25.4m depth.

P-wave is indicated from 0–40 m geophone array. In rest of them, 45–90 m, surface waves recorded

- **VES40-E-D1-Shot 3**

Interpreted seismic refraction data towards east on the traverse of 80m length.

Table 9.1.6.3.76. Interpreted seismic data for shot VES40-E-D1-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.24	Soil	333.3
0.24-1.28	1.05	Dry Alluvium	374.5
1.28-8.7	4.50	Dry Alluvium	263.0
8.7-11.4	5.71	Lateritic soil	2500.0
11.4-20.4	9.05	Dry Alluvium & Sand	666.2
20.4-36.3	15.76	Dry Alluvium	208.2
Below 36.3		Wet Compact Clay	1996

Gravel bed not present down to 36.3m depth. P-wave is indicated from 0–45 m geophone array and in rest of them, 50-75 m, surface waves recorded.

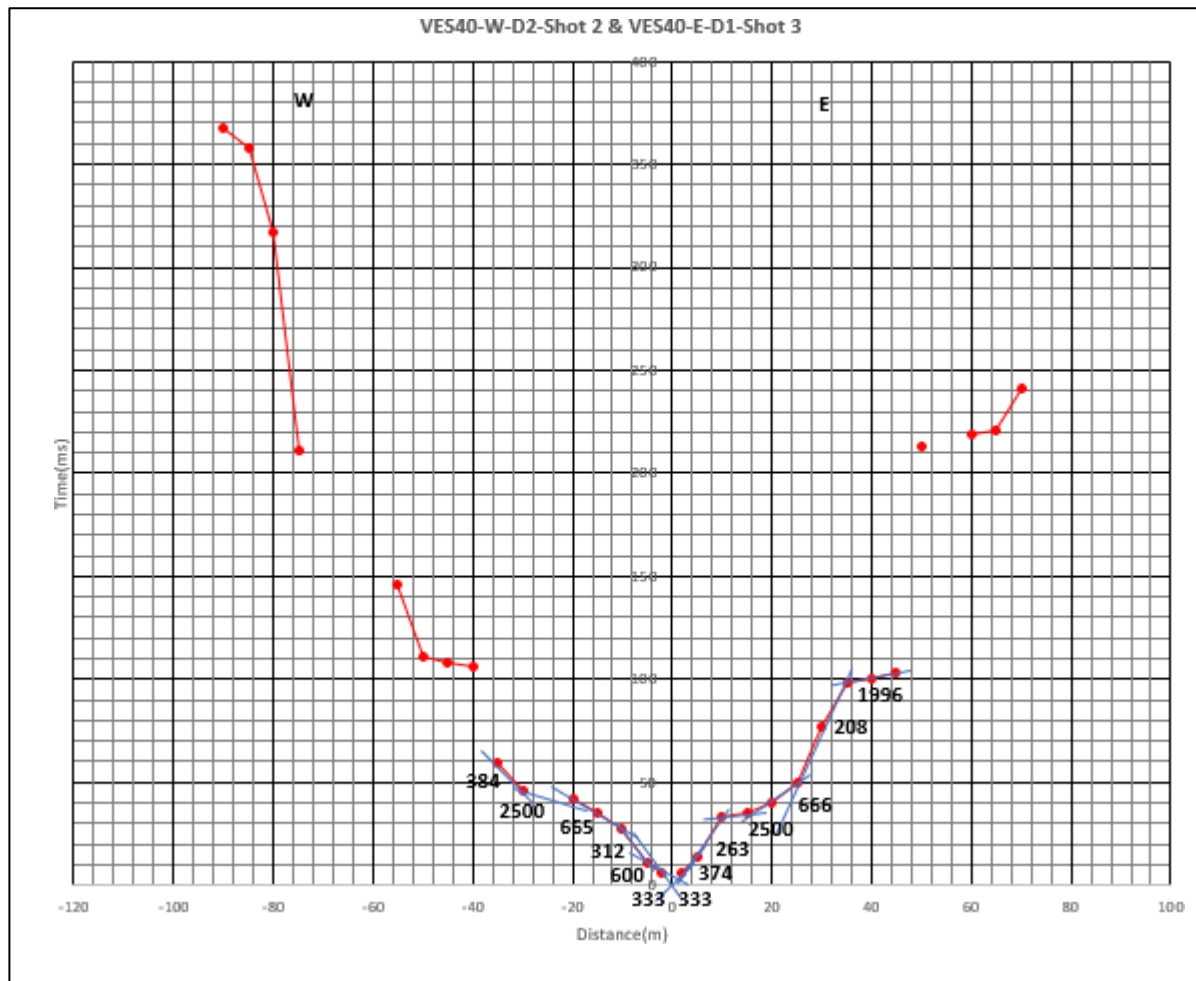


Figure 9.1.6.3.52 seismic hodograph of two shots VES 40-W-D2-Shot 2 and VES 40-E-D1-Shot 3

- 71m SE of VES40 (16°25'45.53"N, 80°37'43.80"E)

Four seismic shots were conducted at this location which are designated as 70m SE of VES40-S-D2-Shot 4(south direction), 70m SE of VES40-W-D1-Shot 5(west direction), 70m SE of VES40-N-D2-Shot 6(north direction) and 70m SE of VES40-E-D1-Shot 8(east direction). The traverse lengths for east, west, north and south directions are 90 m, 90m, 90 m and 105 m respectively.

- **70m SE of VES40-S-D2-Shot 4**

Interpreted seismic refraction data towards south with a traverse of 105 m length

Table 9.1.6.3.77. Interpreted seismic data for shot 70m SE of VES40-S-D2-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.2	0.207	Soil	333
0.2-2.49	2.287	Dry Alluvium	363
2.49-8.95	6.460	Dry Alluvium & sand	555
8.95-22.4	13.478	Lateritic soil	3750
Below 22.4		Dry Alluvium	399

Gravel bed not present down to 22.4m depth. P-wave is indicated from 0–40 m geophone array and in rest of them, 45-105 m, surface waves recorded.

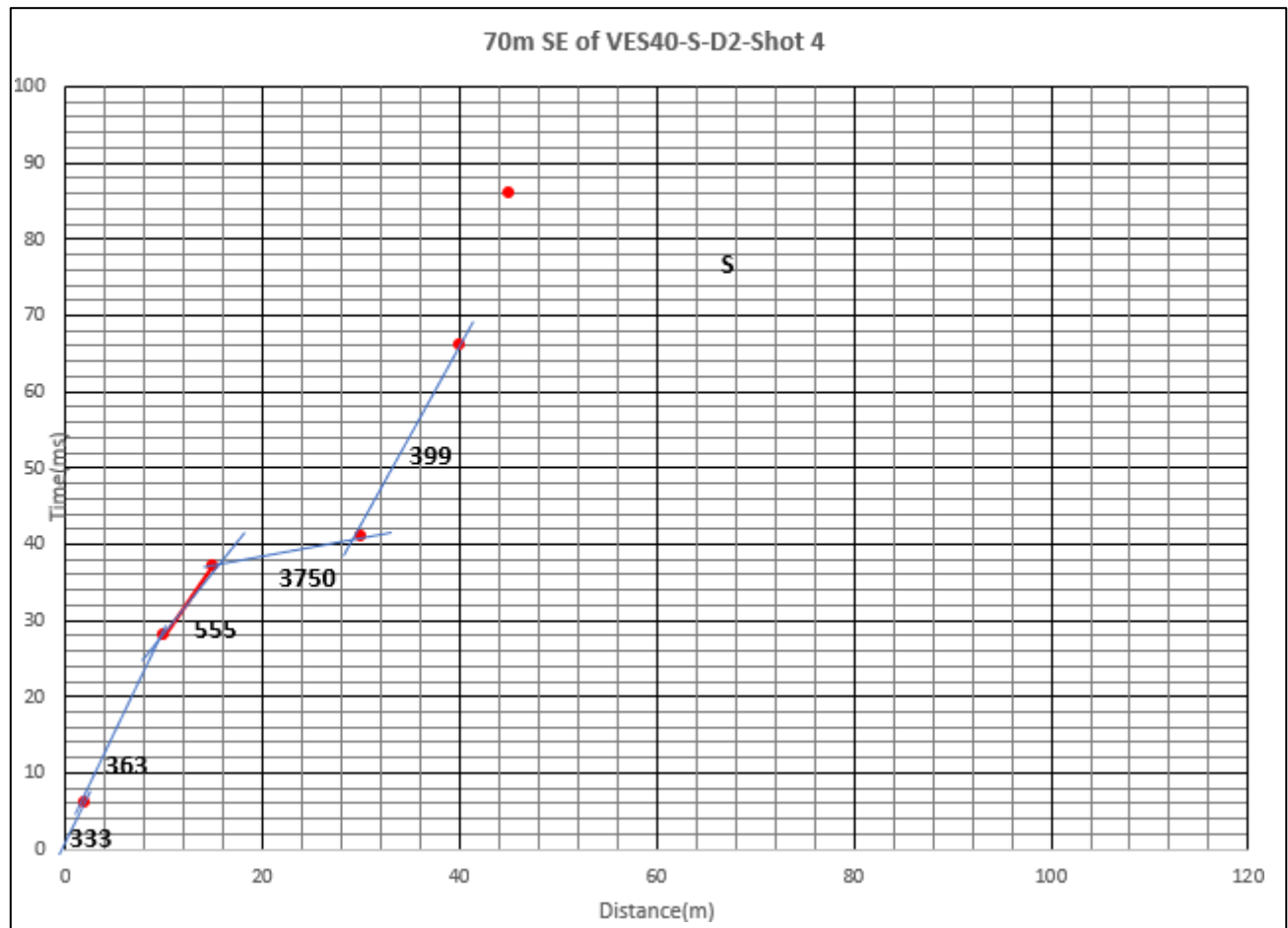


Figure 9.1.6.3.53 seismic hodograph of seismic shot 70m SE of VES 40-S-D2-Shot 4

70m SE of VES40-W-D1-Shot 5- Interpreted seismic refraction data towards west on the traverse of 90 m length

Table 9.1.6.3.78. Interpreted seismic data for shot 70m SE of VES40-W-D1-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.243	Soil	333
0.24-3.45	3.214	Dry Alluvium	296
3.45-7.75	4.303	Dry Alluvium & sand	713
Below 7.75		Dry Alluvium	359

Gravel bed not present in these 4-layer subsurface down to 7.75m. P-wave is indicated from 0–25 m geophone array and in rest of them, 30-45 m, surface waves recorded.

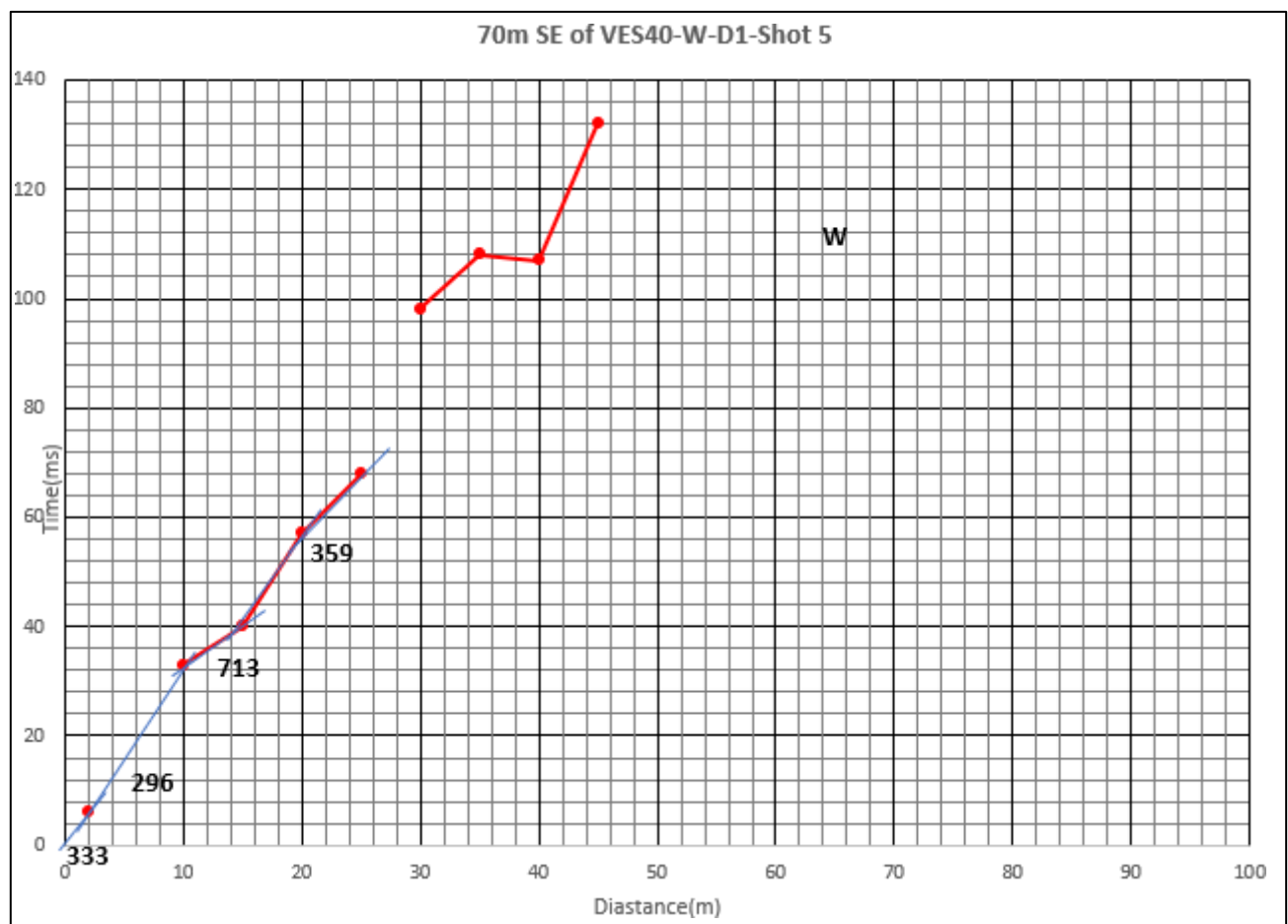


Figure 9.1.6.3.54 seismic hodograph of seismic shot 70m SE of VES 40-W-D1-Shot 5

- **70m SE of VES40-N-D2-Shot 6**

Interpreted seismic refraction data towards north on a traverse of 90 m length.

Table 9.1.6.3.79. Interpreted seismic data for shot 70m SE of VES40-N-D2-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.31	0.32	Soil	333
0.31-2.32	2.00	Dry Alluvium &sand	272
2.32-5.95	3.64	Wet Alluvium &sand	1250
5.95-11.53	5.57	Dry Alluvium	384
Below 11.53		Wet Alluvium &sand	1332

There is no distinct gravel bed up to a depth of 11.53 m.

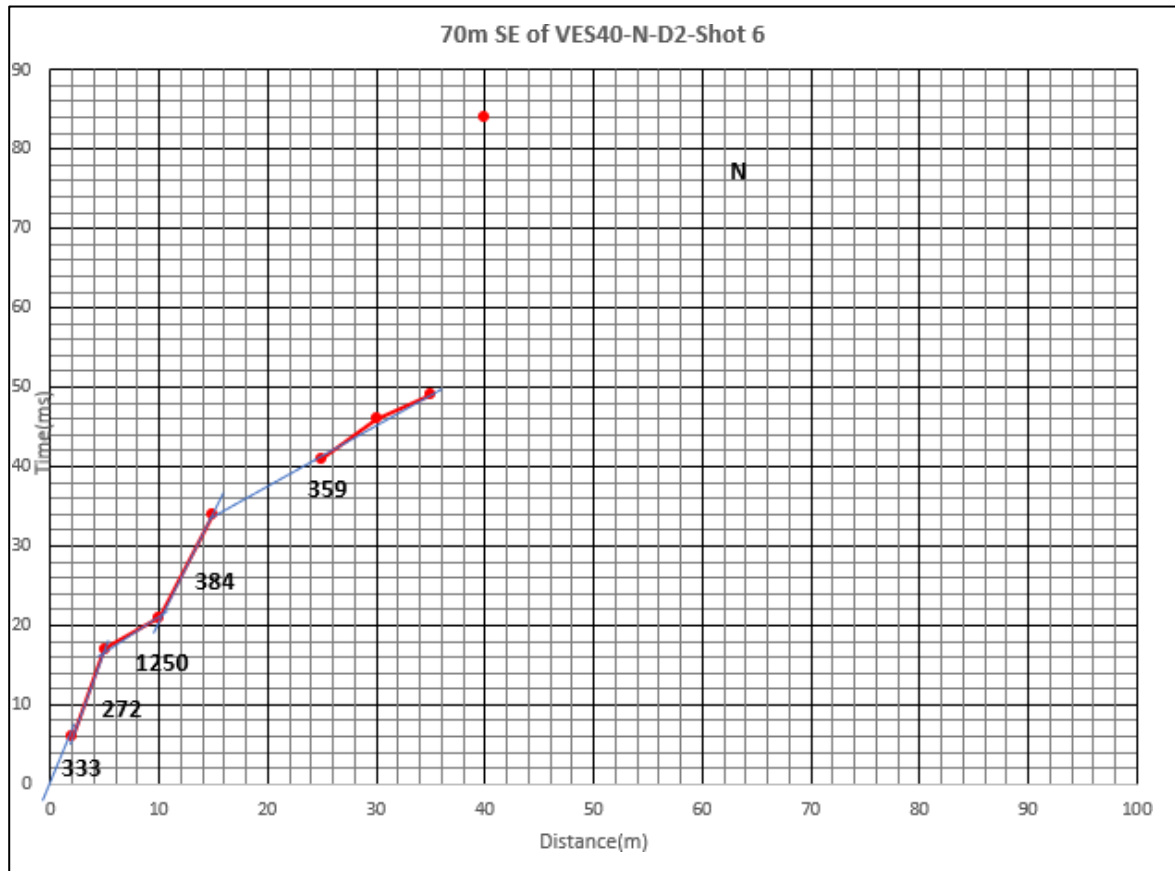


Figure 9.1.6.3.55 seismic hodograph of seismic shot 70m SE of VES 40-N-D2-Shot 6

- **70m SE of VES40-E-D1-Shot 8**

Interpreted seismic refraction data towards east on a traverse of 90 m length.

Table 9.1.6.3.80. Interpreted seismic data for shot 70m SE of VES40-E-D1-Shot 8

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.14	0.144	Soil	333
0.14-2.22	2.082	Dry Alluvium	319
2.22-9.25	7.029	Dry Alluvium	454
Below 9.25		Dry Alluvium	153

Gravel bed is absent down to 9.25m depth. P-wave is indicated from 0–20 m geophone array. From 25–80 m geophone recorded surface waves.

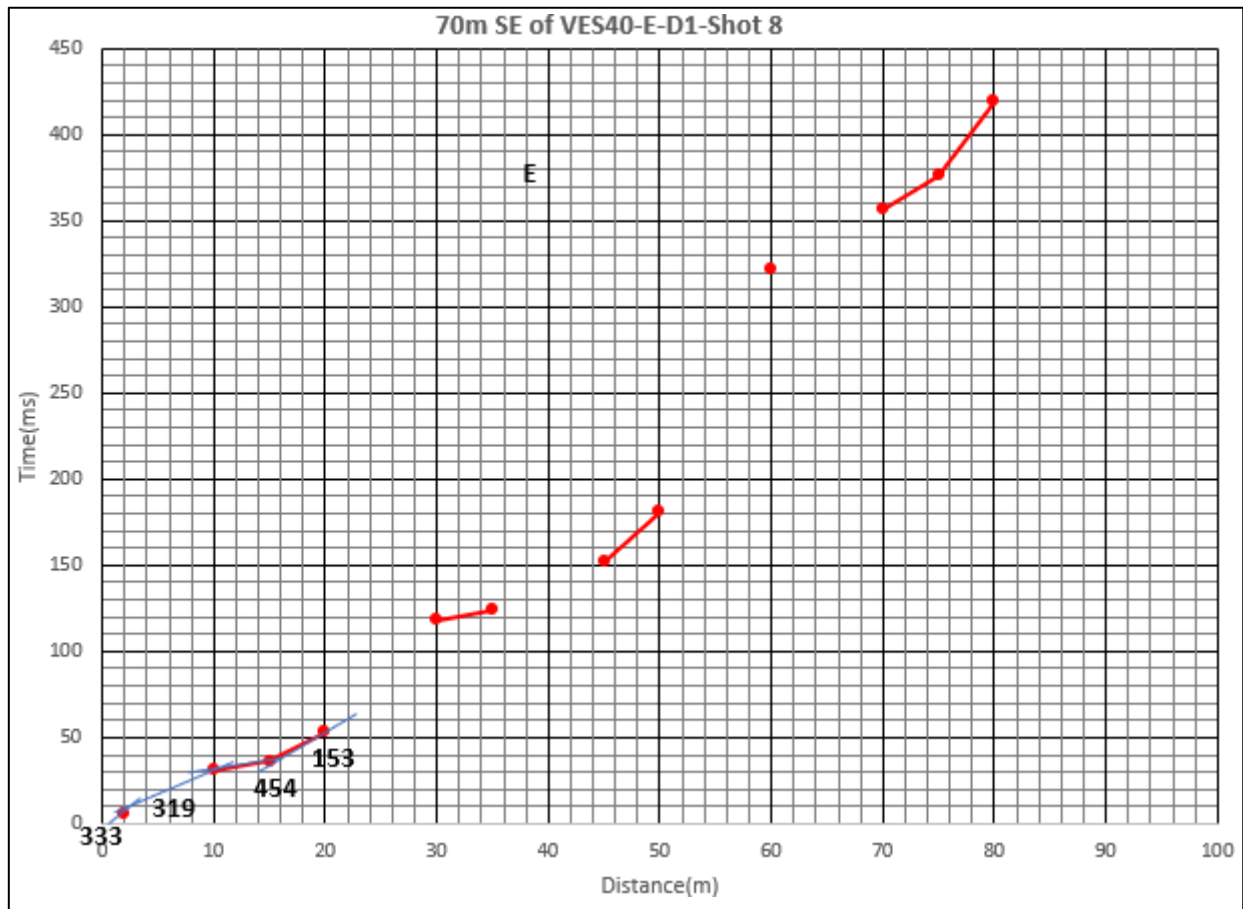


Figure 9.1.6.3.56 seismic hodograph of seismic shot 70m SE of VES 40-E-D1-Shot 8

East of the area towards north east of Mellampudi village, survey conducted at two locations which are named as 35m N of VES32(16°25'46.27"N, 80°38'21.22"E), 57m E of VES32 (16°25'45.00"N, 80°38'22.71"E)

- **35m N of VES32** (16°25'46.27"N, 80°38'21.22"E) -Two seismic shots were conducted at this location, using a split-spread configuration along east–west (VES 28 W 24 E–W) and north–south (VES 28 W 24 N–S) directions. Traverse lengths for the east, west, north and south directions are 55 m, 55m, 55m and 55 m, respectively.

East–West Spread: Interpreted seismic refraction data towards east direction on 55m traverse

Table 9.1.6.3.81. Interpreted seismic data for shot 35m N of VES32-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.59	0.594	Soil	166
0.59-2.42	1.829	Dry Clay	348
2.42-7.42	5.007	Wet Alluvium &sand	1152
7.42-14.13	6.704	Wet Alluvium &sand	1923
14.13-23.43	9.300	Wet Alluvium &sand	1063
23.43-34.2	10.792	Lateritic soil	2392
34.2-42.94	8.719	Wet Alluvium &sand	1074
Below 42.94		Dry Alluvium &sand	793

Gravel layer not identified down to 42.94m depth.

West Direction on 55m traverse. Interpreted seismic refraction data

Table 9.1.6.3.82. Interpreted seismic data for shot 35m N of VES32-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.59	0.595	Soil	183.5
0.59-2.38	1.788	Dry Clay	384.6
2.3-5.2	2.878	Wet Alluvium &sand	1190.5
5.2-9.05	3.793	Lateritic soil	2369.7
9.05-16.5	7.472	Wet Alluvium &sand	1404.5
16.5-26.07	9.545	Gravel/ dry sand	846.0
26.07-40.09	14.024	Wet clay	1562.5
40.09-54.05	13.960	Dry Alluvium &sand	532.5
Below 54.05		Wet Alluvium &sand	1199.0

Gravel layer is detected at a depth of 16.5–26.07m depth.

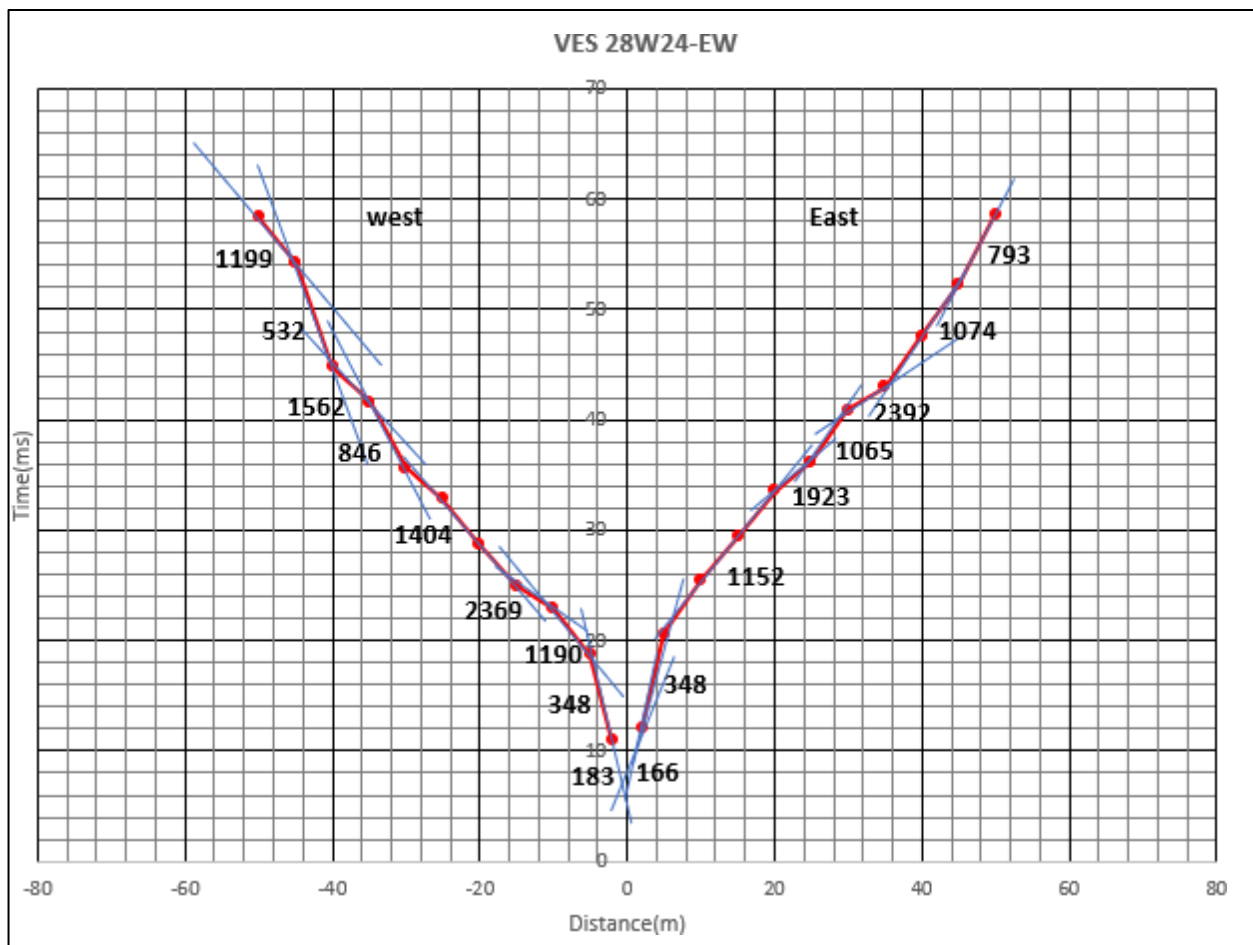


Figure 9.1.6.3.57 seismic hodograph of two shots 35m N of VES32-E and 35m N of VES32-W

North–South Spread-North Direction. -Interpreted seismic refraction data on 55m traverse

Table 9.1.6.3.83. Interpreted seismic data for shot 35m N of VES32-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.79	0.796	Soil	234.7
0.79-2.38	1.590	Wet Alluvium &sand	1049.0
2.38-4.53	2.144	Lateritic soil	2475.2
4.53-8.79	4.265	Wet clay	1706.5
8.79-12.16	3.372	Gravel/ dry sand	872.6
12.16-17.92	5.754	Wet Alluvium &sand	1096.5
17.92-35.24	17.320	Wet Alluvium &sand	1474.9
35.24-52.19	16.957	Dry Clay	377.4
Below 52.19		Wet Alluvium &sand	1020.4

Gravel layer was encountered at a depth of 8.79–12.16 m.

South Direction: Interpreted seismic refraction data on 55m traverse

Table 9.1.6.3.84. Interpreted seismic data for shot 35m N of VES32-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.73	0.739	Soil	242.1
0.73-1.72	0.987	Gravel/ dry sand	824.2
1.72-3.51	1.789	Wet Alluvium &sand	1128.7
3.51-7.57	4.063	Gravel/ dry sand	872.6
7.57-13.78	6.208	Wet clay	1597.4
13.78-22.42	8.638	Wet Alluvium &sand	965.3
22.42-32.88	10.460	Wet Clay	1923.1
32.88-46.72	13.843	Wet Alluvium &sand	910.7
Below 46.72		Lateritic soil	2020.2

Gravel was observed at a depth of 3.51–7.57m.

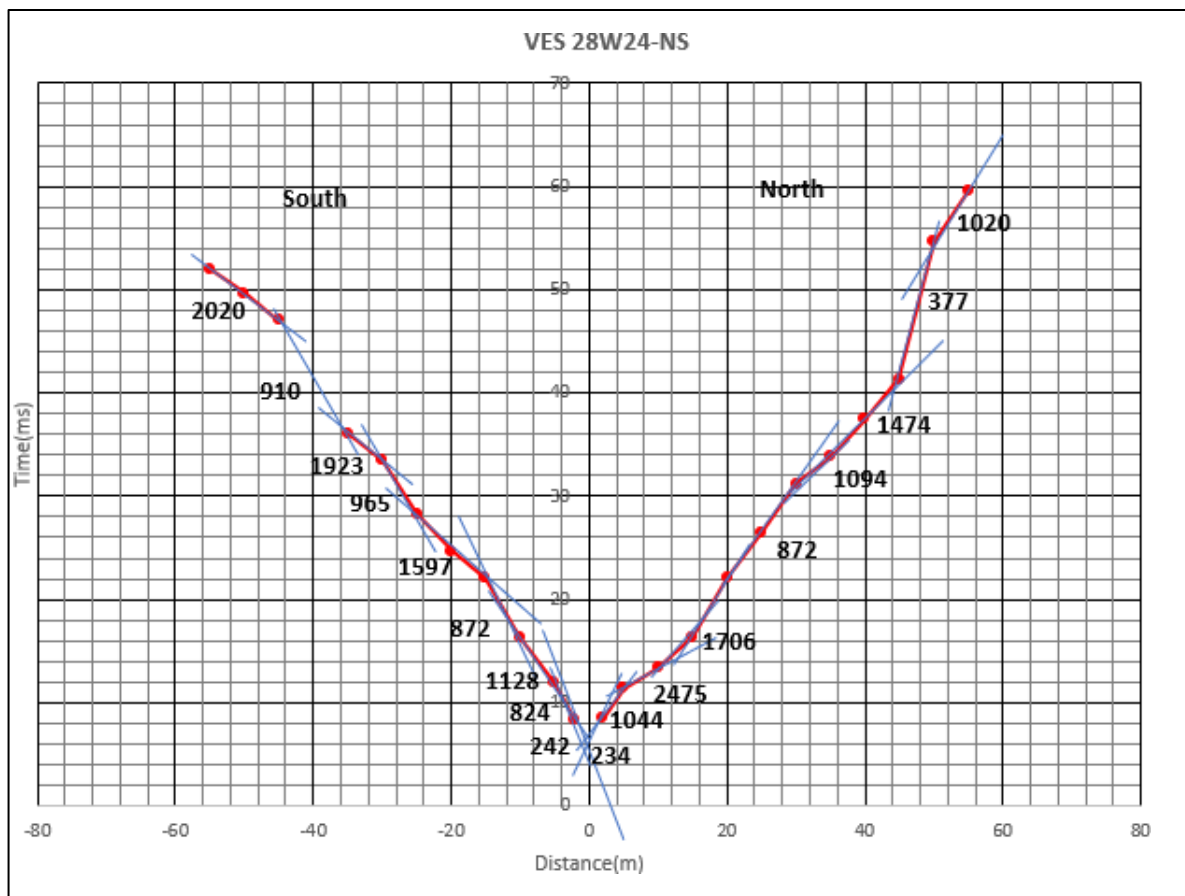


Figure 9.1.6.3.58 seismic hodograph of two shots 35m N of VES32-S and 35m N of VES32-N

- **57m E of VES32** (16°25'45.00"N, 80°38'22.71"E)

Seismic refraction survey was conducted at a location which shows high resistivity in profile viz; P6A19. Toward western direction in a traverse of 94m at 16°25'45.00"N, 80°38'22.71"E.

Seismic profile towards west direction on P6A19. Interpreted seismic refraction data

Table 9.1.6.3.85. Interpreted seismic data for shot 57m E of VES32-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.851	Soil	196.85
0.8-3.5	2.659	Wet Alluvium &sand	1228.88
3.5-8.15	4.648	Lateritic soil	2197.8
8.15-13.93	5.774	Gravel/ dry sand	852.878
13.93-22.2	8.340	Lateritic soil	2046.04
22.2-32.8	10.602	Gravel/ dry sand	852.878
32.8-47.6	14.819	Lateritic soil	2555.91
47.6-59.2	11.537	Dry Alluvium &sand	622.407
59.2-70.6	11.384	Dry Alluvium &sand	959.233
70.6-89.06	18.449	Dry Alluvium &sand	731.261
Below 89.06		Wet Alluvium &sand	1396.16

Gravel layers were delineated at a depth range of 8.15-13.93m and 22.2-32.8m within this sub surface.

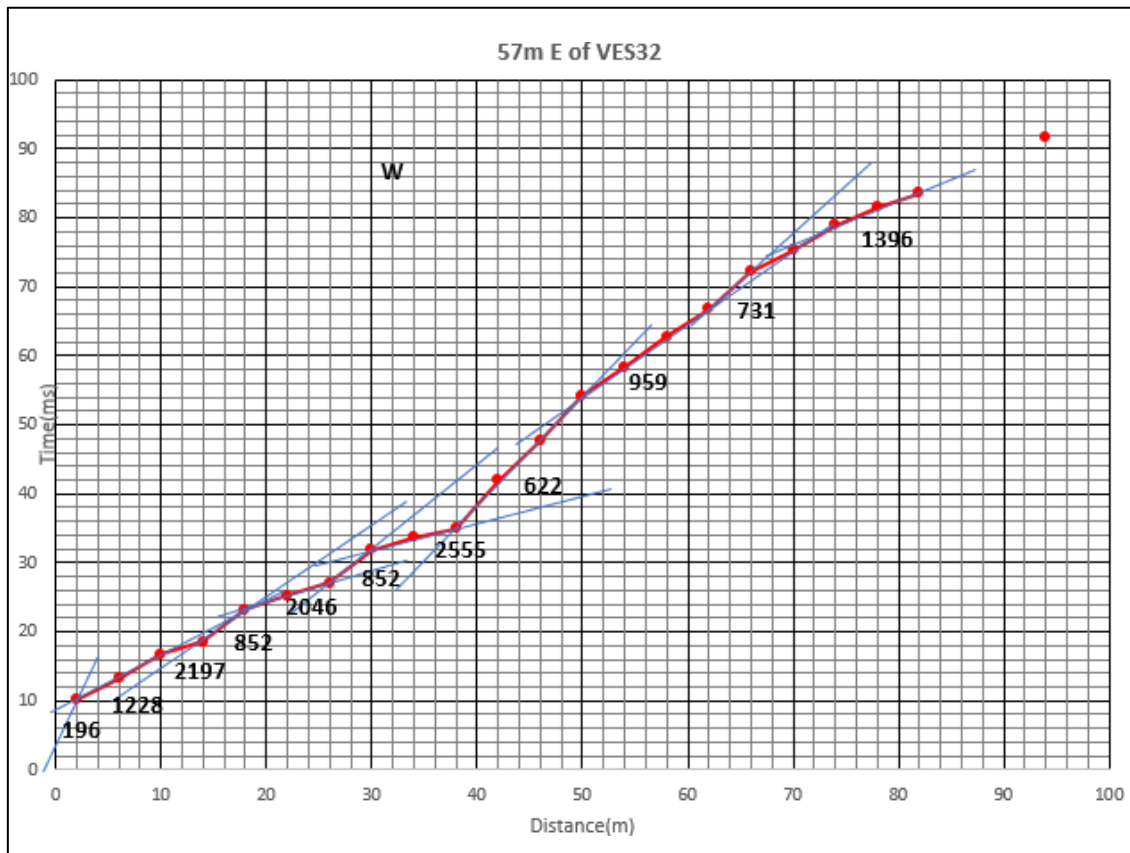


Figure 9.1.6.3.59 seismic hodograph of seismic shot 57m E of VES 32

Seismic survey conducted towards northern part of Nutakki village at three locations. They are named as 64m S of VES54(16°25'41.74"N, 80°38'38.61"E), 83m S of VES 54(16°25'41.13"N, 80°38'38.87"E) and 37m E of VES 53(16°25'42.12"N, 80°38'36.12"E)

64m S of VES54 (16°25'41.74"N, 80°38'38.61"E)

Two seismic shots were conducted at this location, designated as 240m NE of VES 33-N- D1-Shot 1 towards north direction and 240m NE of VES 33-S- D2-Shot 2 towards south direction. Traverse length towards north and south directions are 75 m.

240m NE of VES 33-N- D1-Shot 1

Interpreted seismic refraction data on 55m traverse towards north.

Table 9.1.6.3.86. Interpreted seismic data for shot 240m NE of VES 33-N- D1-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.52	0.530	Soil	333
0.52-2.27	1.742	Dry Alluvium	187
2.27-12.30	10.031	Dry Alluvium & Sand	540
Below 12.30		Lateritic soil	2495

Gravel bed is absent in these 4 layered strata. P-wave is indicated from 0–40 m geophone array and in rest of them, from 45–7 m, shows surface waves.

- **240m NE of VES 33-S- D2-Shot 2**

Interpreted seismic refraction data on 55m traverse towards south.

Table 9.1.6.3.87. Interpreted seismic data for shot 240m NE of VES 33-S- D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.52	0.53	Soil	333.3
0.52-2.31	1.79	Dry Alluvium	187.4
2.31-13.10	10.78	Dry Alluvium & Sand	581.0
Below 13.10		Dry Alluvium	185.1

Gravel bed is absent in these 4 layered strata. P-wave is indicated from 0–35 m geophone array and in rest of them, from 40–75m, surface wave registered.

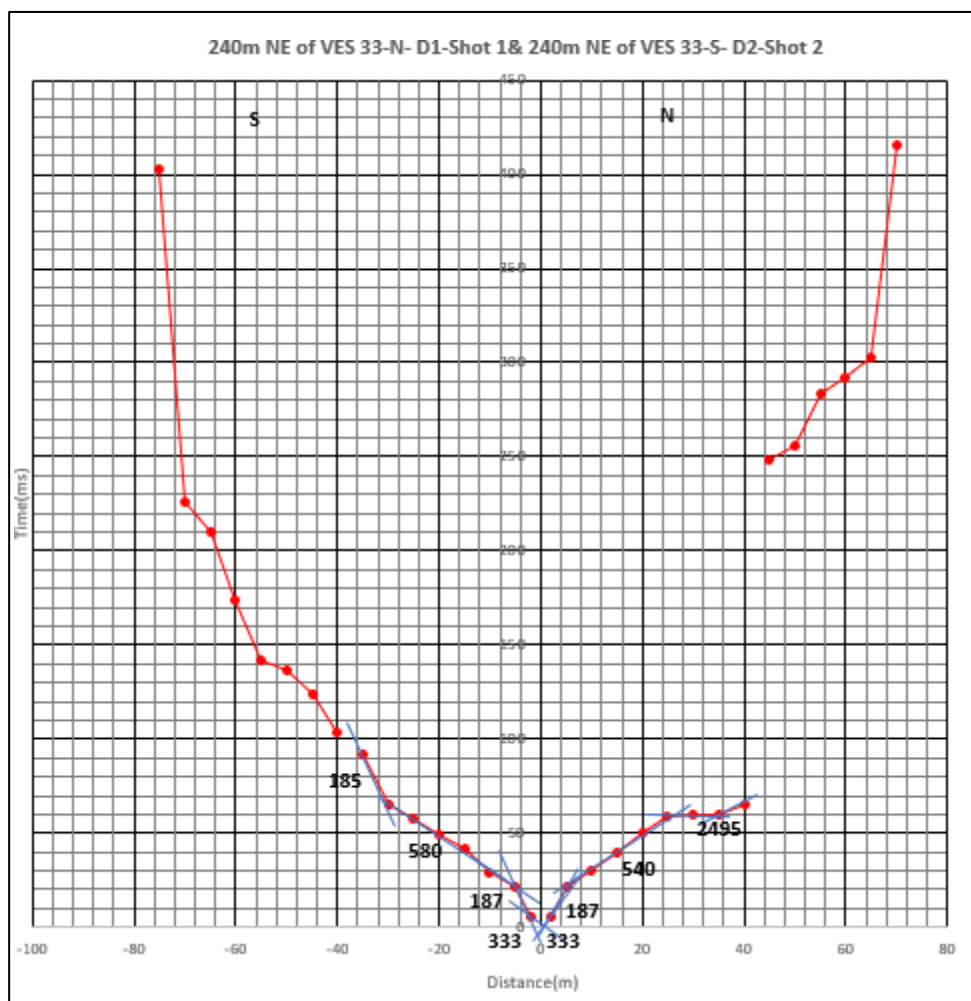


Figure 9.1.6.3.60 seismic hodograph of two shots 240m NE of VES 33-N-D1-Shot 1 and 240m NE of VES 33-S-D2-Shot 2

- **83m S of VES 54 (16°25'41.13"N, 80°38'38.87"E)**

Two seismic shots were conducted at this location which are designated as 245m NE of VES 33-W- D1-Shot 3 towards west direction and 245m NE of VES 33-E – D2-Shot 4 towards east

direction. Traverse length towards east and west directions are 75 m.

- **245m NE of VES 33-W- D1-Shot 3**

Interpreted seismic refraction data towards west with a traverse of 75 m length.

Table 9.1.6.3.88. Interpreted seismic data for shot 240m NE of VES 33-W- D1-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.59	0.60	Soil	333.3
0.59-2.54	1.94	Dry Alluvium	157.8
2.54-12.04	9.50	Dry Alluvium & sand	640.7
Below 12.04		Wet compact Clay	1500.0

Gravel bed is absent in this sub surface down to 12.04m depth. P-wave is indicated from 0–45 m geophone array and in rest of them, from 50-75 m, surface waves are recorded.

- **245m NE of VES 33-E – D2-Shot 4**

Interpreted seismic refraction data towards east on the traverse of 95 m length

Table 9.1.6.3.89. Interpreted seismic data for shot 240m NE of VES 33-E- D2-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.35	0.35	Soil	333.3
0.35-7.69	7.34	Dry Clay	428.4
7.69-17.2	9.59	Wet Alluvium & Sand	1428.6
17.2-32.6	15.40	Dry Alluvium & sand	600.0
Below 32.6		Dry Clay	217.1

Gravel bed is absent down to 32.6m depth. P-wave is indicated from 0–50 m geophone array and in remaining, 55-90 m geophones, surface waves registered.

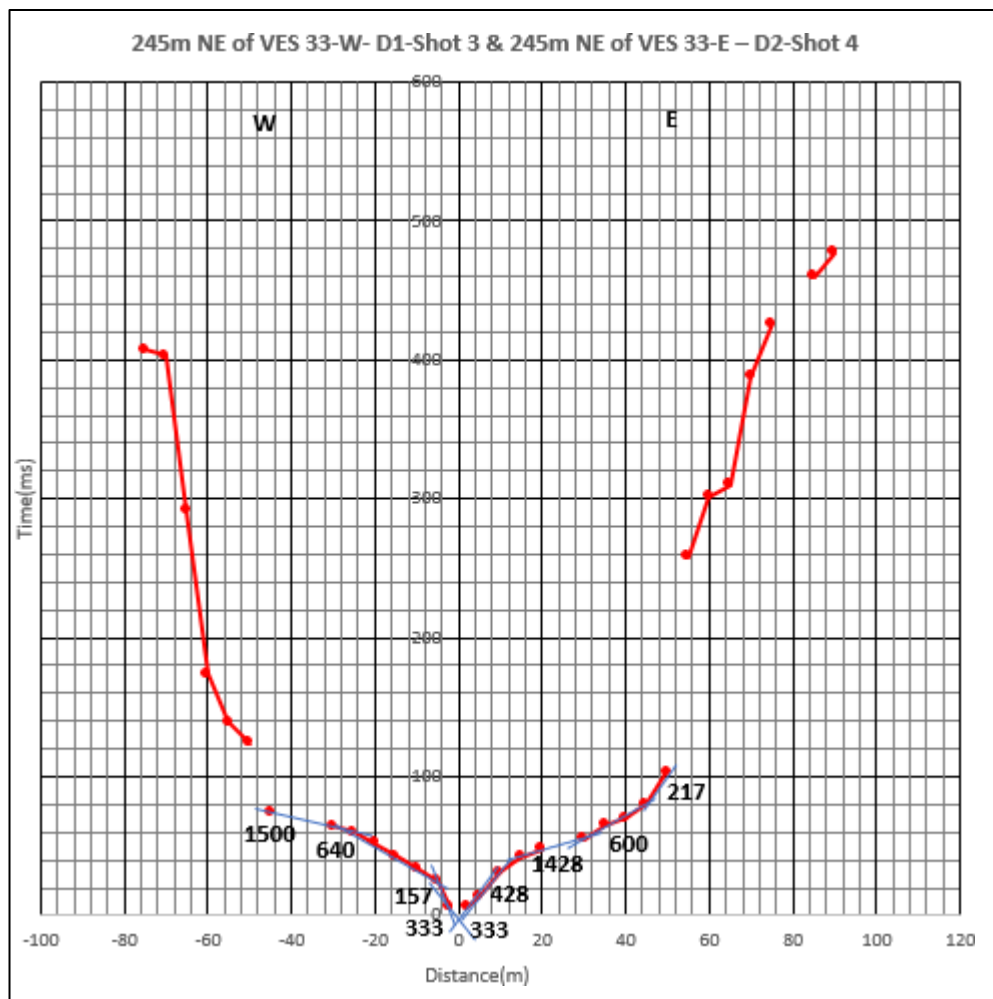


Figure 9.1.6.3.61 seismic hodograph of two shots 245m NE of VES 33-W-D1-Shot 3 and 245m NE of VES 33-E-D2-Shot 4

- **37m E of VES 53** (16°25'41.13"N, 80°38'38.87"E)

Seismic survey was conducted at this location which is designated as 180m NE of VES 33-W– D1-Shot 5 towards west direction with 115m traverse length.

- **180m NE of VES 33-W– D1-Shot 5** - Interpreted seismic refraction data

Table 9.1.6.3.90. Interpreted seismic data for shot 180m NE of VES 33-W– D1-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.24	0.243	Soil	333.3
0.24-3.45	3.214	Dry Clay	296.2
3.45-6.98	3.532	Dry Alluvium & sand	713.3
Below 6.98		Dry clay	454.3

Gravel bed is absent in these 4 layered sub surfaces. P-wave is indicated from 0–25 m geophone array and in remaining, 30-60 m spread, shows surface waves.

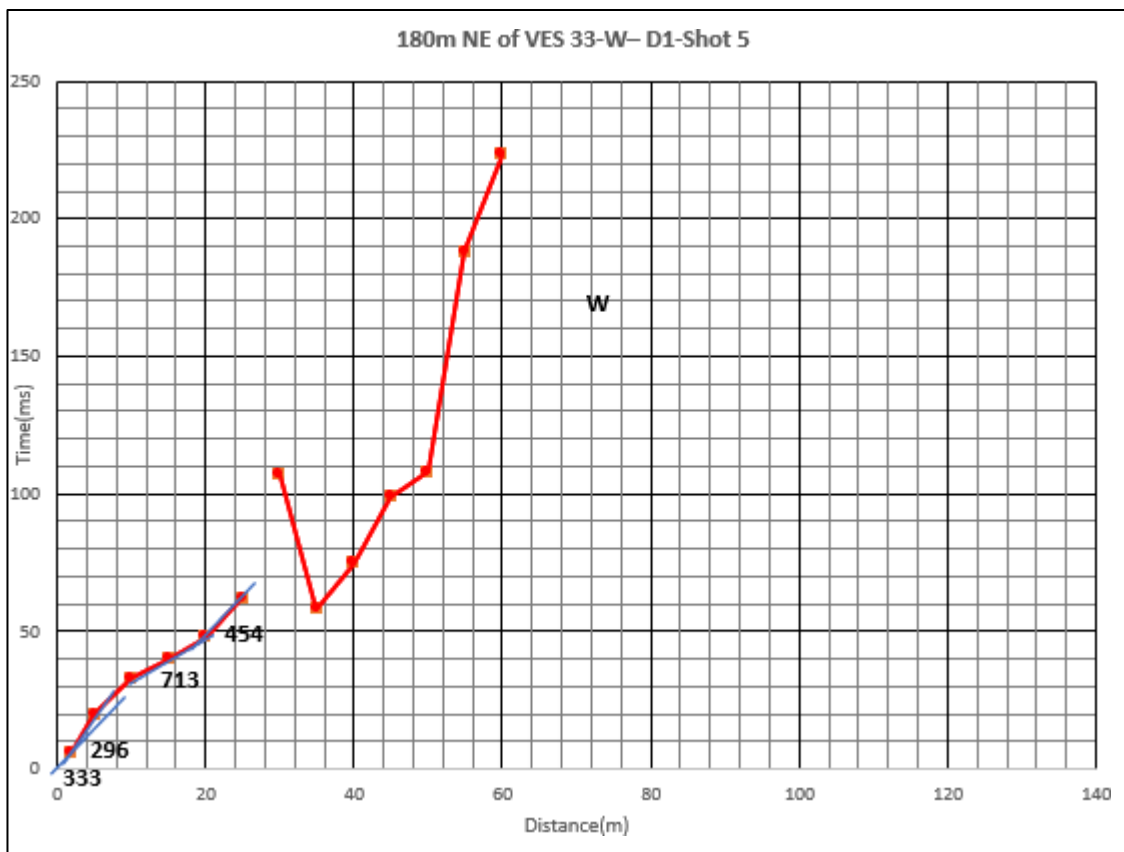


Figure 9.1.6.3.62 seismic hodograph of seismic shot 180m NE of VES 33-W-D1-Shot 5

Towards northern part of Pedavadlapudi area seismic survey was conducted at 12 m northeast of VES 18. Split-spread configuration was employed along east–west and north–south directions. Traverses are laid 55m towards east, 56 m towards west, 56 m towards north and 55 m towards south directions from coordinates 16°25'21.02"N, 80°36'35.37"E.

East–West Spread- Seismic shot towards east direction: Interpreted seismic refraction data

Table 9.1.6.3.91. Interpreted seismic data for shot 12m NE of VES 18-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.9	0.904	Soil	144.9
0.9-1.68	0.780	Wet Alluvium & Sand	1435.4
1.68-4.07	2.389	Wet compact clay	1745.2
4.07-14.3	10.237	Wet Alluvium & Sand	1096.5
14.3-28.1	13.813	Dry Alluvium	399.7
28.1-42.5	14.471	Wet Alluvium & Sand	1128.7
Below 42.5		Dry Alluvium	468.2

Gravel layers were absent down to 42.5m depth.

Seismic survey towards west direction: Interpreted seismic refraction data

Table 9.1.6.3.92. Interpreted seismic data for shot 12m NE of VES 18-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.67	0.673	Soil	232.8
0.67-1.81	1.147	Dry Alluvium &sand	618.8
1.81-5.33	3.515	Dry Alluvium &sand	767.7
5.33-14.23	8.900	Wet compact clay	1828.2
14.23-23.9	9.677	Dry Alluvium &sand	661.4
23.9-33.9	9.994	Wet Alluvium &sand	1199.0
Below 33.9		Dry Alluvium &sand	738.6

Gravel layers not detected down to 33.9m depths.

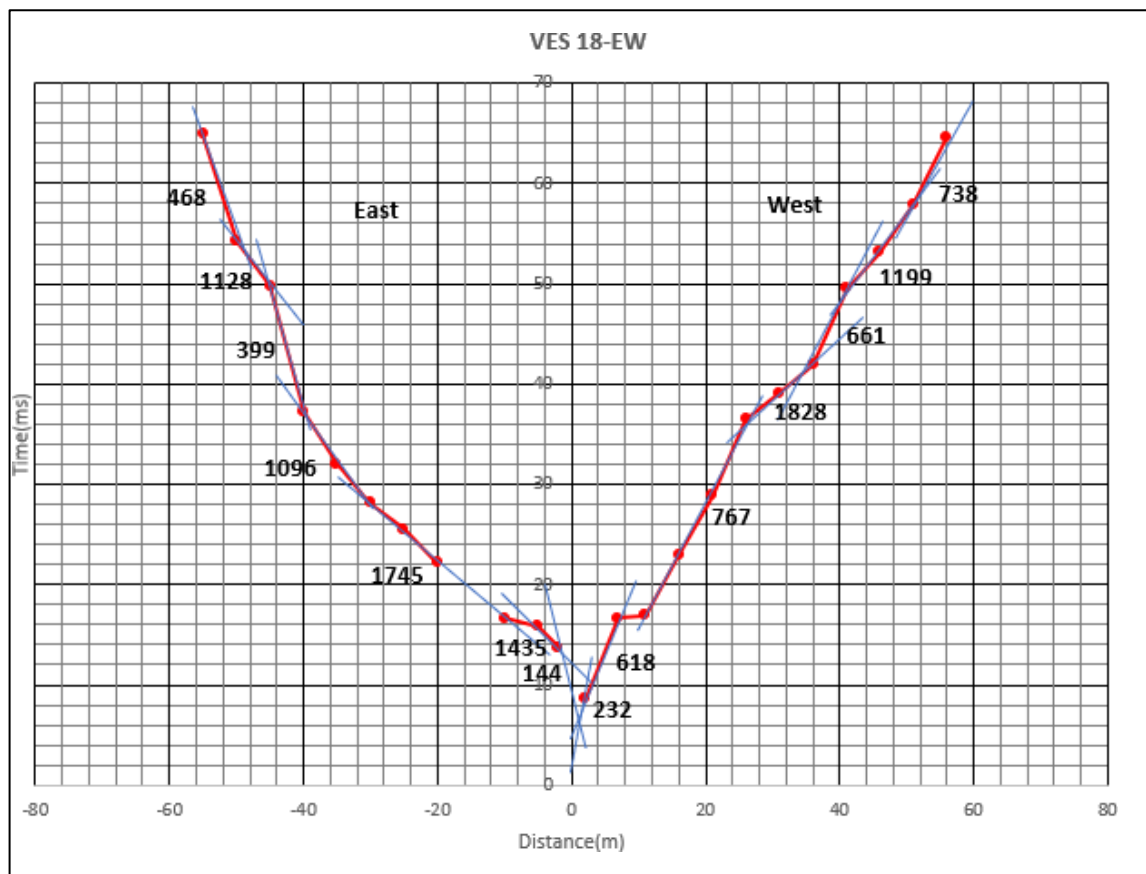


Figure 9.1.6.3.63 seismic hodograph of two shots 12m NE of VES 18-E and 12m NE of VES 18-W

North-South Spread -seismic survey towards north direction: Interpreted seismic refraction data

Table 9.1.6.3.93. Interpreted seismic data for shot 12m NE of VES 18-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.77	0.774	Soil	480.8
0.77-3.35	2.576	Wet compact Clay	1918.5
3.35-7.8	4.456	Dry Alluvium &sand	1113.6
Below 7.8		Dry Alluvium &sand	532.6

Gravel layers not detected down to 7.8m depth.

Seismic survey towards southward direction: Interpreted seismic refraction data

Table 9.1.6.3.94. Interpreted seismic data for shot 12m NE of VES 18-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.78	0.79	Soil	480.8
0.78-4.15	3.37	Lateritic soil	2046
4.15-7.11	2.95	Dry Alluvium & sand	767.5
7.1-13.16	6.06	Wet Alluvium & sand	914
13.16-24.52	11.36	Dry Alluvium & sand	1474
24.52-34.94	10.41	Wet Alluvium & sand	600
Below 34.94		Wet Alluvium & sand	1046.8

Gravel layers not detected down to 34.94 m depth.

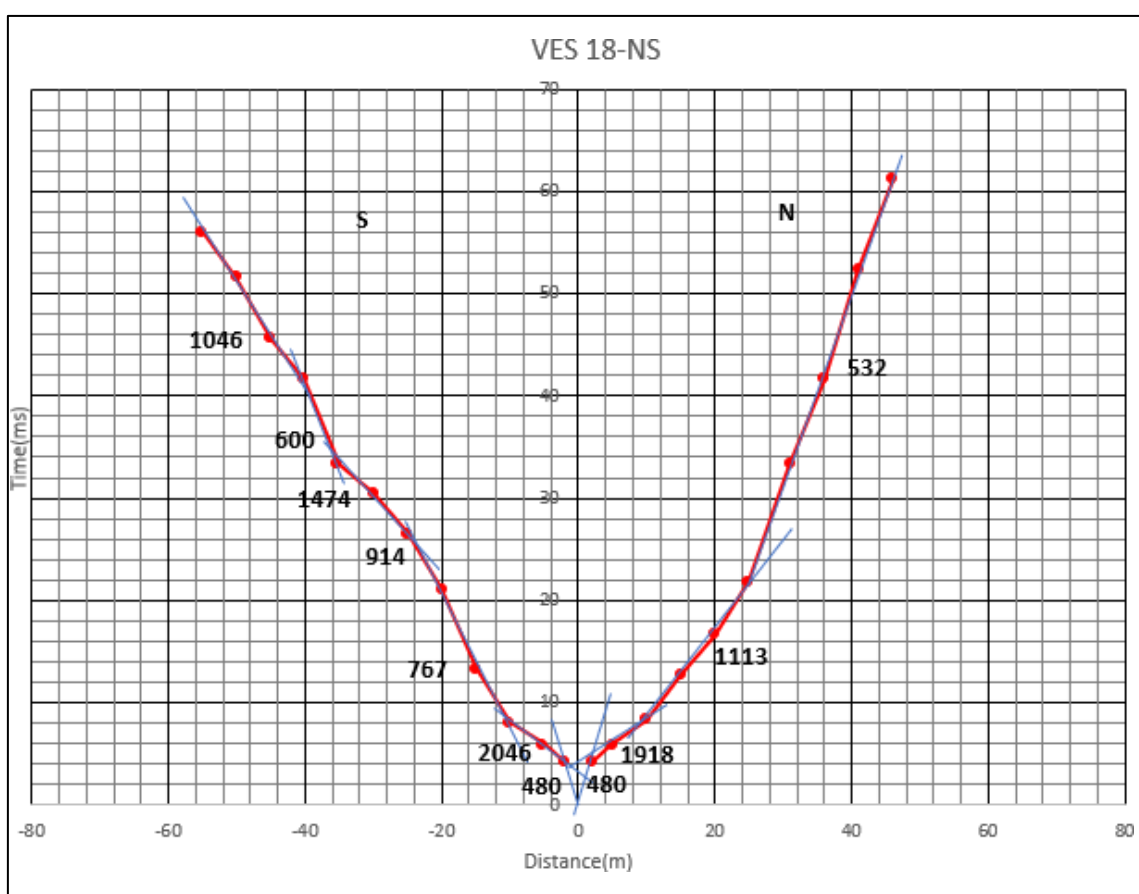


Figure 9.1.6.3.64 seismic hodograph of two shots 12m NE of VES 18-N and 12m NE of VES 18-S

Seismic survey in Pedavadlapudi area was conducted employing split-spread configuration along east–west and north–south directions. The survey line towards E–W spread was established as 30m E of VES30 at 16°25'2.03"N, 80°36'31.6"E and N–S spread was named as 27m S of VES30 at 16°25'1.15"N, 80°36'30.44"E.

East–West Spread – Seismics survey towards east direction with 114m traverse length

Table 9.1.6.3.95. Interpreted seismic data for shot 30m E of VES30-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.81	Soil	174.5
0.8-2.76	1.96	Gravel/dry sand	821.9
2.76-8.2	5.43	Lateritic soil	3461.5
8.2-19.2	11.02	Gravel/dry sand	859.1
19.2-32.8	13.64	Lateritic soil	3205.1
32.8-46.9	14.04	Dry Alluvium &sand	693.5
46.9-66.4	19.52	Wet Alluvium &sand	1371.7
66.4-91.8	25.44	Lateritic soil	3508.8
Below 91.8		Wet Alluvium &sand	1036.8

Gravel layers were detected down to 0.8–2 m and 8.2m depths and thickness ranging from 1.96m and 11.02m respectively.

Seismic survey towards west direction-VES 30 E-W. Interpreted refraction data on 114m traverse.

Table 9.1.6.3.96. Interpreted seismic data for shot 30m E of VES30-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.9	0.91	Soil	196.9
0.9-7.2	6.31	Wet compact Clay	1979.0
7.2-17.2	10.04	Dry Alluvium &sand	767.5
17.2-28.2	11.03	Lateritic soil	2179.6
28.2-45.4	17.20	Wet clay	1556.0
45.4-66.1	20.69	Clay	936.3
66.1-103.8	37.67	Wet compact clay	1644.7
Below 103.8		Dry Alluvium	581.4

Gravel is absent down to 103.8 m depth in these 8 layered strata.

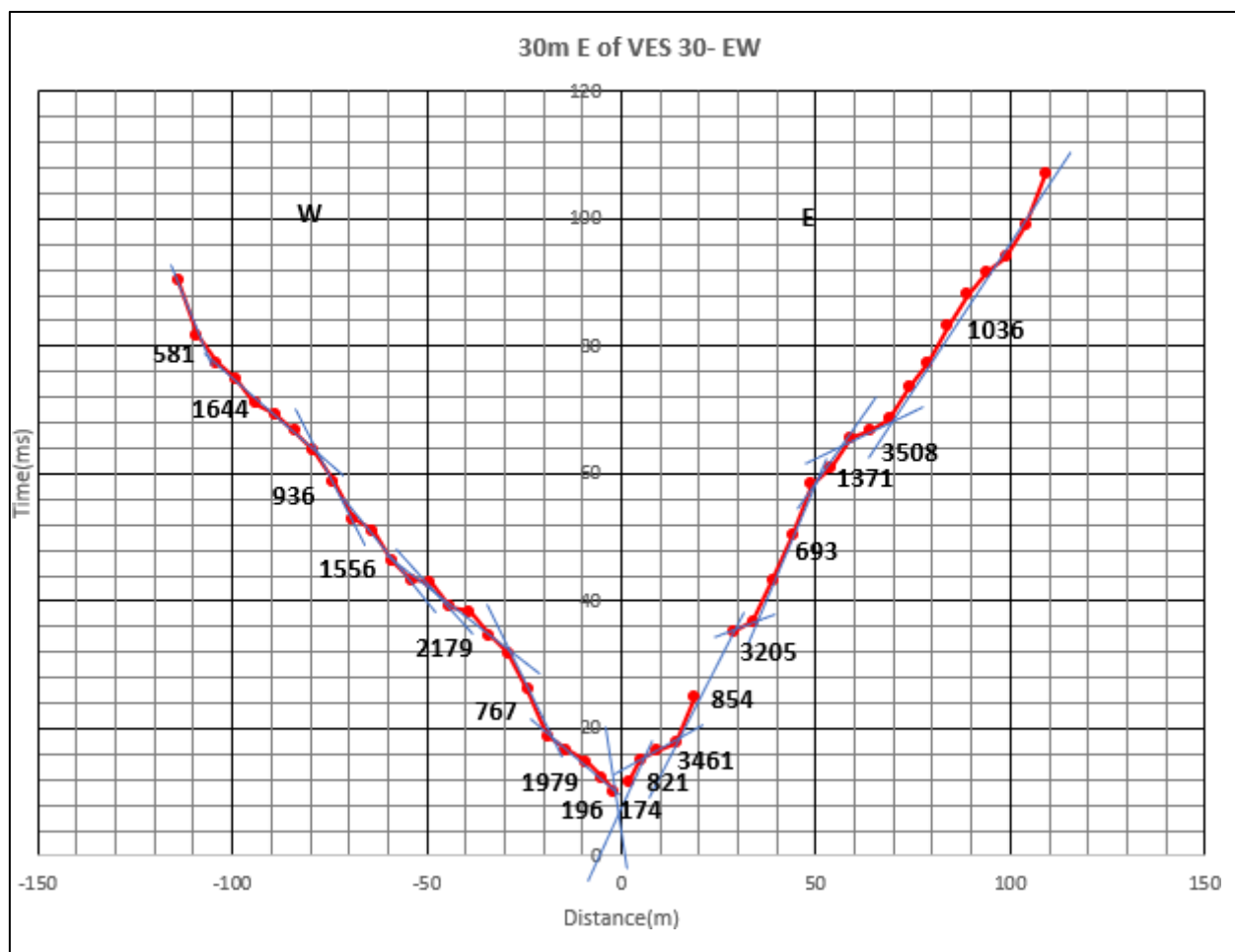


Figure 9.1.6.3.65 seismic hodograph of two shots 30m E of VES 30-E and 30m E of VES 30-W North–South Spread- survey along north direction: Interpreted Seismic data on traverse of 114m length.

Table 9.1.6.3.97. Interpreted seismic data for shot 30m E of VES30-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.79	0.80	Soil	240.1
0.79-1.3	0.51	Wet Alluvium &sand	1073.6
1.3-14.5	13.27	Wet Alluvium &sand	1046.8
14.5-32.5	17.94	Dry Alluvium &sand	639.4
32.5-44.5	12.02	Wet Alluvium &sand	1390.4
44.5-66.7	22.21	Wet Alluvium &sand	1046.8
Below 66.7		Dry Alluvium &sand	629.3

Gravel layer absent up to 66.7m depth.

Seismic survey towards south direction: Interpreted Seismic data on the traverse of 114m length.

Table 9.1.6.3.98. Interpreted seismic data for shot 30m E of VES30-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.83	0.83	Soil	240.1
0.83-7.0	6.17	Wet Alluvium &sand	1331.2
7.0-22.9	15.97	Dry Alluvium &sand	540.5
22.9-40.3	17.39	Lateritic soil	2739.7
40.3-58.5	18.18	Dry Alluvium &sand	903.3
58.5-87.6	29.12	Wet compact clay	1597.4
Below 87.6		Dry Alluvium &sand	639.4

Gravel absent down to 87.6m.

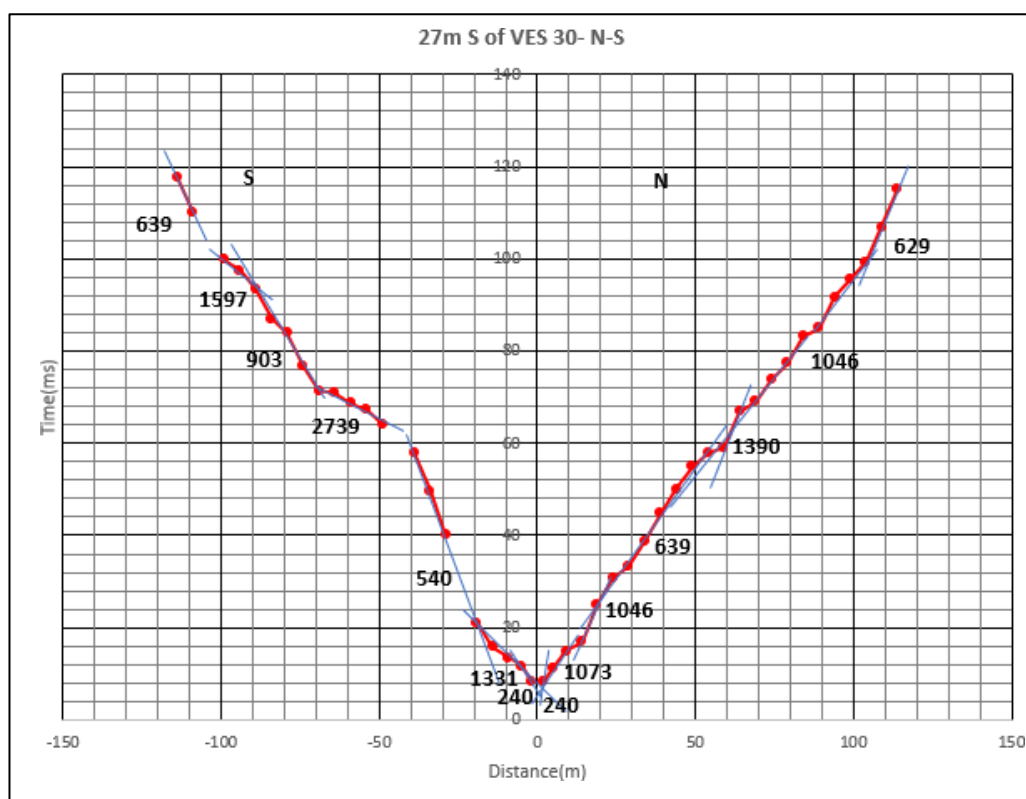


Figure 9.1.6.3.66 seismic hodograph of two shots 27m S of VES 30-N and 27m S of VES 30-S

Seismic survey conducted at two locations named as 70m W of VES 46(16°25'11.75"N, 80°37'19.27"E), 27m East South East of VES 47(16°25'14.53"N, 80°37'19.62"E) towards south west of Mellampudi village.

- **70m W of VES 46** (16°25'11.75"N, 80°37'19.27"E)

Three seismic shots were conducted at this location, designated as 70m W of VES46-N -D2- Shot 1 towards north direction, 70m W of VES46-W -D1-Shot 2 towards west direction and 70m W of VES46-E -D2-Shot 3 towards east direction. Traverse length for the east, west and north directions are 90m, 85m and 90 m respectively.

- **70m W of VES46-N -D2-Shot 1**

Interpreted seismic data. Traverse towards north with 90m Length.

Table 9.1.6.3.99. Interpreted seismic data for shot 70m W of VES46-N -D2-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.02	0.02	Soil	333.3
0.02-3.9	3.89	Dry Alluvium	332.8
Below 3.9		Wet Alluvium& Sand	1363.0

Lithology observed at this locality with three-layer sequence. Gravel not detected. P-wave is indicated from 0–40 m geophone spread and in remaining, 45 - 90m, geophones surface waves registered.

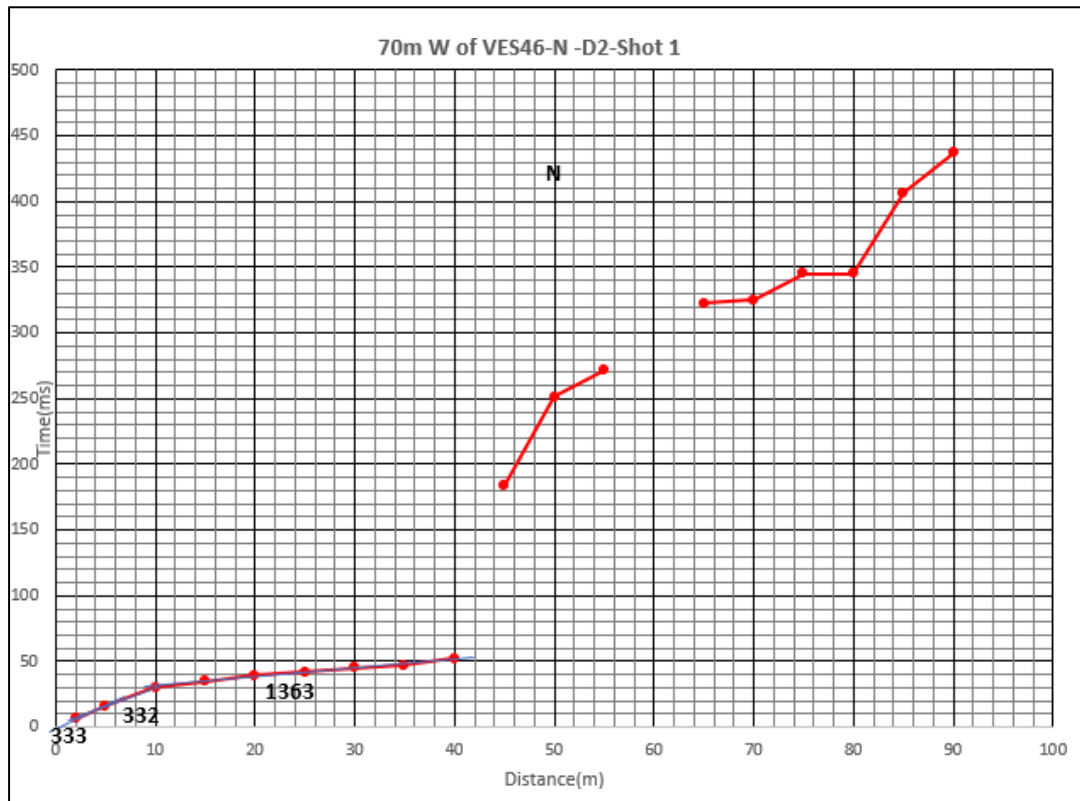


Figure 9.1.6.3.67 seismic hodograph of seismic shot 70m W of VES 46-N-D2-Shot 1

- **70m W of VES46-W -D1-Shot 2**

Interpreted seismic refraction data. Traverse towards west with 85m length.

Table 9.1.6.3.100. Interpreted seismic data for shot 70m W of VES46-W -D1-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.26	0.26	Soil	333
0.26-3.68	3.42	Dry Alluvium	381
Below 3.68		Dry Alluvium	250

Lithology with three-layer sequence. Gravel not detected up to 3.68m depth. P-wave is

indicated from 0–20 m geophone spread and in remaining, 25 - 80m, geophones surface waves registered.

- **70m W of VES46-E -D2-Shot 3**

Interpreted seismic refraction data. Traverse towards east with 90.4 m length.

Table 9.1.6.3.101. Interpreted seismic data for shot 70m W of VES46-E -D2-Shot 3

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.68	0.687	Soil	500.0
0.68-4.45	3.772	Dry Alluvium	179.1
4.45-12.2	7.555	Dry Alluvium/Sand	651.9
Below 12.2		Dry Alluvium	303.0

Four-layer sequence in lithology. Gravel not detected up to 12.2m depth. P-wave is indicated from 0–35 m geophone spread and in remaining, 40-70m, geophones surface waves registered.

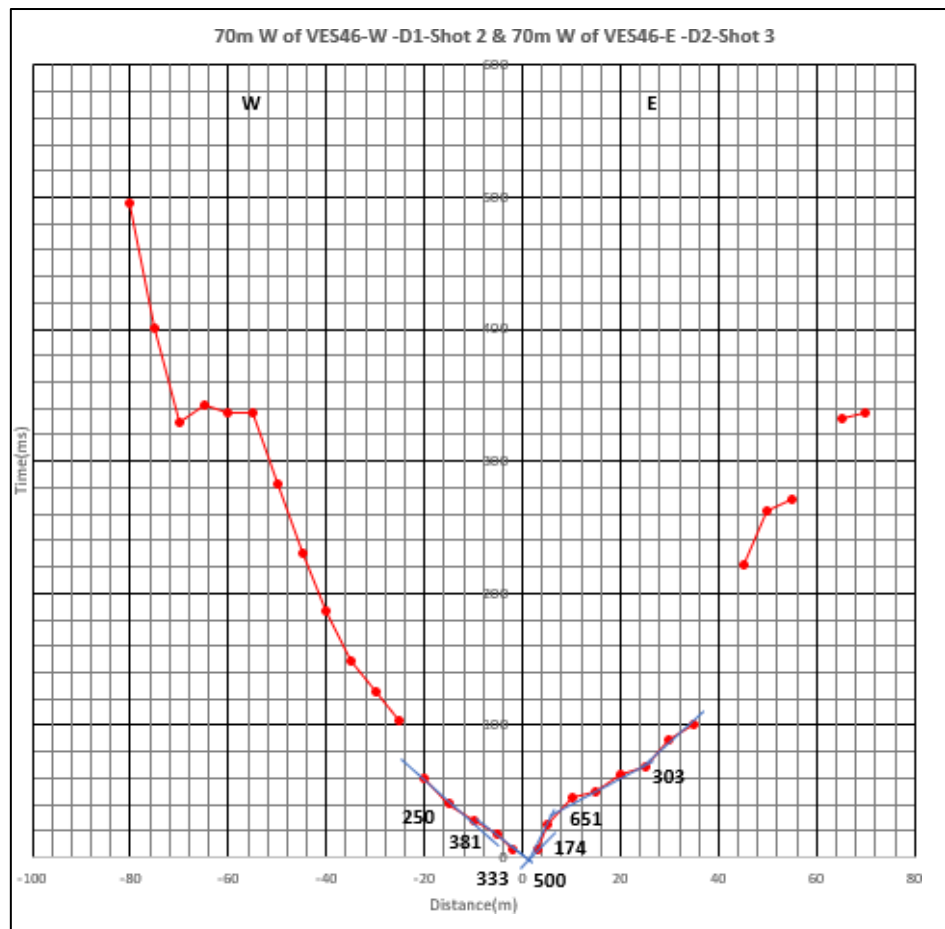


Figure 9.1.6.3.68 seismic hodograph of two shots 70m W of VES 46-W-D1-Shot 2 and 70m W of VES 46-E-D2-Shot 3

27m E-S-E of VES 47 (16°25'14.53"N, 80°37'19.62"E)

Two seismic shots were conducted at this location, designated as 26m SE of VES47-S-D2-

Shot 5 towards south direction and 26m SE of VES47-W-D1-Shot 6 towards west direction.
The traverse length for west and south directions are 85 m and 91.4 m respectively.

26m SE of VES47-S-D2-Shot 5:

Interpreted seismic refraction data. Traverse towards south with 91.4m length.

Table 9.1.6.3.102. Interpreted seismic data for shot 26m SE of VES47-S-D2-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-1.42	1.42	Soil	281.3
1.42-7.89	6.46	Dry Alluvium/Sand	660.7
Below 7.89		Dry Alluvium	153.8

Lithology with three-layer sequence and the possibility of gravel not detected down to 7.89m. P-wave is indicated from 0–26.4m geophone array and in remaining, 31.4-91.4m, geophones surface waves are registered.



Figure 9.1.6.3.69 seismic hodograph of seismic shot 26m SE of VES 47-S-D2-Shot 5

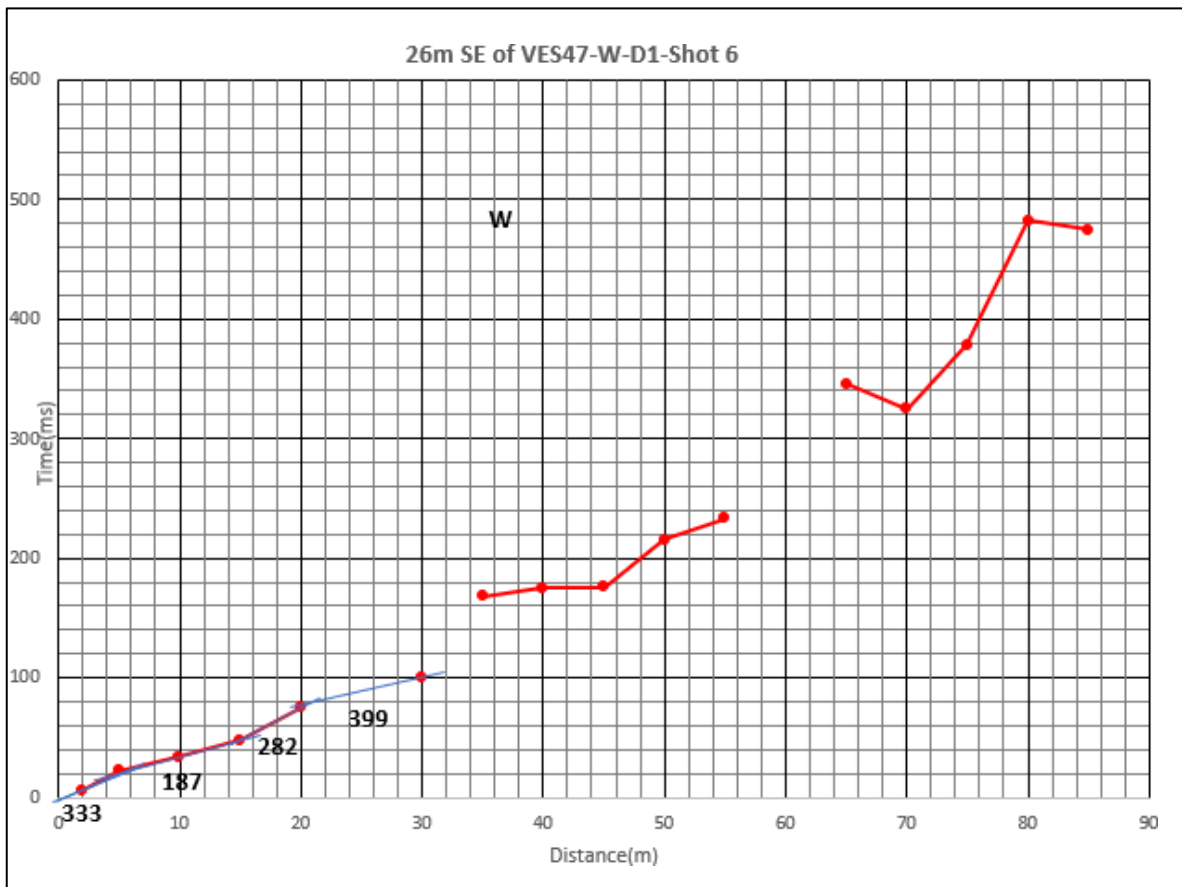
26m SE of VES47-W-D1-Shot 6:

Interpreted seismic refraction data. Traverse towards west with 85 m length.

Table 9.1.6.3.103. Interpreted seismic data for shot 26m SE of VES47-W-D1-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.52	0.53	Soil	333.3
0.52-1.65	1.13	Dry Alluvium	187.5
1.65-5.79	4.14	Dry Alluvium	282.8
Below 5.79		Dry Alluvium	399

Lithology with three-layer sequence and the possibility of gravel not detected up to 5.79m depth. P-wave is indicated from 0–30 m geophone array and in remaining, 35-85 m, geophones surface waves are registered

**Figure 9.1.6.3.70 seismic hodograph of seismic shot 26m SE of VES 47-W-D1-Shot 6**

Seismic survey conducted towards eastern part of Mellampudi village. Survey conducted forward and reverse configuration assess lithology E–W and N–S directions. Towards E–W direction 94 m geophone array was deployed for both forward and reverse shots. They are named as 387m ESE of VES12 at 16°25'20.22"N, 80°38'8.93"E and 298m E of VES12 at 16°25'20.73"N, 80°38'6.04"E. In the N–S direction 98 m array was deployed both forward and reverse shots. These are named as 308m NE of VES12 at 16°25'22.13"N, 80°38'6.49"E and 310m SE of VES12 at 16°25'19.2"N, 80°38'5.99"E. Based on the VES results characterised by a high-resistivity zone the subsurface strata were identified for shallow seismic refraction to delineate the gravel layers.

387m ESE of VES12 (16°25'20.22"N, 80°38'8.93"E): Interpreted seismic refraction data**Table 9.1.6.3.104. Interpreted seismic data for shot 308m NE of VES12**

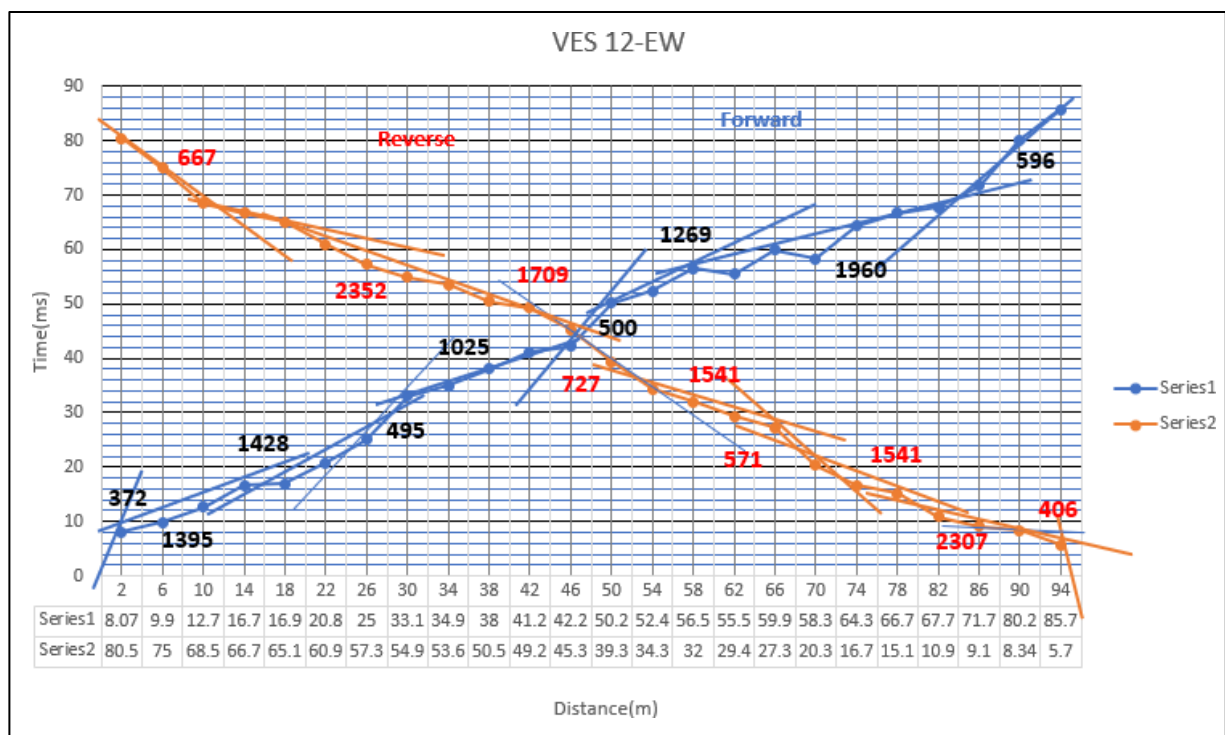
Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.8	Soil	372.4
0.8-1.8	1	Wet Alluvium/Sand	1395.3
1.8-10.8	9	Wet Alluvium/Sand	1428.6
10.8-19.7	8.9	Dry Alluvium/Sand	495.0
19.7-27.7	8	Wet Alluvium/Sand	1025.6
42.3-61.4	14.6	Dry Alluvium/Sand	500.0
61.4-92.5	19.1	Wet Alluvium/Sand	1269.8
Below 92.5		Lateritic soil	1960.8

Lithology shows 8-layer sequence with sand and clay without gravels

298m E of VES12 (16°25'20.73"N, 80°38'6.04"E): Interpreted seismic refraction data**Table 9.1.6.3.105. Interpreted seismic data for shot 298m E of VES12**

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.8	Soil	407.0
0.8-6.6	5.8	Lateritic soil	2307.7
6.6-15.4	8.8	Wet Alluvium/Sand	1541.4
15.4-25.5	10.1	Dry Alluvium/Sand	571.4
25.5-39.7	14.2	Wet Alluvium/Sand	1541.4
39.7-55.8	16.1	Dry Alluvium/Sand	727.3
55.8-72.9	17.1	Compact clay	1709.4
72.9-89.6	16.7	Lateritic soil	2352.9
Below 89.6		Dry Alluvium/Sand	666.7

Lithology shows 9-layer sequence with sand and clay. Absence of gravel layer detected.



**Figure 9.1.6.3.71 seismic hodograph of two shots 298m E of VES12 -Rev -EW
and 387m ESE of VES12-Fwd-EW**

- **308m NE of VES12 (16°25'22.13"N, 80°38'6.49"E)** - Interpreted seismic refraction data

Table 9.1.6.3.106. Interpreted seismic data for shot 308m NE of VES12

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.9	0.9	Soil	240.1
0.9-3.2	2.3	Lateritic soil	2547.8
3.2-6.7	3.5	Wet Alluvium/Sand	1278.0
6.7-12.1	5.4	Lateritic soil	2173.9
12.1-23.6	11.5	Wet Alluvium/Sand	1011.9
23.6-43.1	19.5	Wet Alluvium/Sand	1504.0
43.1-72.4	29.3	Lateritic soil	2877.7
72.4-100.5	28.1	Wet Alluvium/Sand	959.2
Below 100.5		Lateritic soil	2197.8

Nine-layer strata with clay, sand and Lateritic soil up to 100.5m depth. No gravels identified.

- **310m SE of VES12 (16°25'19.2"N, 80°38'5.99"E)** - Interpreted seismic refraction data

Table 9.1.6.3.107. Interpreted seismic data for shot 310m SE of VES12

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.8	Soil	287.9
0.8-5.16	4.8	Lateritic soil	2081.3
5.16-13.6	8.44	Wet Alluvium/Sand	1145.5
13.6-19.7	6.12	Lateritic soil	2173.9
19.7-26.5	6.8	Lateritic soil	2203.9
26.5-39.2	12.7	Dry Alluvium&Sand	645.2
39.2-51.6	12.41	Compact clay	1709.4
51.6-70.4	18.8	Gravel/dry sand	824.2
70.4-83.3	12.9	Lateritic soil	2179.8
83.3-114.8	31.5	Wet Alluvium/Sand	1596.8
Below 114.8		Dry Alluvium&Sand	545.3

Gravel detected in this 11-layer sub surface at 51.6 m depth having 18.8m thickness.

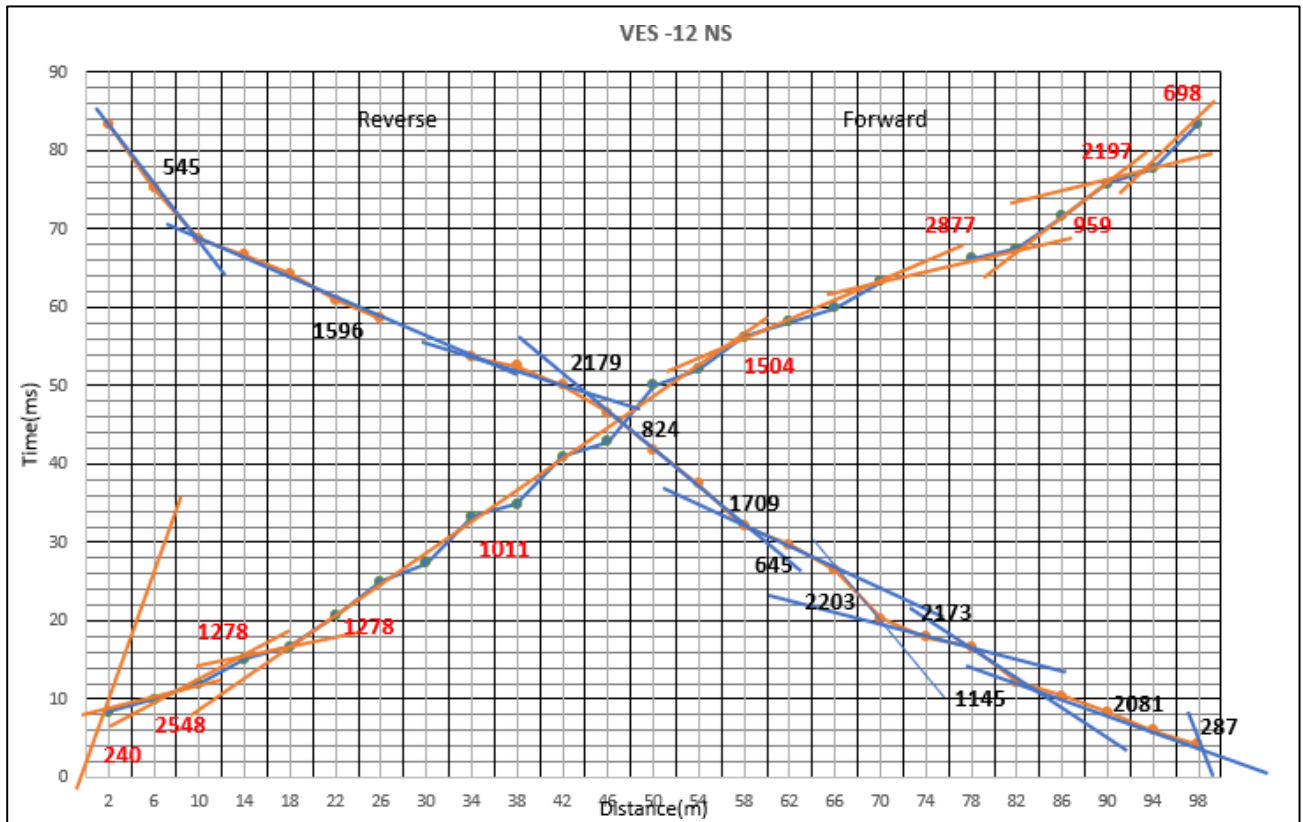


Figure 9.1.6.3.72 seismic hodograph of two shots 308m NE of VES12 -Fwd -NS and 310m SE of VES12 -Rev-NS

Seismic survey was conducted in the Mellampudi area, located towards eastern region, using a split-spread configuration along east–west and north–south directions delineate subsurface lithology.

Survey lines for E–W and N–S spreads were established at coordinates 16°25'16.76"N,

80°38'31.68"E; 212 m east of VES 13, by 37 m traverse toward south, 53 m length toward the north and 55 m each towards east and west.

East–West Spread - Eastward Direction: Interpreted seismic refraction data

Table 9.1.6.3.108. Interpreted seismic data for shot 212 m east of VES 13-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.84	0.840	Soil	248.8
0.84-2.17	1.338	Wet Alluvium& Sand	1442.3
2.17-5.41	3.240	Dry Alluvium& Sand	800.0
5.41-16.7	11.343	Lateritic soil	1957.7
16.76-25.2	8.508	Dry Alluvium& Sand	799
25.2-38.5	13.23	Wet Alluvium& Sand	1066.1
Below 38.5		Dry Alluvium& Sand	599.5

Lithology is seven-layer strata with clay and sand. No gravels identified.

Westward Direction- Interpreted seismic refraction data:

Table 9.1.6.3.109. Interpreted seismic data for shot 212 m east of VES 13-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.84	0.845	Soil	241.0
0.84-2.18	1.338	Wet Alluvium& Sand	1442.3
2.18-5.33	3.153	Dry Alluvium& Sand	800.0
5.33-12.03	6.698	Compact clay	1856.4
12.03-22.2	10.263	Wet Alluvium& Sand	1028.1
22.2-36.6	14.344	Dry Alluvium& Sand	599.5
Below 36.6		Wet Alluvium& Sand	1420.5

Lithology is seven-layer strata with clay and sand. No gravels identified.

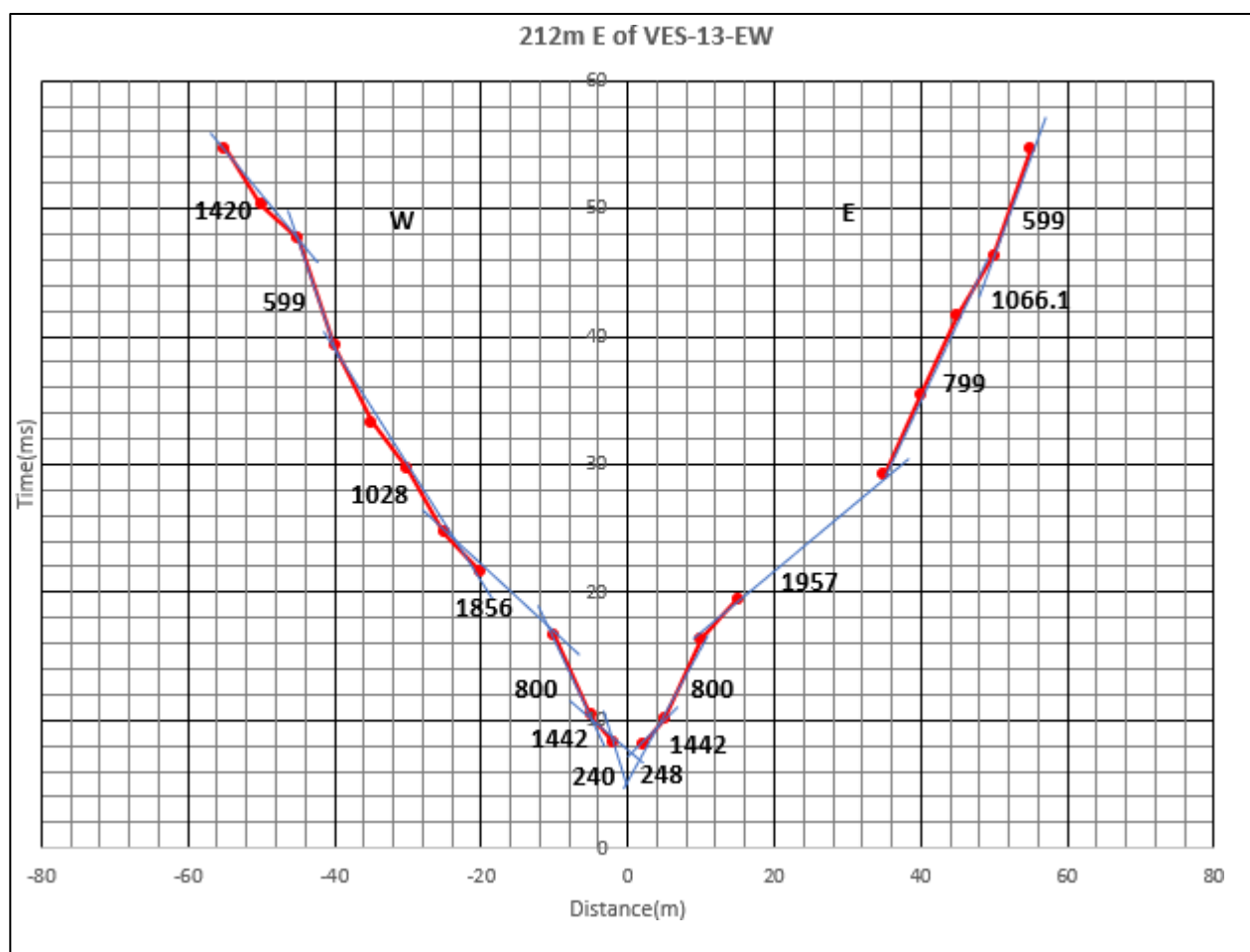


Figure 9.1.6.3.73 seismic hodograph of two shots 212m E of VES 13-E and 212m E of VES 13-W
North–South Spread- Seismic shot towards North direction: Interpreted seismic refraction data.

Table 9.1.6.3.110. Interpreted seismic data for shot 212 m east of VES 13-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.89	Soil	240.7
0.8-5.3	4.45	Lateritic soil	1996.9
5.3-8.6	3.35	Wet Alluvium& Sand	957.9
8.6-14.7	6.11	Wet Alluvium& Sand	1200.5
Below 14.7		Wet Alluvium& Sand	1678.7

No distinct gravel layer detected in this 5-layer strata.

Seismic survey towards South direction- Interpreted seismic refraction data:

Table 9.1.6.3.111. Interpreted seismic data for shot 212 m east of VES 13-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.64	0.65	Soil	275.1
0.64-2.38	1.73	Dry Alluvium & Sand	677.2
2.38-4.93	2.55	Lateritic soil	1923.1
4.93-10.1	5.18	Wet Alluvium & Sand	1128.7
10.1-16.8	6.73	Lateritic soil	3184.7
16.8-24.6	7.84	Wet Alluvium & Sand	1200.5
24.6-36.7	12.04	Dry Alluvium & Sand	684.9
36.7-49.9	13.20	Lateritic soil	1915.7
Below 49.9		Dry Alluvium & Sand	753.0

No distinct gravel layer was delineated in the southern direction.

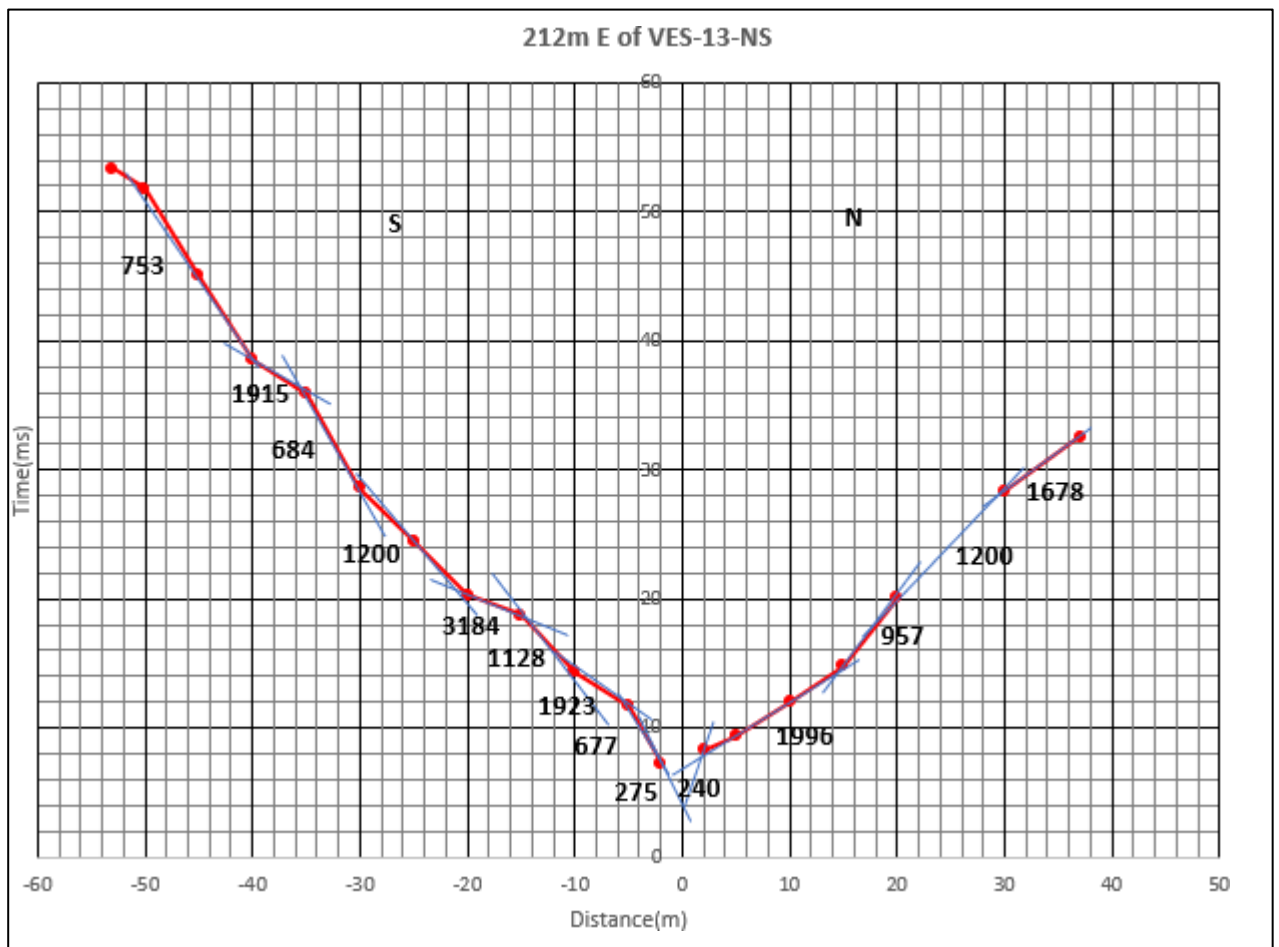


Figure 9.1.6.3.74 seismic hodograph of two shots 212m E of VES 13-N and 212m E of VES 13-S

Seismic survey conducted at two locations towards north west of Nutakki village. These spots are named as 40m S of VES42(16°25'11.87"N, 80°38'34.78"E), 33m N of VES42 (16°25'14.16"N, 80°38'34.99"E)

33m N of VES42 (16°25'14.16"N, 80°38'34.99"E): Four seismic shots were conducted at this location. They are designated as 30m N of VES42-S-D2-Shot 5 towards south, 30m N of VES42-N-D2-Shot 6 towards north, 30m N of VES42-E-D2-Shot 7 towards east and 30m N of VES42-W-D2-Shot 8 towards west directions. The traverse length for the south, north, east and west directions are 81.4 m, 103.6 m, 70m and 105 m respectively.

30m N of VES42-S-D2-Shot 5: Interpreted seismic data towards south direction with 81.4m traverse length.

Table 9.1.6.3.112. Interpreted seismic data for shot 30m N of VES42-S-D2-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.12	0.12	Soil	233
0.12-1.73	1.73	Dry Alluvium	249
Below 1.73		Dry Alluvium	456

Three-layer sequence in the subsurface delineated. Gravel not detected. P-wave is indicated from 0–16.4 m geophone spread and in remaining, 21.4-56.4 m, geophones surface waves registered.

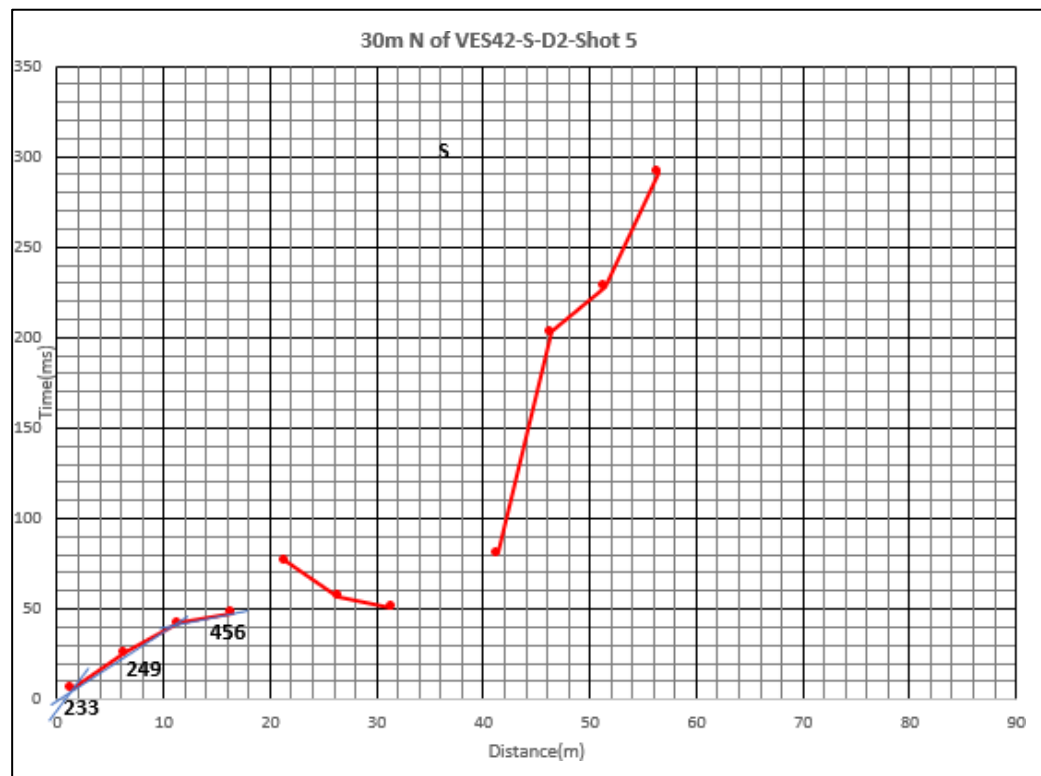


Figure 9.1.6.3.75 seismic hodograph of seismic shot 30m N of VES 42-S-D2-Shot 5

- **30m N of VES42-N-D2-Shot 6**

Interpreted seismic data towards north with a traverse of 103.6 m length.

Table 9.1.6.3.113. Interpreted seismic data for shot 30m N of VES42-N-D2-Shot 6

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.84	0.84	Soil	327
0.84-4.48	3.63	Dry Alluvium	208
Below 4.48		Wet Alluvium& Sand	1250

Three-layer sequence of lithology and gravel not detected. P-wave is indicated from 0–13.6 m geophone spread and in remaining 18.6-98.6 m geophones surface waves registered.

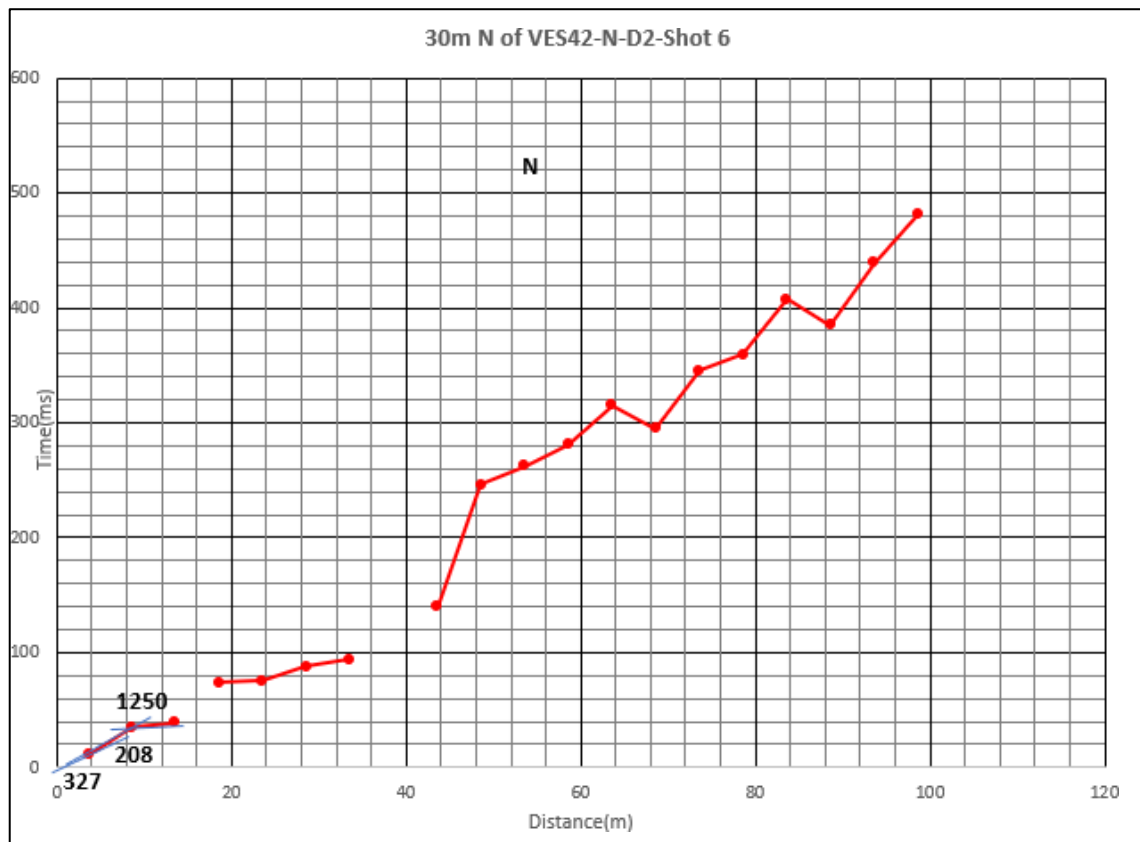


Figure 9.1.6.3.76 seismic hodograph of seismic shot 30m N of VES 42-N-D2-Shot 6

- **30m N of VES42-E-D2-Shot 7**

Interpreted seismic data towards east with a traverse of 70 m length.

Table 9.1.6.3.114. Interpreted seismic data for shot 30m N of VES42-E-D2-Shot 7

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.16	0.16	Soil	333
0.16-3.44	3.29	Dry Alluvium	351
3.4-12.06	8.62	Dry Alluvium	238
Below 12.06		Wet Alluvium& Sand	1612

Four-layer sequence down to 12.06 depth and gravel not detected. P-wave is indicated from 0–25 m geophone spread and in remaining 30-70 m geophones surface waves registered.

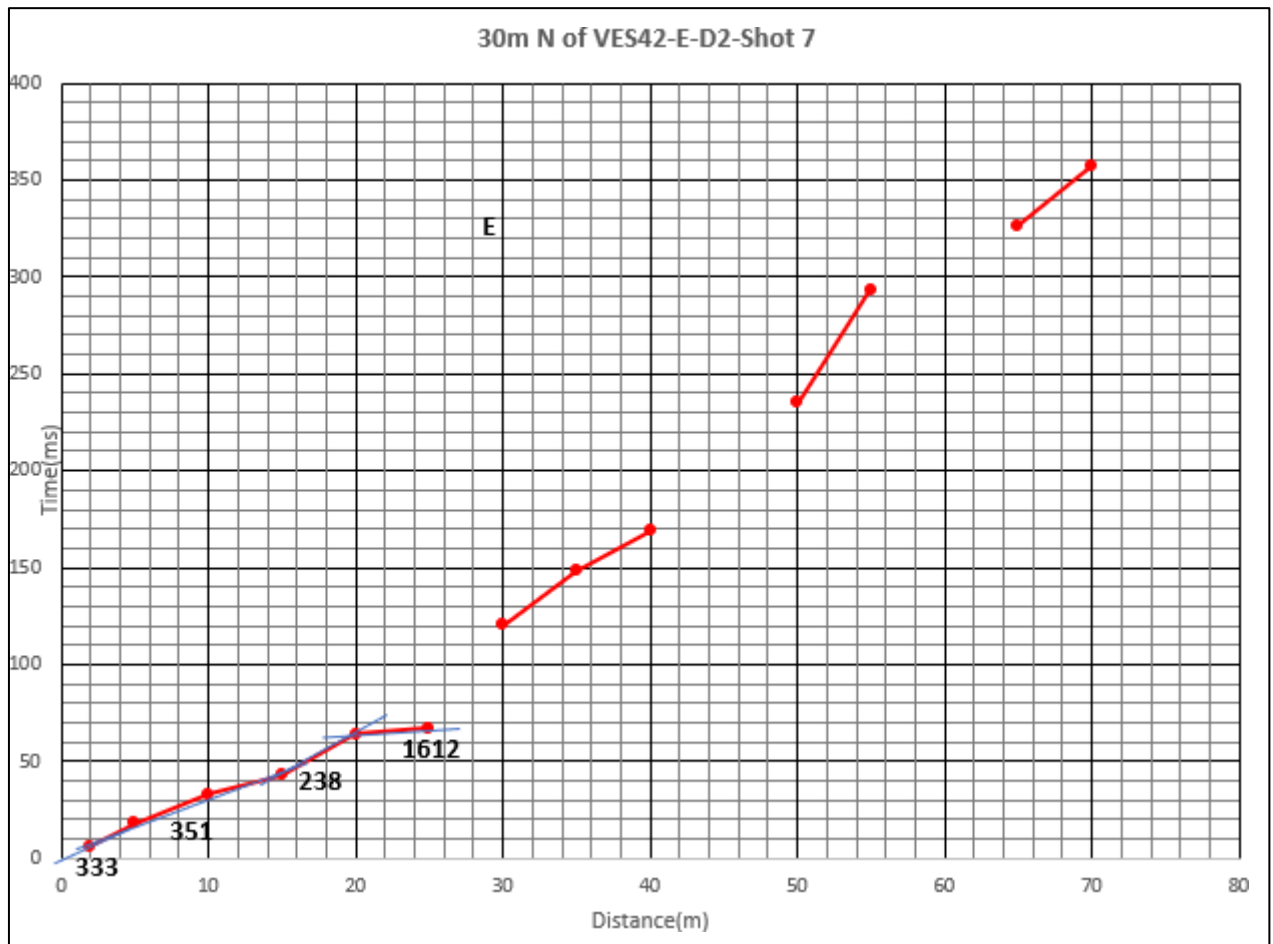


Figure 9.1.6.3.77 seismic hodograph of seismic shot 30m N of VES 42-E-D2-Shot 7

30m N of VES42-W-D2-Shot 8: Interpreted seismic data towards west with a traverse of 105m length.

Table 9.1.6.3.115. Interpreted seismic data for shot 30m N of VES42-W-D2-Shot 8

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.30	0.30	Soil	333
0.30-3.85	3.54	Dry Alluvium	275
Below 3.85		Gravel/dry sand	832

Gravel detected in this 3-layer sequence down to 3.85 m depth as in table. P-wave is indicated from 0–30 m geophone spread and in remaining 35-95 m geophones surface waves registered.

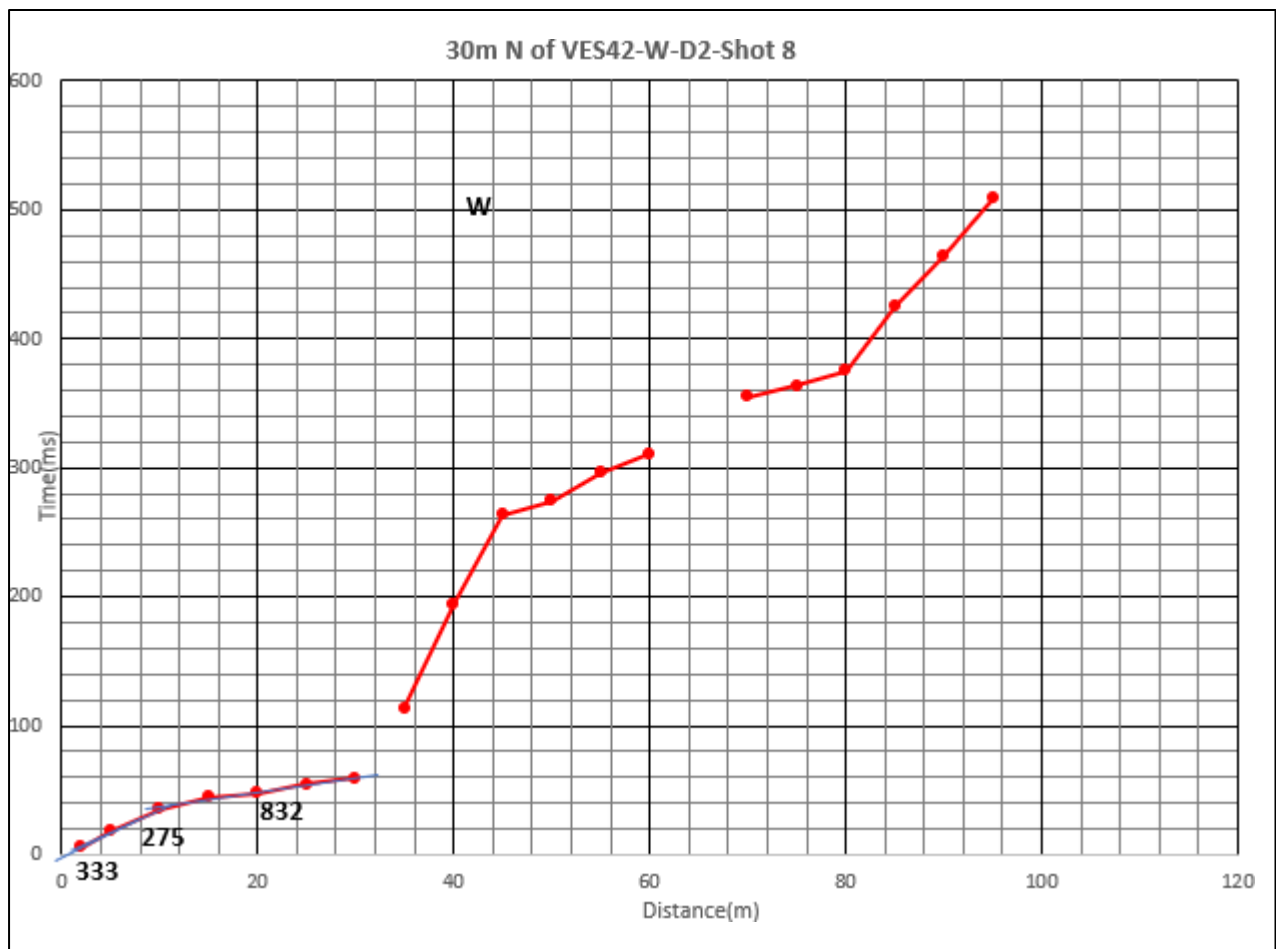


Figure 9.1.6.3.78 seismic hodograph of seismic shot 30m N of VES 42-W-D2-Shot 8

40m S of VES 42 (16°25'11.87"N, 80°38'34.78"E):

Three seismic shots were conducted at this location, designated as 40m S of VES42-S-D2-Shot 1 towards south, 40m S of VES42-N-D2-Shot 2 towards north and 40m S of VES42-E-D2-Shot 4 towards east directions. Traverses are of 100 m, 150 m and 75 m length in these directions.

40m S of VES42-S-D2-Shot 1: Interpreted seismic data towards south direction

Table 9.1.6.3.116. Interpreted seismic data for shot 40m S of VES42-S-D2-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.19	0.19	Soil	333
0.19-5.08	4.89	Dry Alluvium	360
Below 5.08		Dry Alluvium & Sand	894

Three-layer litho units delineated up to 5.08m depth. Gravel not detected. P-wave is indicated from 0–40 m geophone spread and in remaining array, 45-55 m, surface waves registered.

40m S of VES42-N-D2-Shot 2: Interpreted seismic refraction data towards north

Table 9.1.6.3.117. Interpreted seismic data for shot 40m S of VES42-N-D2-Shot 2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.38	0.382	Soil	333.3
0.38-7.03	6.653	Dry Alluvium & Sand	447.1
7.03-16.2	9.175	Lateritic soil	3746.9
Below 16.2		Wet Alluvium&Sand	1706.5

Four-layer sequence without gravel down to 16.2m depth. P-wave is indicated from 0–40 m geophone spread and in remaining array, 45-150 m, surface waves recorded.

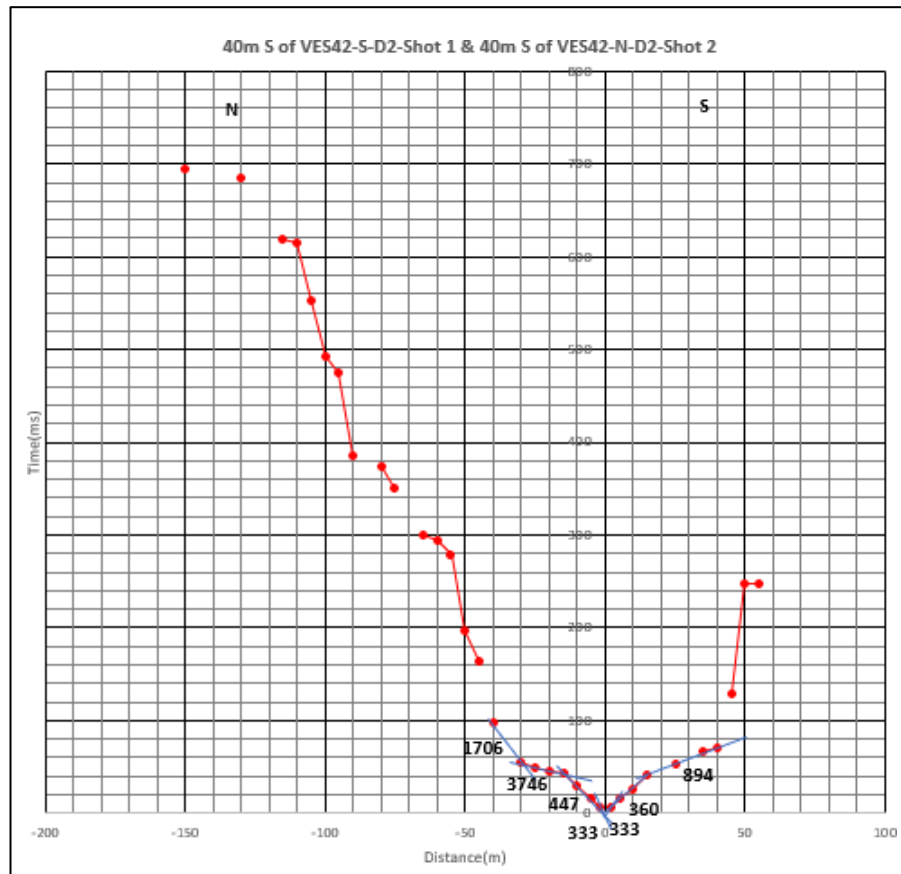


Figure 9.1.6.3.79 seismic hodograph of two shots 40m S of VES 42-S-D2-Shot 1 and 40m S of VES 42-N-D2-Shot 2

40m S of VES42-E-D2-Shot 4: Interpreted seismic refraction data towards east direction

Table 9.1.6.3.118. Interpreted seismic data for shot 40m S of VES42-E-D2-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.22	0.22	Soil	333.3
0.22-6.62	6.39	Dry Alluvium	299
6.62-14.6	8.07	Dry Alluvium&Sand	714
Below 14.6		Dry Alluvium	293

Four-layer sequence of litho unit without gravel. P-wave is indicated from 0–35 m geophone array. In remaining array, 40-75 m geophones, surface waves observed.

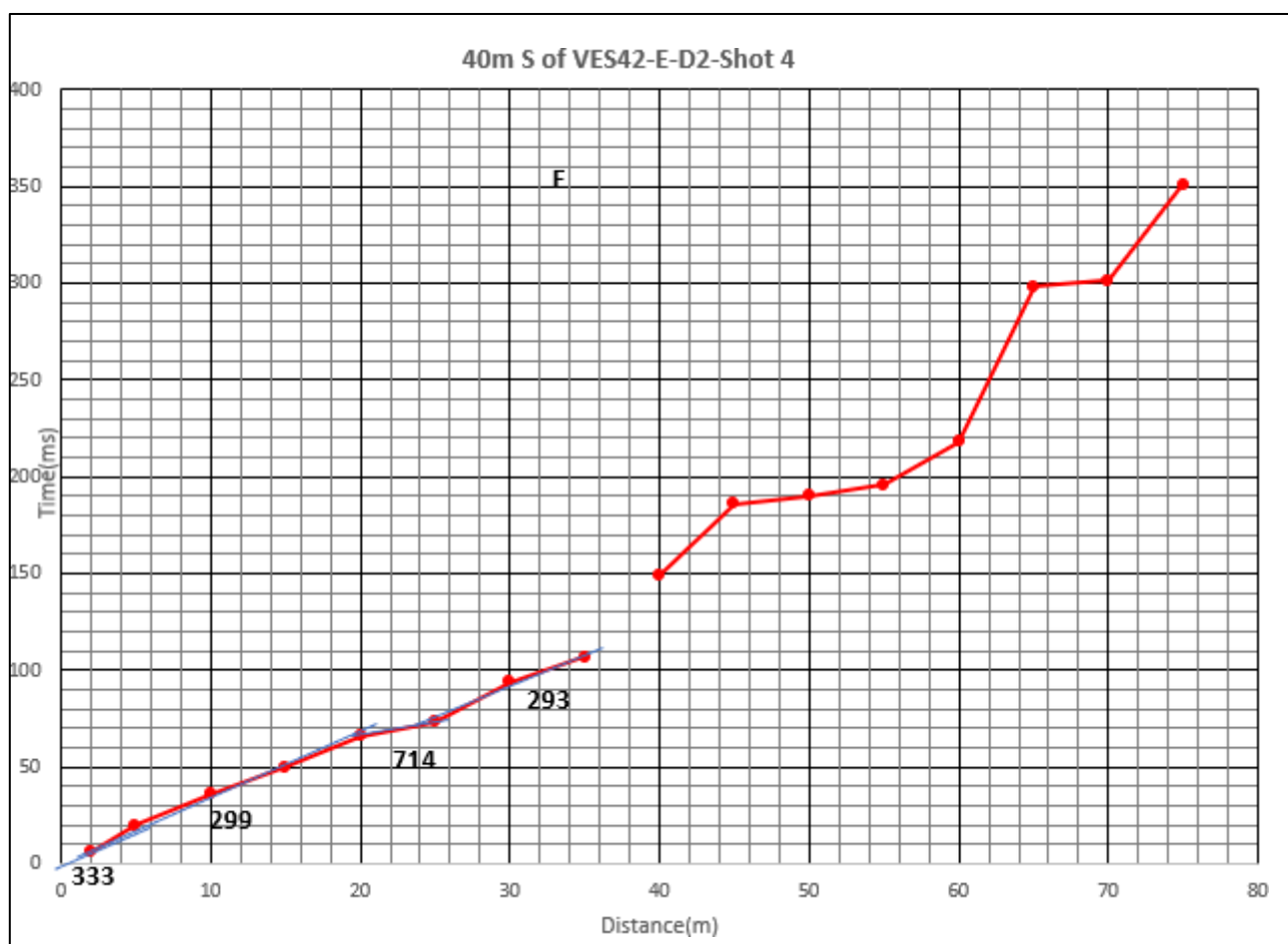


Figure 9.1.6.3.80 seismic hodograph of seismic shot 40m S of VES 42-E-D2-Shot 4

Seismic survey was conducted northwest of Nutakki village at three locations identified as 20 m north of VES 43 at 16°25'15.32"N, 80°38'45.11"E, 88m south of VES 43 at 16°25'11.01"N, 80°38'45.17"E and 115 m northwest of VES 43 at 16°25'11.74"N, 80°38'45.25"E.

20m N of VES 43 (16°25'15.32"N, 80°38'45.11"E)

Three seismic shots were conducted at this location designated as 20m NW of VES 43-S-D2 towards south, 20m NW of VES 43-N-D1 towards north direction and 20m NW of VES 43-E-D2 towards east directions. The traverse length for south, north and east directions are 85m, 85m and 60 m respectively.

20m NW of VES 43-S-D2

Interpreted seismic data towards south with a traverse of 85 m length.

Table 9.1.6.3.119. Interpreted seismic data for shot 20m NW of VES 43-S-D2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.46	0.46	Soil	333
0.46-2.10	1.63	Dry Alluvium	214
2.10-6.33	4.22	Dry Alluvium	535
6.33-15.4	9.10	Dry Alluvium&Sand	768
15.4-27.8	12.37	Wet Alluvium&Sand	1666
27.8-41.2	13.47	Dry Alluvium	555
41.2-67.3	26.04	Wet Alluvium&Sand	1175
Below 67.3		Dry Alluvium	256

Eight-layer sequence and the possibility of gravel not detected down to 67.3m depth.

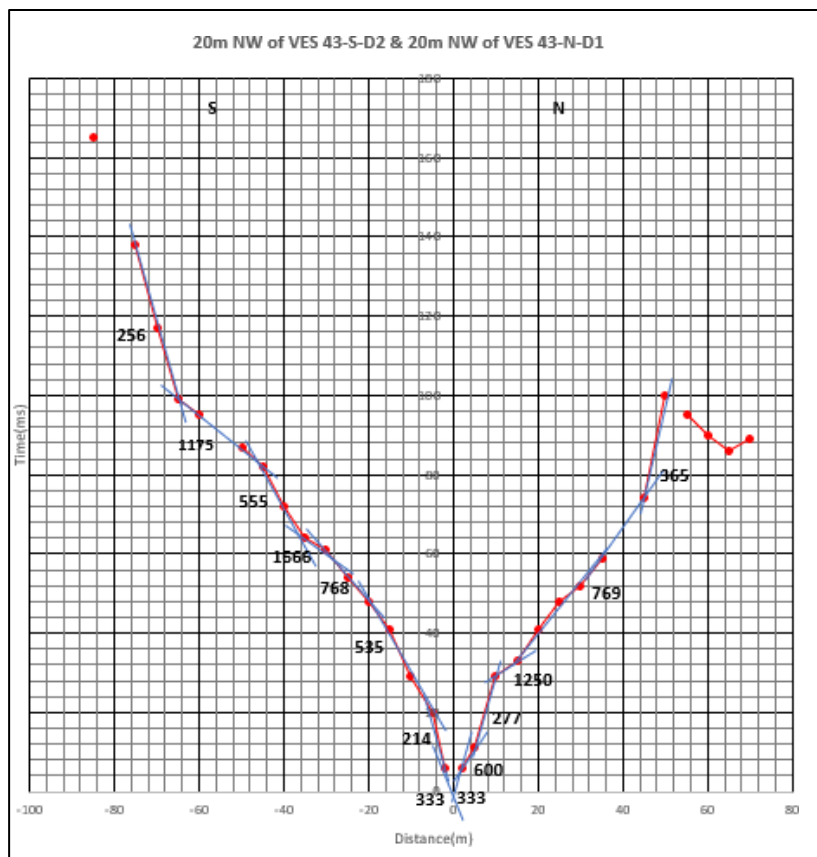
20m NW of VES 43-N-D1

Interpreted seismic data towards north with a traverse of 85 m length.

Table 9.1.6.3.120. Interpreted seismic data for shot 20m NW of VES 43-N-D1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.53	0.53	Soil	333
0.53-2.04	1.51	Dry Alluvium&Sand	600
2.04-6.03	3.98	Dry Alluvium	277
6.03-9.69	3.65	Wet Alluvium&Sand	1250
9.69-20.13	10.43	Dry Alluvium&Sand	769
Below 20.13		Dry Alluvium	365

Six-layer sequence and the possibility of gravel not detected down to 20.13m depth. P-wave is indicated from 0–50 m geophone spread and in remaining, 55-70 m, geophones surface waves registered.



**Figure 9.1.6.3.81 seismic hodograph of two shots 20m NW of VES 43-S-D2
and 20m NW of VES 43-N-D1**

20m NW of VES 43-E-D2

Interpreted seismic data towards east with a traverse of 60 m length.

Table 9.1.6.3.121. Interpreted seismic data for shot 20m NW of VES 43-E-D2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.25	0.26	Soil	333
0.25-2.86	2.61	Dry Alluvium	380
2.86-5.36	2.50	Dry Alluvium&Sand	666
5.36-13.0	7.64	Dry Alluvium&Sand	587
13.0-21.7	8.75	Wet Alluvium&Sand	1000
21.7-35.5	13.83	Wet Alluvium&Sand	1666
35.5-56.5	20.92	Dry Alluvium&Sand	587
Below 56.5		Lateritic soil	3333

Eight-layer strata down to 56.5m depth and gravel not detected with in this sub surface.

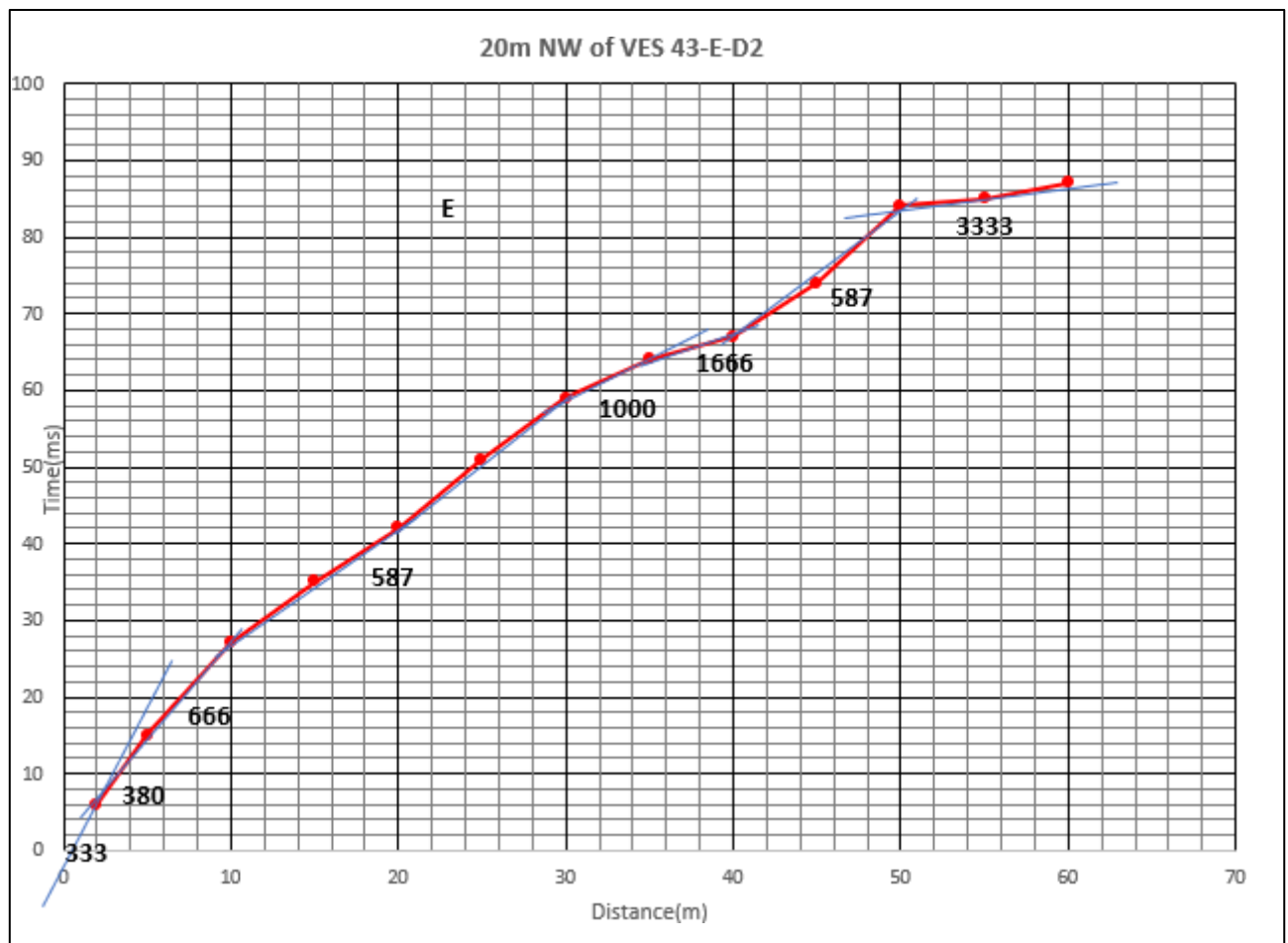


Figure 9.1.6.3.82 seismic hodograph of seismic shot 20m NW of VES 43-E-D2

88m S of VES 43 (16°25'11.01"N, 80°38'45.17"E)

Seismic shot was conducted at this location named as 88m S of VES 43-NE-D2 in north eastern direction with a traverse of 75m. Interpreted seismic refraction data

Table 9.1.6.3.122. Interpreted seismic data for shot 88m S of VES 43-NE-D2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.427	Soil	333
0.42-2.03	1.606	Dry Alluvium	230
2.03-5.06	3.034	Dry Alluvium& Sand	554
5.06-11.93	6.869	Dry Alluvium	256
Below 11.93		Dry Alluvium& Sand	714

Five-layer strata and the possibility of gravel not detected down to 11.93m depth. P-wave is indicated from 0–25 m geophone array and in remaining, 30-75 m, geophones surface waves registered.

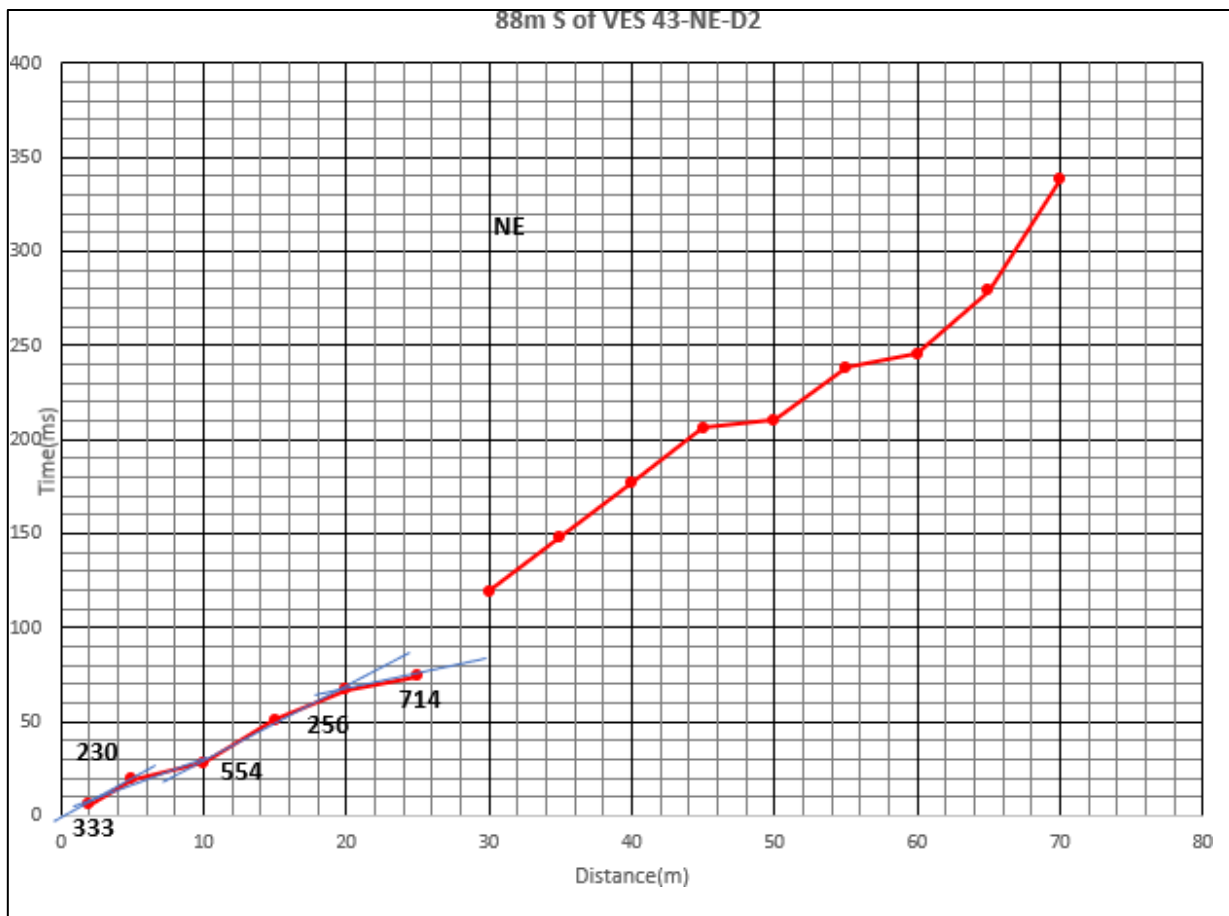


Figure 9.1.6.3.83 seismic hodograph of seismic shot 88m S of VES 43-NE-D2

115m NW of VES 43 (16°25'11.74"N, 80°38'45.25"E):

Seismic survey was conducted at this location named as 115m S of VES 43-S-D2 towards south direction with a traverse of 85m.

Table 9.1.6.3.123. Interpreted seismic data for shot 115m S of VES 43-S-D2

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.01	0.01	Soil	333.3
0.01-2.51	2.50	Dry Alluvium	333.2
2.51-7.52	5.01	Dry Alluvium& Sand	554.9
Below 7.52		Dry Alluvium	212.6

Four-layer lithology and the possibility of gravel not detected up to 7.52m depth. P-wave is indicated from 0–25 m geophone array and in remaining array, 30-65 m, surface waves recorded.

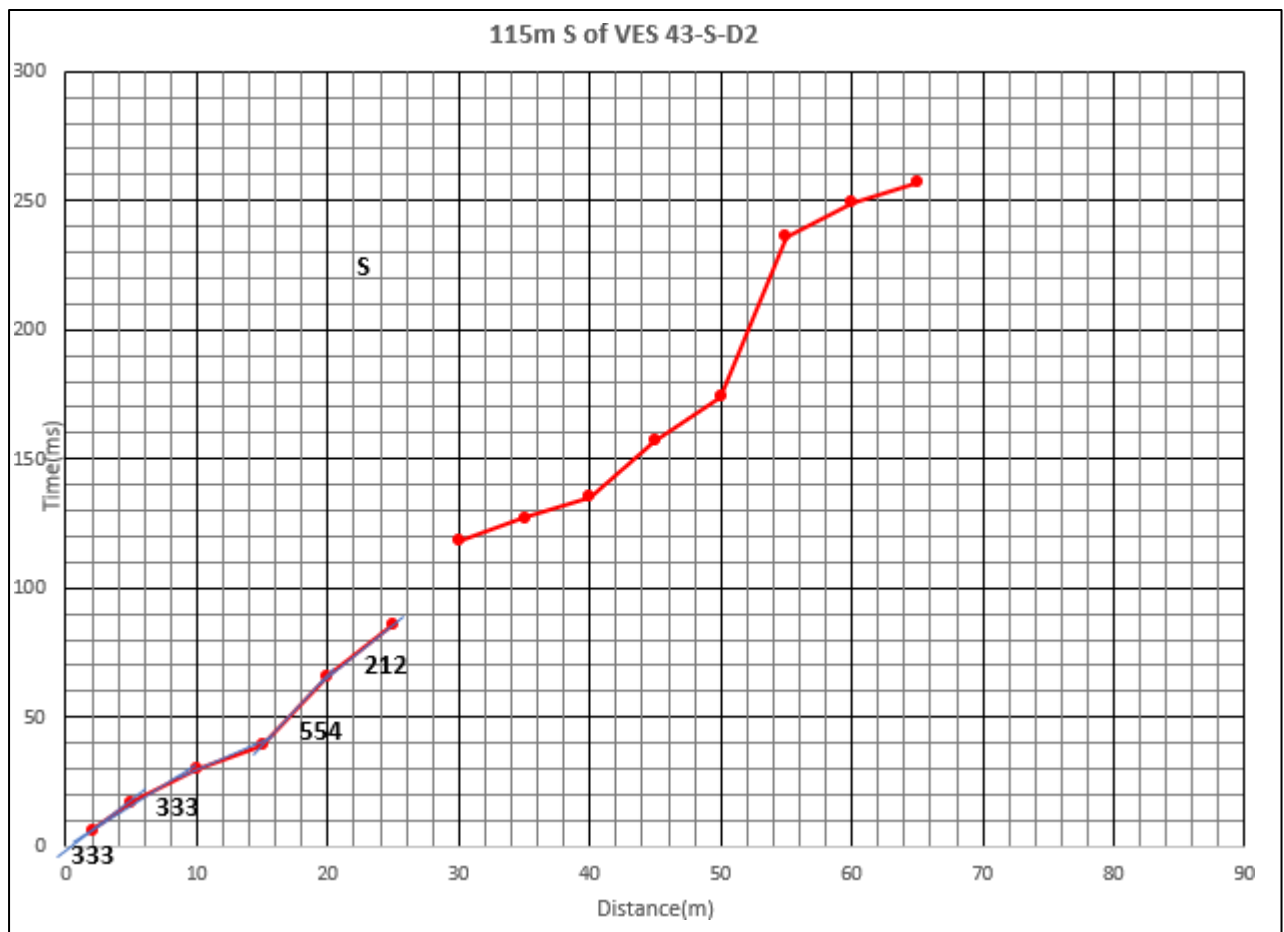


Figure 9.1.6.3.84 seismic hodograph of seismic shot 115m S of VES 43-S-D2

Seismic survey was conducted at this location described as 22m S of VES 44 at 16°25'32.33"N, 80°38'32.11"E, northwest of Nutakki village. Two seismic shots designated as 20m SE of VES44-W-D2-Shot 4 towards west and 20m SE of VES44-E-D1-Shot 5 towards east directions were conducted at this spot. The traverses are of 90m length towards east and 85m towards west.

20m SE of VES44-W-D2-Shot 4: Interpreted seismic refraction data on traverse towards west.

Table 9.1.6.3.124. Interpreted seismic data for shot 20m SE of VES44-W-D2-Shot 4

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.42	0.42	Soil	333
Below 0.42		Dry Alluvium	230

In this two-layer sequence of subsurface the possibility of gravel not detected. P-wave is indicated from 0–20 m geophone spread and in remaining, 25-80m, geophones surface waves registered.

20m SE of VES44-E-D1-Shot 5:

Interpreted seismic refraction data. Traverse towards east with 90m length.

Table 9.1.6.3.125. Interpreted seismic data for shot 20m SE of VES44-E-D1-Shot 5

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.61	0.62	Soil	333
0.61-2.09	1.48	Dry Alluvium	149
2.09-5.82	3.73	Dry Alluvium	312
Below 5.82		Dry Alluvium	188

Four-layer strata in the sub surface delineated and gravel not detected. P-wave is indicated from 0–25 m geophone spread and in remaining, 30-70 m, geophones surface wave registered.

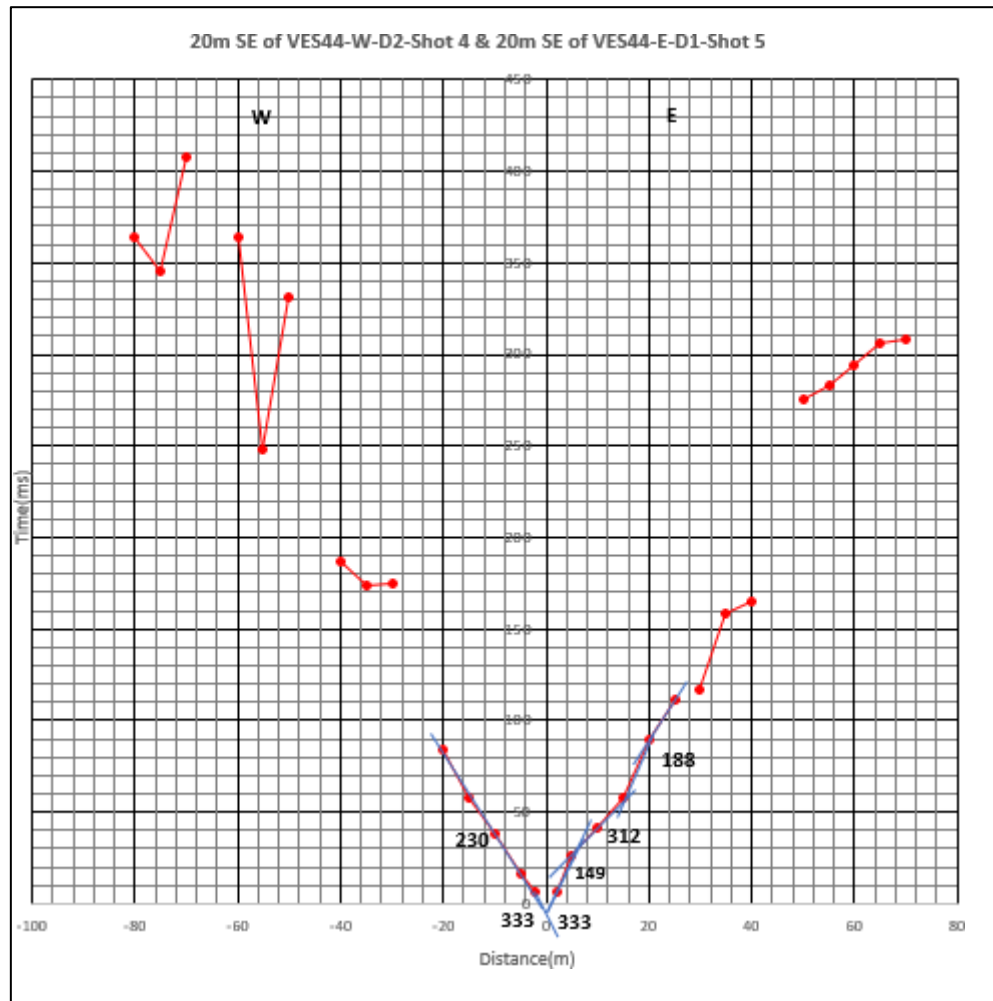


Figure 9.1.6.3.85 seismic hodograph of two shots 20m SE of VES 44-W-D2-Shot 4 and 20m SE of VES 44-E-D1-Shot 5

Seismic survey was conducted at this location described as 18m E of VES60 (16°24'25.36"N, 80°35'31.25"E) towards west of Pedavadlapudi village. This shot is named as VES 16-S-D1-Shot 1 of traverse length 85.4m towards south direction

VES 16-S-D1-Shot 1- Interpreted seismic refraction data

Table 9.1.6.3.126. Interpreted seismic data for shot VES 16-S-D1-Shot 1

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.62	0.62	Soil	333
0.62-4.95	4.32	Dry Alluvium/Sand	766
Below 4.95		Dry Alluvium	383

Three-layer strata and gravel not detected in this sub surface. P-wave is indicated from 0–20 m geophone spread. remaining 25-75.4 m geophones in this array recorded surface waves.

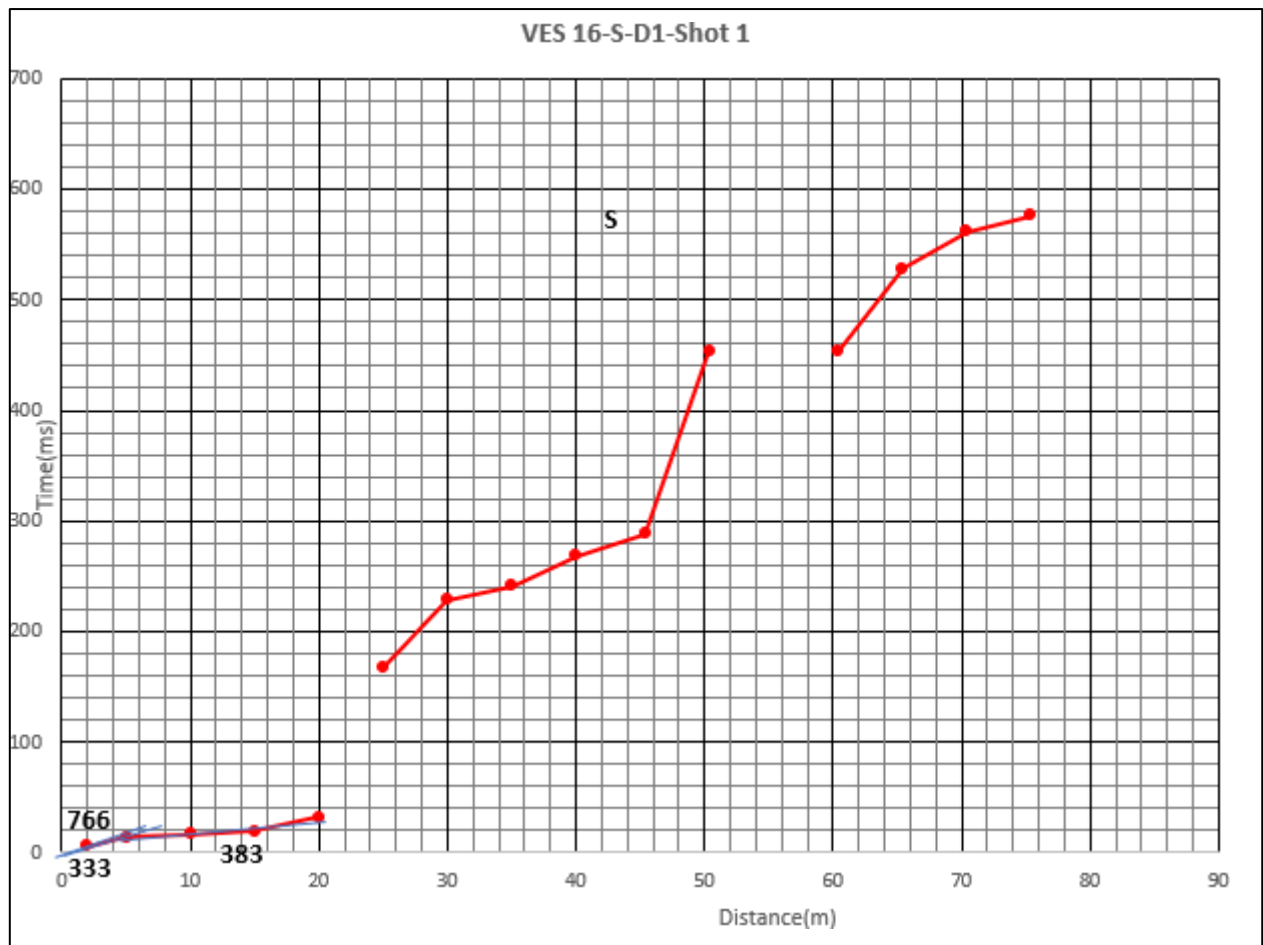


Figure 9.1.6.3.86 seismic hodograph of seismic shot VES 16-S-D1-Shot 1

Seismic survey was conducted west-north-west of Pedavadlapudi village near VES 15 location. Split-spread configuration has been employed towards east–west (E–W) and north–south directions. The survey lines for E–W is of 55 m and 58 m and for N–S it is 68m and 45m length. Seismic shot point coordinates are 16°24'51.97"N, 80°36'14.02"E, at 15 m north of VES15.

15 m north of VES15

East–West geophone array with transect towards east: Interpreted seismic refraction data.

Table 9.1.6.3.127. Interpreted seismic data for shot 15 m north of VES15 -E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.82	0.829	Soil	240
0.82-3.99	3.165	Wet Alluvium/Sand	1296
3.9-9.21	5.220	Lateritic soil	3030
9.21-16.59	7.376	Wet Alluvium/Sand	1052
16.59-28.9	12.320	Compact clay	1724
28.9-42.8	13.988	Dry Alluvium/Sand	581
42.8-56.7	13.880	Wet Alluvium/Sand	1694
Below 56.7		Dry sand/clay	760

Gravel layer was not detected in this 8-layer sequence of strata.

Seismic survey towards West Direction:**Table 9.1.6.3.128. Interpreted seismic data for shot 15 m north of VES15 -W**

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.74	0.75	Soil	240.1
0.74-2.39	1.65	Gravel/dry sand	840.3
2.39-7.2	4.75	Lateritic soil	2127.7
7.2-10.8	3.60	Wet Alluvium&Sand	951
10.8-14.8	3.98	Gravel/dry sand	878
14.8-26.08	11.27	Dry Alluvium&Sand	781.3
Below 26.08		Wet Alluvium&Sand	1373.6

Gravel detected in this 6-layer sub surface strata at 0.74m and 10.8m depth as in table.

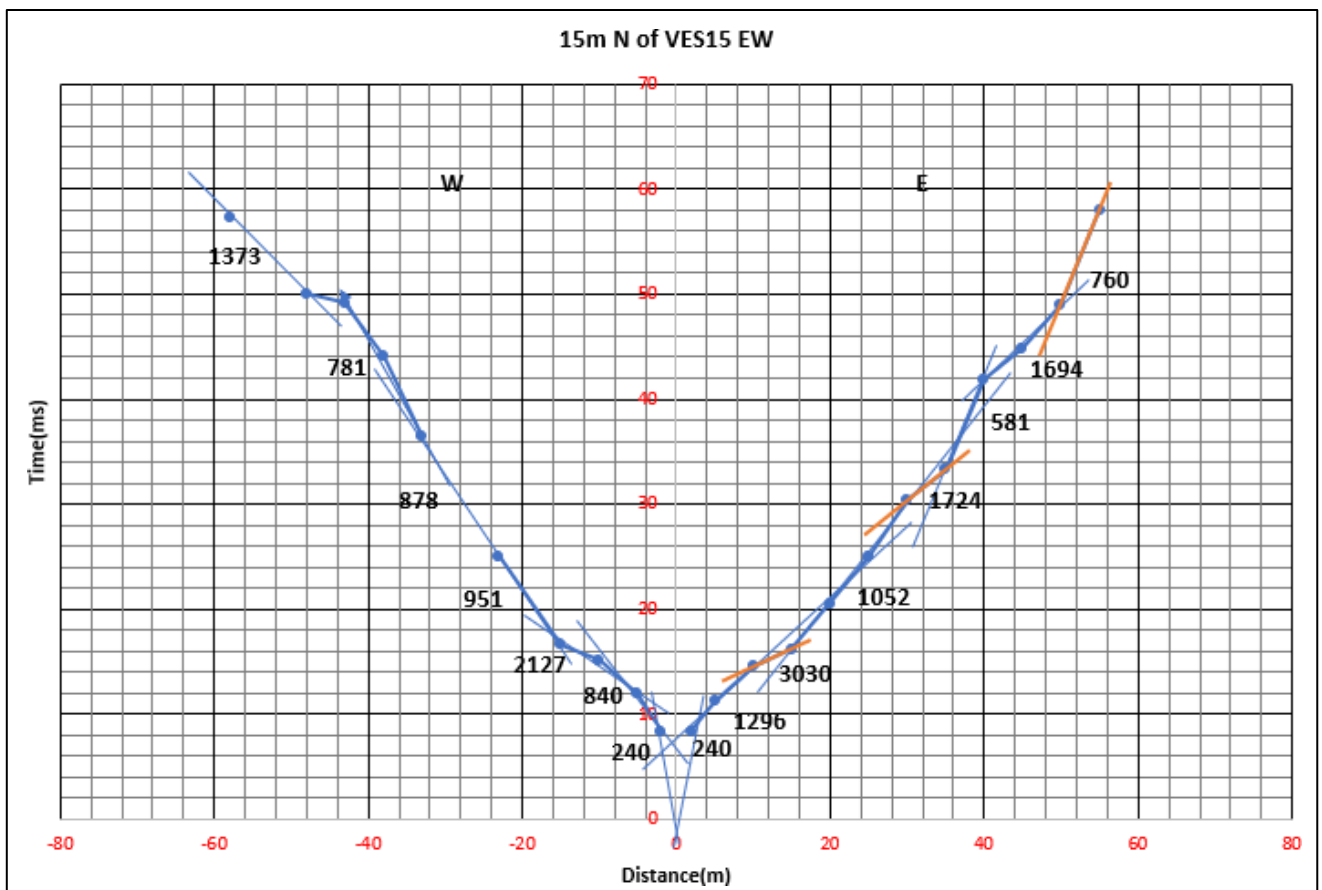


Figure 9.1.6.3.87 seismic hodograph of two shots 15m N of VES 15-E and 15m N of VES 15-W

North–South Spread- Geophone array towards north direction: Interpreted seismic refraction data.

Table 9.1.6.3.129. Interpreted seismic data for shot 15 m north of VES15 -N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.8	0.802	Soil	207.7
0.8-2.0	1.201	Wet Alluvium& Sand	958.5
2.0-6.63	4.627	Wet Alluvium& Sand	1533.7
6.63-15.5	8.896	Lateritic soil	3418.8
15.5-24.1	8.590	Gravel/dry sand	859.1
24.1-41.2	17.160	Dry Alluvium& Sand	533.0
41.2-56.8	15.600	Lateritic soil	2403.8
Below 56.8		Wet Alluvium& Sand	975.9

Gravel detected in this 8-layer sequence at 15.5 m depth as in table.

Geophone array towards south direction: Interpreted seismic refraction data.

Table 9.1.6.3.130. Interpreted seismic data for shot 15 m north of VES15 -S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.85	0.85	Soil	207.7
0.85-3.2	2.41	Wet Alluvium& Sand	1333.3
3.2-8.5	5.31	Lateritic soil	2136.8
8.5-14.01	5.45	Dry Alluvium& Sand	710.2
Below 14.01		Wet Alluvium& Sand	1308.9

Data displays 5-layer strata with wet and dry layers of sand. No gravels detected.

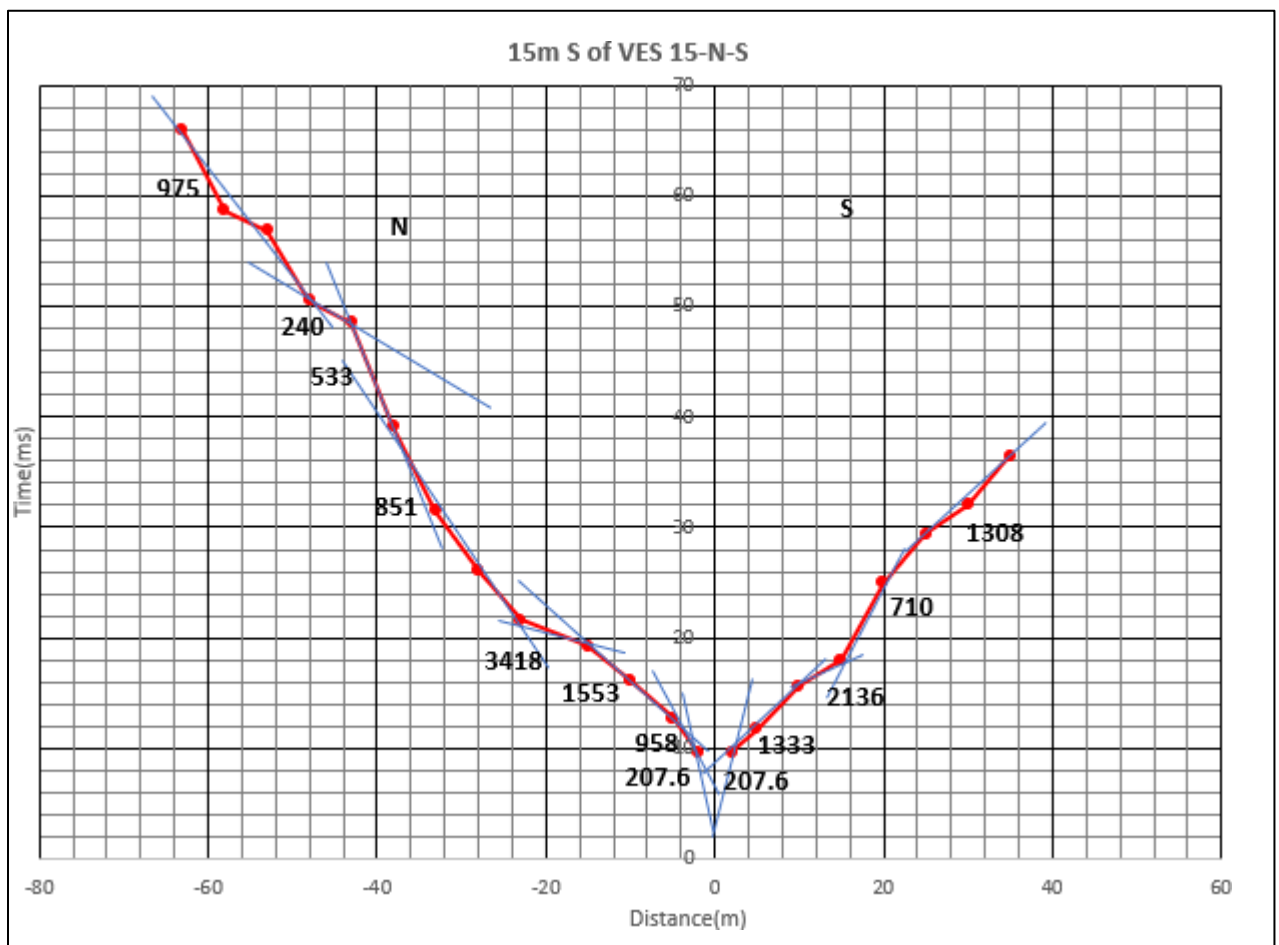


Figure 9.1.6.3.88 seismic hodograph of two shots 15m N of VES 15-N and 15m N of VES 15-S
Seismic survey near VES27 in Nutakki village:

Seismic refraction survey was conducted employing split-spread configuration along east–west direction. Another traverse also laid toward north-south direction. Both shots are conducted at 16°24'32.18"N, 80°38'10.79"E which is 9 m south of VES 27. These traverses are laid towards east

75m, west 34m, north and south 55m each at latitude and longitude quoted above.

East–West geophone array- Seismic shot towards east: Interpreted seismic refraction data.

Table 9.1.6.3.131. Interpreted seismic data for shot 9m S of VES27 -E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.91	0.91	Soil	232.3
0.91-3.6	2.78	Lateritic soil	2589.0
3.6-8.7	5.05	Wet Alluvium&Sand	1364.3
8.7-15.7	6.99	Dry Alluvium&Sand	810.4
Below 15.7		Wet Alluvium&Sand	1546.4

Data displays 5-layer strata with wet and dry layers of sand. No gravels detected.

Seismic survey towards West. Interpreted seismic refraction data.

Table 9.1.6.3.132. Interpreted seismic data for shot 9m S of VES27 -W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.78	0.78	Soil	283.7
0.78-7.8	7.09	Wet Alluvium&Sand	1182.5
7.8-18.1	10.26	Lateritic soil	2304.1
18.1-30.6	12.47	Gravel/dry sand	834.7
30.6-48.8	18.21	Lateritic soil	2557.5
48.8-70.7	21.94	Dry Alluvium&Sand	533.0
Below 70.7		Lateritic soil	2398.1

Gravel detected in this 7-layer sequence down to 18.1m depth as in table.

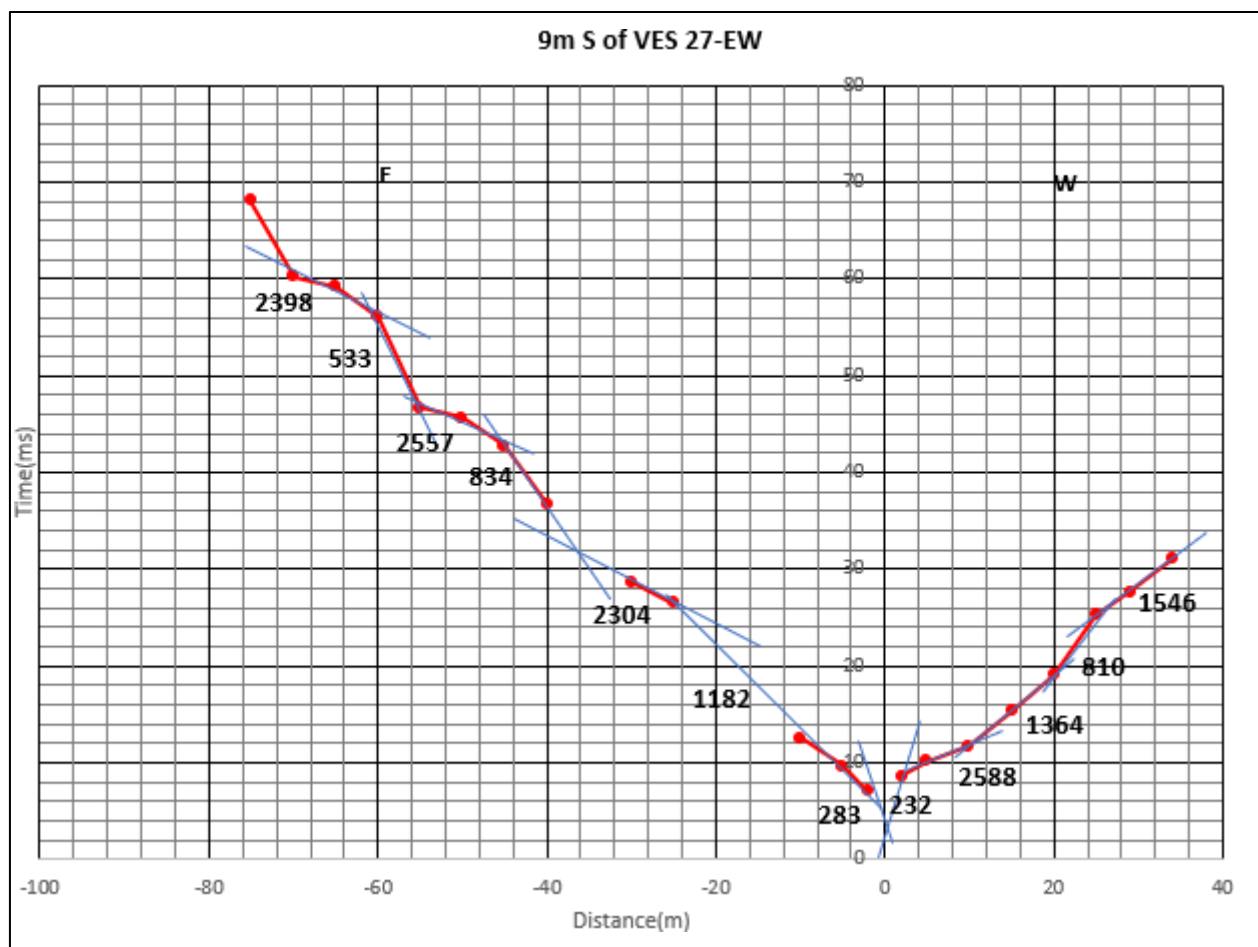


Figure 9.1.6.3.89 seismic hodograph of two shots 9m S of VES 27-E and 9m S of VES 27-W

North–South geophone array – seismic profile towards north direction interpreted data:

Table 9.1.6.3.133. Interpreted seismic data for shot 9m S of VES27 -N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.86	0.87	Soil	232.83
0.86-2.2	1.35	Wet Alluvium& Sand	1648.35
2.2-8.02	5.81	Lateritic soil	2994.01
8.02-14.02	6.00	Dry Alluvium& Sand	749.63
14.02-24.12	10.10	Wet Alluvium& Sand	1199.04
24.1-37.1	12.99	Dry Alluvium& Sand	599.88
Below 37.1		Wet Alluvium& Sand	1199.04

Data displays 7-layer strata with wet and dry layers of sand. No gravels detected.

Seismic profile towards South Direction: Interpreted seismic refraction data:

Table 9.1.6.3.134. Interpreted seismic data for shot 9m S of VES27 -S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.87	0.87	Soil	232.8
0.87-1.68	0.81	Compact clay	1704.5
1.68-6.58	4.90	Lateritic soil	2105.3
6.58-12.2	5.67	Gravel/dry sand	846.5
12.2-19.4	7.23	Wet Alluvium& Sand	1128.7
19.4-30.65	11.18	Dry Alluvium& Sand	799.6
Below 30.6		Wet Alluvium& Sand	1199.0

Gravel detected in this 7-layer sequence at 6.58 m depth as in table.

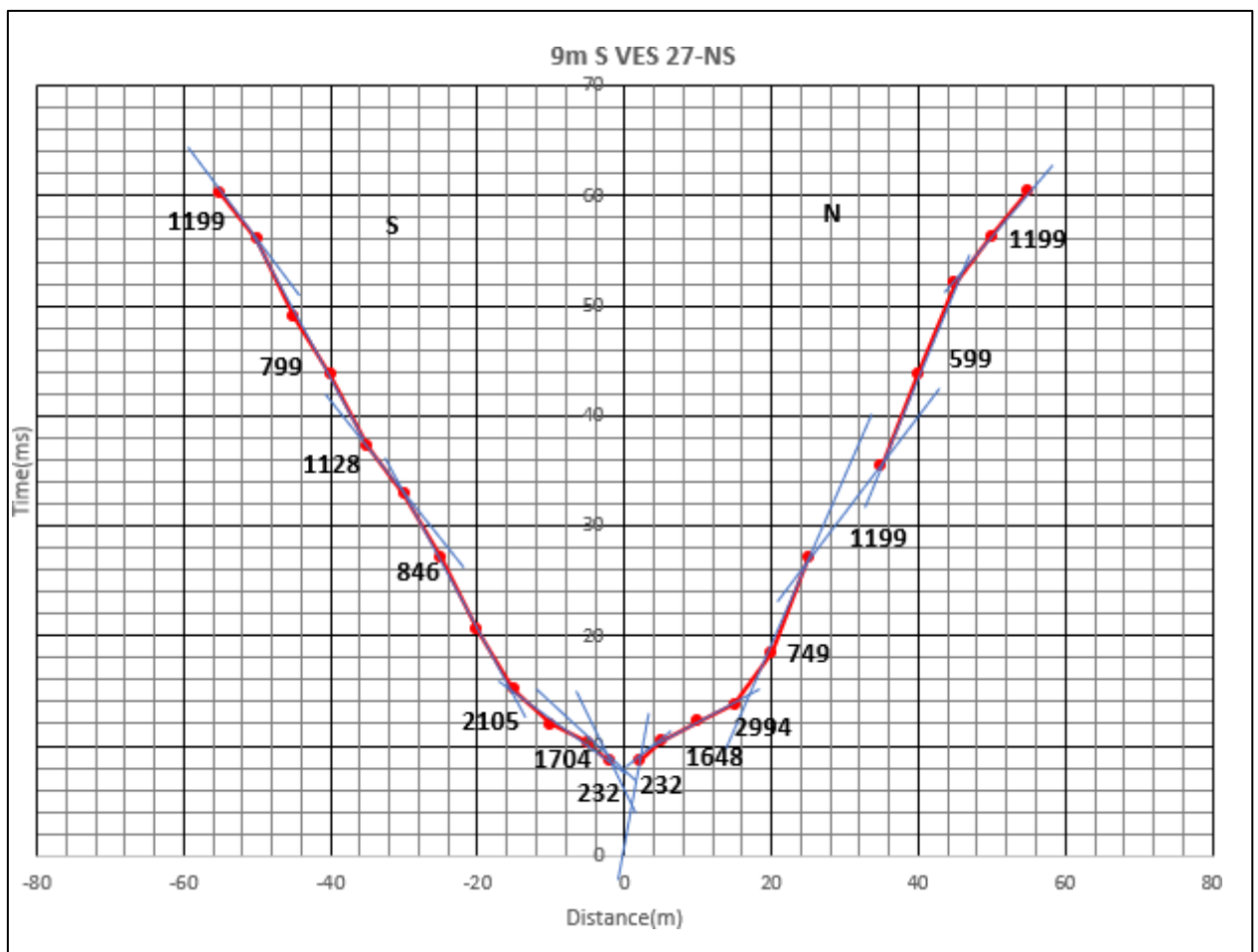


Figure 9.1.6.3.90 seismic hodograph of two shots 9m S of VES 27-N and 9m S of VES 27-S

Seismic Survey at Nutakki village near VES 7 location -38.55m SW of VES7.

Seismic survey was conducted at this location employing split-spread configuration. The survey line is along E–W direction at coordinates 16°24'49"N, 80°38'14"E.

East–West Spread- survey laid towards East: Interpreted seismic refraction data

Table 9.1.6.3.135. Interpreted seismic data for shot 38.55m SW of VES7-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.85	0.856	Soil	240.1
0.85-4.3	3.450	Wet Alluvium& Sand	1558.8
4.3-6.8	2.580	Wet Alluvium& Sand	1014.2
6.8-16.19	9.305	Dry Alluvium& Sand	887.6
16.1-30.6	14.452	Wet Alluvium& Sand	1587.3
30.6-49.4	18.764	Lateritic soil	3816.8
Below 49.4		Wet Alluvium& Sand	1066.1

Data displays 7-layer strata with wet and dry layers of sand. Gravels detected at 6.8m depth

Seismic survey towards west: Interpreted seismic refraction data

Table 9.1.6.3.136. Interpreted seismic data for shot 38.55m SW of VES7-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.7	0.73	Soil	247.8
0.7-2.3	1.62	Gravel/dry sand	821.9
2.3-7.16	4.81	Lateritic soil	2020.2
7.16-12.2	5.08	Gravel/dry sand	843.2
12.2- 20.8	8.61	Wet Alluvium& Sand	1429.9
20.8-37.8	17.02	Gravel/dry sand	872.6
37.8-57.03	19.16	Lateritic soil	3205.1
Below 57.03		Gravel/dry sand	833.3

Gravel detected in this 7-layer sequence at 0.73, 7.16, 20.8 and 57m depth as in table.

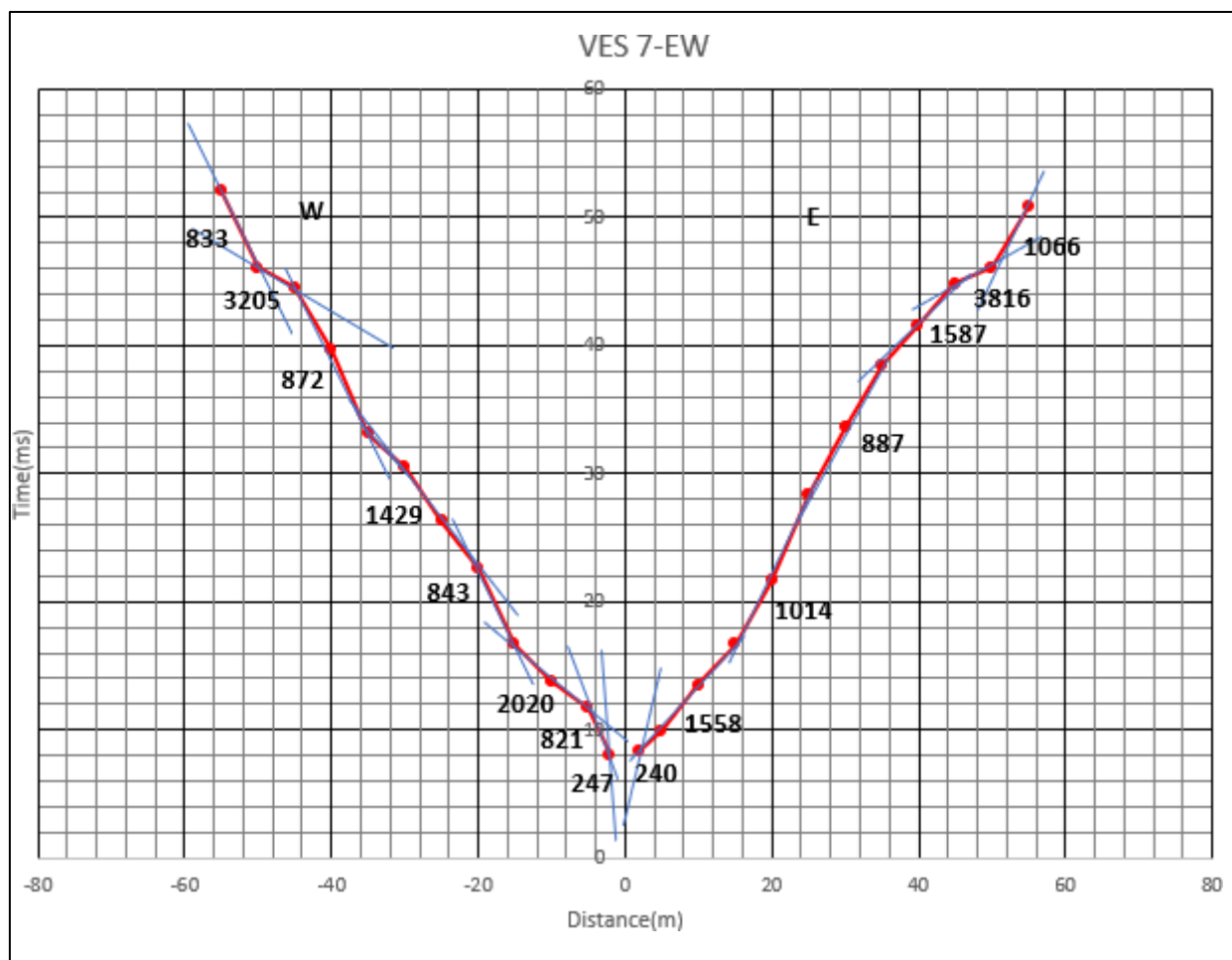


Figure 9.1.6.3.91 seismic hodograph of two shots 38.55m SW of VES7-E and 38.55m SW of VES7-W

Seismic survey in Nutakki village at 51m S of VES26 location.

Seismic survey conducted by split-spread configuration along east–west and north–south direction at $16^{\circ}24'39''\text{N}$, $80^{\circ}38'27''\text{E}$. Traverses are laid 55m towards east- west, 40 and 55m along north – south directions.

East–West Spread- Survey towards east direction: Interpreted seismic refraction data

Table 9.1.6.3.137. Interpreted seismic data for shot 51m S of VES26-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.79	0.79	Soil	240
0.79-1.82	1.03	Wet Alluvium& Sand	1049
1.82-2.87	1.04	Wet Alluvium& Sand	1474
2.87-8.68	5.81	Wet Alluvium& Sand	1610
8.68-14.12	5.43	Dry Alluvium& sand	796
14.12-25.2	11.09	Dry Alluvium& sand	611
25.2-30.85	5.64	Wet Alluvium& Sand	1154

Below 30.85		Wet Alluvium& Sand	1278
-------------	--	--------------------	------

Eight-layer lithology delineated in the sub surface. Gravel not detected.

Westward Direction: Interpreted seismic refraction data

Table 9.1.6.3.138. Interpreted seismic data for shot 51m S of VES26-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.84	0.84	Soil	240
0.84-1.93	1.08	Wet Alluvium& Sand	1449
1.93-5.46	3.53	Wet Alluvium& Sand	990
5.46-16.95	11.48	Wet Alluvium& Sand	1556
16.95-34.22	17.26	Dry Alluvium& sand	619
Below 34.22		Compact clay	1748

Six-layer strata identified. Gravel not detected.

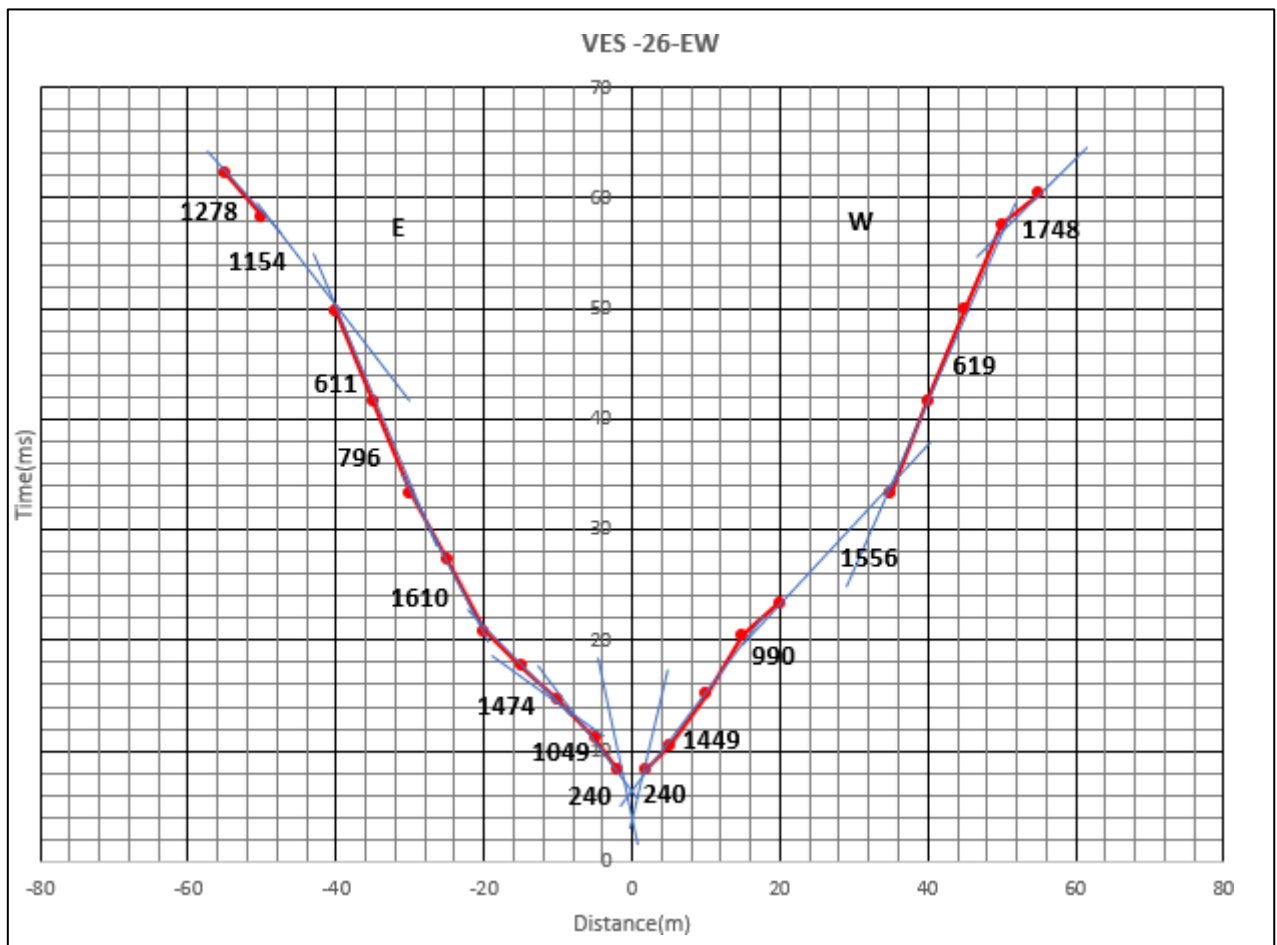


Figure 9.1.6.3.92 seismic hodograph of two shots 51m S of VES26 -E and 51m S of VES26 -W

North–South Array – Seismic survey towards north direction. Interpreted seismic refraction data

Table 9.1.6.3.139. Interpreted seismic data for shot 51m S of VES26-N

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.85	0.860	Soil	191.9
0.85-3.35	2.494	Wet Alluvium& Sand	1280.0
3.3-6.8	3.481	Lateritic soil	2127.7
6.8-10.6	3.793	Wet Alluvium& Sand	1373.6
10.6-21.18	10.558	Wet Alluvium& Sand	1028.1
Below 21.18		Dry Alluvium& sand	479.4

Six-layer strata observed with in 21.18m of the sub surface. Gravel not detected.

Southward Direction:

Table 9.1.6.3.140. Interpreted seismic data for shot 51m S of VES26-S

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.79	0.80	Soil	226.0
0.79-3.24	2.45	Wet Alluvium& Sand	1023.0
3.24-6.8	3.64	Wet Alluvium& Sand	1669.4
6.8-10.9	4.04	Wet Alluvium& Sand	1278.8
10.9-17.7	6.78	Wet Alluvium& Sand	1037.3
17.7-25.4	7.79	Dry Alluvium& sand	766.9
25.4-34.5	9.05	Dry Alluvium& sand	565.0
Below 34.5		Dry Alluvium& sand	783.1

Eight-layer sequence and the possibility of gravel not detected.

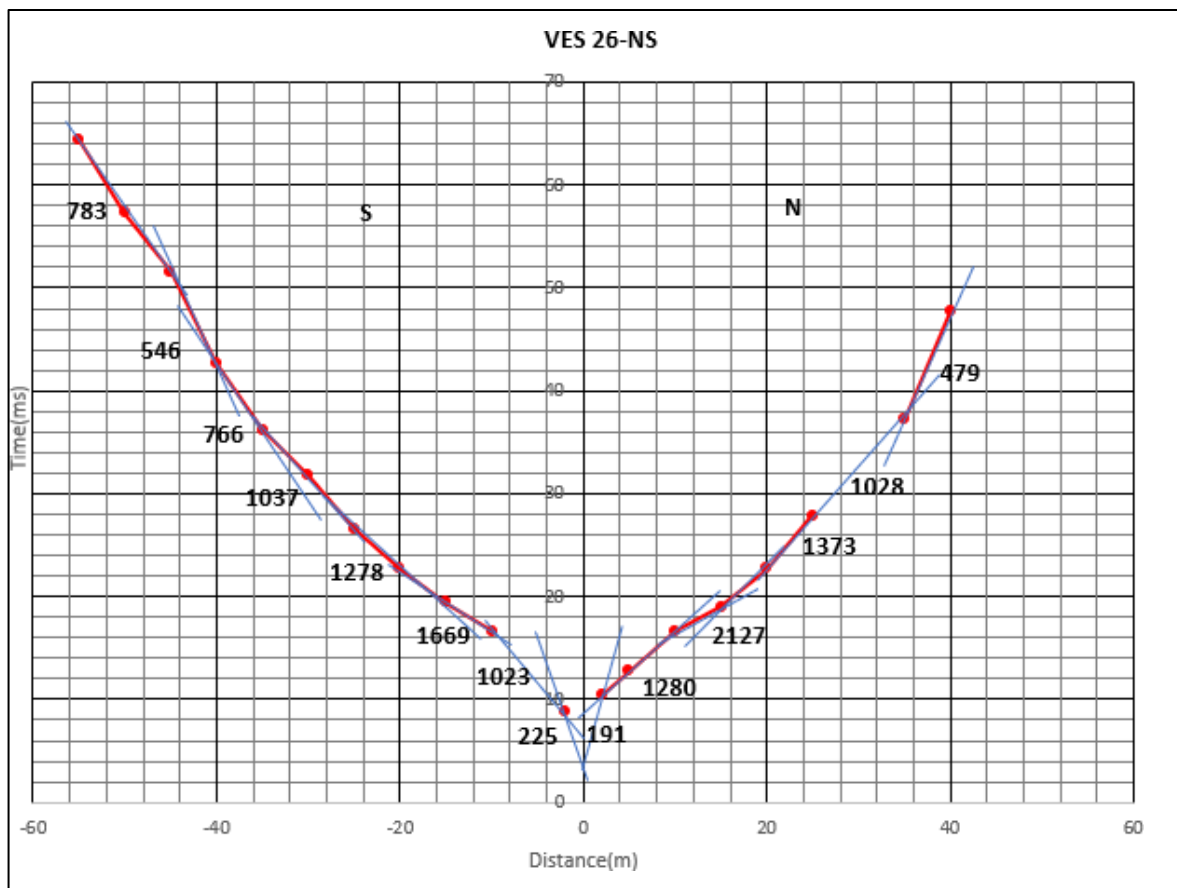


Figure 9.1.6.3.93 seismic hodograph of two shots 51m S of VES26 -N and 51m S of VES26 -S

Seismic Survey near 61m SE of VES 25 at Nutakki village

Seismic survey was conducted at 16°24'51"N, 80°38'42"E. Split-spread configuration along east–west transect with 44m on either direction were conducted. Towards north 94m traverse also laid.

East–West Spread- Traverse towards east direction: Interpreted seismic refraction data
Table 9.1.6.3.141. Interpreted seismic data for shot 61m SE of VES 25-E

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.53	0.53	Soil	187.3
0.53-2.2	1.68	Dry Alluvium& sand	333.9
2.2-4.99	2.79	Lateritic soil	1923.1
4.9-9.1	4.18	Dry Alluvium& sand	666.7
9.1-14.5	5.42	Lateritic soil	1923.1
14.5-23.1	8.57	Dry Alluvium& sand	713.6
23.1-35.6	12.48	Lateritic soil	2197.8
Below 35.6		Dry Alluvium& sand	535.5

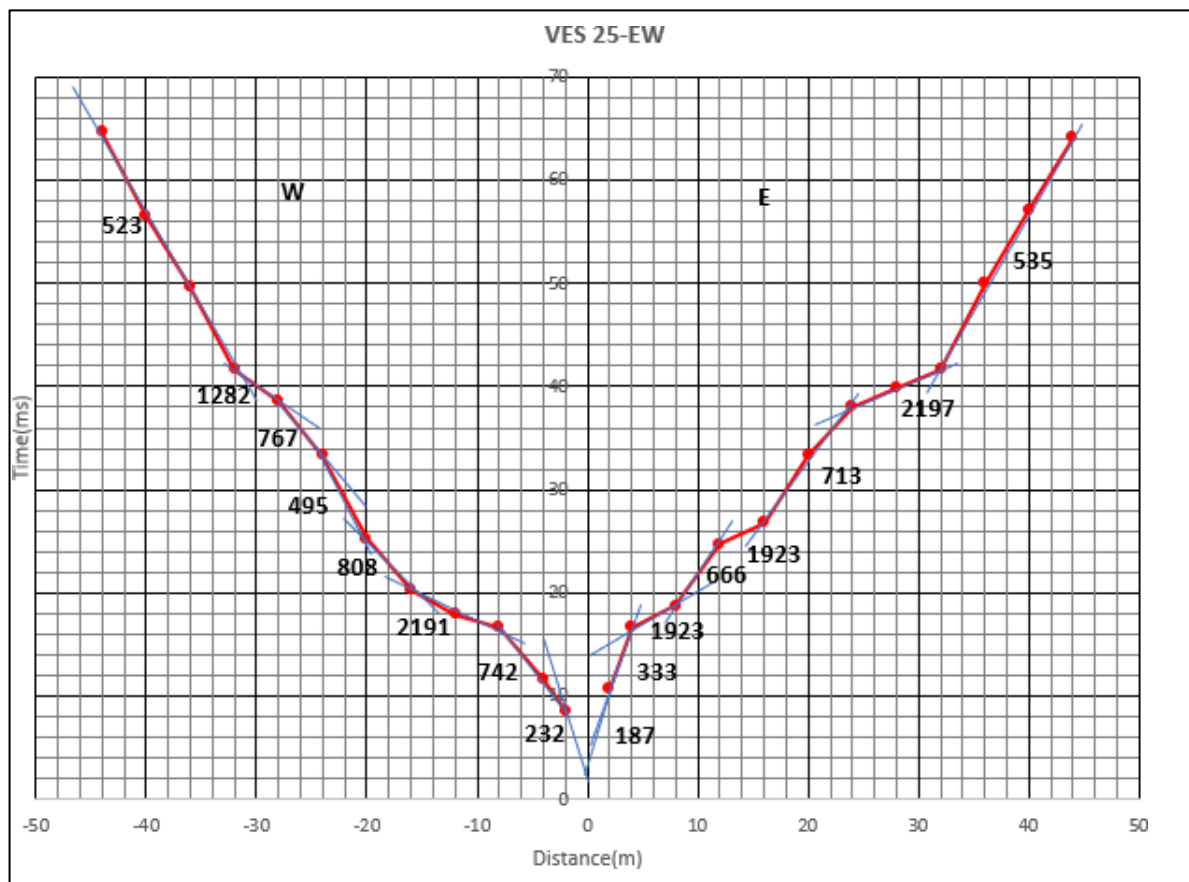
Eight-layer strata identified and Gravel not detected.

Profile towards western side: Interpreted seismic refraction data

Table 9.1.6.3.142. Interpreted seismic data for shot 61m SE of VES 25-W

Depth(m)	Thickness(m)	Lithology	Velocity (m/s)
0-0.72	0.72	Soil	232.8
0.72-3.5	2.81	Dry Alluvium& sand	742.6
3.5-8.9	5.43	Lateritic soil	2191.8
8.9-13.8	4.90	Dry Alluvium& sand	808.1
13.9-19.4	5.58	Dry Alluvium& sand	495.0
19.4-26.4	7.01	Dry Alluvium& sand	767.8
26.4-36.8	10.37	Wet Alluvium& Sand	1282.1
Below 36.8		Dry Alluvium& sand	523.3

Eight-layer lithology and Gravel not detected down to 36.8m depth.



**Figure 9.1.6.3.94 seismic hodograph of two shots 61m SE of VES 25 -E
and 61m SE of VES 25 -W**

North–South Spread- seismic profile towards north: Interpreted seismic refraction data

Table 9.1.6.3.143. Interpreted seismic data for shot 61m SE of VES 25-N

Depth (m)	Thickness (m)	Lithology	Velocity (m/s)
0-0.85	0.85	Soil	196.9
0.85-3.5	2.66	Wet Alluvium & Sand	1228.9
3.5-8.15	4.65	Lateritic soil	2197.8
8.15-13.9	5.77	Gravel/dry sand	852.9
13.9-22.2	8.34	Lateritic soil	2046.0
22.2-32.8	10.60	Gravel/dry sand	852.9
32.8-47.6	14.82	Lateritic soil	2555.9
47.6-59.2	11.54	Dry Alluvium & Sand	622.4
59.2-70.6	11.38	Wet Alluvium & Sand	959.2
70.6-86.6	16.01	Dry Alluvium & Sand	731.3
86.6-101.5	14.91	Wet Alluvium & Sand	1181.7
Below 101.5		Compact clay	1705.8

Gravel detected in this 12-layer sequence at 8.15m and 22.2m depth as in table.

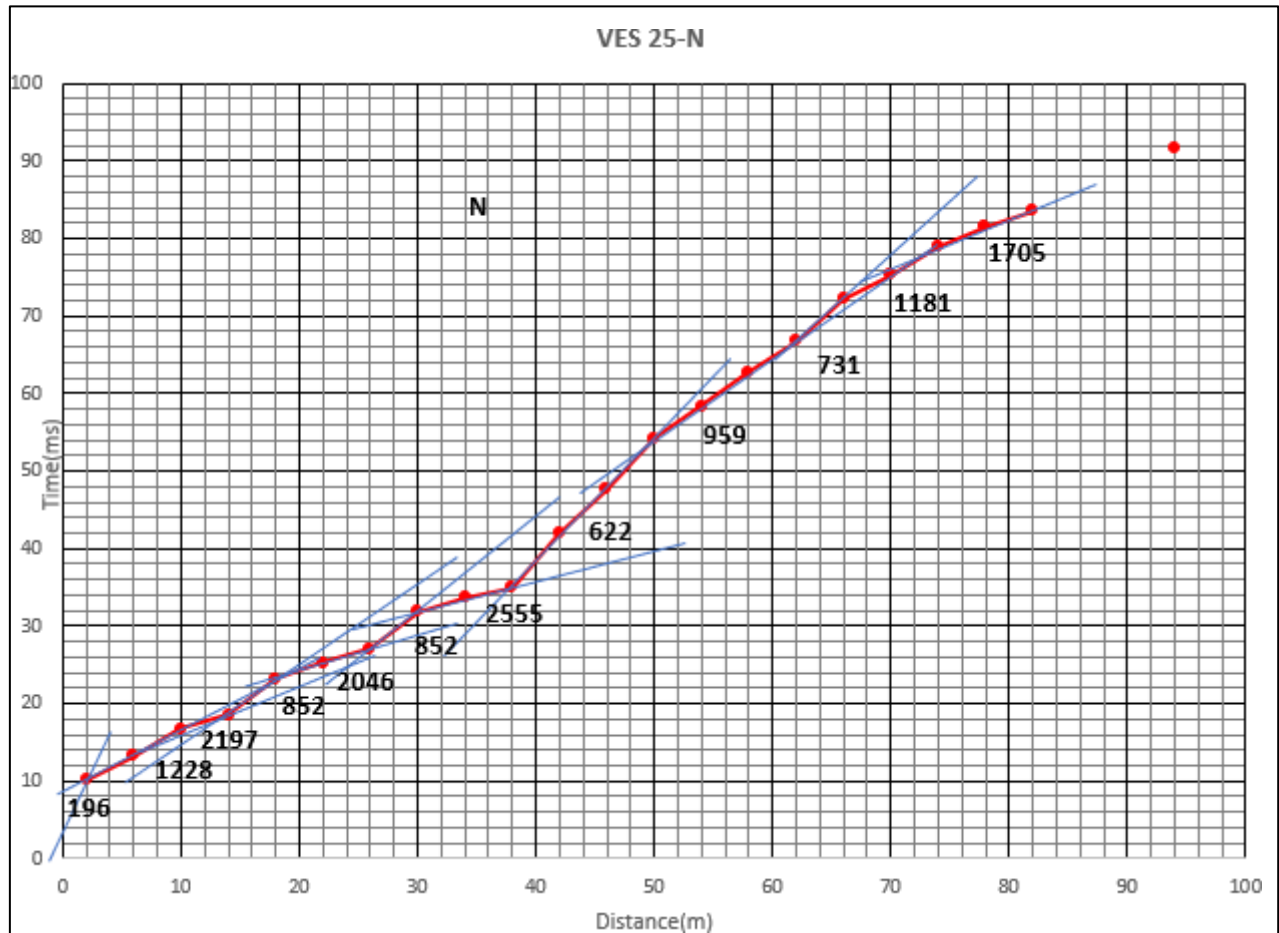


Figure 9.1.6.3.95 seismic hodograph of seismic shot 61m SE of VES 25-N

9.1.6.4 Interpreted Gravel zones by geophysical investigations.

Out of 123 seismic shots in 25.1 sq. km area in Mangalagiri Survey block 25 gravel zones were delineated at 19 locations from seismic refraction data.

Table 9.1.6.4.1 Interpreted Gravel zones by geophysical investigations

Sl. No.	Location name	Weight drop location		Direction	Distance from shot Point in (m)	Interpreted gravel Depth (m)		Velocity Range 830-875 m/s	Remarks Drilled bore holes BH 1 to 7 and recommended
		Latitude	Longitude			From	To		
1	53m W of VES 66-E	16°26'20.58"N	80°36'46.12"E	E	25	22.7	42.3	834.7	Recommended
2	400m SE of VES 3-W	16°26'20.49"N	80°36'50.47"E	W	15	1.19	4.02	833	Recommended
						8.73	19.34	833	
3	10m NE of VES 34-E	16°26'29.34"N	80°37'3.29"E	E	10	4.43	12.09	832	Recommended
4	10m SE of VES 36	16°26'46.64"N	80°37'31.35"E	N	20	6.2	15.14	833.3	BH-02(20m NE of shot point)
5	VES 70-NE-SW-NW-SE	16°26'33.05"N	80°37'59.99"E	NE	5	1.69	5.02	833.3	Gravel velocity seen in the top soil
6	VES 70-NE-SW-NW-SE	16°26'33.05"N	80°37'59.99"E	SW	5	1.69	5.11	833.3	Gravel velocity seen in the top soil
7	36m N of VES 37	16°26'25.36"N	80°38'27.60"E	S	27.5	12.9	18.9	871.8	Recommended
						33.4	51.02	852.5	
8	70m W of VES 48	16°25'51.88"N	80°37'26.47"E	E	5	1.94	4.72	833.3	Gravel velocity seen in the top soil
9	80m SW of VES 48	16°25'50.27"N	80°37'26.23"E	W	12.5	5.32	10.06	831.9	BH-07
10	28m S of VES 4	16°26'1.00"N	80°37'38.79"E	SE	25	27.6	38.4	859	Recommended
11	108m N of VES 4	16°26'5.05"N	80°37'40.11"E	S	35	41.7		834.3	Gravel velocity seen in the deeper layer
12	35m N of VES 32	16°25'46.31"N	80°38'21.08"E	W	17.5	16.5	26.07	846	BH-01
13	35m N of VES 32	16°25'46.31"N	80°38'21.08"E	N	10	8.79	12.16	872	Recommended
14	35m N of VES 32	16°25'46.31"N	80°38'21.08"E	S	7.5	0.73	1.72	824.2	Recommended
						3.51	7.57	872.6	
15	57m E of VES 32	16°25'45.00"N	80°38'22.71"E	W	15	8.15	13.93	852.8	Recommended
						22.2	32.8	852.8	
16	30m E of VES 30	16°25'2.03"N	80°36'31.60"E	E	14.5	0.8	2.76	821.9	BH-05

Sl. No.	Location name	Weight drop location		Direction	Distance from shot Point in (m)	Interpreted gravel Depth (m)		Velocity Range 830-875 m/s	Remarks Drilled bore holes BH 1 to 7 and recommended
		Latitude	Longitude			From	To		
						8.2	19.2		
17	310m SE of VES 12	16°25'19.20"N	80°38'5.99"E	NS-Reverse	27	51.6	70.4	824.2	Recommended
18	33m N of VES 42	16°25'14.16"N	80°38'34.99"E	W	15	3.85		832	
19	15m N of VES 15	16°24'51.97"N	80°36'14.02"E	W	16.5	0.74	2.39	840.3	BH-06
						10.8	14.8	878	
20	15m N of VES 15	16°24'51.97"N	80°36'14.02"E	N	19	15.5	24.1	859.1	Recommended
21	9m S of VES 27	16°24'32.18"N	80°38'10.79"E	E	22.5	18.1	30.6	834.7	Recommended
22	9m S of VES 27	16°24'32.18"N	80°38'10.79"E	S	15	6.58	12.2	846.5	Recommended
23	38.55m SW of VES 7	16°24'49.00"N	80°38'14.00"E	E	17.5	6.8	16.19	887.6	Recommended
24	38.55m SW of VES 7	16°24'49.00"N	80°38'14.00"E	W	10	0.7	2.3	821.9	BH-04
						7.16	12.2	843.2	
						20.8	37.8	872.6	
						57.03		833.3	
25	61m SE of VES 25	16°24'51.00"N	80°38'42.00"E	N	15	8.15	13.9	852.9	BH-03
						22.2	32.8	852.9	

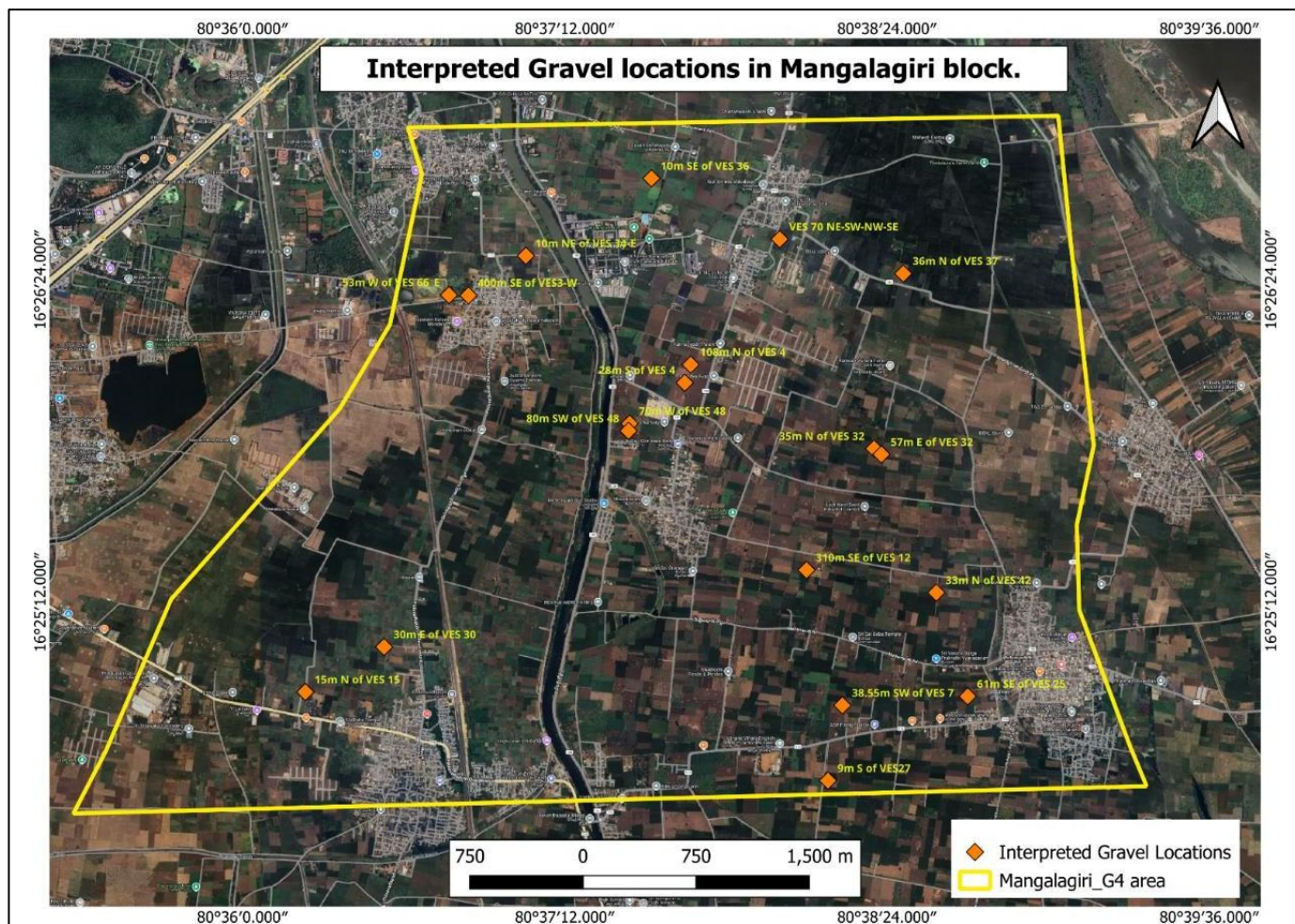


Figure 9.1.6.4.1 Interpreted gravel locations by Geophysical investigations

CHAPTER 10. EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

Details of pitting, trenching, drilling, etc., with spacing and distribution of the sample points along with geographical co-ordinates.

10.1 Geological mapping

The primary focus of this investigation is geophysical surveying; the project is not demanding geological mapping.

10.2 Pitting, Trenching:

The primary focus of this investigation is geophysical surveying; and NQT of the project is not demanding the pitting and trenching.

10.2.1 Drilling:

Scout Boreholes

As per the approved NQT and MEMC Guidelines, 2015 (amended in 2021), G4-level reconnaissance exploration was undertaken through scout drilling. Based on the interpretation of geophysical survey data, seven boreholes (BHs) were drilled at strategically selected locations across the block (Fig 10.1). The depth of each borehole was finalized considering the nature and extent of geophysical anomalies, subsurface geological conditions, and prevailing field constraints. A cumulative drilling meterage of 301 m was achieved through seven boreholes. The drilling programme was designed to validate the identified geophysical anomalies, assess the subsurface lithology and its lateral continuity, and obtain representative samples from the targeted gravel horizons for further evaluation of their mineral potential.

During the initial phase of the geophysical survey, electrical resistivity profiling was employed as a reconnaissance tool to map lateral variations in subsurface resistivity across the Mangalagiri block. Anomalously high resistivity zones identified from the profiling data were subsequently subjected to vertical electrical sounding (VES) using the Schlumberger electrode array. A total of 78 VES stations were occupied within the block, and the acquired resistivity curves exhibited a wide spectrum of geoelectric signatures, including KH, A, AK, AKQ, HKA, K, HKH, AKH, HA, HKQ, KQ, HAQ, AKQH, AKA, AQ, AKKK, and AH-type curves. Among these, the K-type and its composite variants (such as KH and KQ) are particularly significant, as they denote a three-layer or multi-layer sequence wherein the intermediate layer displays markedly higher resistivity relative to the overlying and underlying strata. This specific curve morphology is diagnostically indicative of coarse-grained, unsaturated granular materials—chiefly gravel or coarse sand horizons—which inherently exhibit elevated formation resistivity owing to reduced capillary moisture retention, increased pore-air content, and diminished electrolytic conduction pathways.

To complement and validate the resistivity findings, shallow seismic refraction survey was subsequently planned and executed along selected profiles crossing the interpreted high-resistivity anomalies. The seismic survey yielded critical parametric data, including the depth to each refracting interface and the corresponding compressional wave (P-wave) velocity distribution across the layered subsurface. The integration of resistivity and seismic datasets facilitated a multi-parametric lithological interpretation, enabling calibration of resistivity contrasts with P-wave velocity gradients. This synergistic approach substantially enhanced the confidence in layer identification, reduced ambiguity in geophysical inversion, and provided a more reliable correlation between electrical and mechanical rock properties.

Upon comprehensive integration and interpretation of the combined geophysical datasets, a total of 19 distinct gravel-bearing locations were delineated within the Mangalagiri block, encompassing 25 individual gravel zones of variable thickness and areal extent. From these 25 identified zones, a targeted subset of 11 zones was systematically selected based on the criterion of shallow overburden thickness and the presence of near-surface gravel deposits. These 11 prioritized zones offer distinct advantages, including greater accessibility for drilling and minimized geological uncertainty due to better surface correlation and higher signal-to-noise ratios in both resistivity and seismic responses. Based on the integrated geophysical interpretation, these 11 locations were recommended for drilling and for obtaining the necessary permissions from landowners. Subsequently, permissions were secured for drilling at 7 of the 11 selected locations, enabling the achievement of the planned drilling target of 301.0 m. The drilling programme was designed to validate the geophysical interpretations, assess gravel thickness and quality, and establish the subsurface continuity of the identified gravel horizons.

The following table gives the co-ordinates and collar details of the 7 boreholes.

Table 10.1 Borehole Co-ordinates and Collar details					
Sl. No.	BH No.	Northing (m)	Easting (m)	Collar RL (m)	Meterage (m)
1	MGLBH01	1816487.090	461451.510	16.031	50.0
2	MGLBH02	1818345.777	460025.000	16.555	25.0
3	MGLBH03	1814799.226	462086.806	15.818	48.0
4	MGLBH04	1814728.841	461278.496	15.775	40.0
5	MGLBH05	1815116.909	458242.513	16.151	40.0
6	MGLBH06	1814817.579	457697.959	15.649	40.0
7	MGLBH07	1816609.810	459837.587	16.373	58.0
TOTAL					301.0 m

10.3 Data spacing for reporting of exploration results:

Since the current investigation is a Reconnaissance (G4 level) survey, seven scout boreholes has been drilled. Achievements in drilling meterage and number of sub-samples are being carried out as per the targets assigned and approved by TCC-NMEDT.

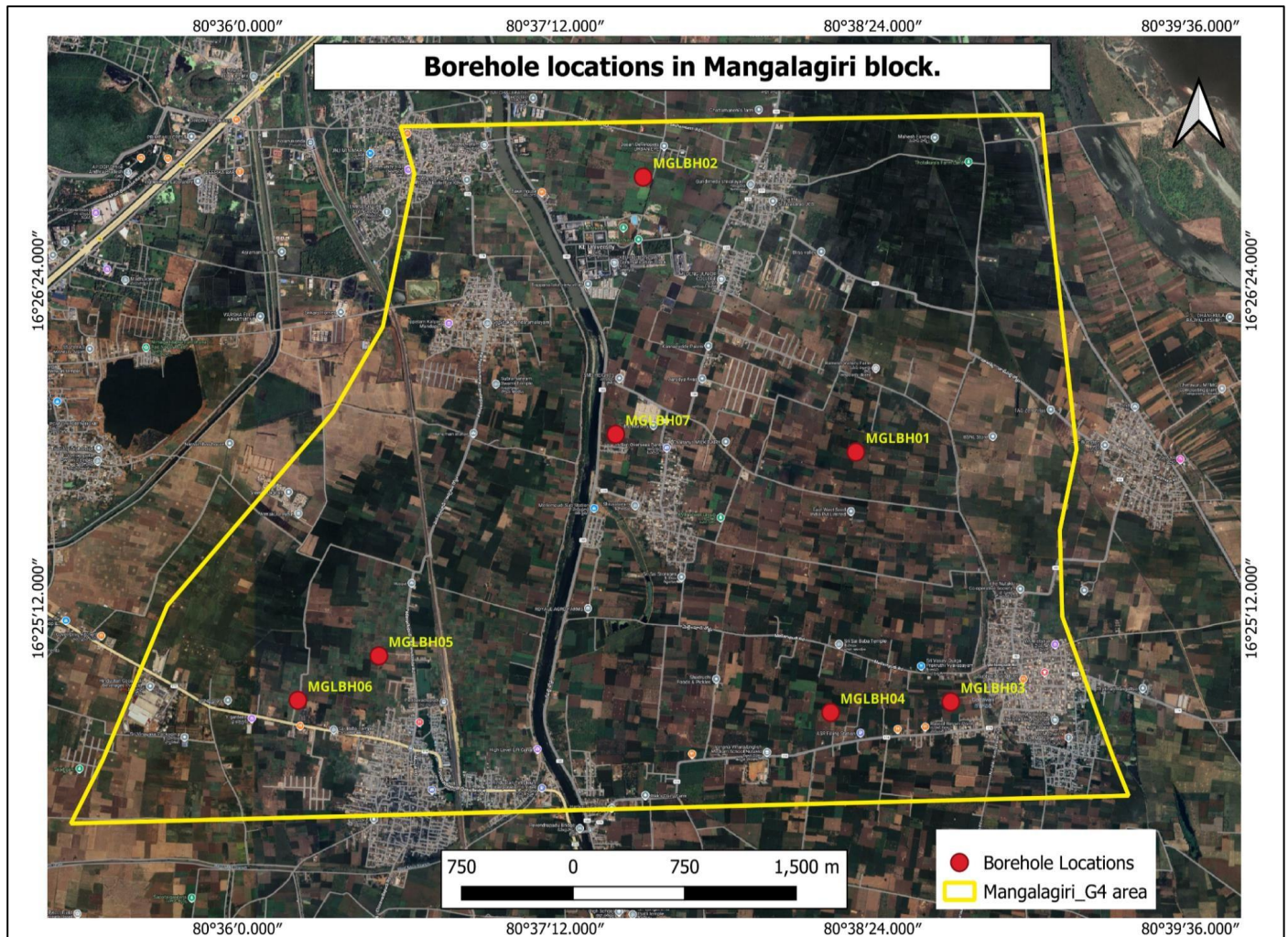


Figure. 10.1 Map showing drilled Boreholes

CHAPTER 11. LOCATION OF DATA POINT

11.1 Accuracy and quality of Survey used to locate drill holes.

As per the guidelines by NMEDT for exploration activity under NMEDT funding, all the borehole coordinates are recorder by using CORS (Continuously Operating Reference Station) connected DGPS equipment.

The **CORS network** (Continuously Operating Reference Station network) established by Survey of India, is a system of permanently installed satellite-tracking receivers that provide high-precision, real-time location corrections for GPS and GNSS (Global Navigation Satellite System) devices.

The details of borehole coordinates are given in Chapter 10.

CHAPTER 12.0 SAMPLING TECHNIQUES

12.1 Nature and Quality of Sampling

Sampling was carried out by means of core drilling at seven selected locations, with a total drilling meterage of 301 m. As pitting and trenching were not required to meet the objectives of the present investigation, the same were not undertaken.

12.2 Measures taken to ensure sample representation

The borehole locations were selected based on gravel / sand bed indications interpreted from geophysical survey data. During drilling, it was ensured that all interpreted gravel beds were intersected and the assigned drilling targets were completely achieved.

12.3 Mineralogy of the ore zones and ore textures:

Since the targeted mineral is Diamond and associated Kimberlite Indicator minerals (KIMs), which are categorized as heavy minerals. In the current project, heavy minerals including diamond and associated KIMs are expected in the gravel/sand zones, all the measures are taken to extract the targeted minerals through, Magnetic, Electro-magnetic and gravity separation as well as intensive microscopic studies.

Heavy minerals are characterized by high density ($>2.89\text{g/cm}^3$), durability and resistance to weathering. Unlike any other ore deposits, palaeo channel placer deposits do not exhibit prominent geochemical or mineralogical zonations. Based on the provenance or source rock for the deposit, concentration of heavy mineral content and mineral chemistry may vary. There are no specific textures or structures that are characteristic of the igneous, metamorphic, or sedimentary source rocks for these placer deposits (Basha, & Pal, 2020).

The heavy minerals in the area predominantly consists of magnetite, ilmenite, garnet, diopside, Fe-hydroxides etc. Other non-magnetic heavy minerals (NMHM) such as amphibole and pyroxene etc. The shapes of the mineral grains range from rounded to sub-rounded and sub-angular to angular, indicating varied distances that the detritus has travelled before getting deposited.

12.3.1 Ore Zones: Targeted litho unit zones were demarcated based on the visual observation during the core logging itself. All the suspected lithology having grains of granules, very coarse sand & coarse sand are carefully logged and noted. Out of the 301m run, 20 no of composite samples were generated. Each sample subjected to Heavy mineral separation to get heavy mineral concentrates. From which, different mineral composites were separated using hand magnet and Electro-magnetic separation methods.

Sl. No.	Mineral Fractions	Methodology	Magnetic flux intensity	Minerals separated	Remarks
1.	Magnetite	Using Hand magnet	Highly magnetic	Magnetite/Titano Magnetite	
2.	EM-1 fraction	Electro-magnetic separation	@ 6500 Gauss (high to Moderately Magnetic)	ilmenite, garnet, spinel etc.	Expected KIMs
3.	EM-2 fraction	Electro-magnetic separation	@ 20000 Gauss (Low Magnetic)	iopside, monazite & ther magnetic heavy minerals, etc.	Expected KIMs
4.	EM-3 fraction	Electro-magnetic separation	Non-magnetic fraction	on-Magnetic Heavy Minerals like diamond, kyanite, rutile etc.	Expected Diamond

All the four fraction from each sample is thoroughly studied under microscope and suspected minerals are subjected for EPMA analysis.

CHAPTER 13.0 DRILLING TECHNIQUE AND DRILL SAMPLING EMPLOYED

13.1 Drilling and types of Drilling

Following detailed geophysical investigations, including Resistivity Profiling, Vertical Electrical Sounding (VES), and Shallow Seismic Refraction Survey with in the Mangalagiri block, locations exhibiting favorable geophysical signatures indicative of potential gravel horizons were identified and selected for drilling. Diamond core drilling was adopted for subsurface investigation.

Drilling operations were carried out using an Glory Tek XY-3 core drilling rig. All boreholes were drilled vertically using HX drilling. Borehole locations and depths were finalized based on the geophysical anomalies and prevailing field conditions.

13.2 Whether core and chip sample recoveries have been properly recorded and results assessed.

All the core samples recovered during drilling were properly measured and core recoveries were reordered during the core logging. Core recovery was monitored very carefully after each run. Wherever, the core recovery was reduced, in the immediate next run suitable measures were taken to optimize the drilling and to increase the core recovery.

13.3 Measures taken to maximise recovery

To maximize core recovery, particularly within unconsolidated and semi-consolidated formations, the following measures were adopted during drilling:

1. Appropriate core barrels of suitable type and length were selected based on the anticipated lithology and drilling conditions for each run.
2. A specialized drilling additive, "Sand Drill," was used to enhance core recovery within loose sand horizons.
3. Basket core catcher employed to improve recovery in sand and gravel-bearing formations.
4. In clay-rich horizons, water in combination with the Sand Drill additive was judiciously used to optimize core recovery.
5. Adapting shorter runs of 30cm, 50cm and slow drilling to reduce the core loss and maximum recovery.

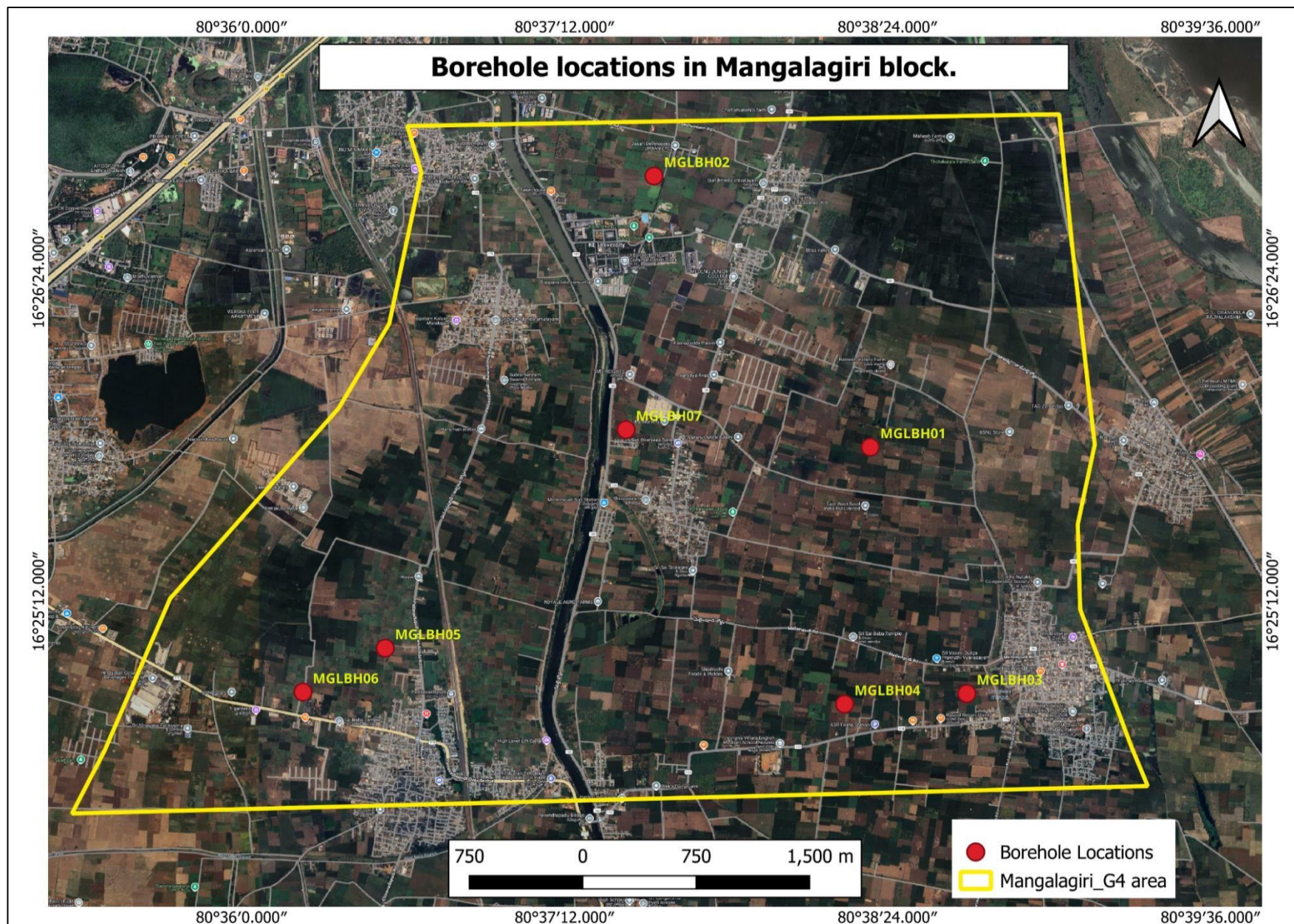


Figure. 13.1 Map showing drilled Boreholes

Based on the lithology encountered and the core recovery achieved in each run, drilling parameters and operating conditions were continuously modified and optimized for subsequent runs to ensure maximum possible core recovery and sample integrity.

During drilling, both double and triple tube barrels of 1.50m length were used to attain maximum core recovery.

Use of SAND-DRILL Additive

To improve drilling performance and core recovery in unconsolidated sand, gravel, and cobble-bearing horizons, the drilling additive SAND-DRILL was used during drilling operations. SAND-DRILL is a synthetic polymer-based additive that stabilizes loose formations by forming a matrix that binds sand and gravel particles, thereby minimizing borehole collapse and material washout. The additive was mixed with water and used as a drilling fluid to enhance borehole stability and maximize core recovery from difficult formations. Depending on the ground conditions encountered, SAND-DRILL was used at a dosage of approximately 1–3 litres per 1000 litres of water. The concentration was adjusted as required to optimize drilling efficiency, borehole stability, and core recovery.

13.4 Relationship between core recovery and grade of the sample

Core recovery % in all the boreholes has been achieved >80% (avg.). Since the target is sand-gravel, all precautions were taken to maximize the core recovery. The details are dealt in section 13.3. Since there is no resource estimation in the current project, core recovery via-a-viz grade not applicable.

13.5 Borehole logging

Drill cores recovered from each drilling run were carefully examined and logged in the field. Based on visual observation lithological characteristics, texture, grain size, colour, and composition, the recovered materials were classified into the following litho-codes:

1. Soil
2. Very fine to fine Sand
3. Fine to Medium Sand
4. Medium to Coarse Sand
5. Clayey sand and Sandy clay
6. Gravel-bearing Clay
7. Lateritic Clay
8. Gravel with Lateritic Clay
9. Variegated Clay/Compact Clay

10. Black Clay

Soil

The topmost horizon comprises black alluvial soil, which is slightly compact and predominantly medium- to fine-grained in nature. This unit was encountered in all seven boreholes with a thickness ranging from 2 to 4 m.

Very Fine to Fine Sand

Immediately below the topsoil, a riverine sand unit was encountered in all boreholes. The grain size of this unit varies from very fine to fine sand, with occasional transitions to coarser fractions. The thickness of this horizon varies across the boreholes.

Fine to Medium Sand

The very fine to fine sand unit is generally underlain by a fine- to medium-grained sand horizon in all boreholes. This unit exhibits moderate sorting and variable thickness from borehole to borehole.

Medium to Coarse Sand

A medium- to coarse-grained sand horizon occurs below the fine- to medium-grained sand unit in most boreholes. The thickness of this unit varies spatially. Granules are commonly associated with the coarser sand fractions, indicating higher-energy depositional conditions.

Clayey Sand: This zone consists predominantly of sand with a significant proportion of clay, forming a moderately compact to loose horizon. It commonly represents a transitional layer between sandy and clay-rich units.

Sandy Clay: This zone is composed mainly of clay with a notable proportion of fine sand, resulting in a cohesive but slightly gritty texture. It generally occurs as a compact horizon and serves as a transitional unit between clay-dominated and sandy lithologies.

Gravel-bearing Clay

This litho-code represents a thick and relatively hard clay horizon containing varying proportions of gravel. The gravel content ranges from sparse to abundant and comprises granules, pebbles, and cobbles. The clasts display a wide range of shapes, from rounded to angular, suggesting deposition under variable transport and depositional environments. This unit constitutes one of the principal gravel-bearing horizons encountered during drilling.

Lateritic Clay: This zone consists of reddish to limonitic-white, friable lateritic clay and is generally of limited thickness. It typically occurs immediately above the gravel with lateritic clay

zone, marking the transitional horizon preceding the gravel-rich layer.

Gravel with lateritic Clay

This litho-code represents reddish to lateritic clay containing gravel and fragments of crystalline rock. Such horizons were encountered in most boreholes at varying depths, commonly occurring between variegated clay units and gravel-bearing clay horizons.

Variegated Clay/Compact Clay

This lithocode includes clay horizons of various colours, including yellow, brown, white, grey, ivory-grey, and purple. The clay is generally plastic and sticky when wet, while becoming moderately friable upon drying. The thickness and occurrence of these clay layers vary among boreholes.

Black Clay

A distinctive black clay horizon was encountered only in one borehole. This unit occurs at a depth of approximately 53.0 m and continues to the termination depth of the borehole at 58.0 m. The horizon is characterized by its dark colour and relatively homogeneous nature.

Detailed lithology of boreholes:

The detailed lithology of each borehole is attached in the Annexure-IV and graphical representation of lithology is given in Fig. 13.2 to 13.8

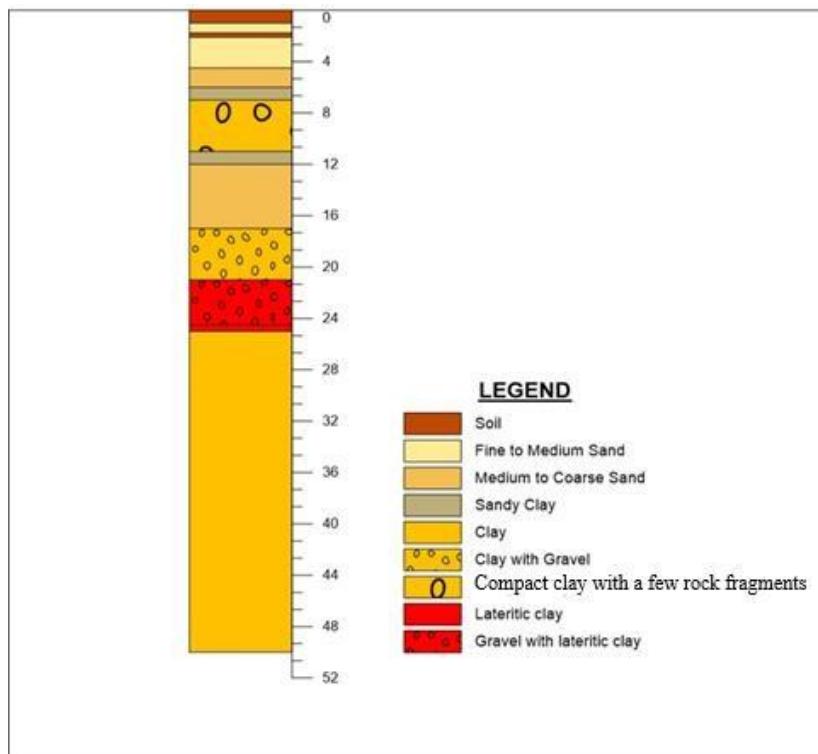


Fig. 13.2 MGLBH01

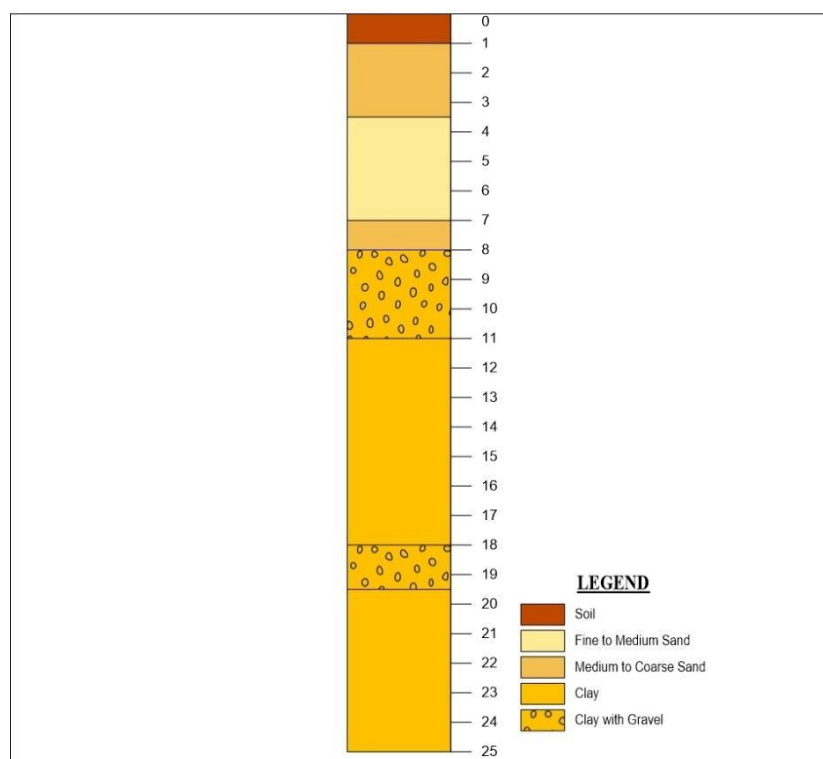


Fig. 13.3 MGLBH02

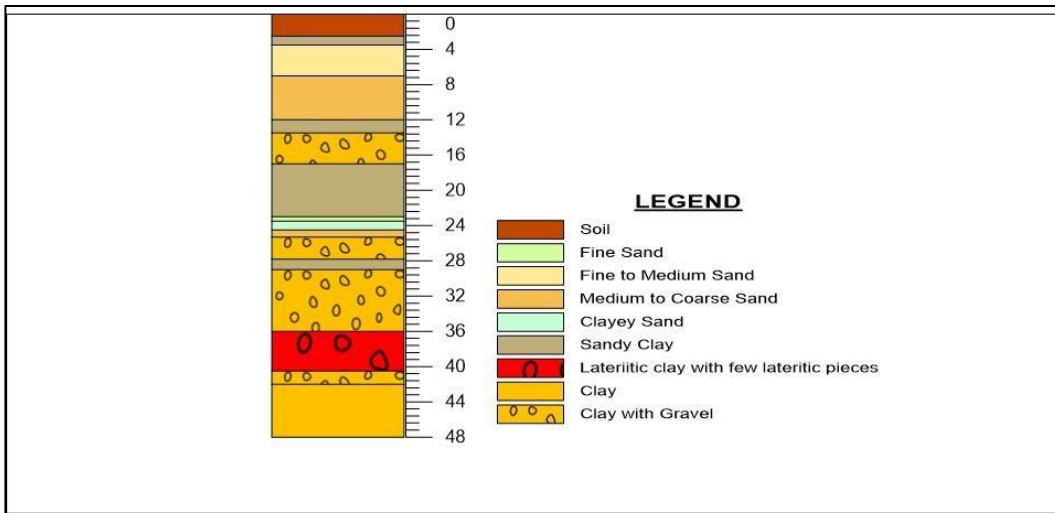


Fig. 13.4 MGLBH03

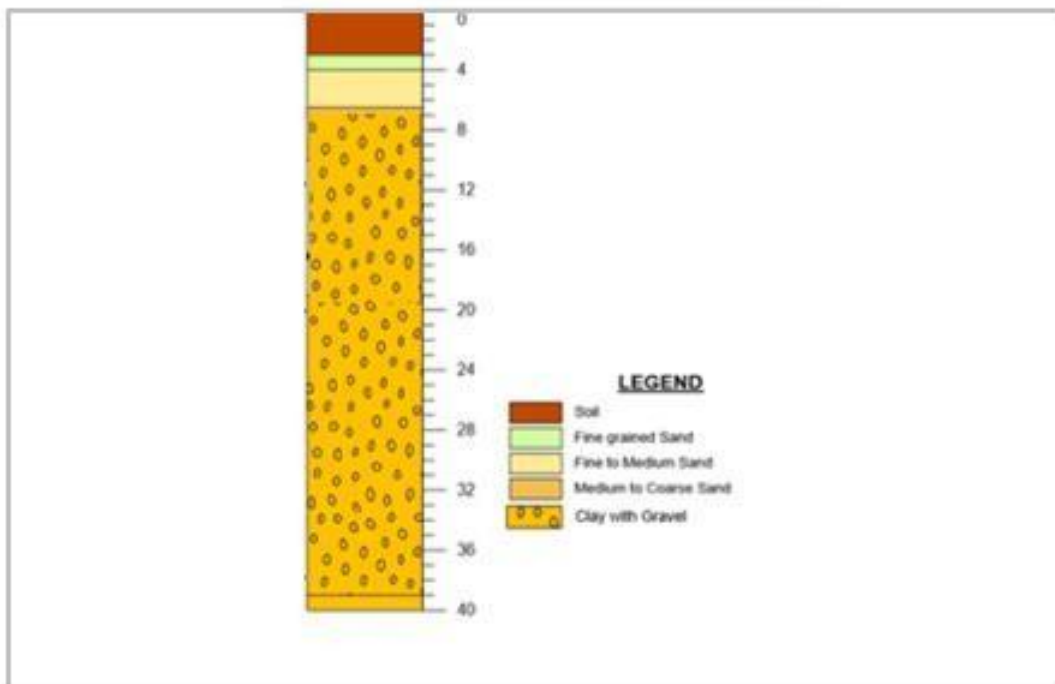


Fig. 13.5 MGLBH04

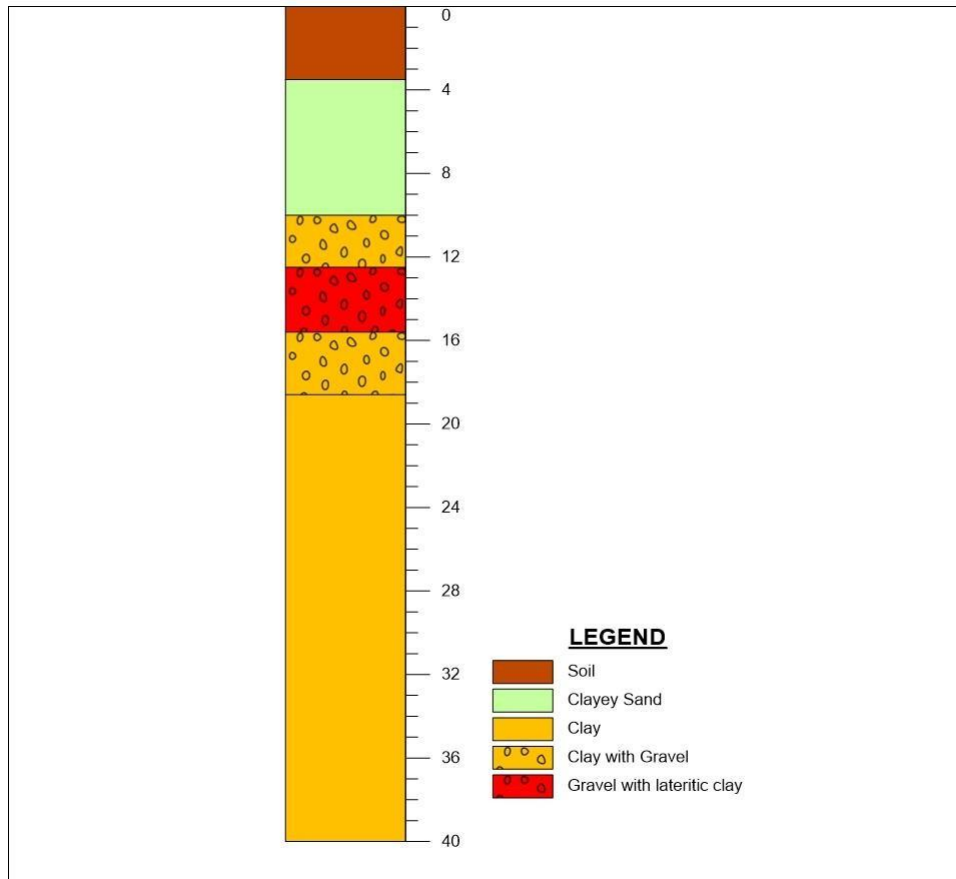


Fig. 13.6 MGLBH05

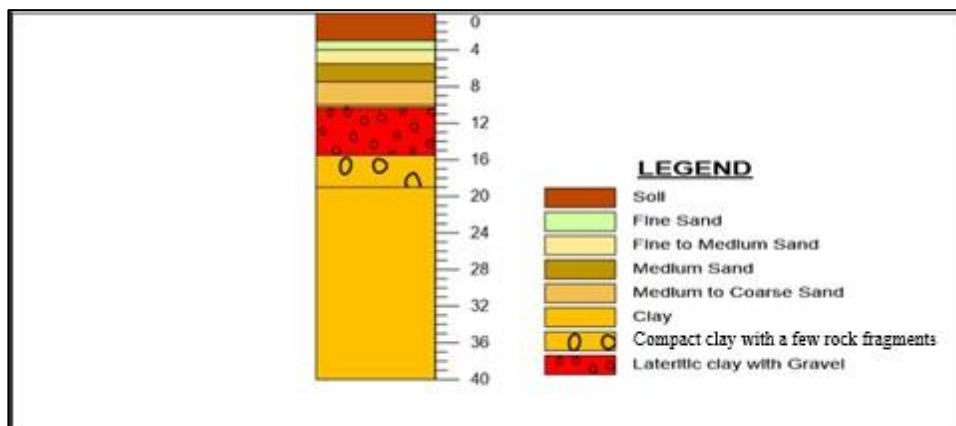


Fig. 13.7 MGLBH6

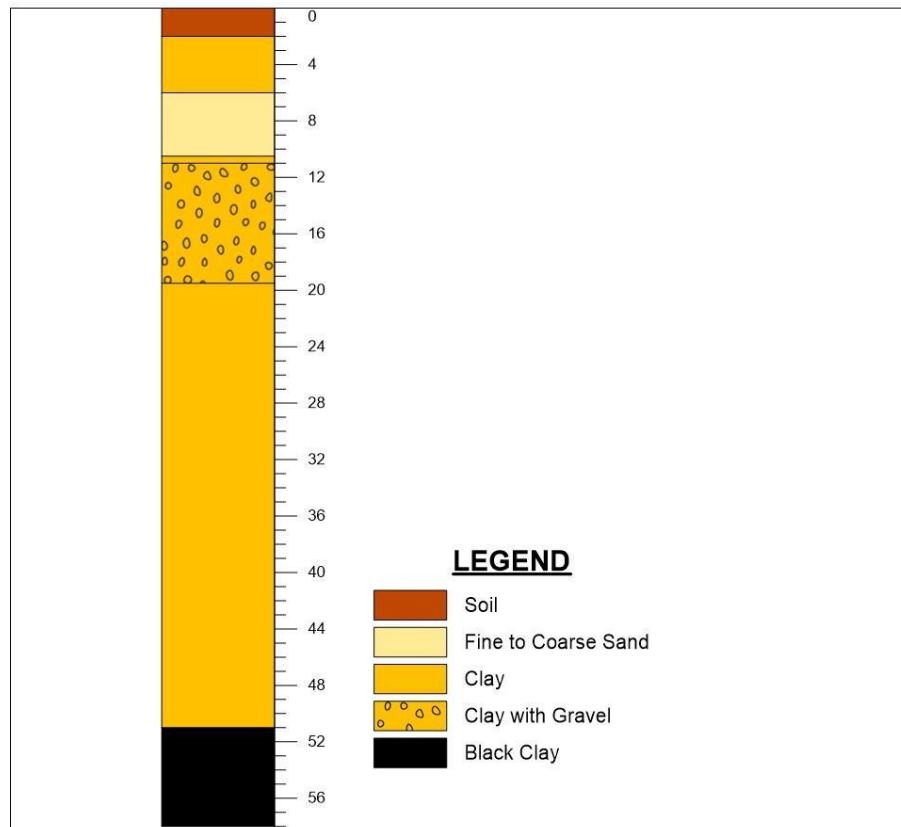


Fig. 13.8 MGLBH07

13.6 Discussion on the analysis results of handheld X-ray fluorescence (XRF), if used in the investigation.

Since the project not demanding the same, it was not carried out.

CHAPTER 14.0 INTEGRATION OF GEOPHYSICAL AND GEOLOGICAL STUDIES

14.1 Comparison diagram with seismic data and litho- log

The current project is reconnaissance survey for diamond and associated minerals with in the palaeo-channel deposit by integrating geophysical and geological data.

Determination of Borehole Locations

The paleo river course is in N-S direction. Hence the Sand/ Gravel flow will be along N-S direction and gets deposited at various levels which is considered as the strike direction for geophysical exploration. Sand/gravel presence is characterized by high resistivity anomalies. Since strike direction is N-S, resistivity profiling is conducted, along E-W direction, to identify the lateral variation in resistivity in that direction. By observing high resistivity anomalies which is characterized by sand/ gravel presence, vertical electrical sounding (VES) is proposed at these locations to find the vertical extension of it. This VES data plotted in double log graph, from the apparent resistivity parameters, gives a K -type curve, i.e., $\rho_1 < \rho_2 > \rho_3$, with high resistivity at the middle followed by low resistivities on either flank. Since the depth estimation and delineating gravel is not specific by resistivity analysis, Seismic refraction survey is conducted to identify them. An inhouse developed wireless seismograph with 170 to 210kg weight drop device as signal source is deployed for this project. The specific P-wave velocity reference is initially considered for estimation from IS code of practice for geophysical exploration such as:

12.3.1 500 to 900 m/s for gravel zone with dry alluvium and sand.

12.3.2 1100 to 1600 m/s for gravel zone in wet alluvium and sand.

Accordingly, twenty-five gravel sites were identified. This data were correlated with that of lithology of the first borehole and brought out generalized velocity vs lithology table for the area which is shown below:

Litho unit	Velocity (m/s)
Soil	160- 600
Dry Alluvial Sand	460-800
Gravel with sand/ Mud	820-880
Saturated sand / Mud	900-1600
Compact clay / Mud	1700-3400

From the above table, it is observed that the gravel zone represents 820 to 880 m/s velocity range and therefore, the remaining drilling locations were precisely relocated along with gravel thickness considering every seismic shot point and the geophone array positions. Out of 25 gravel sites selected,

7 locations were drilled and gravel zones at one or two levels were established.

The map showing borehole locations and interpreted gravel locations are given in fig 14.1. The integration of core lithology with nearest seismic data were compared below (Fig 14.2 to 14.8).

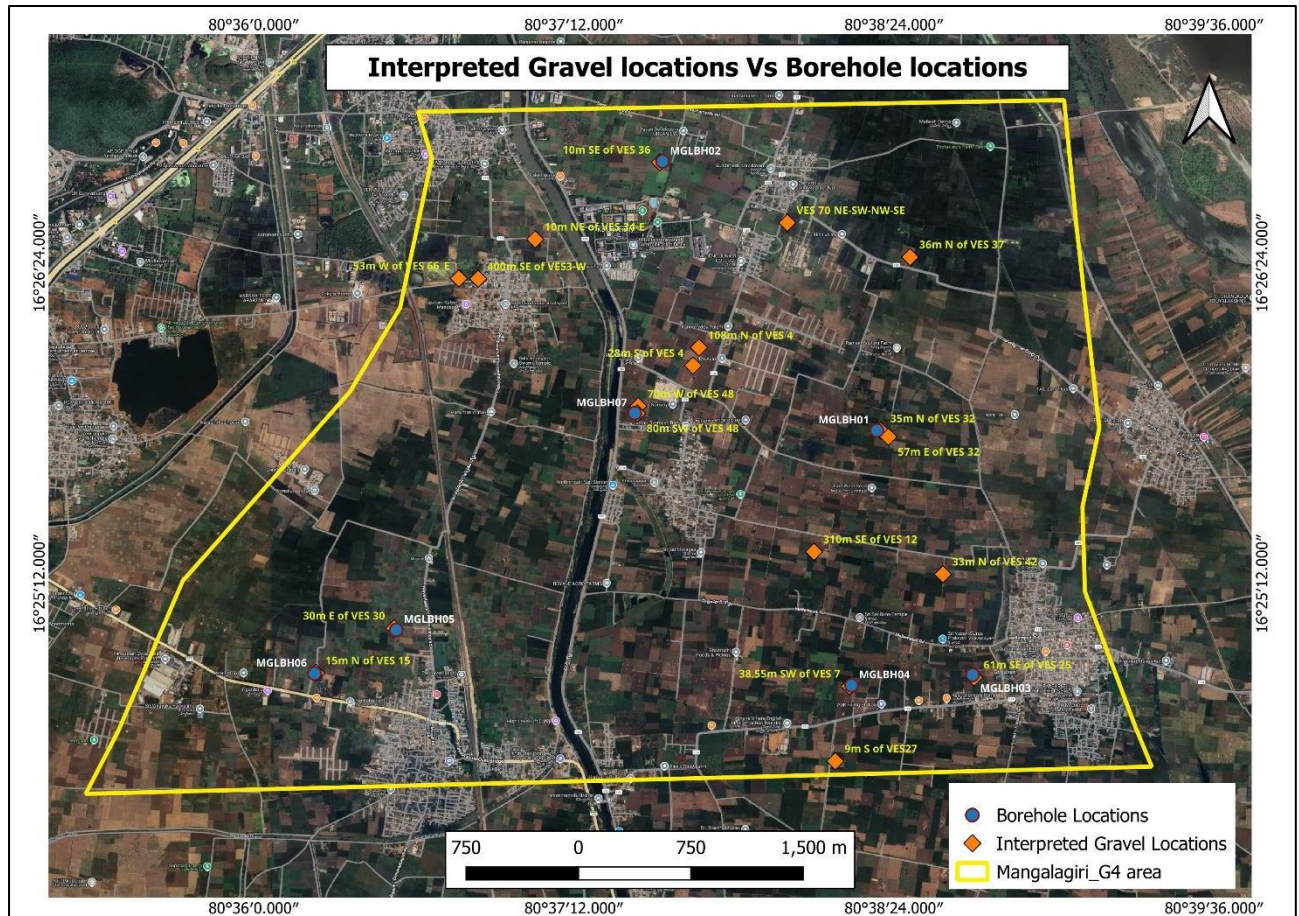


Fig. 14.1. Interpreted gravel location vs Drilled borehole locations

Seismic log vs BH-01 Litho- log

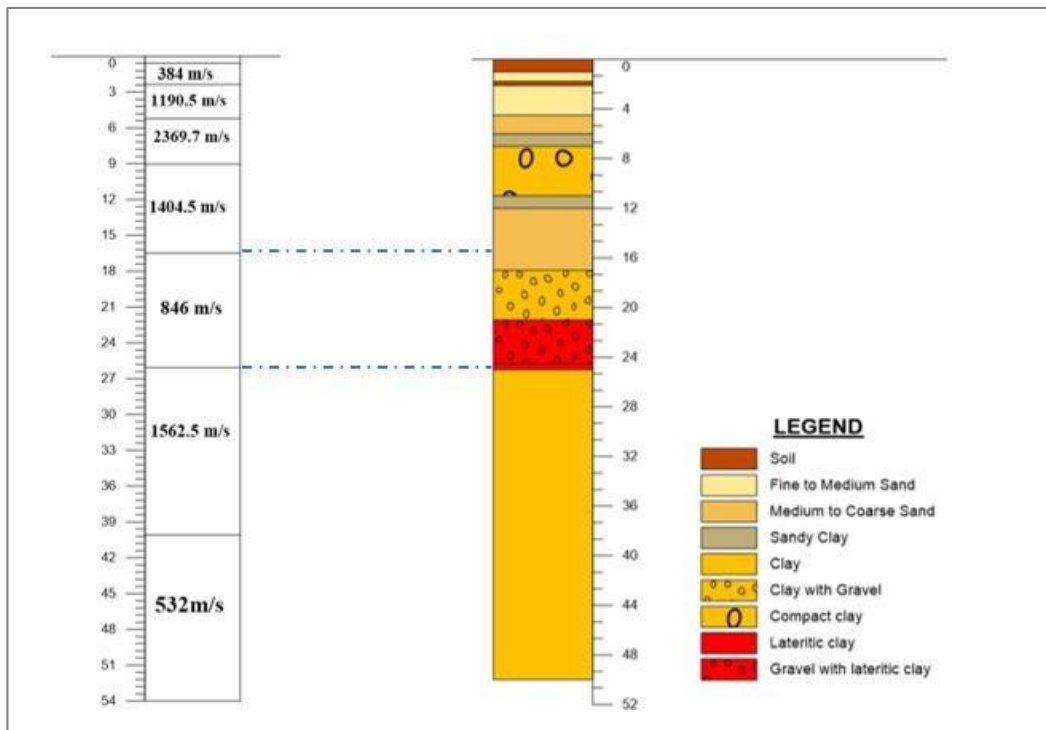


Figure 14.2 Comparison diagram with seismic data (35m N of VES 32-W) and BH-01 litho- log

Seismic log vs BH-02 Litho- log

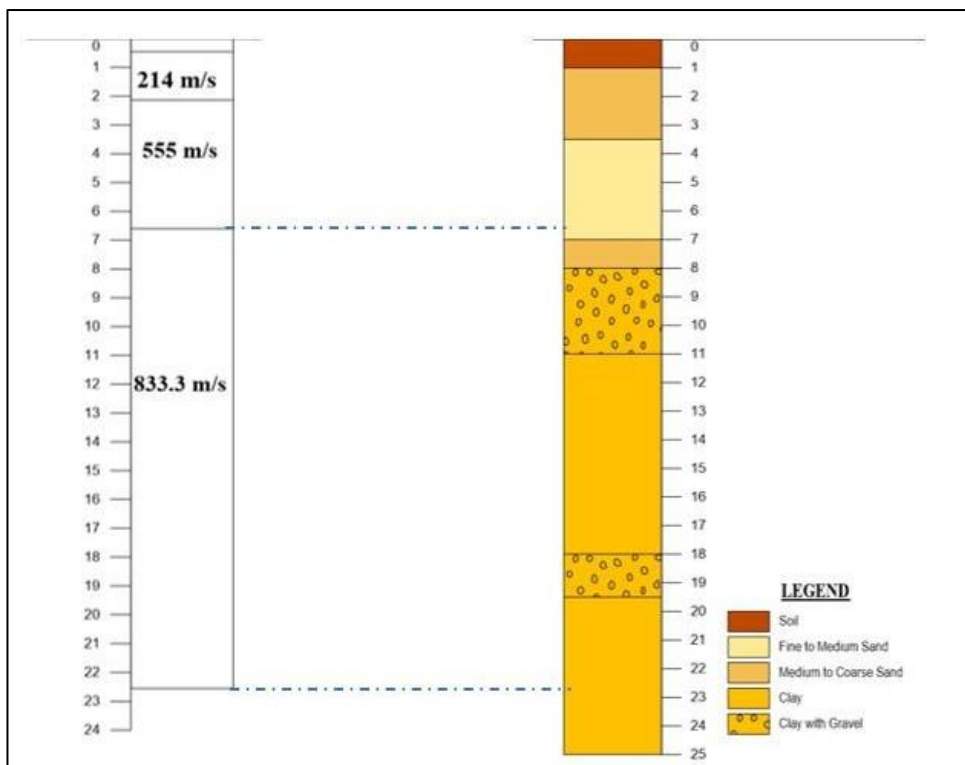


Figure 14.3 Comparison diagram with seismic data (10m SE of VES 36 N-D2-Shot 4) and BH-02 litho- log

Seismic log vs BH-03 Litho- log

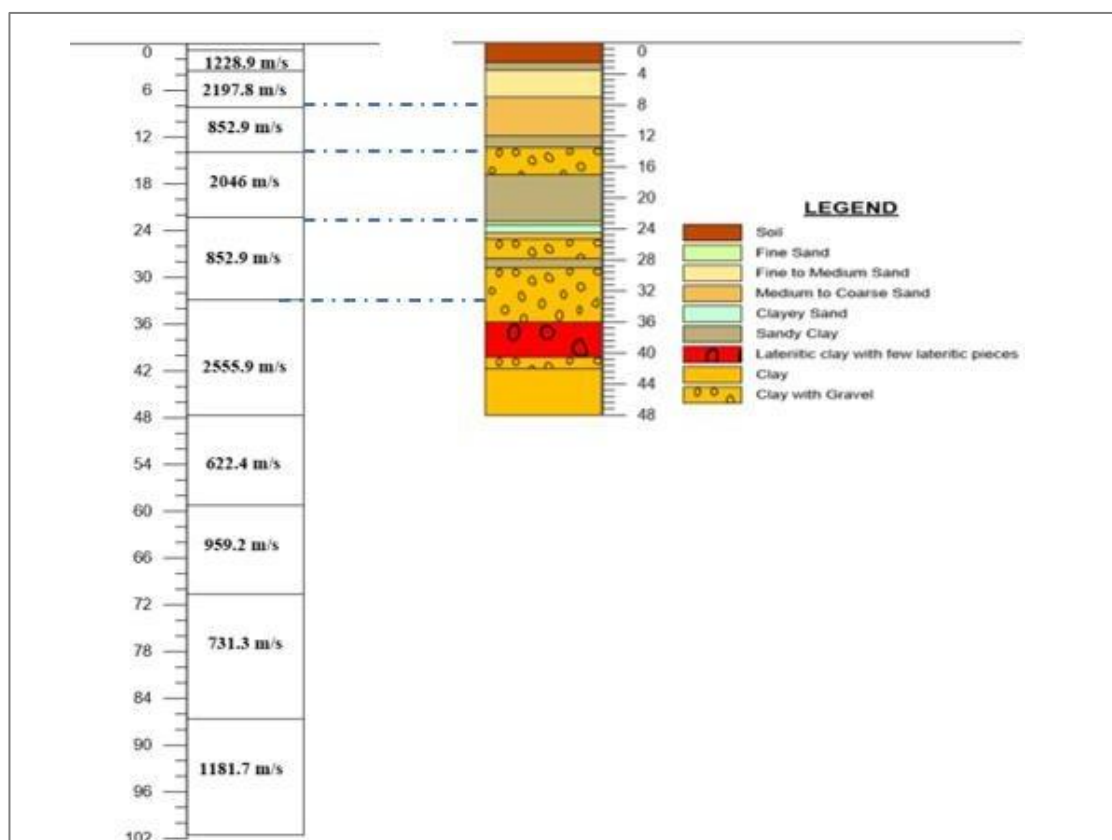


Figure 14.4 Comparison diagram with seismic data (61m SE of VES 25-N) and BH-03 litho- log

Seismic log vs BH-04 Litho- log

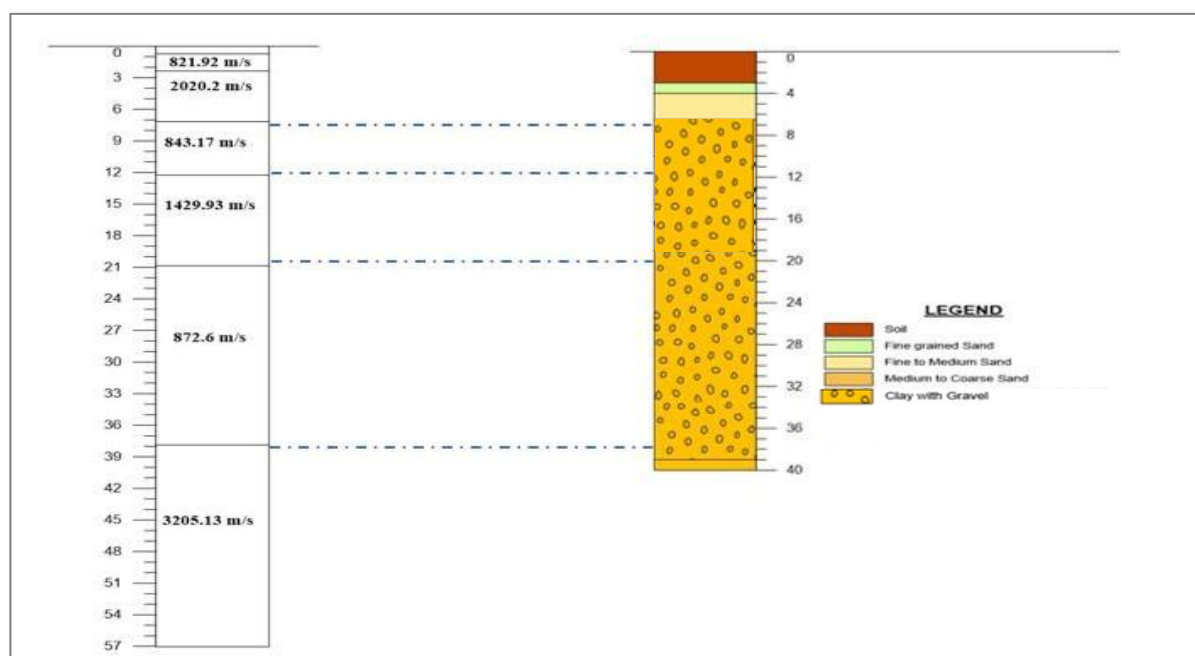
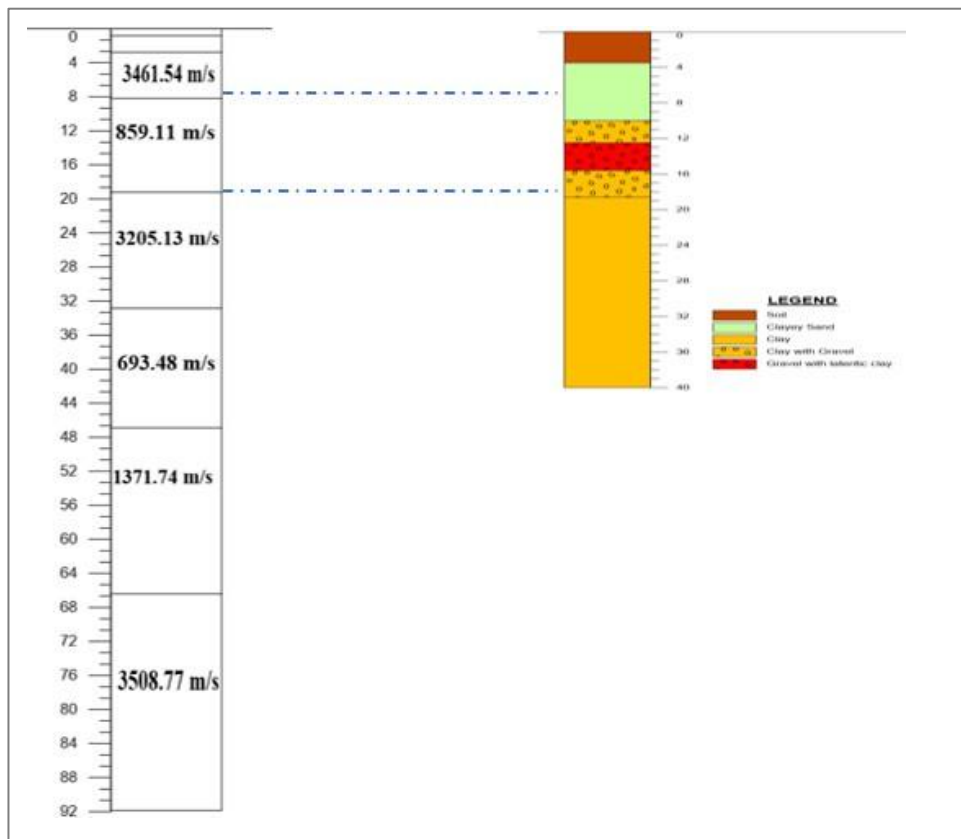
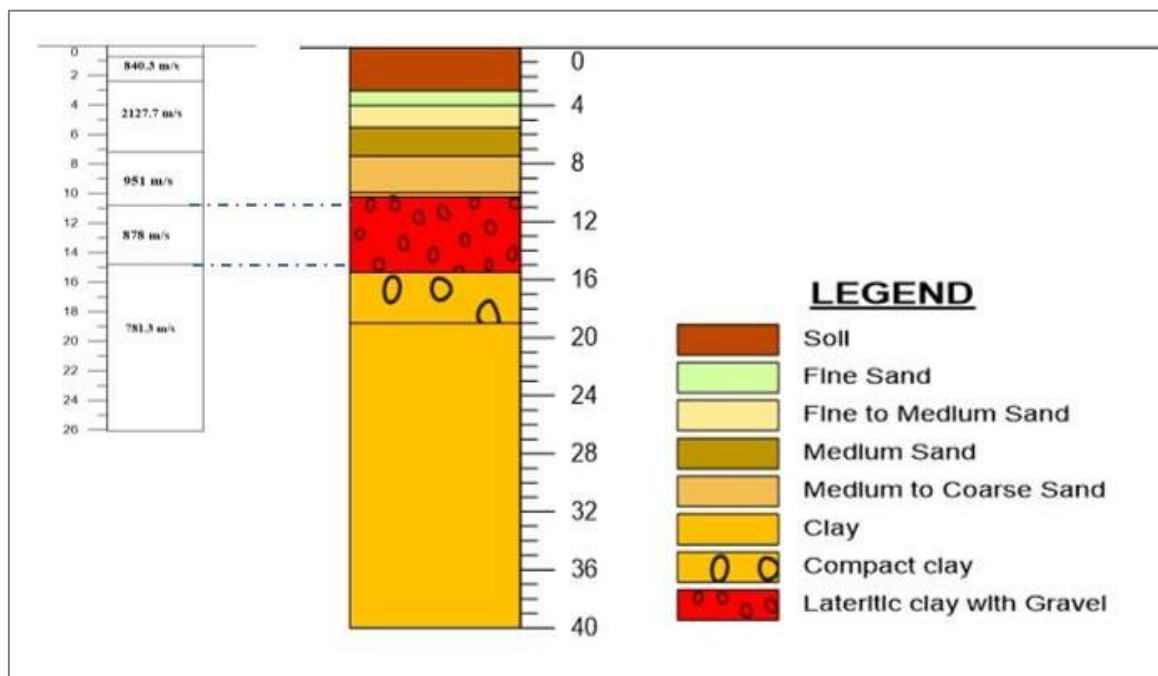


Figure 14.5 Comparison diagram with seismic data (38.55m SW of VES 7-W) and BH-04 litho- log

Seismic log vs BH-05 Litho- log



Seismic log vs BH-06 Litho- log



Seismic log vs BH-07 Litho- log

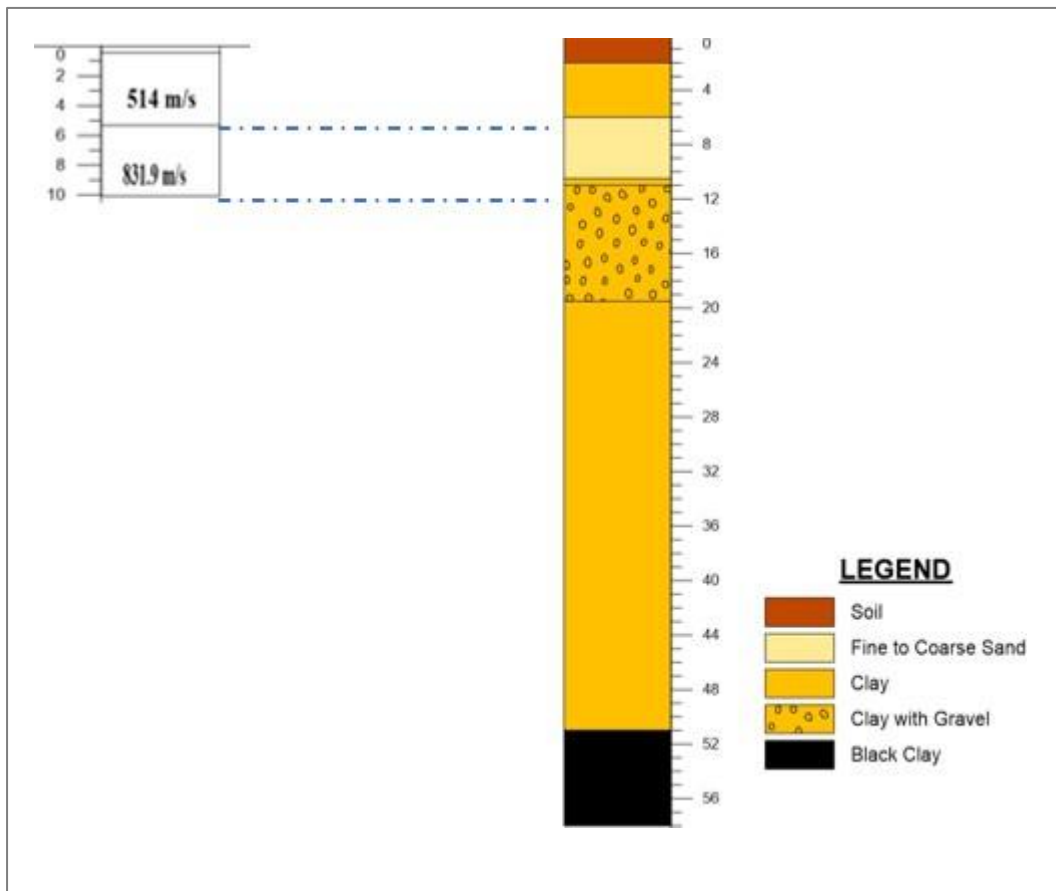


Figure 14.8 Comparison diagram with seismic data (85m SW of VES 48-W-D2-Shot 2) and BH-07 litho- log

CHAPTER 15.0 SUB-SAMPLING TECHNIQUES AND SAMPLE PREPARATION

For further laboratory investigations, including Heavy Mineral (HM) separation and Electron Probe Micro-analysis (EPMA), samples were collected from the medium- to coarse-grained sand, Clayey sand, sandy clay, Gravel sand and gravel clay horizons encountered in the boreholes. Sampling was carried out after detailed lithological logging of the drill cores.

The recovered cores were longitudinally split into two equal halves using a core splitter and/or using chisel and hammer manually. One half was preserved for record and reference purposes, while the other half was used for sampling. Target lithological units were identified based on their sedimentological characteristics, and representative samples were collected accordingly. Continuous horizons of similar lithology, such as medium- to coarse-grained sand, were composited into a single sample unless a distinct change in depositional character or lithology was observed. Similarly, gravel horizons occurring within clay-rich sequences were treated as separate sampling units.

Samples were grouped based on lithological continuity rather than depth intervals to ensure representative characterization of individual sedimentary units. A total of 20 composite samples were prepared from the seven boreholes. These samples were subsequently processed through washing, jigging and panning for heavy mineral separation, followed by petrological studies and EPMA analysis. Details of samples are given in Table 15.1.

Table no. 15.1. Details of generated Sub samples.

Sample No.	Borehole No	Depth from (m)	Depth to (m)
1	MGLBH07	7.00	10.5
2	MGLBH07	12.0	18.8
3	MGLBH05	3.5	10.0
4	MGLBH05	10.0	15.6
5	MGLBH04	6.3	10.0
6	MGLBH04	10.0	19.0
7	MGLBH04	30.0	35.0
8	MGLBH06	10.0	19.0
9	MGLBH06	4.0	10.0
10	MGLBH03	9.0	12.0
11	MGLBH03	12.0	21.5
12	MGLBH03	21.5	25.5
13	MGLBH03	25.5	36.0
14	MGLBH01	4.0	12.0
15	MGLBH01	12.0	17.0
16	MGLBH01	17.0	25.0

Sample No.	Borehole No	Depth from (m)	Depth to (m)
17	MGLBH02	3.0	8.0
18	MGLBH02	9.0	11.0
19	MGLBH04	19.0	21.5
20	MGLBH04	21.5	30.0

15.1 If core, whether cut or sawn and whether quarter, half or all core taken.

The core samples split in to two halves and one portion subjected to further processing and other halve kept as repository.

15.1a. Sieving

The samples were washed, dried and sieved through 5 mm, 2.5 mm for separation of coarser grains and sieving with 0.17mm sieves (80 ASTM) for limiting the finer fraction. The + 5 mm, +2.5 mm size fractions were manually scanned to recover the heavy minerals. Below 0.17mm ie, -80 ASTM fractions were rejected. Further concentration through sample processing and microscopic studies were carried out for the samples having size ranges below 2.5 mm and above 0.17mm only. (Fig. 15.1 a-d)



Fig. 15.1 a: Water Washing, b: Sun drying



Fig. 15.1 c: Packing and labelling d: Manual Sieving

15.1b. Jigging and Panning

The washed and de-slimed - 2.5 mm to 0.17 mm fractions were subjected to manual jigging and panning to separate the heavies based on the specific gravity at Diamond processing plant Wajrakaruru, Geological survey of India. (Fig 15.2 a & b).



Fig. 15.2 a: Jigging b: Panning

15.1 c. Two level Magnetic/Electro-magnetic and gravity Separation

The jigged/panned heavy concentrates were subjected to first level magnetic separation using hand magnet to remove all highly magnetic fractions. After magnetic separation, the remaining fraction was washed with diluted hydrochloric acid to remove surface coatings. Further, it is washed with fresh water to remove acid content. The washed samples were dried and collected into duly numbered zip packets.

The concentrates were further subjected to bromoform treatment to separate the heavy mineral grains (Fig 15.3). The gravity separation helps to separate heavy minerals having specific gravity higher than 2.89g/cm^3 from the light minerals having specific gravity less than 2.89g/cm^3 .



Fig. 15.3a: Gravity separation by bromoform method



Fig. 15.3b: Magnetic mineral separation by Electromagnetic method

The separation medium used is bromoform (CHBr_3), which is dense liquid with specific gravity of 2.89g/cm^3 . It is the most commonly used medium in gravity separation techniques.

When the mixture of sample is added to the bromoform liquid filled with in the pear-shaped separating funnels lead to sink and settle the heavy minerals at the bottom due to higher specific gravity and all the lighter minerals will float at the surface. The heavy mineral fraction settled at the bottom is collected on to a cone shaped funnel with filter paper kept below the conical flask by draining out only the heavies. The heavy mineral fraction thus separated is retained in the filter paper is washed using acetone to remove bromoform coated on the minerals.

The lights were rejected and heavies were further taken to Electro-Magnetic separation

15.1 d. Electromagnetic separator

Electromagnetic separator helps to separate magnetic minerals using the electrically generated magnetic field. Since each mineral having its own magnetic susceptibility towards the magnetic field, Electromagnetic separator succeeds to separate the minerals by adjusting the magnetic field intensity. Gauss is the unit used for Magnetic field intensity.

In the present study, 6500 gauss and 20000 gauss limits were used to segregate three magnetic fractions namely; Ilmenite/garnet (**EM-1 fraction**), other heavy magnetic-minerals (**EM-2 fraction**) and the remaining Non-magnetic heavy minerals (**EM-3 fractions**) respectively. A total of 60 sub-fractions are generated from 20 no. of samples. The magnetic intensity range and expected minerals in each fraction is given in the table 15.2. The heavy minerals thus separated were studied under microscope to find out KIMs if any. Flow chart of detailed methodology is given in the Fig.15.4.

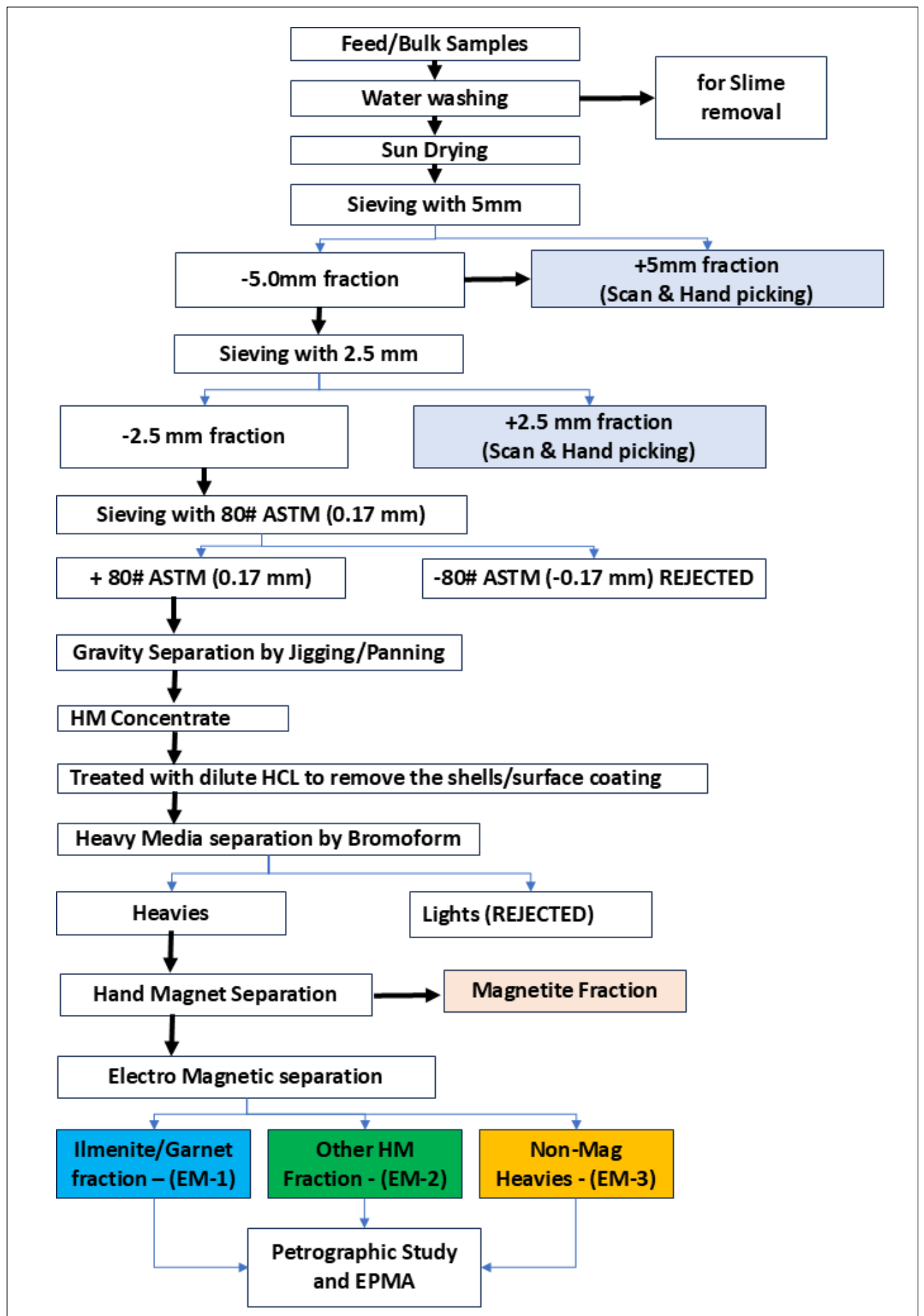


Fig. 15.4 Flow chart of Sample Processing and Lab Studies

Table 15.2 Details of Magnetic flux intensity range and expected minerals

Sl. No.	Mineral Fractions	Methodology	Magnetic susceptibility	Minerals separated	Remarks
1	Magnetite	Hand magnet separation	Highly magnetic	Magnetite/Titano Magnetites	
2	EM-1 fraction	Electro-magnetic separation	@ 6500 Gauss (high to Moderately Magnetic)	Ilmenite, Garnet, spinel etc.	Expected KIMs
3	EM-2 fraction	Electro-magnetic separation	@ 20000 Gauss (Low Magnetic)	Diopside & Other Magnetic Heavy Minerals	Expected KIMs
4	EM-3 fraction	Electro-magnetic separation	Non-magnetic fraction	Non-Magnetic Heavy Minerals like diamond, kyanite, rutile etc.	Expected Diamond

15.2. Hand picking of Coarser fractions

All the grains/material which is above 2.5mm and 5mm are subjected to hand picking. The transparent, translucent and other suspected minerals are carefully handpicked with aide of hand lens and subjected to gravity separation using bromoform. After the gravity separation of all handpicked grains/minerals using bromoform, it is noticed that no heavy minerals were found in the +2.5mm and +5mm fraction.

15.3 Laboratory procedures

Each fraction viz, EM-1, EM-2 & EM-3 from all the 20 samples are subjected to microscopic studies and details are given below.

15.3a. Hand Picking of Indicator Minerals using microscope

Following electromagnetic (EM) separation, each sub-sample (EM-1, EM-2, and EM-3) was sieved using an 18 ASTM-mesh sieve to obtain two size fractions: +18 ASTM mesh (coarser fraction) and –18 ASTM mesh (finer fraction). Both fractions were subsequently subjected to manual hand picking for the recovery of targeted Kimberlite Indicator Minerals (KIMs), primarily garnet, ilmenite, and green (Cr) diopside, along with other minerals of interest.

The +18 ASTM mesh fraction predominantly contain garnets with a few ilmenite grains, whereas the –18 mesh fraction comprised a wider variety of minerals, including garnet, ilmenite, possible chrome diopside, other pyroxenes, and accessory heavy minerals.

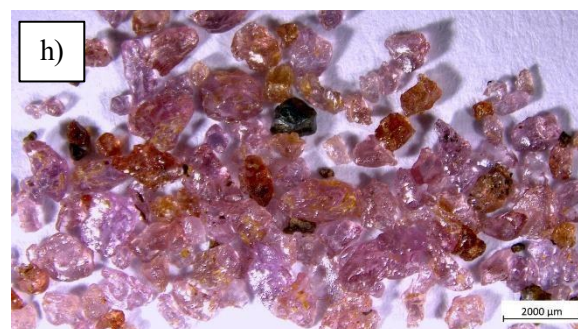
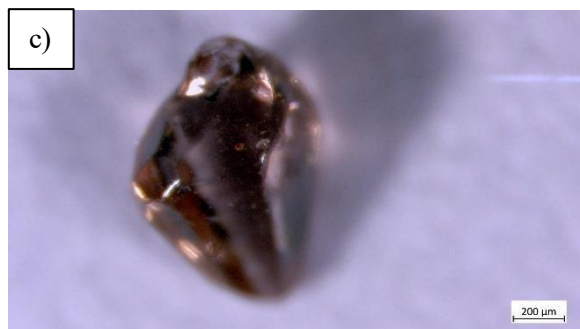
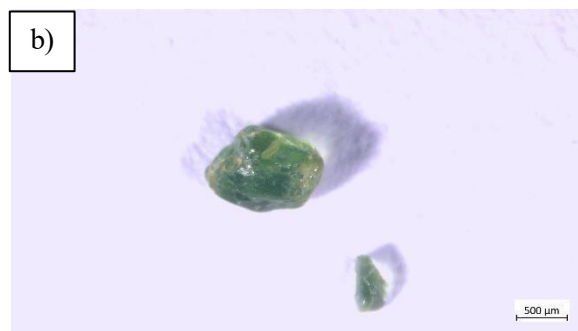


Plate-1. Representative grains of garnet, pyroxene, ilmenites in hand-picked grains for polished section preparation (a, b, e, f, g, h, i, j); c) Zircon; d) EM separated bulk sample

15.3b. Mount Preparation/ Polished section preparation

The hand-picked grains were mounted on a total of eight epoxy slides. Of these, two slides were prepared using +18 fraction, while the remaining six slides represent –18 fraction. The grains were mounted in a systematic linear arrangement, and each grain was assigned a unique identification on a graphical layout corresponding to the respective slide. This ensured complete traceability of every grain to its original sample and facilitated its identification during subsequent microscopic examination and EPMA study.

15.3c. Microscopic Examination and Grain Selection

After polishing, the mounted slides were examined under reflected/transmitted light microscope to identify the most suitable grains for Electron Probe Micro-Analysis (EPMA). Priority was given to garnets and possible chrome diopside (clinopyroxene) followed by ilmenite. In addition, a limited number of other minerals, including zircon, monazite, and rutile, were also selected for analysis.

The polished section slides and individual mineral grains were labelled systematically to ensure precise identification and facilitate future re-examination. Slides **S1+18** and **S7+18** contain all **+18 mesh** grains, whereas the remaining slides (e.g., **S2-18**) contain **–18 mesh** grains.

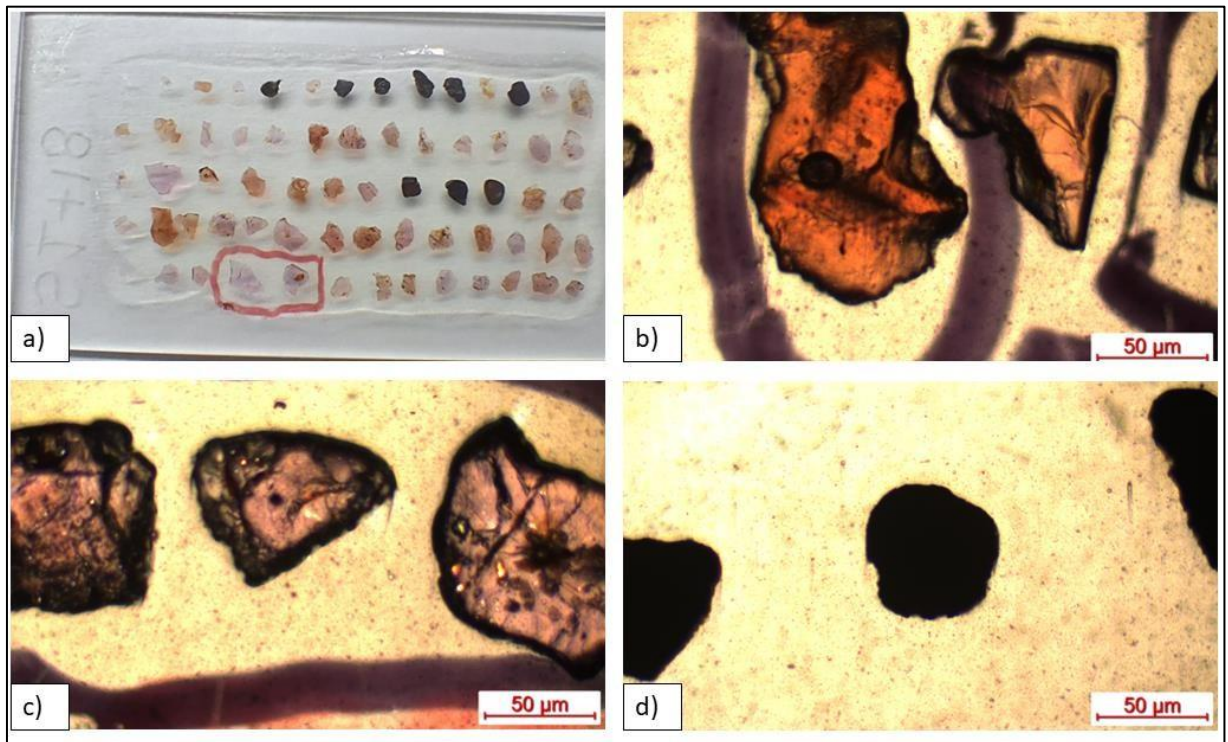
A standardized nomenclature was adopted for all grains analyzed by EPMA, incorporating the slide number, electromagnetic fraction, sample number, and grain number. For example, the notation **S1+18_EM1_2-3** can be interpreted as follows:

- **S1+18** – Polished slide number. (likewise, **S2-18, S3-18, S4-18, S5-18, S6-18, S7+18, S8-18**)
- **EM1** – Electromagnetic fraction from which the grain was obtained. (Likewise, EM2, EM3)
- **2** – Sample number (Sample 2 out of the 20 processed samples).
- **3** – Grain number within the respective sample.

This systematic naming convention enables each analyzed grain to be uniquely identified, ensuring accurate correlation between microscopic observations, EPMA analytical data, and polished section photographs, while also facilitating reliable future verification and re-examination of individual grains.

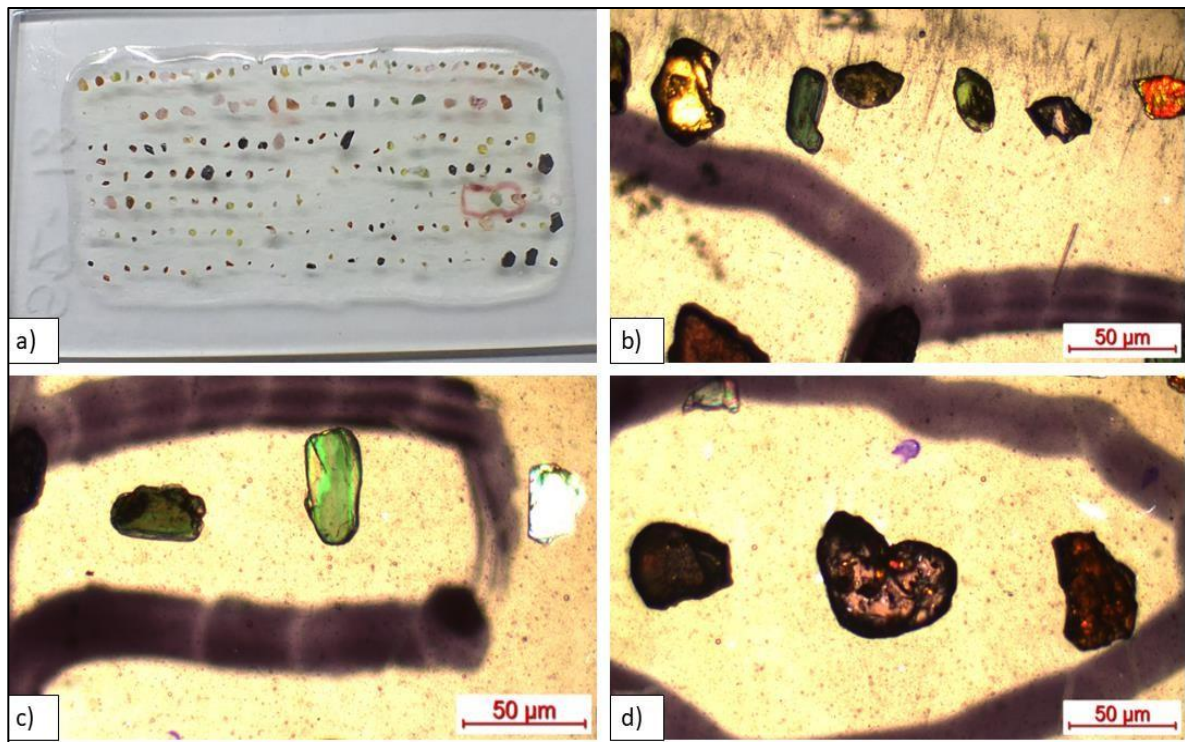
Photographs of the polished sections, along with their corresponding microscopic images and schematic diagram for all eight slides, are presented in Plate 2 to Plate 9.

The selected grains were marked directly on the polished mounts and subsequently submitted for EPMA analysis.



✂ S1+18														e)
1	EM1/1	EM1/1	EM1/1	EM1/5	EM1/5	EM1/5	EM1/5	EM1/6	EM1/6	EM1/6	EM1/6	EM1/6	EM1/6	EM1/6
	1	2	3	1	2	3	4	1	2	3	4	5	6	7
2	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10
	1	2	3	4	5	1	2	3	4	5	6	7	8	
3	EM1/10	EM1/10	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/12	EM1/12	
	9	10	1	2	3	4	5	6	7	8		1	2	
4	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12	EM1/12
	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5	EM1/13	EM1/15	EM1/15	EM1/18	EM1/19	EM1/13	EM1/13	EM1/15	EM1/15	EM1/15	EM1/15	EM1/15	EM1/15	EM1/15
	1	1	2	1	1	2	3	3	4	5	6	7	8	
PRIORITY														

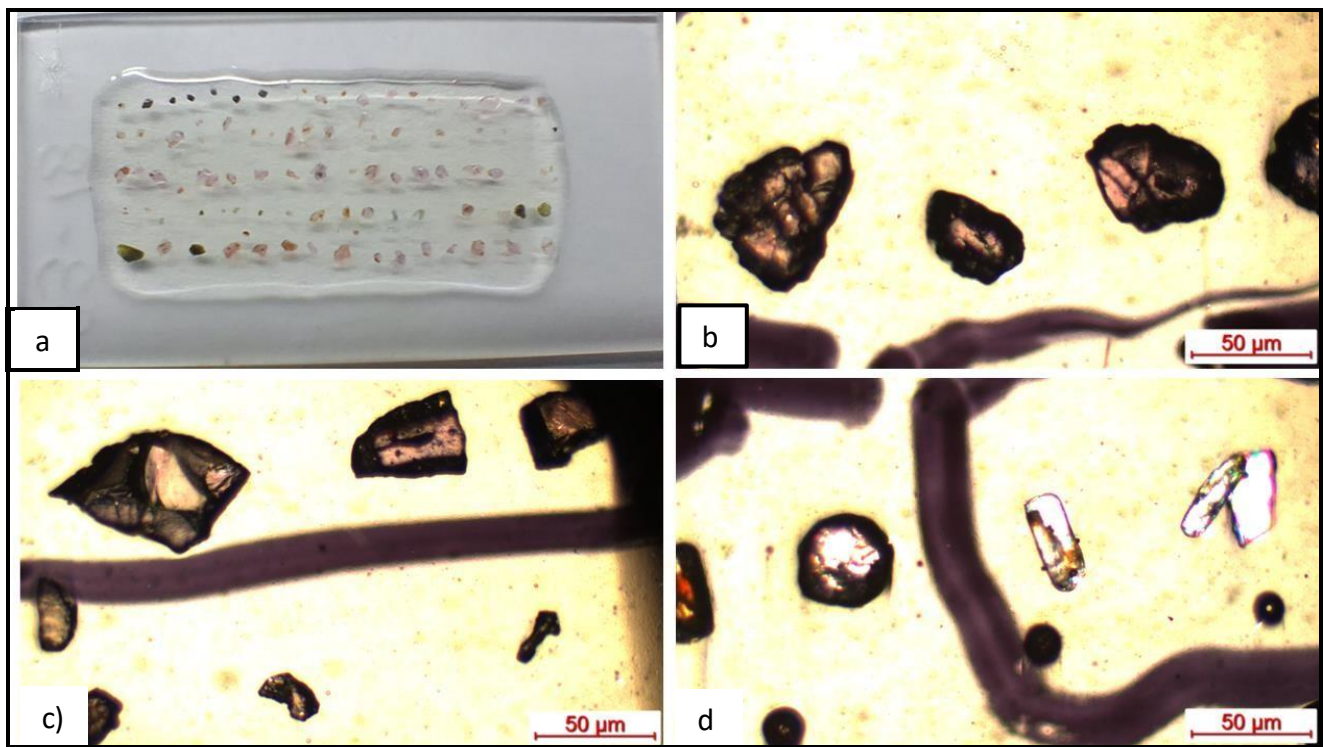
Plate-2. a) Polished Section S1+18; b) & c) Garnets; d) Ilmenite;
 e) Schematic Diagram of Section S1+18



S2-18																												
1	EM2 /10 1	EM2 /10 2	EM2 /10 3	EM2 /10 4	EM2 /10 5	EM2 /10 6	EM2 /10 7	EM2 /10 8	EM2 /10 9	EM2 /10 10	EM2 /10 11	EM2 /10 12	EM2 /10 13	EM2 /10 14	EM2 /10 15	EM2 /10 16	EM2 /10 17	EM2/ 10 18	EM2 /10 19	EM2 /10 20	EM2 /10 21	EM2 /10 22	EM2 /10 23	EM2/ 10 24	EM2 /10 25	EM2 /10 26	EM2/ 10 27	
	EM2 /10 28	EM2 /10 29	EM2 /10 30	EM2 /10 31	EM2 /10 32	EM2 /10 33	EM2 /10 34	EM2 /10 35	EM2 /10 36	EM2 /10 37	EM2 /10 38	EM2 /10 39	EM2 /10 40	EM2 /10 41	EM2 /10 42	EM2 /10 43												
2	EM2 /10 44	EM2 /10 45	EM2 /10 46	EM2 /11 1	EM2 /11 2	EM2 /11 3	EM2 /11 4	EM2 /11 5	EM2 /11 6	EM2 /11 7	EM2 /11 8	EM2 /11 9	EM2 /12 1	EM2 /12 2	EM2 /17 1	EM2 /17 2	EM2 /17 3	EM2/ 17 4	EM2 /17 5	EM2 /17 6	EM2 /17 7	EM2 /17 8						
3	EM3 /20 1	EM3 /20 2	EM3 /20 3	EM3 /20 4	EM3 /20 5	EM3 /20 6	EM3 /20 7	EM3 /20 8	EM3 /20 9	EM3 /20 10	EM3 /20 11	EM3 /20 12	EM3 /20 13	EM3 /20 14	EM3 /20 15	EM3 /20 16	EM3 /20 17	EM3/ 7 1	EM3 /16 1	EM3 /16 2	EM3 /16 3	EM3 /16 4	EM3 /16 5	EM3/ 16 6	EM3 /16 7	EM3 /16 8	EM3/ 16 9	
4	EM3 /13 1	EM3 /13 2	EM3 /13 3	EM3 /15 1	EM3 /15 2	EM3 /15 3	EM3 /15 4	EM3 /15 5	EM3 /15 6	EM3 /15 7	EM3 /15 8	EM3 /15 9	EM3 /15 10	EM3 /15 11	EM3 /15 12	EM3 /15 13	EM3 /15 14	EM3/ 14 1	EM3 /14 2	EM3 /14 3	EM3 /14 4	EM3 /14 5	EM3 /14 6	EM3 /14 7				
5	EM3 /9 1	EM3 /9 2	EM3 /9 3	EM3 /9 4	EM3 /9 5	EM3 /9 6	EM3 /9 7	EM3 /9 8	EM3 /9 9	EM3 /9 10	EM3 /9 11	EM3 /9 12	EM3 /9 13	EM3 /9 14	EM3 /9 15	EM3 /9 16	EM3 /9 17	EM3/ 9 18	EM3 /11 1	EM3 /11 2	EM3 /4 1	EM3 /10 1	EM3 /10 2					
6	EM3 /10 3	EM3 /10 4	EM3 /10 5	EM3 /10 6	EM3 /10 7	EM3 /10 8	EM3 /10 9	EM3 /10 10	EM3 /10 11	EM3 /10 12	EM3 /10 13	EM3 /10 14	EM3 /10 15	EM3 /10 16	EM3 /10 17	EM3 /7 2	EM3 /7 3	EM3/ 7 4	EM3 /7 5	EM3 /7 6	EM3 /7 7	EM3 /7 8	EM3 /7 9	EM3/ 7 10	EM3 /7 11	EM3 /7 12	EM3/ 7 13	EM3/ 7 14
7	EM3 /5 1	EM3 /5 2	EM3 /5 3	EM3 /5 4	EM3 /5 5	EM3 /5 6	EM3 /5 7	EM3 /5 8	EM3 /5 9	EM3 /5 10	EM3 /18 1	EM3 /18 2	EM3 /18 3	EM3 /18 4	EM3 /18 5	EM3 /18 6	EM3 /18 7	EM3/ 18 8	EM3 /18 9	EM3 /18 10	EM3 /8 1	EM3 /8 2	EM3 /8 3					

e)

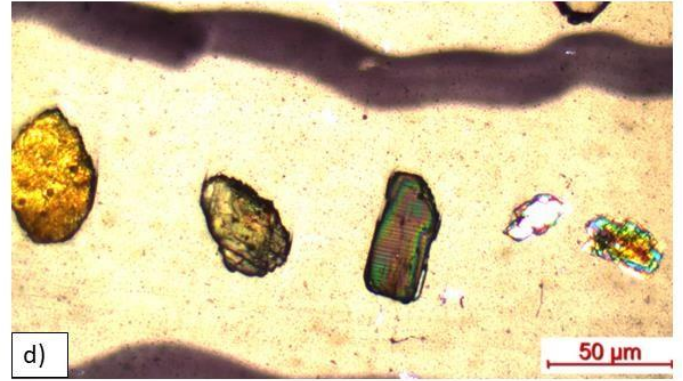
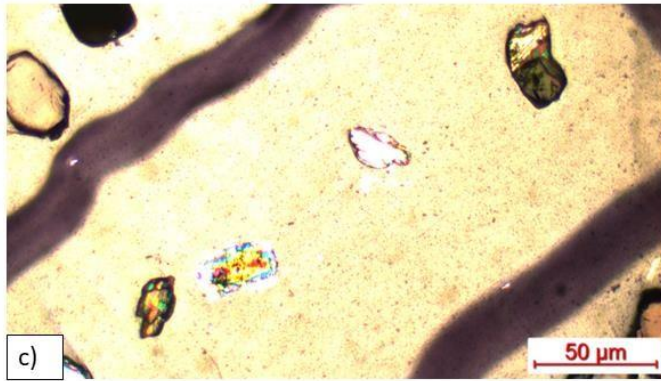
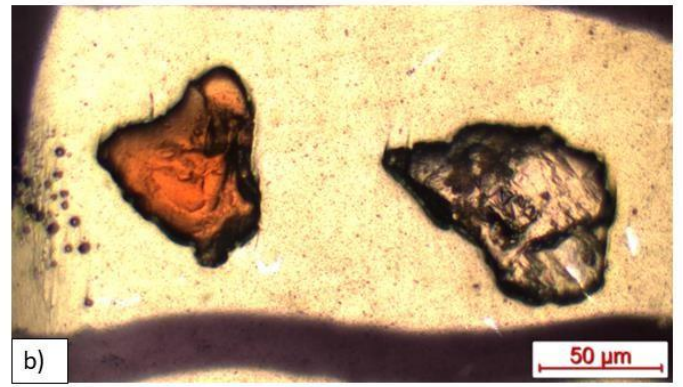
Plate-3. a) Polished Section S2-18; b) &c) pyroxenes (green); d) Garnets; e) Schematic Diagram of Section S2-18



S3-18																								
1	EM3/8	EM3/8	EM3/8	EM3/8	EM3/8	EM3/8	EM3/8	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	13	14			
2	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5	EM1/5
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35			
3	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1	EM1/1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
4	EM1/1	EM1/1	EM3/12	EM3/12	EM3/12	EM3/12	EM3/12	EM3/12	EM3/12	EM3/12	EM3/12	EM3/12	EM3/14	EM3/14	EM1/5	EM1/5	EM1/10	EM1/10	EM1/10	EM1/10				
	22	23	1	2	3	4	5	6	7	8	9	1	2	1	2	1	2	3	4					
5	EM1/10	EM1/10	EM1/10	EM1/10	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9								
	5	6	7	8	1	2	3	4	5	6	7	8	9	10	11									

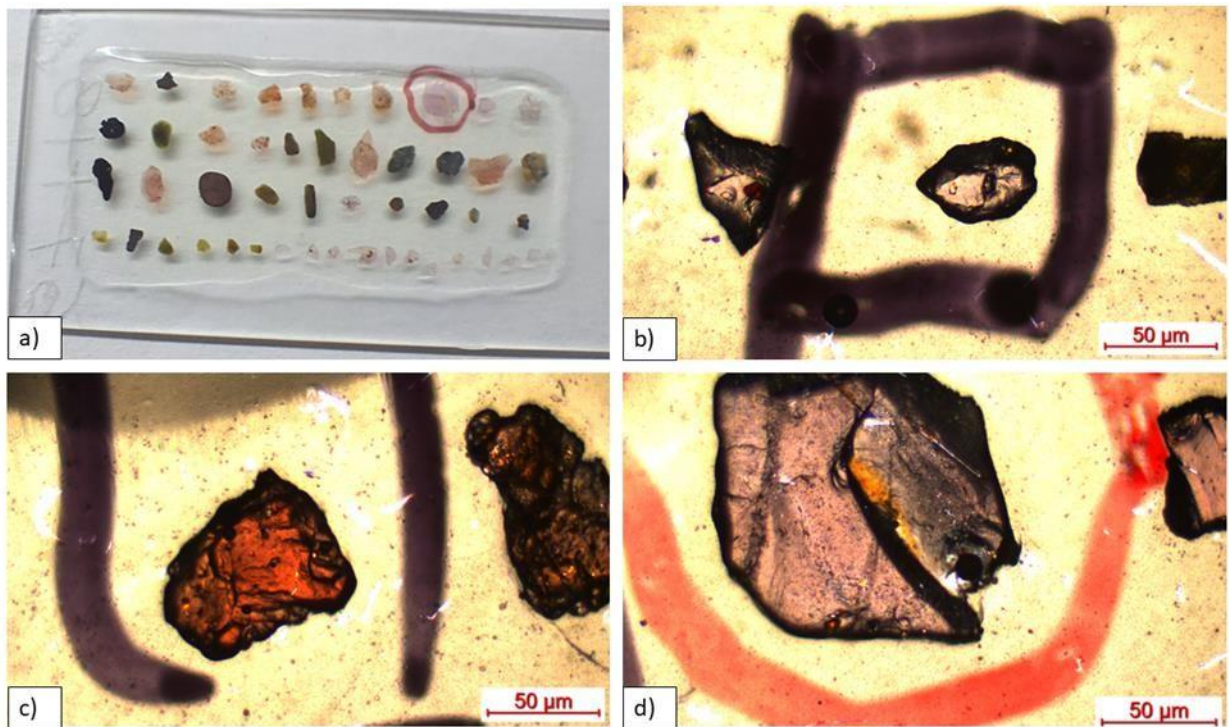
e

Plate-4. a) Polished Section S3-18; b) &c) Garnets; d) Monazite(rounded) and pyroxenes; e) Schematic Diagram of Section S3-18



S4-18																			
1	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	e
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
2	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/11	EM1/11	EM1/11	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9	EM1/9
	19	20	21	22	23	24	25	26	27	28	1	2	3	29	30	31	32	33	34
3	EM1/19	EM1/19	EM1/19	EM1/19	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/10	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	
	1	2	3	4	1	2	3	4	5	6	7	8	1	2	3	4	5	6	
4	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/11	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	
	7	8	9	10	11	12	1	2	3	4	5	6	7						
5	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	EM1/17	
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

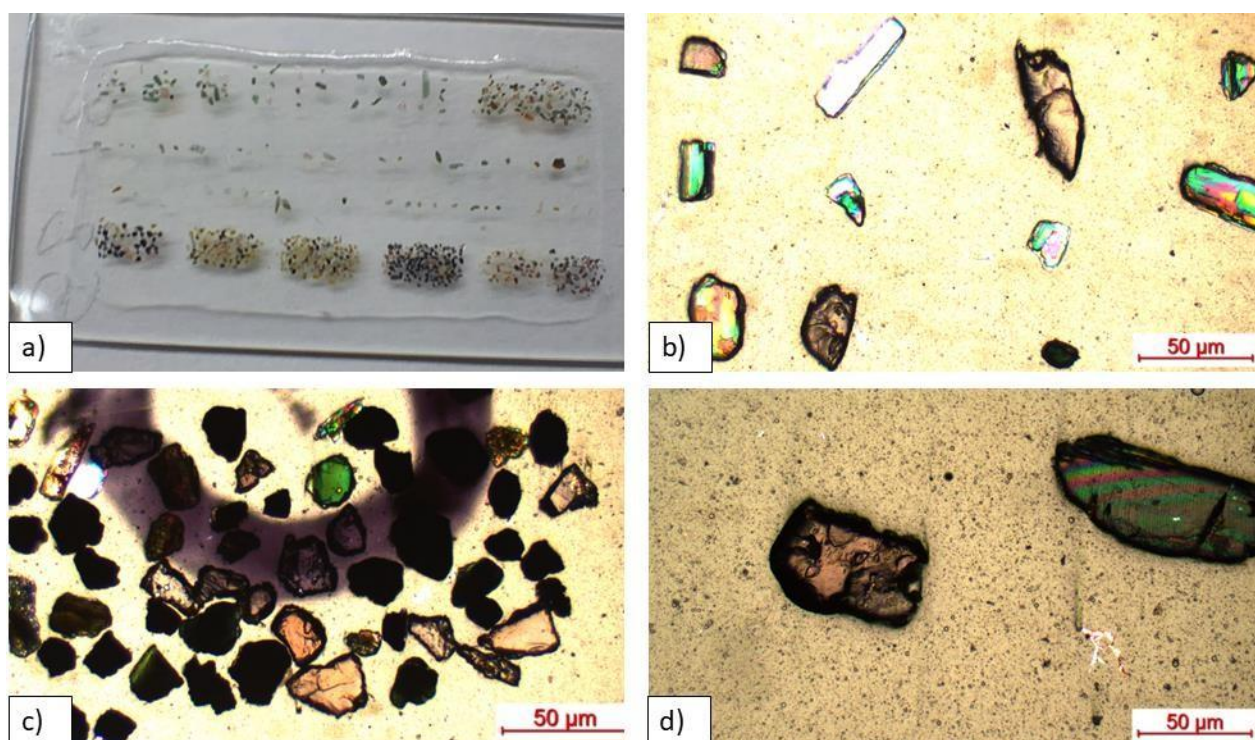
Plate-5. a) Polished Section S4-18; b) Garnets; c) Pyroxenes (last grain Cr-Diopside); d) Pyroxenes (2nd grain Cr- Diopside); e) Schematic Diagram of Section S4-18



S7+18											
1	EM2/10	EM1/6	EM1/6	EM1/15	EM1/15	EM1/15	EM1/15	EM2/12	EM2/11	EM2/11	
	1	1	2	1	2	3	4	1	1	2	
2	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12	EM2/12
	2	3	4	5	6	7	8	9	10	11	12
3	EM2/10	EM2/10	EM2/10	EM2/10	EM2/9	EM2/9	EM2/9	EM2/14	EM2/14	EM2/14	
	2	3	4	5	1	2	3	1	2	3	
4	EM2/10	EM2/10	EM2/10	EM2/10	EM2/10	EM2/10	EM1/13	EM1/13	EM1/13	EM1/13	EM1/13
	6	7	8	9	10	11	1	2	3	4	5
4	EM1/13	EM1/13	EM1/13	EM1/13	EM1/13						
	8	9	10	11	12						

e

Plate-8. a) Polished Section S7+18; b, c & d) Garnets; e) Schematic Diagram of Section S7+18



✶	S8-18																												
	EM2/1 (14 Grains)			EM2/3 (12 Grains)			EM2/5		EM2/9		EM2/9		EM2/13		EM2/13		EM2/15		EM2/15		EM2/15		EM2/15		EM2/19				
							EM2/5		EM2/9		EM2/9		EM2/13		EM2/13		EM2/15		EM2/15		EM2/15		EM2/15						
							EM2/5		EM2/9		EM2/9		EM2/13		EM2/13														
EM3/3 EM3/3 EM3/3 EM3/3 EM3/3 EM3/3 EM3/3 EM3/3 EM3/3 EM3/3 EM2/6 EM2/6 EM2/6 EM2/6 EM2/6 EM2/6 EM2/6 EM2/6 EM2/6 EM2/6 EM3/17 EM3/17 EM3/17																													
1 2 3 4 5 6 7 8 9 1 2 3 4 5 6 7 8 9 1 2 3																													
EM3/6 EM3/6 EM3/6 EM3/6 EM3/1 EM3/1 EM3/1 EM3/1 EM2/14																													
1 2 3 4 1 2 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15																													
Bulk										Bulk										Bulk									
EM1/12										EM2/12										EM2/17									
										EM1/11										EM3/11									
										EM3/13																			
e																													

Plate-9. a) Polished Section S8-18; b), c) & d) Pyroxenes (green, white interference color), Garnets (light brownish) and ilmenite (black); e) Schematic Diagram of Section S8-18

15.4. EPMA Studies

Preliminary Electron microprobe studies were carried out at EPMA Laboratory, Geological Survey of India, Hyderabad to identify possible presence of Kimberlite Indicator Minerals (KIMs) in the heavy mineral separates. Following are the salient observations:

- Two mineral separate fractions namely +18 ASTM and -18 ASTM mesh sizes were studied.
- Bulk of the grains in +18 ASTM mesh size were garnets. In this fraction, out of 32 points probed, 29 grains were of garnets, 3 belonged to ilmenite.
- The -18 fractions have almost equal amounts of garnet, clinopyroxene and opaques.

Garnets: A total of 93 garnet grains were analyzed. Most garnet grains are pink in color. Dark pink and reddish pink variants are not uncommon. Salient observations related to mineral chemistry of garnets are:

- Most garnet grains analyzed SiO_2 in the range of 36 wt % and 39 wt % (rarely some grains analyzed 35 wt % and 40 wt %). FeO ranges between 25 wt % to 38 wt %. However, there are some garnets that exhibit moderately high MgO (up to 13 wt %) and CaO (25 wt%, 33 wt%). Therefore, the mineral composition suggests that most garnets are almandine garnets but a few have moderately rich pyrope and andradite species. Among minor and trace elements, the garnets have low Na_2O (<01 wt%) and very low Cr_2O_3 (<0.3 wt %). Thus, the garnets are low-soda, low chrome garnets.
- The garnets were plotted on binary discriminant diagrams, mainly to know their geochemical affinity i.e whether they are formed by the crustal or mantle related processes. In Cr_2O_3 vs CaO diagram, most garnets plots in G0 field. These may be the almandine rich garnets representing crustal sources (Fig-15.5). Schults (1999) has interpreted the low-chrome garnets with moderate CaO content falling in G4 and G3 fields as to represent diamond facies websterite-eclogite and diamond facies eclogite respectively. A few samples of garnet (14 nos.) from the study area fall in G4 field indicating the affinity of those garnets to be related to mantle related process (diamond facies websterite-eclogite). The garnet EPMA values falling in G4 are shown in the Table-15.3.

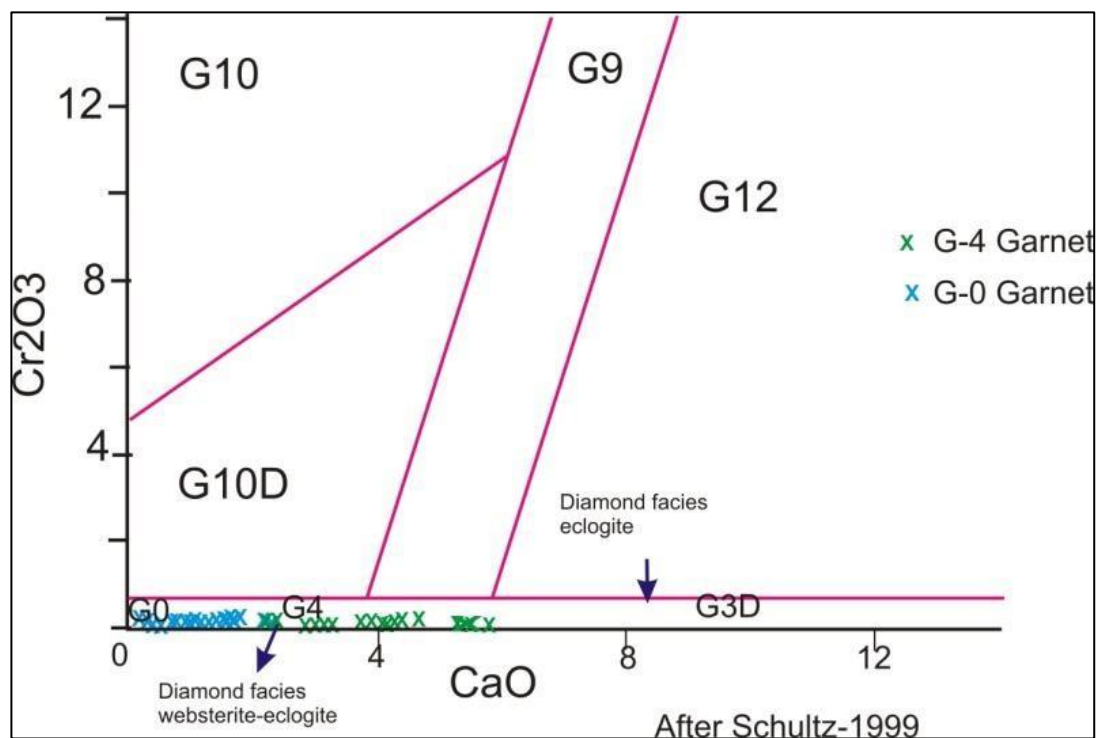


Fig. 15.5: Cr_2O_3 vs CaO Plot for Garnets (after Schultz, 1999)

Another binary diagram that uses Na_2O - TiO_2 space (after McCandless and Gurney, 1989) to discriminate the fields of eclogitic and non-eclogitic source regions of garnets was used here to confirm further the observation made from the Fig- 15.5 above.

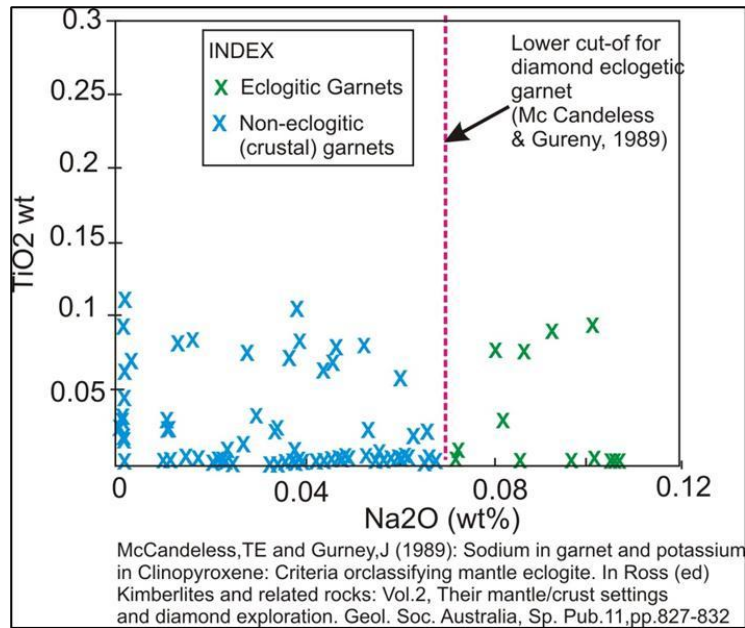


Fig. 15.6: Na₂O vs TiO₂ Plot for Garnets (source: McCandeleless & Gurney, 1989)

- In this diagram also, whereas most garnets plot in field below the cut-off defined for eclogitic source, there are fifteen garnets are plotted above this cut-off line, suggesting there are garnets present in the study area that may have formed at deeper mantle regions representing diamond-eclogitic garnet field. Thus, this preliminary study suggests two sources for the garnet detritus of the study area. These are (i) bulk of the garnets have come from crustal source and (ii) there appears to be some garnets that owe mantle paragenesis (Fig. 15.6). The garnet EPMA values falling in the field where Na₂O > 0.07% are shown in the Table-15.4.
- Another ternary diagram based on MgO–FeO–CaO, after Dawson and Stephens (1975) (Fig 15.7), was used to discriminate between mantle-derived and crustal garnets and to further assess their genetic affinity. All 93 analysed garnet grains were plotted on the diagram. Approximately 40 grains fall within Cluster 5, which corresponds to Fe-rich eclogitic garnets, with a mean FeO content of approximately 28.3%.

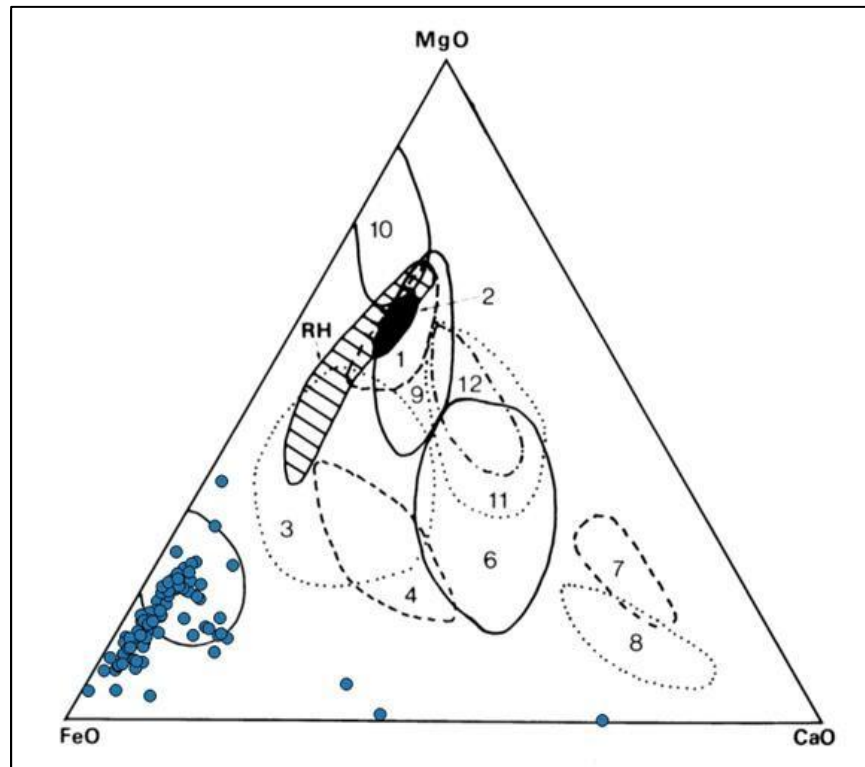


Fig.15.7: MgO-FeO-CaO Plot for Garnets (J. B. Dawson & W. E. Stephens, 1975)

The concentration of these garnets within the Fe-rich eclogitic field provides additional evidence supporting a mantle-derived origin, particularly indicating a possible eclogitic source. Thus, the MgO–FeO–CaO ternary classification further strengthens the interpretation that a significant proportion of the analysed garnets were derived from an eclogitic mantle source.

Table 15.5 presents the details of the mantle-derived garnets, along with the corresponding borehole locations and depths of recovery.

Table no. 15.3 EPMA results for Cr₂O₃ vs CaO Plot (after Schultz,1999)

Grain Number	S1+18_E M1_12- 4A	S1+18_ EM1_1 2-8	S1+18_ EM1_1 0-8	S7+18_ EM2_1 0-1	S7+18_ EM1_1 5-1	S7+18_ EM2_1 2-5	S7+18_ EM2_1 2-8	S2- 18_EM2 _10-11	S2- 18_EM 2_11-1	S2- 18_EM 2_11-3	S8- 18_EM 2_6-1	S8- 18_EM 2_13-1	S4- 18_EM 1_19-1
Datase t/Point	3 / 1 .	9 / 1 .	19 / 1 .	22 / 1 .	23 / 1 .	24 / 1 .	31 / 1 .	3 / 1 .	4 / 1 .	6 / 1 .	1 / 1 .	18 / 1 .	8 / 1 .
Na2O	0	0.053	0.093	0.102	0	0.014	0.016	0.043	0	0.029	0.086	0.012	0.087
MgO	5.396	7.393	9.265	5.229	4.314	5.798	5.655	5.04	5.45	6.246	1.608	7.649	6.219
F	0	0	0	0	0	0	0.125	0.05	0	0	0	0	0
SiO2	38.661	38.229	38.204	38.493	37.396	38.366	38.296	39.029	38.733	38.595	37.493	38.156	38.236
Al2O3	20.586	21.036	21.083	20.921	20.017	20.675	20.643	21.208	21.037	21.117	20.398	21.398	21.101
P2O5	0	0.119	0.133	0.051	0	0.01	0	0	0.148	0	0.027	0.05	0.061
K2O	0.005	0	0.032	0.033	0.024	0.05	0	0	0	0.045	0	0	0.005
CaO	4.132	3.244	3.914	5.384	5.799	4.436	4.673	5.904	5.535	3.045	3.737	3.075	4.859
TiO2	0.028	0.024	0.09	0	0.111	0	0	0	0.063	0.034	0	0.082	0.077
FeO	31.934	29.393	26.206	29.78	31.187	30.396	30.119	29.244	30.055	30.976	36.688	29.912	28.71
MnO	0.918	0.619	0.747	0.355	1.14	1.077	1.363	0.825	0.633	1.277	0.813	0.716	0.891
ZnO	0	0	0.044	0	0.023	0.145	0	0.32	0	0	0	0	0.042
Cr2O3	0	0	0.033	0	0	0	0.071	0	0.061	0.015	0.091	0.025	0
NiO	0	0	0.071	0.112	0.024	0	0	0.002	0	0	0.033	0	0
V2O3	0.074	0.013	0.067	0	0.02	0	0.028	0.003	0.031	0.01	0.03	0.008	0
SrO	0	0	0	0	0	0	0	0.381	0.255	0	0.384	0	0
BaO	0	0.12	0	0.007	0.086	0	0	0	0.018	0	0	0	0
ZrO2	0	0	0.212	0.166	0	0	0	0	0.211	0.308	0	0.039	0.071
Total	101.733	100.242	100.193	100.634	100.142	100.969	100.989	102.048	102.229	101.697	101.38 9	101.123	100.36
Si	6.037	5.986	5.940	5.940	5.982	6.018	6.013	6.061	6.018	6.010	6.047	5.924	5.993
Ti	0.003	0.003	0.011	0.011	0.013	0.000	0.000	0.000	0.007	0.004	0.000	0.010	0.009
Al	3.788	3.882	3.863	3.863	3.774	3.822	3.820	3.882	3.852	3.875	3.877	3.915	3.898
Fe	4.169	3.848	3.407	3.407	4.172	3.987	3.954	3.798	3.905	4.033	4.948	3.883	3.763
Mn	0.121	0.082	0.098	0.098	0.154	0.143	0.181	0.109	0.083	0.168	0.111	0.094	0.118
Mg	1.256	1.726	2.148	2.148	1.029	1.356	1.324	1.167	1.262	1.450	0.387	1.770	1.453
Ca	0.691	0.544	0.652	0.652	0.994	0.745	0.786	0.982	0.921	0.508	0.646	0.511	0.816
TOTAL	16.066	16.071	16.118	16.118	16.118	16.071	16.077	15.998	16.049	16.049	16.015	16.109	16.049

End Members													
Py	20.136	27.833	34.062	34.062	16.205	21.759	21.195	19.270	20.454	23.540	6.347	28.285	23.628
Alm	66.838	62.067	54.038	54.038	65.708	63.982	63.317	62.716	63.268	65.479	81.229	62.040	61.182
Gro	11.080	8.776	10.340	10.340	15.654	11.963	12.586	16.222	14.928	8.247	10.601	8.171	13.267
Sp	1.946	1.324	1.560	1.560	2.433	2.296	2.902	1.792	1.350	2.734	1.823	1.504	1.923

Table no. 15.4 EPMA results for Na₂O vs TiO₂ Plot (McCandless & Gurney, 1989)

Grain Number	S1+18_E EM1_9-4	S1+18_E EM1_10-8	S1+18_E EM1_11-5	S7+18_E EM2_10-1	S7+18_E EM1_13-1	S7+18_E EM1_13-2	S7+18_E EM2_11-1	S2-18_E M2_11-6	S2-18_E M2_17-6	S3-18_E M1_1-2	S3-18_E M1_1-14	S3-18_E M1_5-13	S8-18_E M2_6-1	S5-18_E M1_11-40	S4-18_E M1_19-1
Dataset /Point	5 / 1 .	19 / 1 .	21 / 1 .	22 / 1 .	26 / 1 .	27 / 1 .	33 / 1 .	9 / 1 .	13 / 1 .	20 / 1 .	26 / 1 .	31 / 1 .	1 / 1 .	33 / 1 .	8 / 1 .
Na ₂ O	0.097	0.093	0.071	0.102	0.106	0.08	0.107	0.072	0.102	0.071	0.107	0.097	0.086	0.082	0.087
MgO	7.858	9.265	1.923	5.229	8.566	7.318	6.836	10.085	0.404	5.168	3.597	3.562	1.608	5.113	6.219
F	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SiO ₂	39.022	38.204	36.788	38.493	38.737	37.991	37.366	39.581	37.775	38.337	37.552	36.198	37.493	37.519	38.236
Al ₂ O ₃	21.519	21.083	19.919	20.921	21.302	21.223	20.567	21.582	20.238	21.272	20.813	20.31	20.398	20.506	21.101
P ₂ O ₅	0.042	0.133	0.014	0.051	0.066	0	0.037	0.144	0	0	0.046	0	0.027	0.046	0.061
K ₂ O	0	0.032	0	0.033	0	0.06	0	0.029	0	0	0.053	0	0	0	0.005
CaO	2.271	3.914	1.672	5.384	1.322	1.669	1.312	0.58	15.044	0.541	1.088	1.049	3.737	1.625	4.859
TiO ₂	0	0.09	0	0	0	0.076	0.001	0.008	0.095	0	0	0	0	0.031	0.077
FeO	29.704	26.206	37.648	29.78	29.718	32.217	32.49	28.747	21.776	34.906	37.763	38.145	36.688	33.768	28.71
MnO	0.935	0.747	2.241	0.355	0.599	0.718	0.465	0.354	5.387	1.187	0.684	0.635	0.813	1.526	0.891
ZnO	0	0.044	0.098	0	0	0	0.133	0.013	0	0.074	0.021	0	0	0	0.042
Cr ₂ O ₃	0.053	0.033	0	0	0.039	0	0.03	0.015	0.034	0.047	0.021	0	0.091	0.007	0
NiO	0	0.071	0.016	0.112	0.018	0	0	0	0.047	0	0	0.015	0.033	0	0
V ₂ O ₃	0.043	0.067	0	0	0	0.066	0.008	0	0	0.035	0.002	0.01	0.03	0	0

Grain Number	S1+18_ EM1_9- 4	S1+18_ EM1_10 -8	S1+18_ EM1_11 -5	S7+18_ EM2_10 -1	S7+18_ EM1_13 -1	S7+18_ EM1_13 -2	S7+18_ EM2_11 -1	S2- 18_E M2_1 1-6	S2- 18_E M2_1 7-6	S3- 18_E M1_1 -2	S3- 18_E M1_1 -14	S3- 18_E M1_5 -13	S8- 18_E M2_6 -1	S5- 18_E M1_1 1-40	S4- 18_E M1_1 9-1
SrO	0.256	0	0	0	0.129	0.128	0	0	0	0	0	0	0.384	0	0
BaO	0.127	0	0.066	0.007	0.026	0.05	0	0	0.014	0.007	0.066	0.091	0	0.004	0
ZrO2	0	0.212	0	0.166	0	0.071	0.147	0.032	0.025	0	0.108	0	0	0.077	0.071
Total	102.029	100.193	100.455	100.634	100.628	101.667	99.5	101.24 1	100.94 1	101.6 44	101.9 23	100.1 13	101.3 89	100.30 4	100.36
Si	6.009	5.940	6.013	5.940	6.011	5.926	5.969	6.038	6.006	6.023	5.985	5.903	6.047	5.994	5.993
Ti	0.000	0.011	0.000	0.011	0.000	0.009	0.000	0.001	0.011	0.000	0.000	0.000	0.000	0.004	0.009
Al	3.905	3.863	3.837	3.863	3.895	3.901	3.872	3.880	3.792	3.939	3.909	3.903	3.877	3.861	3.898
Fe	3.825	3.407	5.146	3.407	3.856	4.202	4.340	3.667	2.895	4.586	5.033	5.202	4.948	4.511	3.763
Mn	0.122	0.098	0.310	0.098	0.079	0.095	0.063	0.046	0.725	0.158	0.092	0.088	0.111	0.206	0.118
Mg	1.804	2.148	0.469	2.148	1.982	1.702	1.628	2.294	0.096	1.210	0.855	0.866	0.387	1.218	1.453
Ca	0.375	0.652	0.293	0.652	0.220	0.279	0.225	0.095	2.562	0.091	0.186	0.183	0.646	0.278	0.816
TOTAL	16.039	16.118	16.068	16.118	16.042	16.114	16.095	16.021	16.087	16.007	16.060	16.145	16.015	16.072	16.049
Endmembers															
Py	29.451	34.062	7.537	34.062	32.294	27.108	26.026	37.593	1.525	20.024	13.862	13.662	6.347	19.599	23.628
Alm	62.442	54.038	82.764	54.038	62.841	66.938	69.379	60.104	46.109	75.857	81.627	82.063	81.229	72.602	61.182
Gro	6.116	10.340	4.709	10.340	3.582	4.443	3.589	1.554	40.813	1.506	3.013	2.891	10.601	4.476	13.267
Sp	1.991	1.560	4.990	1.560	1.283	1.511	1.006	0.750	11.553	2.613	1.497	1.384	1.823	3.323	1.923

Table no. 15.5 BH Details of Garnets having mantle paragenesis

Grain Number	BH Number	Core Depth (m)
S7+18_EM1_15-1	MGLBH01	12 -17
S2-18_EM2_17-6	MGLBH02	3 - 8
S1+18_EM1_10-8	MGLBH03	9 -12
S7+18_EM2_10-1		
S2-18_EM2_10-11		
S1+18_EM1_11-5	MGLBH03	12 - 21.5
S7+18_EM2_11-1		
S2-18_EM2_11-6		
S5-18_EM1_11-40		
S2-18_EM2_11-1		
S2-18_EM2_11-3	MGLBH03	21.5 - 25.5
S1+18_EM1_12-4		
S1+18_EM1_12-4A		
S1+18_EM1_12-8		
S7+18_EM2_12-5		
S7+18_EM2_12-8	MGLBH03	25.5 - 36
S7+18_EM1_13-1		
S7+18_EM1_13-2		
S8-18_EM2_13-1	MGLBH04	6.3 - 10
S3-18_EM1_5-13		10 - 19
S8-18_EM2_6-1		19 - 21.5
S4-18_EM1_19-1	MGLBH06	4 - 10
S1+18_EM1_9-4	MGLBH07	7 - 10.5
S3-18_EM1_1-2		
S3-18_EM1_1-14		

Clinopyroxenes: About 40 grains of clinopyroxenes were analyzed during this study. These grains were ubiquitous in-18 mesh-size fraction. The grains observed were in different shades of green. Salient features of the analysed clinopyroxenes are given below:

- SiO_2 in these grains range from 41 wt% to 57 wt %, CaO between 11 and 21 wt%, MgO between 9 and 22% and FeO between 4 and 9 wt %. Generally, chromium is low (<0.1 wt %) but some grains show higher values (0.1 to 0.8 wt%). Therefore, whereas most of the clinopyroxene represents diopside (enstatite-diopside), some grains represent chrome diopsides.
- The diopside grains were plotted on binary discriminant diagrams, mainly to know their geochemical affinity i.e to know whether they are formed by the crustal or mantle related processes. In $\text{Ca}/(\text{Ca}+\text{Mg})$ vs Na_2O diagram (after Morris et al., 1975), the grains define two clusters. These are (i) low calcic cluster - this cluster falls in area of non-kimberlitic diopsides and (ii) moderately-high calcic cluster. The latter cluster of chrome diopside grains falls either within or proximal to the area defined by kimberlitic and mantle xenocrystic (Fig. 15.8 & Table-15.6). This was again re-examined using another binary diagram that uses Al_2O_3 vs Cr_2O_3 space (Nixon & Boyd, 1973). In this diagram, some samples of chrome diopside falls in spinel- peridotite field. (Fig. 15.9 & Table-15.7)

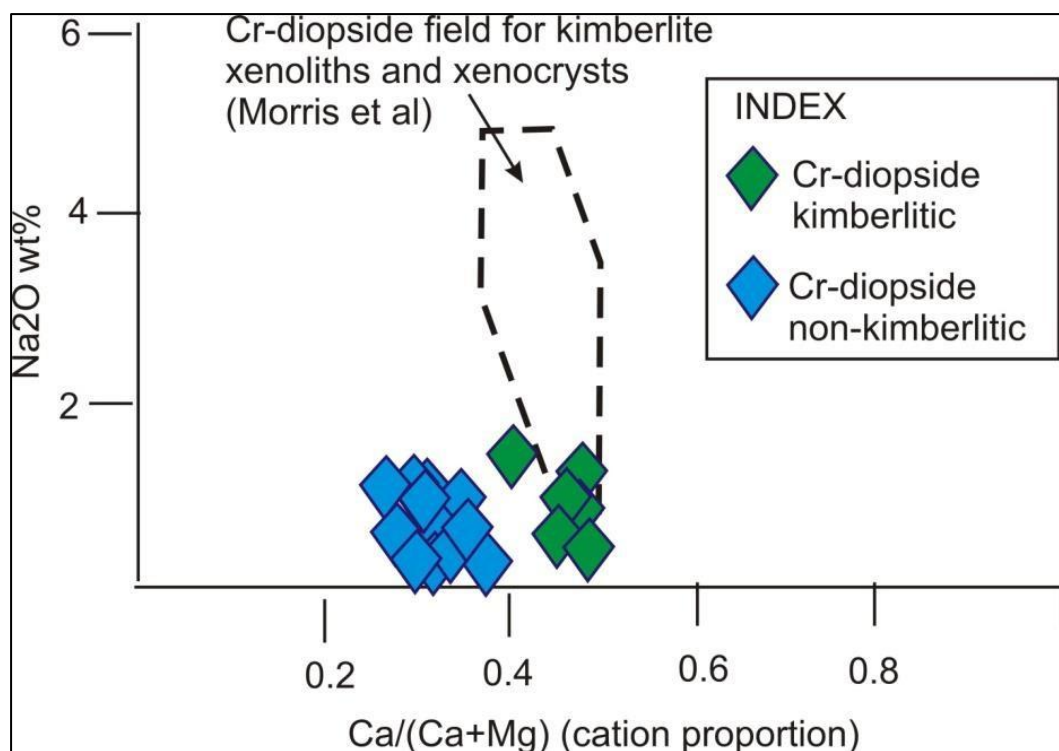


Fig. 15.8: $\text{Ca}/(\text{Ca}+\text{Mg})$ vs Na_2O Plot for diopside (after Morris et al., 1975)

Table no. 15.6 EPMA results of clinopyroxene for Ca/(Ca+Mg) vs Na2O Plot (after Moris et al., 1975)

Grain Name	S2-18_EM_2_12-2	S8-18_EM1_12	S4-18-EM-1-9-28	S4-18-EM-1-9-32	S4-18-EM-1-9-28_2	S4-18-EM-1-9-32_2
DataSet/Point	8 / 1 .	40 / 1 .	3 / 1 .	7 / 1 .		
SiO2	43.992	44.324	51.369	51.325	51.015	49.938
TiO2	0.04	0.515	0.443	0.444	0.432	0.59
Al2O3	13.43	11.009	3.962	3.504	3.347	2.965
Cr2O3	0.033	0.118	1.09	0.873	0.986	0.619
FeO	9.231	16.941	4.678	5.409	5.793	7.001
MnO	0.018	0.298	0.139	0.056	0.132	0.184
MgO	13.533	9.86	16.437	16.982	16.746	16.593
CaO	12.387	12.086	21.101	20.329	21.125	19.978
Na2O	1.365	1.3	0.369	0.259	0.264	0.463
K2O	0.688	1.275	0	0.03	0	0.076
F	0	0	0.172	0.295	0.029	0
P2O5	0.076	0.065	0.188	0.206	0.154	0.067
ZnO	0	0.013	0	0	0	0.077
NiO	0	0.072	0	0	0.051	0
V2O3	0	0.025	0.057	0.009	0.09	0.059
SrO	0	0	0	0	0	0
BaO	0	0	0.003	0	0	0
ZrO2	0	0	0.013	0	0	0
Total	94.792	97.901	100.023	99.721	100.163	98.608
Si	1.683	1.705	1.884	1.889	1.870	1.858
Ti	0.001	0.015	0.012	0.012	0.012	0.017
Al	0.605	0.499	0.171	0.152	0.145	0.130
Cr	0.001	0.004	0.032	0.025	0.029	0.018
Fe(ii)	0.295	0.545	0.143	0.166	0.178	0.218
Mn	0.001	0.010	0.004	0.002	0.004	0.006
Mg	0.772	0.565	0.899	0.932	0.915	0.920
Ca	0.508	0.498	0.829	0.802	0.830	0.796
Na	0.101	0.097	0.026	0.018	0.019	0.033
K	0.034	0.063	0.000	0.001	0.000	0.004
TOTAL	4	4	4	4	4	4
Endmembers						
Wo	32.307	30.969	44.213	42.165	43.092	41.095
En	49.116	35.158	47.926	49.015	47.535	47.497
Fs	18.577	33.872	7.860	8.819	9.373	11.409

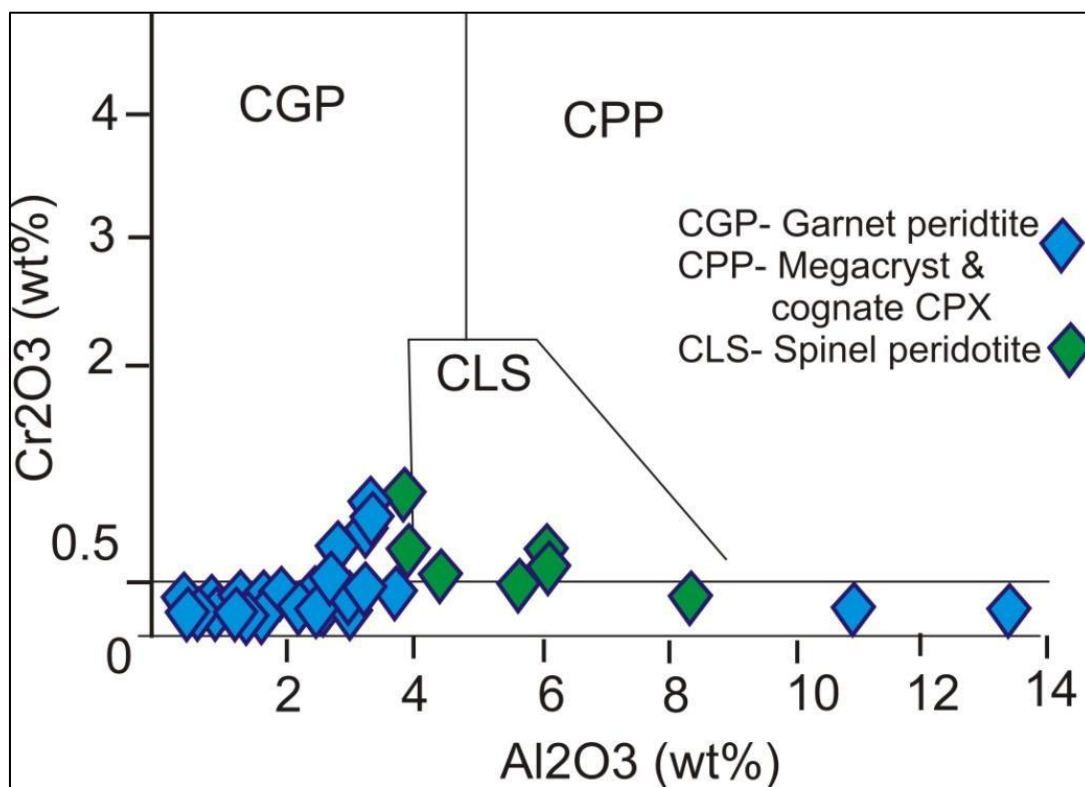


Fig 15.9: Al₂O₃ vs Cr₂O₃ Plot for diopside (after Nixon and Boyd, 1973)

Table no. 15.7 EPMA results of Spinel peridotite field - Al₂O₃ vs Cr₂O₃ Plot (Nixon and Boyd, 1973)

DataSet/Point	S2-18_EM2_10-35	S8-18_EM2_6-5	S8-18_EM2_14-3	S8-18_EM2_9-4	S8-18_EM2_9-4_repeat	S8-18_EM2_6-5A	S8-18_EM2_14-3A	S4-18_EM1_9-28	S4-18_EM1_11-2	S4-18_EM1_10-1
	10 / 1 .	5 / 1 .	11 / 1 .	15 / 1 .	22 / 1 .	37 / 1 .	38 / 1 .	3 / 1 .	5 / 1 .	10 / 1 .
SiO ₂	53.717	53.359	52.256	51.682	51.757	54.186	52.342	51.369	49.409	52.323
TiO ₂	0.034	0.146	0.143	0.075	0.102	0.078	0.091	0.443	0.121	0.064
Al ₂ O ₃	4.622	4.055	4.788	6.2	6.14	3.861	5.715	3.962	8.383	4.019
Cr ₂ O ₃	0.297	0.294	0.308	0.4	0.564	0.21	0.253	1.09	0.138	0.579
FeO	6.848	7.241	8.036	6.406	5.922	7.044	8.834	4.678	7.897	5.62
MnO	0.135	0.223	0.117	0.264	0.134	0.133	0.213	0.139	0.181	0.15
MgO	18.772	19.3	18.519	19.12	19.17	19.382	17.232	16.437	17.5	19.125
CaO	12.364	12.093	12.144	11.667	12.023	12.274	12.128	21.101	10.655	11.741
Na ₂ O	0.624	0.827	0.878	1.107	1.061	0.664	0.996	0.369	1.112	0.762
K ₂ O	0.073	0.05	0.053	0.098	0.123	0.106	0.036	0	0.203	0.084
Si	1.993	1.974	1.945	1.91	1.912	1.999	1.946	1.884	1.862	1.992
Ti	0.001	0.004	0.004	0.002	0.003	0.002	0.003	0.012	0.003	0.002
Al	0.202	0.177	0.21	0.27	0.267	0.168	0.25	0.171	0.372	0.18
Cr	0.009	0.009	0.009	0.012	0.016	0.006	0.007	0.032	0.004	0.017
Fe(ii)	0.212	0.224	0.25	0.198	0.183	0.217	0.275	0.143	0.249	0.179
Mn	0.004	0.007	0.004	0.008	0.004	0.004	0.007	0.004	0.006	0.005
Mg	1.038	1.064	1.028	1.054	1.056	1.066	0.955	0.899	0.983	1.085
Ca	0.492	0.479	0.484	0.462	0.476	0.485	0.483	0.829	0.43	0.479
Na	0.045	0.059	0.063	0.079	0.076	0.047	0.072	0.026	0.081	0.056
K	0.003	0.002	0.003	0.005	0.006	0.005	0.002	0	0.01	0.004
TOTAL	4	4	4	4	4	4	4	4	4	4
Endmembers										
Wo	28.097	26.984	27.409	26.826	27.677	27.333	28.062	44.213	25.785	27.365
En	59.362	59.928	58.164	61.176	61.410	60.063	55.485	47.926	58.933	62.029
Fs	12.541	13.088	14.426	11.998	10.913	12.604	16.453	7.860	15.282	10.607

The pyroxene grains were plotted on a pyroxene end-member ternary diagram (Fig. 15.10) to determine their geochemical affinity and to assess their possible crustal or mantle-derived origin. Based on the classification scheme of Fipke et al. (1989), 11 Cpx grains plot within the eclogitic diamond-inclusion field, indicating an eclogitic affinity. The calculated end-member compositions of these 11 Cpx grains are presented in Table 15.8.

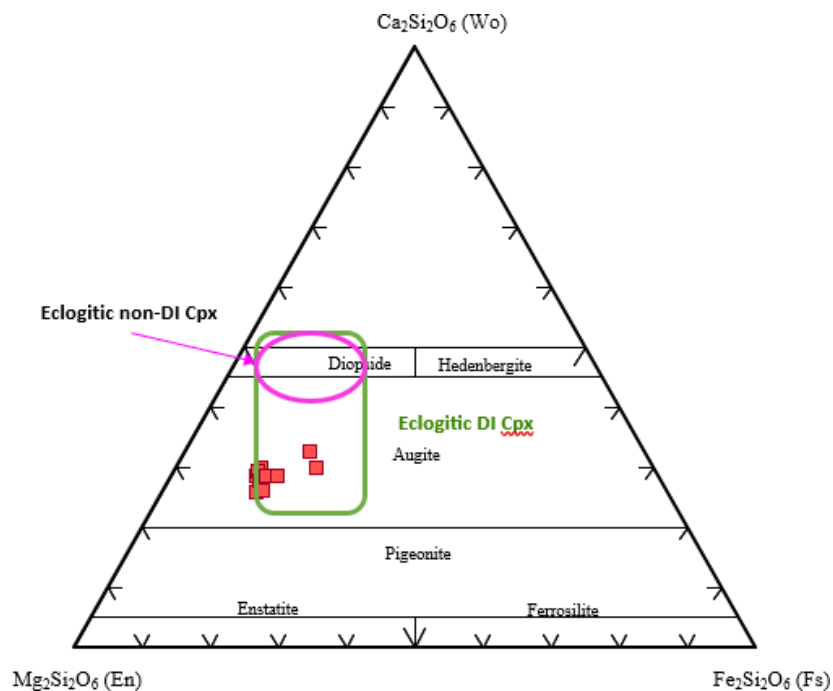


Fig 15.10. Triangular plot for clinopyroxenes showing Eclogitic Diamond inclusion field ((Fipke et al.,1989)

Table. 15.8 EPMA results of Cpx falling in Eclogitic Diamond inclusion field (Fipke et al., 1989)

Grain Name	S2- 18_EM3_9- 18	S2- 18_EM_2 12_1	S2- 18_EM_2 12_2	S8- 18_EM2 6-6	S8- 18_EM2 6-8	S8- 18_EM2 14-1	S8- 18_EM2 9-5	S8- 18_EM2 13-2	S8- 18_EM2_1 4-3A	S4- 18_EM1 11-2	S6- 18_EM1 3-1
Na2O	0.201	0.316	1.365	0.367	0.263	0.214	0.77	0.746	0.996	1.112	0.219
MgO	19.626	18.074	13.533	19.875	19.202	19	19.422	18.266	17.232	17.5	15.921
F	0.018	0.167	0	0.209	0	0	0.155	0.285	0.043	0	0.467
SiO2	56.73	56.815	43.992	56.26	56.417	55.011	53.622	53.723	52.342	49.409	54.722
Al2O3	0.657	2.28	13.43	0.997	1.022	1.833	2.704	3.371	5.715	8.383	1.767
P2O5	0.133	0.094	0.076	0.157	0.092	0.056	0.107	0.165	0.137	0.161	0.059
K2O	0.099	0.077	0.688	0.124	0.142	0.019	0.068	0.283	0.036	0.203	0.036
CaO	13.095	13.003	12.387	11.753	12.677	13.19	12.703	12.507	12.128	10.655	13.298
TiO2	0.051	0.05	0.04	0.001	0.1	0.038	0.116	0.072	0.091	0.121	0.044
FeO	7.639	7.27	9.231	8.309	8.349	7.334	8.162	8.029	8.834	7.897	12.181
MnO	0.113	0.413	0.018	0.276	0.249	0.259	0.231	0.226	0.213	0.181	0.412
ZnO	0	0	0	0	0	0	0.01	0	0.063	0	0.023
Cr2O3	0.003	0.032	0.033	0.181	0.021	0.036	0.078	0.223	0.253	0.138	0.01
NiO	0.154	0.107	0	0.068	0.167	0.074	0.129	0.1	0.093	0.112	0
V2O3	0.022	0	0	0.03	0	0	0	0.005	0.035	0.049	0
SrO	0	0	0	0	0	0	0	0	0	0	0
BaO	0.031	0	0	0.07	0	0.11	0	0	0	0.053	0.017
ZrO2	0	0	0	0.053	0	0	0	0	0.02	0.085	0
Total	98.573	98.699	94.792	98.731	98.701	97.175	98.278	98.001	98.231	96.059	99.176
Si	2.104	2.112	1.683	2.087	2.093	2.067	1.984	2.003	1.946	1.862	2.068
Ti	0.001	0.001	0.001	0.000	0.003	0.001	0.003	0.002	0.003	0.003	0.001
Al	0.029	0.100	0.605	0.044	0.045	0.081	0.118	0.148	0.250	0.372	0.079
Cr	0.000	0.001	0.001	0.005	0.001	0.001	0.002	0.007	0.007	0.004	0.000
Fe(ii)	0.237	0.226	0.295	0.258	0.259	0.230	0.252	0.250	0.275	0.249	0.385
Mn	0.004	0.013	0.001	0.009	0.008	0.008	0.007	0.007	0.007	0.006	0.013
Mg	1.085	1.002	0.772	1.099	1.062	1.064	1.071	1.015	0.955	0.983	0.897
Ca	0.520	0.518	0.508	0.467	0.504	0.531	0.503	0.500	0.483	0.430	0.538
Na	0.014	0.023	0.101	0.026	0.019	0.016	0.055	0.054	0.072	0.081	0.016

K	0.005	0.004	0.034	0.006	0.007	0.001	0.003	0.013	0.002	0.010	0.002
TOTAL	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000	4.000
Endmembers											
Wo	28.121	29.354	32.307	25.430	27.424	28.891	27.435	28.155	28.062	25.785	29.262
En	58.648	56.777	49.116	59.843	57.804	57.912	58.371	57.220	55.485	58.933	48.752
Fs	13.232	13.869	18.577	14.727	14.772	13.197	14.194	14.625	16.453	15.282	21.987

McCandless and Gurney (1989) proposed that eclogitic clinopyroxenes containing $K_2O > 0.08$ wt.% can be classified as Group I eclogites. Group I eclogites are closely related to diamondiferous eclogitic assemblages and are considered to represent high-pressure mantle-derived rocks. The occurrence of clinopyroxene with Group I eclogitic characteristics is therefore of particular significance in diamond exploration, as such compositions may indicate the presence of mantle-derived eclogitic material associated with diamond-bearing kimberlitic systems.

Among the 11 Cpx grains that fall within the eclogitic diamond-inclusion field of Fipke et al. (1989), six grains (Table 15.9) contain $K_2O > 0.08$ wt.% and consequently satisfy the compositional criterion for Group I eclogites of McCandless and Gurney (1989). The presence of six Group I eclogitic clinopyroxenes suggests a significant contribution from mantle-derived eclogitic assemblages and may have implications for evaluating the diamond potential.

Table 15.9 EPMA results of Group I eclogite Cpx given by McCandless and Gurney (1989)

Grain Name	S2-18_EM3_9-18	S2-18_EM_2_12_2	S8-18_EM2_6-6	S8_EM2_6-8	S8-18_EM2_13-2	S4-18_EM1_11-2
Na2O	0.201	1.365	0.367	0.263	0.746	1.112
MgO	19.626	13.533	19.875	19.202	18.266	17.5
F	0.018	0	0.209	0	0.285	0
SiO2	56.73	43.992	56.26	56.417	53.723	49.409
Al2O3	0.657	13.43	0.997	1.022	3.371	8.383
P2O5	0.133	0.076	0.157	0.092	0.165	0.161
K2O	0.099	0.688	0.124	0.142	0.283	0.203
CaO	13.095	12.387	11.753	12.677	12.507	10.655
TiO2	0.051	0.04	0.001	0.1	0.072	0.121
FeO	7.639	9.231	8.309	8.349	8.029	7.897
MnO	0.113	0.018	0.276	0.249	0.226	0.181
ZnO	0	0	0	0	0	0
Cr2O3	0.003	0.033	0.181	0.021	0.223	0.138
NiO	0.154	0	0.068	0.167	0.1	0.112
V2O3	0.022	0	0.03	0	0.005	0.049
SrO	0	0	0	0	0	0
BaO	0.031	0	0.07	0	0	0.053
ZrO2	0	0	0.053	0	0	0.085
Total	98.573	94.792	98.731	98.701	98.001	96.059
Si	2.104	1.683	2.087	2.093	2.003	1.862
Ti	0.001	0.001	0.000	0.003	0.002	0.003
Al	0.029	0.605	0.044	0.045	0.148	0.372
Cr	0.000	0.001	0.005	0.001	0.007	0.004
Fe(ii)	0.237	0.295	0.258	0.259	0.250	0.249
Mn	0.004	0.001	0.009	0.008	0.007	0.006
Mg	1.085	0.772	1.099	1.062	1.015	0.983
Ca	0.520	0.508	0.467	0.504	0.500	0.430
Na	0.014	0.101	0.026	0.019	0.054	0.081
K	0.005	0.034	0.006	0.007	0.013	0.010
TOTAL	4.000	4.000	4.000	4.000	4.000	4.000
Endmembers						
Wo	28.121	32.307	25.430	27.424	28.155	25.785
En	58.648	49.116	59.843	57.804	57.220	58.933
Fs	13.232	18.577	14.727	14.772	14.625	15.282

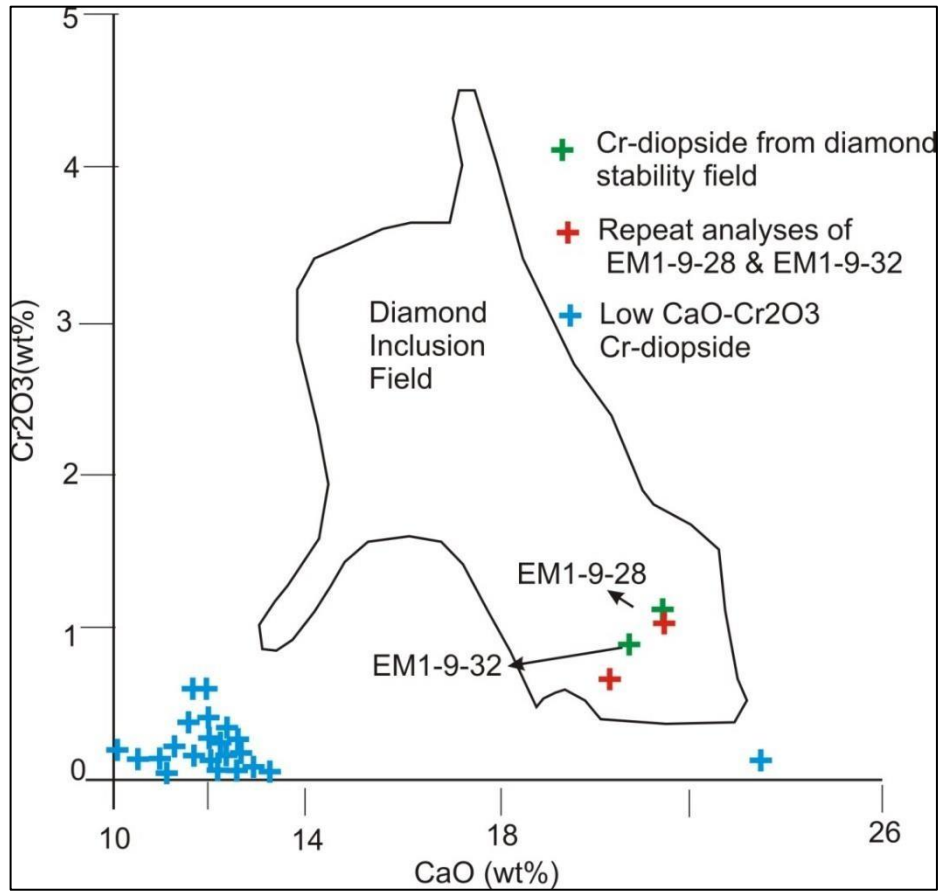


Fig. 15.11: CaO vs Cr₂O₃ Plot (after Boyd et al., 1984)

The CaO vs Cr₂O₃ diagram (Boyd et al., 1984) that identifies chrome diopsides of diamond stability field was used here to know whether the chrome diopside of the study area shows any affinity to those formed in diamond stability field. This discriminant diagram, highlighting the diamond inclusion field where mantle-derived chrome diopsides equilibrated under diamond-stable conditions. Two grains (EM-1-9-28 & EM1-9-32) are plotted in diamond stability field (Fig. 15.11). These two grains were re-analysed to confirm the chemistry. The re-analyzed grains also plotted in diamond stability field. Thus, clearly attesting formation of these two grains within the diamond stability field.

Table 15.10 presents the details of clinopyroxene samples of mantle paragenesis, including their respective borehole numbers and depths of recovery.

Table no. 15.10 BH Details of Clinopyroxenes Grains Showing Mantle Paragenesis

Field of Plot	Grain Number	BH	Core Depth(m)	Total
Kimberlitic Cr-Diopside	S2-18_EM2_12-2	MGLBH03	21.5-25.5	18 Grains
	S8-18_EM1_12			
	S4-18_EM1_9-28	MGLBH06	4-10	
	S4-18_EM1_9-32			
Spinel Peridotite	S8-18_EM2_14-3	MGLBH01	4-12	
	S4-18_EM1_11-2	MGLBH03	12-21.5	
	S4-18_EM1_10-1	MGLBH03	9-12	
	S2-18_EM2_10-35			
	S8-18_EM2_6-5	MGLBH04	10-19	
	S8-18_EM2_9-4	MGLBH06	4-10	
	S4-18_EM1_9-28			
Diamond Stability Field	S4-18_EM1_9-28	MGLBH06	4-10	
	S4-18_EM1_9-32			
Eclogitic DI Cpx	S8-18_EM2_14-3A	MGLBH01	4-12	
	S8-18_EM2_14-1			
	S4-18_EM1_11-2	MGLBH03	12-21.5	
	S2-18_EM2_12-1		21.5-25.5	
	S2-18_EM2_12-2			
	S8_EM2_13-2		25.5-36	
	S8-18_EM2_6-6	MGLBH04	10-19	
	S8-18_EM2_6-8			
	S6-18_EM1_3-1	MGLBH05	3.5-10	
	S8-18_EM2_9-5	MGLBH06	4-10	
	S2-18_EM3_9-18	MGLBH06		
Group I Mantle Eclogite	S4-18_EM1_11-2	MGLBH03	12-21.5	
	S2-18_EM2_12-2		21.5-25.5	
	S8_EM2_13-2		25.5-36	
	S8-18_EM2_6-6	MGLBH04	10-19	
	S8-18_EM2_6-8			
	S2-18_EM3_9-18	MGLBH06	4-10	

Ilmenite: Opaques constitute a significant proportion of the detrital assemblage. However, distinguishing the opaque grains from Fe-hydroxide coatings was difficult; consequently, only four grains could be confidently identified and analyzed as ilmenite. These ilmenite grains are characterized by very low Cr_2O_3 contents (<0.05 wt.%). When plotted on the MgO versus TiO_2 discrimination diagram of Haggerty (1975), all four analyzed ilmenite grains fall within the high-Ti trend, plotting above the non-kimberlitic field. (Fig. 15.12).

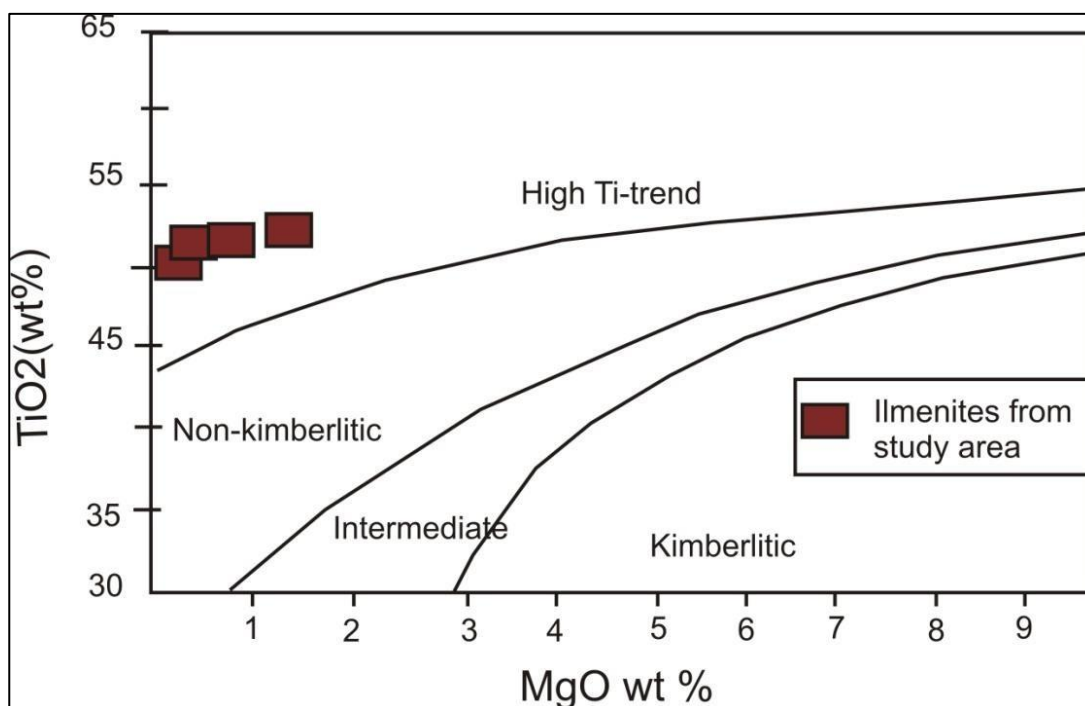


Fig. 15.12: MgO vs TiO_2 Plot for Ilmenites (after Haggerty, 1975)

In summary, the Krishna River palaeo-channel detritus is dominated by crustal garnets, pyroxenes and a few ilmenites. The presence of **mantle-derived garnets and chrome diopsides provides compelling evidence of diamondiferous mantle sampling**. This justifies advancing to the next stage of exploration, combining geophysical prospecting with mineral chemistry to locate sub-surface sand-gravel beds and primary kimberlite sources.

Salient Points

Reid et al., 1976, Robinson et al., 1984, McCandless and Gurney, 1989 etc noted that Group-1 mantle eclogites (diamondiferous) have K_2O enriched clinopyroxenes and Na_2O enriched garnets. Globally and regionally (such as the nearby Jaggayyapeta and Ramannapeta lamproites), lamproitic intrusions frequently carry strong eclogitic xenocryst/xenolith suites rather than purely peridotitic suites. Group-I mantle eclogites are exceptionally diamond-fertile host rocks (Jaques et al., 1986 & Mitchell and Bergman,

1991, Reddy et al., 2003, Chalapathi Rao et al., 2004, Sridhar and Rau, 2005).

EPMA data from Mangalagiri Block

EPMA data suggests that the indicator mineral suite from Mangalagiri block contains both mantle peridotitic indicators and Group-I eclogitic indicators. The peridotitic signals are manifested by the presence of 7 cpx grains plotted in the spinel-peridotite field (Fig. 15.9) (Nixon & Boyd, 1973) representing upper, shallower lithospheric mantle rocks entrained during magma ascent. Four cpx EPMA values fall in Cr-diopside kimberlitic field (Fig. 15.8) (Morris et al., 1975), in which 2 grains represent deep, high-pressure, diamond-stable peridotitic mantle environments (Fig. 15.11) (Boyd et al., 1984). Among the peridotitic cpx mentioned above, six are K-rich in which K₂O $\geq 0.08\%$ with an avg. of 0.413%.

Whereas the Group-1 eclogitic indicators are well revealed in the Mangalagiri gravel beds by 15 Na-rich almandine-dominant garnets with $\geq 0.07\%$ Na₂O (Fipke et al., 1989 and McCandless and Gurney, 1989, Fig.15.6) having average Na₂O concentration 0.101%. Suggesting primary source pipe tapped a lithospherically diverse, highly fertile mantle column. Further, eclogitic garnets are also represented by 13 G4-field garnets (Fig. 15.5) (Schultz, 1999). Among these, 2 garnets are overlapping known as G4D garnets (Grutter et al., 2004) that carry elevated sodium (Na₂O ≥ 0.07 wt%), explicitly marking them as Group-1 diamondiferous eclogitic garnets formed at ultra-high pressures (≥ 5 GPa). In the MgO-FeO-CaO plot for garnets by Dawson & Stephen, 1975, forty values are plotted in the Cluster-5 field representing Fe-rich Eclogite (Fig.15.7). The triangular plot of Wo-En-Fs by Fipke et al., 1989 was tried and found that 11 cpx values are falling in the Eclogitic Diamond Inclusion Cpx field (Fig. 15.10). And 6 of these 11 have K₂O more than 0.08%. High potassium in clinopyroxenes and high sodium in garnets serve as a robust chemical fingerprint pointing toward deep-seated mantle roots, suggesting that the paleo-channel system has tapped a fertile, diamond-associated source region (McCandless & Gurney, 1989).

KLF Host Rocks vs. Mangalagiri KIMs

Comparing EPMA data from primary KLF rocks to the KIM EPMA dataset from the Mangalagiri block reveals distinct chemical differences: Pyroxenes analyzed directly from the KLF lamproites represent phenocryst/groundmass diopside. But xenocrystic Cr-diopsides crossing the > 0.08 wt% K₂O threshold (indicative of sublithospheric

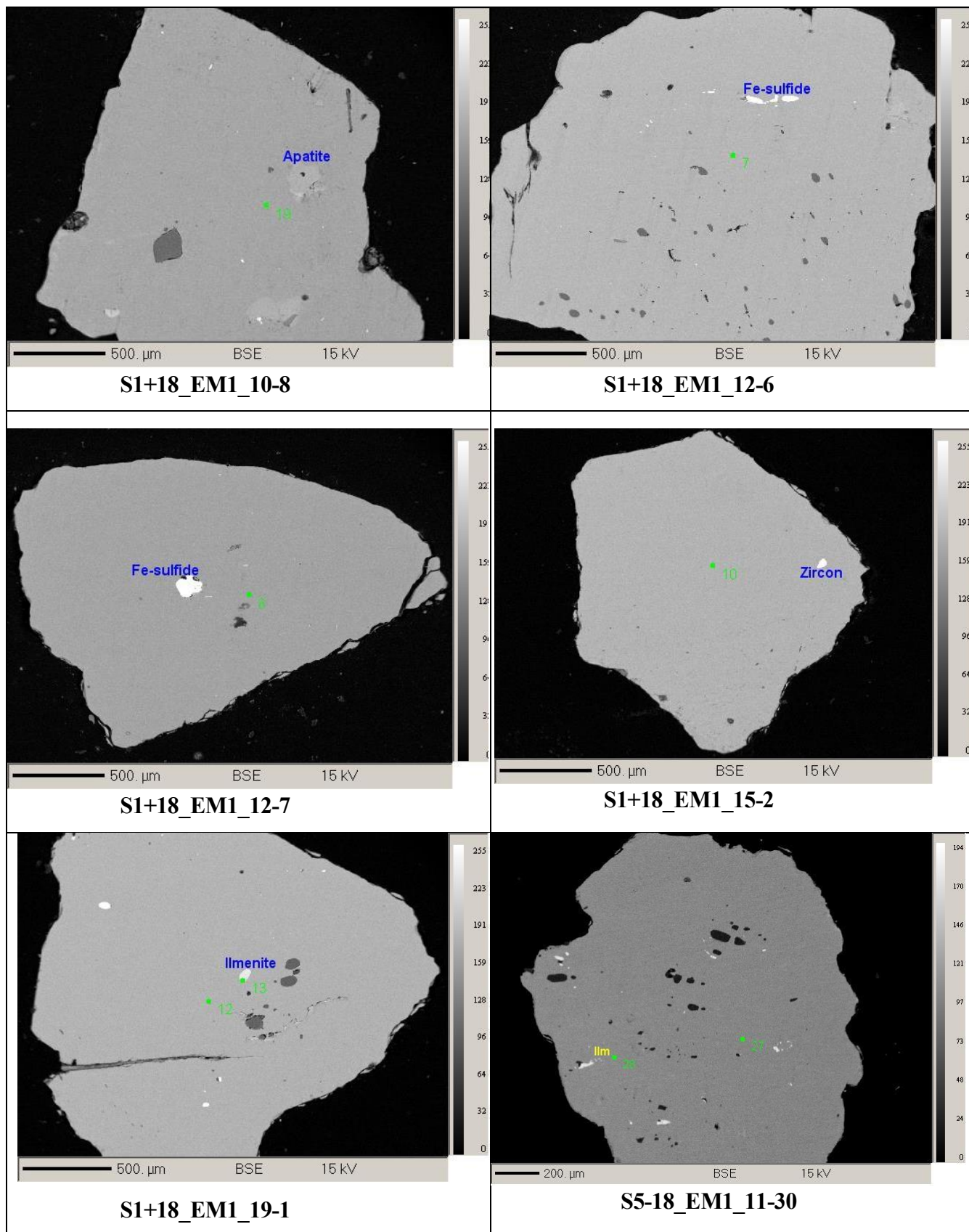
Group-1 mantle eclogite) are essentially absent or extremely rare. The garnet data pertaining to KLF is dominated by peridotitic pyropes (G9/G11 series) derived from magnesium-rich mantle peridotite. High-sodium, Group-1 eclogitic garnets are rare or virtually absent in those host rocks (Ravi and Sufija, 2012; Nayak et al., 2001, Chalapathi Rao et al., 2004, Paul et al., 2007).

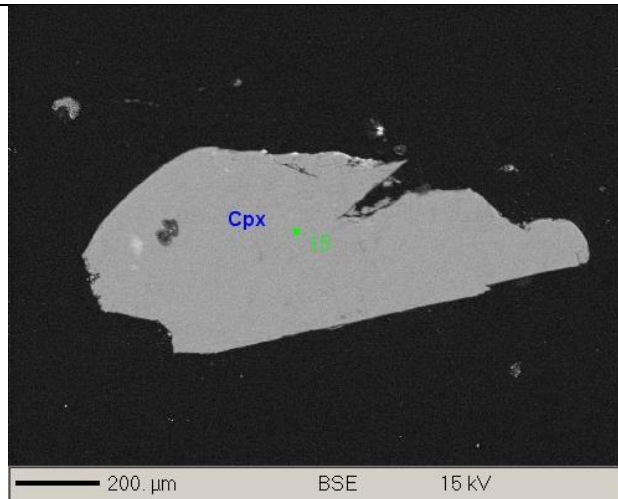
In Conclusion, the reported KLF lamproites are geochemically distinct from the Mangalagiri Kimberlite Indicator Mineral (KIM) suite. The distinct geochemical signatures between the two suites suggest that the reported Krishna Lamproite Field (KLF) bodies are likely not the primary source host rocks for the Mangalagiri Kimberlite Indicator Minerals (KIMs). Ravi et al., 2009 documents the recovery of diamonds and mantle indicator minerals as *E*-type and *P*-type phases directly from the alluvial gravels around Paritala and the lower Krishna basin.

While primary exposed lamproites of the Krishna Lamproite Field (KLF) have historically been documented as non-diamondiferous or depleted in deep mantle xenocrysts (Nayak et al., 2001; Chalapathi Rao et al., 2004; GSI, 2006), the surrounding Krishna alluvial tract is well known for hosting diamondiferous gravels (Ravi et al., 2009). The discovery of bimodal mantle indicator suites (*G4D* garnets, K-rich Cpx, and diamond-stability Cr-diopsides) in the Mangalagiri block suggests either a previously unmapped, concealed diamondiferous primary host rock in proximity.

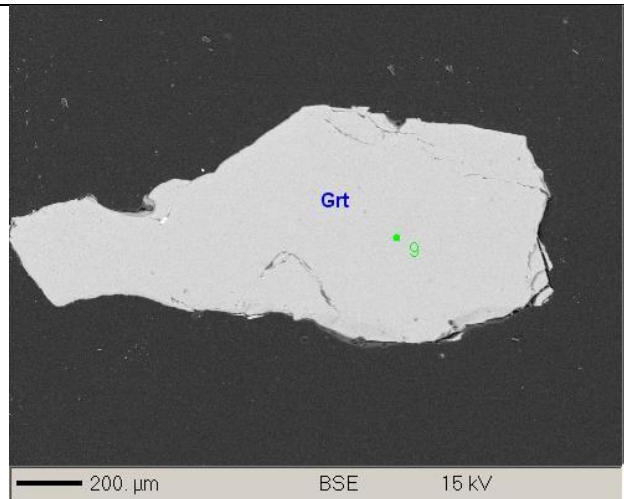
Based on the monograph “*Diamond Fields of Southern India*”, GSI Bulletin Series A No. 68 by Ravi et al., 2018, several authors (S.S. Nayak, K.S. Bhaskara Rao, S.V. Satyanarayana etc) proposed buried or concealed host rocks in and around the Paritala–Kolleru tract. Regional diamond transport via the Krishna River drainage system is a recognized factor, the authors argued that the localized concentration, size, and quality of diamonds in the Paritala–Nuzvid–Kolluru alluvial tract strongly point to proximal, blind, or concealed primary sources (lamproites/kimberlites) hidden beneath the Proterozoic/Gondwana cover, Tertiary strata, or thick Quaternary alluvium.

Plate: 10 BSE images

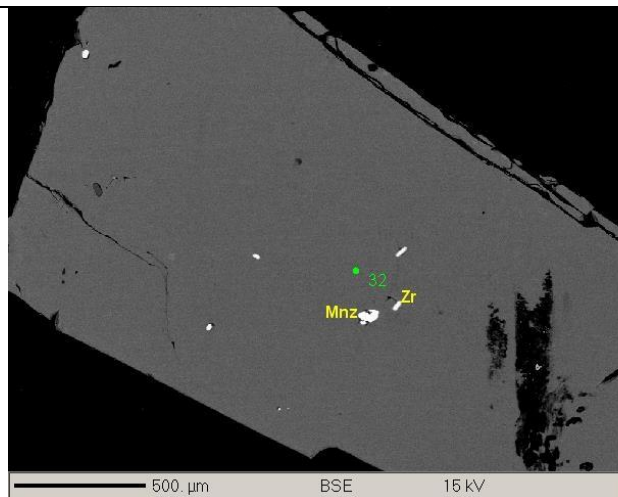




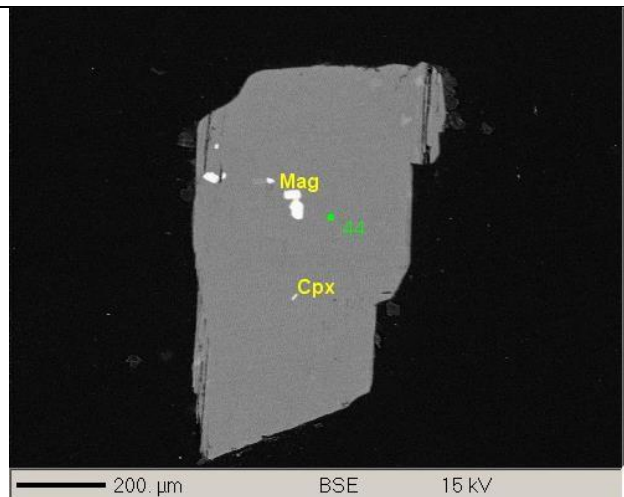
S2-18_EM2_17-3



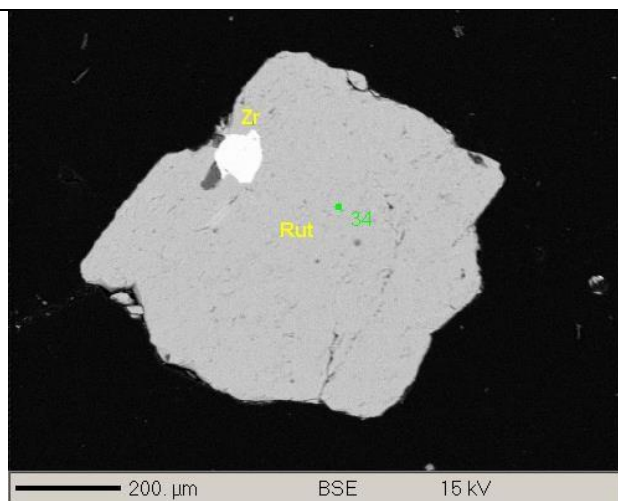
S2-18_EM2_11-6



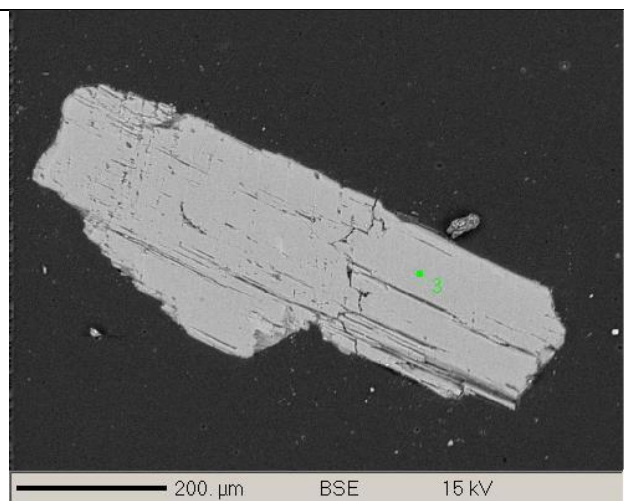
S5-18_EM1_11-39



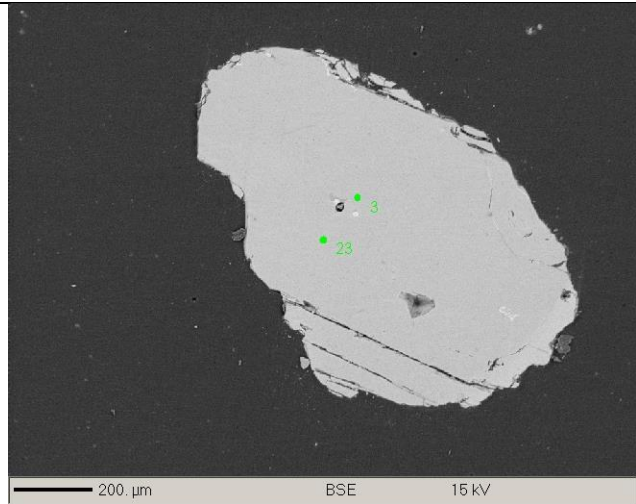
S3-18_EM1_5-36



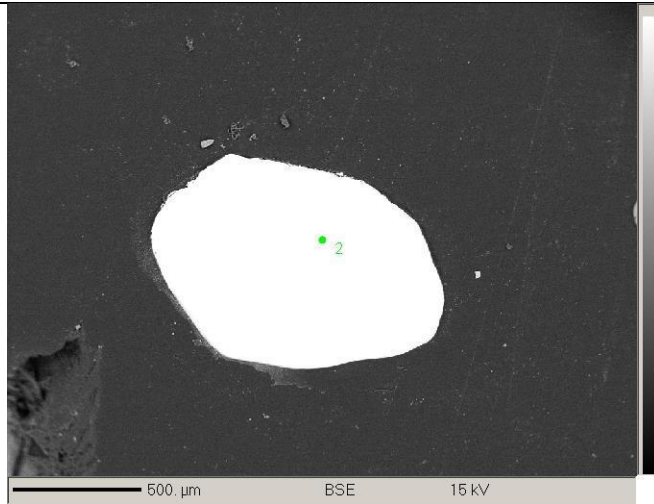
S3-18_EM3_8-7



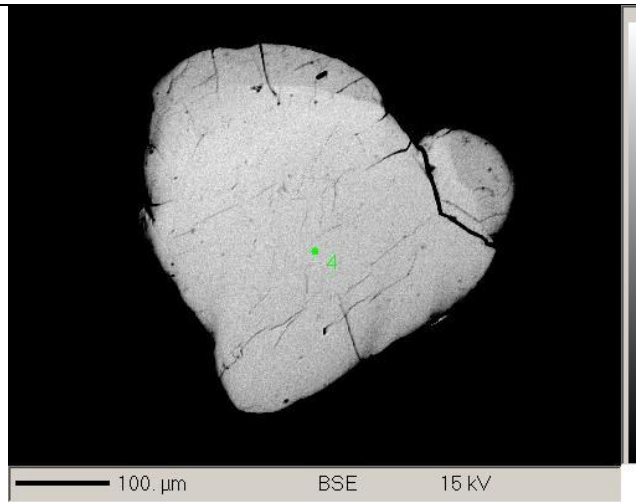
S8-18_EM2_6-3



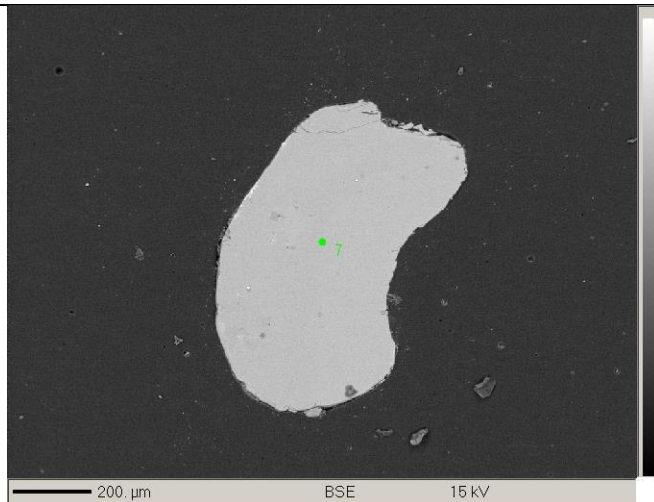
S4-18_EM1_9-8



S2-18_EM3_4-1



S8-18_EM2_6-4



S4-18_EM1_9-32

CHAPTER 16. QUALITY OF ASSAY DATA AND LABORATORY TESTS

16.1 The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.

In the current project, heavy minerals including diamond and associated KIMs are expected in the gravel/sand zones. Which are separated through systematic sub sampling procedures, followed by two level magnetic and gravity, Electro-magnetic separation methodology as well as intensive microscopic studies. The sample processing and magnetic separation is carried out as per standard SOP of GSI.

Petrographic studies and EPMA has been carried out at Petrological lab, GSI, Hyderabad.

The objective of the project not demanded any chemical analysis (XRF/ICPMS) at the current stage of exploration.

16.2 Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.

Since there is no chemical analysis/assaying, this is not applicable.

16.3 Check analysis of at least 10% of samples may be analyzed from third party NABL accredited/or department of science & technology (DST)/BIS recognized laboratories or government laboratories for assessing the acceptable levels of accuracy.

The section is not applicable.

CHAPTER 17. MOISTURE

17.1 Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.

The objective of the current project is not demanding the resource estimation, hence the moisture content not relevant.

CHAPTER 18. BULK DENSITY

18.1 Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.

Not applicable

CHAPTER 19. BENEFICIATION STUDIES AS MAY BE REQUIRED

19.1 Details of beneficiation studies carried out at laboratory scale of bench scale involving bulk sampling tests to understand and suggest technological factors for optimum recovery of explored mineral commodity, any additional by-products or co-products that may be available in the ore which is recoverable should also be discussed. The detailed flow sheet with yield recovery factors and to be discussed.

Not Applicable

CHAPTER 20. RESOURCE ESTIMATION TECHNIQUES & REPORTING OF RESOURCE

During the current G4 level exploration only 7 scout boreholes were drilled and alluvial diamonds were not recovered; hence resource estimation for diamond is not carried out. Even though estimation of volume of sand-gravel beds based on the geophysical and borehole data were attempted and given below.

20.1 Estimated gravel volume using borehole data

The volume of gravel is calculated by multiplying the designated area by the layer's thickness ($V = A \times t$). To determine the area, we use the formula for a circle, $A = \pi r^2$, where the radius (r) is derived from seismic data. Specifically, the radius is defined as half of the total diameter, which is established by the distance between the geophones that define the slope on the hodograph. This slope on the hodograph is critical, as it directly represents the seismic velocity of the gravel layer, and the distance across the geophones contributing to this slope provides the full diameter measurement used for the calculation and the estimated gravel volume shown in Table 20.1

Table 20.1 Estimated gravel volume using borehole data

Si. No	Bore hole	Borehole Location		Gravel Depth (m)		Velocity Range 830-875 (m/s)	Area (m ²) $A = \pi r^2$	Volume (m ³) $V=A \times t$
		Latitude	Longitude	From	To			
1	BH-01	16°25'46.44"N	80°38'20.13"E	17	24.5	846	19.625	147.189
2	BH-02	16°26'46.85"N	80°37'31.92"E	8	11	833.3	314	942
				18	19.5		314	471
3	BH-03	16°24'51.55"N	80°38'41.65"E	13.5	17	852.9	12.56	43.96
				25.3	27.8	852.9	12.56	31.4
				29	36	852.9	12.56	87.92
4	BH-04	16°24'49.21"N	80°38'14.41"E	7	9	843.2	19.625	39.25
				19	39	872.6	78.5	1570
5	BH-05	16°25'1.66"N	80°36'32.02"E	10	18.6	859.1	176.625	1518.98
6	BH-06	16°24'51.88"N	80°36'13.67"E	10	19	878	78.5	706.5
7	BH-07	16°25'50.34"N	80°37'25.70"E	11	17.5	831.9	19.625	127.56

CHAPTER 21. SUMMARY & RECOMMENDATIONS

Summary

1. Integrated geophysical profiling (VES, resistivity profiling, and seismic refraction) effectively mapped different subsurface profiles, identifying buried paleo-channel sediment disposition and tracking discontinuous gravel-bearing paleochannel pockets beneath a cover of black cotton soil and alluvium within the Mangalagiri block.
2. Scout core drilling (301 m across 7 boreholes) confirmed the presence of fine to very coarse sand and gravel beds resting at depths of 5 m to 40 m, corroborating the predictive geophysical anomalies for paleo-alluvial deposition in the region. Based on the borehole data, the seismic logs were reinterpreted and velocity ranges were assigned to each lithology of the area.
3. The coarser fractions ($>2.5\text{mm}$) were thoroughly scanned by naked eye and suspected minerals (transparent, translucent, coloured etc) were hand-picked and tested in bromoform. However, this was not yielded any heavy mineral. Therefore, gem testing was not necessitated.
4. The Krishna River palaeo-channel heavy detritus is dominated by garnets, pyroxenes and opaques with a little amphiboles, rutile etc. The opaques include magnetite, ilmenite, iron-oxides and others. EPMA studies were mainly focused on garnets and pyroxenes. In addition, a few opaques were also studied are turned out to be crustal ilmenites and iron oxides.
5. Garnets of mantle eclogitic paragenesis and clino-pyroxenes pertaining to peridotitic and eclogitic origin are reported from EPMA data. Among clino-pyroxenes (cpx), two Cr-diopsides are falling within the diamond stability of Boyd et al., 1984 provides compelling evidence of diamondiferous mantle sampling. Apart from opaques, 93 garnets and 39 pyroxenes were analysed using EPMA. Out of total 132 analysis of garnets and pyroxenes, about 43% are of mantle paragenesis. Further, the eclogitic garnets are present in six boreholes out of seven and cpx of mantle paragenesis are retrieved from five boreholes and reported within 3m and 36m core depth suggesting KIMs are distributed both spatially and temporally covering most part of the exploration block.

6. The reported non-diamondiferous lamproites of Krishna Lamproite Field (KLF) are geochemically distinct from the Mangalagiri Kimberlite Indicator Mineral (KIM) suite. The distinct geochemical signatures between the two suites suggest that the reported Krishna Lamproite Field (KLF) bodies are likely not the primary source host rocks for the Mangalagiri Kimberlite Indicator Minerals (KIMs).

Recommendations

1. The exposed lamproites of the (KLF) have historically been documented as non-diamondiferous or depleted in deep mantle xenocrysts. The surrounding Krishna alluvial tract is historically well known for hosting diamondiferous gravels. The presence of mantle indicator suites such as eclogitic garnets and clino-pyroxenes (especially diamond stability field Cr-diopsides) in the Mangalagiri block suggests either a previously unmapped, concealed diamondiferous primary host rock in proximity which may be brought to light by high resolution drone magnetic and EM surveys within about 50km radius.
2. Bulk sampling weighing up to 300-500 tons may be carried out from shallow potential zones within Mangalagiri block and studied for diamond and KIMs.
3. The Mangalagiri block and its upstream and downstream areas may be subjected to systematic drilling to bring out the 3D Model of sand-gravel beds, presence of diamonds and KIMs.

REFERENCE

Boyd, F.R., Nixon, P.H., and Meyer, H.O.A. (1984). Geochemistry of chrome diopside inclusions from diamonds and their relation to the diamond stability field. *Contributions to Mineralogy and Petrology*, 85(2), 174–187.

B.Kriahna Rao, J.S.Ramaiah,P.B Murthy and S.R Swamy (1993), Studies on Heavy Minerals in the Krishna river basin,Dept, of Geology, Andhra University, Vishakapatnam,Jout. Indian Association of Sedimentologists, Vol.12, pp79-78.

G Lakshminarayana,T. Rajakumar, Traverse Geological Mapping Of The Upper Gondwana And Tertiary Formations In Krishna Sub-Basin, In Parts Of Guntur And Prakasam Districts, Andhra Pradesh, Geological Survey Of India, , Unpub. Geol. Surv. Ind. Reports.

Gabbrosoft, <https://www.gabbrosoft.org/>

Huntec Ltd., Toronto Operational manual for F.C.3 Fascimile Seismograph

Haggerty, S.E. (1975). The chemistry and genesis of ilmenite in kimberlites. *Physics and Chemistry of the Earth*, 9, 295–307.

J. Nageshwara Rao,1978, Report On The Systematic Study Of Quarternary Formations And Geomorphology Of The Plains On The Right Bank Of Krishna River Between Pondugala And Undavalli, Guntur District, Andhra Pradesh, Geological Survey Of India, , Unpub. Geol. Surv. Ind. Reports.

J. Nageswara Rao,1981, Report on The Study of Quaternary Formations and Geomorphology of The Western Krishna Delta Between Revendrapadu And Tsundur, Guntur District, Andhra Pradesh, Geological Survey Of India, Unpub. Geol. Surv. Ind. Reports.

K. Nageswara Rao, P. Subraelu, K. Ch. V. Nagakumar, G. Demudu, B. Hema Malini, A. S. Rajawat and Ajai, 2012, Geomorphological implications of the basement structure in the Krishna-Godavari deltas, India, *Zeitschrift für Geomorphologie* Vol. 57,1, 25–44, 2013.

K R Subrahma,(2006), Origin And Evolution Of The West Coast Of India, *Jour Geol Soc India* Vol 67.

M.Balakrishnan, K. Raghuramaiah (2004), Seismic microzonation studies of Visakhapatnam and its urban agglomeration, Andhra Pradesh- Unpublished report of Geophysical division, GSI, SR, Hyderabad.

M.J. Viljoen, (2006), Alluvial Diamonds In South Africa *Geol Soc India* Vol 67.

McCandless, T.E., & Gurney, J.J. (1989). Sodium in garnet and potassium in clinopyroxene: Criteria for classifying mantle eclogite. In J. Ross (Ed.), *Kimberlites and related rocks: Vol. 2, Their mantle/crust setting and diamond exploration*. Geological Society of Australia Special Publication No. 11, pp. 827–832.

Morris, D., Moore, R.O., and Reid, A.M. (1975). “Diopside chemistry as a discriminant in kimberlite petrology.” *Contributions to Mineralogy and Petrology*, Vol. 52, pp. 1–16. This is the source of the $\text{Ca}/(\text{Ca}+\text{Mg})$ vs Na_2O discriminant diagram widely used in kimberlite exploration.

Nixon, P.H. and Boyd, F.R., 1973. Petrogenesis of kimberlites and related rocks. *Geological Society of America Memoir*, 136, pp.48–76.

Nageswara Rao, K. (1988): Mapping of lineaments and morphostructures from air photos in Krishna delta, India. – *Indian Jour. Landscape Systems and Ecological Studies* 11: 37– 41.

Ravi Bastial, Prasanta Nayak1, and Pankaj Singh1,(2007), Shelf Delta to Deepwater Basin: A Depositional Model for Krishna-Godavari Basin, extended abstract prepared for presentation at AAPG International Conference, Perth, West Australia.

R- 6B Recording Oscillograph, Operating and maintenance manual, Houston Texas.

Schulze, D.J. (1999). Constraints on the origin of garnet in kimberlites and their use in diamond exploration. *Lithos*, 48(3–4), 189–202. [https://doi.org/10.1016/S0024-4937\(99\)00026-0](https://doi.org/10.1016/S0024-4937(99)00026-0) ([doi.org in Bing](https://doi.org/10.1016/S0024-4937(99)00026-0)).

Shri.P. R. Chandra Geologist, P. N. Chakravarty & Dr. M.Ramamurthy, ,(1982), Status Report On The Offshore Diamond Investigation, Andhra Pradesh, Geological Survey Of India, Unpub. Geol. Surv. Ind. Reports.

Shanmugam G (2018), A Global Satellite Survey Of Density Plumes At River Mouths And At Other Environments: Plume Configurations, External Controls, And Implications For Deep-Water Sedimentation, *Petroleum Exploration And Development* Volume 45, Issue 4, August 2018.

T. Madhusudhana Rao, (1959), *Geology Of Parts Of Guntur, Narasaraopet, Tenali Taluks, And Mangalagiri Sub-Taluk, Guntur District, Andhra Pradesh*, Geological Survey Of India, , Unpub. Geol. Surv. Ind. Reports.

V. Singa Raju, And K.S. Bhaskara Rao,(2004), Sedimentological, Geomorphological And Heavy Mineral Studies Of Mallavalli Area, Krishna District, Andhra Pradesh, Geological Survey Of India, , Unpub. Geol. Surv. Ind. Reports.

V.Anil Kumar, T.Desapati, A.V. Subramaniam, R.D, Deshmukh, G.Viswanathan. (2005), Discovery of microdiamonds in the beach placers of East Coast, Andhrapradesh,India,Current Science, Vol.88, No.8.

Bluck, B. J., Ward, J. D., de Wit, M. C. J., & Frimmel, H. E. (2005). *Diamonds in the Orange River: A possible link between the Kaapvaal Craton and the Atlantic coast of southern Africa*, South African Journal of Geology, 108, 1–16.

Chalapathi Rao, N. V., Miller, J. A., Pyle, D. M., & Madhavan, V. (2004). New $^{40}\text{Ar}/^{39}\text{Ar}$ ages and geochemical data for kimberlites and lamproites from the Eastern Dharwar Craton, southern India: Implications for the timing of craton-wide alkaline magmatism. *Journal of the Geological Society of London*, Vol. 161(4), pp. 601–612.

Dawson, J.B. and Stephens, W.E., 1975. Statistical classification of garnets from kimberlites and associated xenoliths. *The Journal of Geology*, 83(5), pp.589–607. <https://doi.org/10.1086/628143>

Fipke, C.E., Gurney, J.J., Moore, R.O., and Nassichuk, W.W., 1989. *The Development of Advanced Technology to Distinguish Between Diamondiferous and Barren Diatremes*. Geological Survey of Canada, Open File 2124, 1175 p.

Grutter, H.S., Gurney, J.J., Menzies, A.H., Winter, F., 2004. An updated classification scheme for mantle-derived garnet, for use by diamond explorers. *Lithos* 77, 841–857.

Jaques, A. L., Lewis, J. D., & Smith, C. B. (1986). The Kimberlites and Lamproites of Western Australia. Geological Survey of Western Australia, Bulletin 132, 268 p.

Mitchell, R. H., & Bergman, S. C. (1991). *Petrology of Lamproites*. Plenum Press, New York, 447 p.

Nayak, S. S., Rao, K. S., Satyanarayana, S. V., & Roy, A. (2001). “Discovery of new lamproite field in Krishna district, Andhra Pradesh.” *Journal of the Geological Society of India*, Vol. 58(5), pp. 421–425.

Paul, D. K., Crocket, J. H., & Reddy, T. A. K. (2007). Petrology and geochemistry of Proterozoic lamproites from the Krishna district, Andhra Pradesh, India. *Journal of the Geological Society of India*, 69(3), 513–526.

Ravi, S., Bhaskar Rao, Y. J., & Waheed, A. (2009). Indicator mineral chemistry and micro-diamond processing of gravels in the lower Krishna river basin, Andhra Pradesh. Publication: Memoir of the Geological Society of India, Vol. 75, pp. 215–230.

Ravi.S., and Sufija.M.V., 2012. Characterization of Sub-Continental Lithospheric Mantle (SCLM) of Dharwar Craton by studies on the Kimberlites/Lamproites- their xenoliths, xenocrysts and diamonds. GSI Field Season Report (2010-2012).

Reid, A.M., Brown, R.W., Dawson, J.B., Whitfield, G.G., and Siebert, J.C. 1976. Garnet and Clinopyroxene compositions in some diamondiferous eclogites. Contr. Mineralogy Petrology, 58, pp.203-220.

Robinson, D.N., Gurney, J.J., and Shee, S.R. 1984. Diamond eclogite and graphite eclogite xenoliths from Orapa, Botswana. In Kornprobst, J. Ed. Kimberlites II: The mantle and Crust-mantle relationships. Developments in Petrology IIB, Elsevier, New York, pp. 11-24.

Reddy, T. A. K., Sridhar, M., Ravi, S., & Bhaskar Rao, K. S. (2003). Petrology and geochemistry of the Krishna Lamproite Field, Andhra Pradesh. Journal of the Geological Society of India, Vol. 61(2), pp. 131–146.

Sridhar, M., & Rau, T. K. (2005). Discovery of lamproite bodies in the Ramadugu and Jaggayyapeta areas, Krishna District, Andhra Pradesh: Implications for diamond exploration in the Krishna River Basin. Special Publication of the Geological Survey of India, No. 84, pp. 115–128.

Kar, R., Shah, M. B., Shaikh, N. H. B., & Mujtaba, S. A. I. (2018). *Paleo beach-ridge complexes, indicator of sea-level changes and climatic fluctuations: A case study from part of the Andhra Pradesh coast, India*. 35th International Geological Congress (IGC35)

Ravi, S., Bhaskara Rao, K. S., & Ananda Reddy, R. (2018). Diamond Fields of Southern India. Geological Survey of India, Bulletin Series A, No. 68.

Department of Mines & Geology, Government of Andhra Pradesh (2023). District Survey Report – 2023: Guntur District. Andhra Pradesh Space Applications Centre (APSAC), Government of Andhra Pradesh.

Kubo, S., Naga Kumar, K. Ch. V., Demudu, G., Hema Malini, B., Nageswara Rao, K., Agrawal, R., Ramakrishnan, R. & Rajawat, A. S. (2017). ‘Monitoring of Eco-Restoration of Mangrove Wetlands through Time Series Satellite Images: A Study on Krishna-Godavari Delta Region, East Coast of India’, Geographical Review of Japan Series B, 90(2).

Office of the Registrar General & Census Commissioner, India (2011). Census of India 2011: Primary Census Abstract, Guntur District, Andhra Pradesh. New Delhi: Government of India.

Andhra Pradesh Forest Department (2013) Annual Administration Report 2012–13. Government of Andhra Pradesh.

Shah, R. et al. (2006). Preparation of profiles of Quaternary deposits in Krishna Delta, East Coast Andhra Pradesh (under IGCP-475). IGCP-475 project report, Andhra Pradesh, India.

Bureau of Indian Standards (2006). IS 15681:2006: Geological Exploration by Geophysical Method (Seismic Refraction) — Code of Practice. New Delhi: Bureau of Indian Standards.

Lowrie, W. (2007). Fundamentals of Geophysics. 2nd edn. Cambridge: Cambridge University Press.

LOCALITY INDEX

Sl. No.	Name	Latitude	Longitude
1.	Pedavadlapudi	16°24'36.49"N	80°36'38.09"E
2.	Nutakki	16°24'57.12"N	80°39'01.01"E
3.	Mellampudi	16°25'32.86"N	80°37'36.72"E
4.	Ippatam	16°26'16.93"N	80°36'55.50"E
5.	Gundimeda	16°26'42.08"N	80°37'59.66"E
6.	Vaddeshwaram	16°26'47.40"N	80°36'51.38"E
7.	Vijayawada	16°30'18.66"N	80°38'6.09"E

REVIEWERS COMMENTS & ACTION TAKEN

Sl no	Comments	Action taken
1	As the objective of the item is Reconnaissance Survey(G4), a Reconnaissance Map on 1: 50,000 scale with block area, details of field observations, borehole data, Geophysical data and new findings etc. may be attached as a plate.	Attended
2	The Drainage maps on 1:50,000 scale should include the present Mangalagiri block area of investigation and its disposition with Krishna river drainage basin. Large Scale Geological map on 1:12,500 scale may also be attached incorporating outcrops, all Borehole data and other field details.	Attended
3	The Toposheet No.65D/11 may be mentioned with the title in the cover page.	Attended
4	The draft report may be thoroughly checked and typographical errors including subscript/superscript may be corrected.	Attended
5	Please add Resource Estimate along with UNFC classification at Chapter 10	Since the current project is G4 level and only 7 scout boreholes were drilled and alluvial diamonds were not recovered, resource estimation is not done.
6	Modified Conclusion and Recommendations may be given at Chapter 11	Incorporated in GR
7	A chapter on Reference, Locality Index & List of Figures, Tables, photographs, Annexures, and plates (Reconnaissance Map {1:50,000 scale} and Large-Scale Map (1:12,500 scale)	Incorporated in GR as Annexure 7 & 8
8	Please mention about block area covered during the investigation in the NQT table.	Incorporated in GR

Sl no	Comments	Action taken
9	As the aim of the item was to search for Diamond in palaeo-channel of Krishna basin, field components such as Pitting & Trenching and Bulk Sampling would have been required for processing and recovery of kimberlitic indicators and diamonds from favorable zones. Pitting & Trenching would be important to expose palaeo channels and diamond bearing gravel deposits after identifying target areas through Geophysical survey.	The top gravel bed is at ~10m b.g.l. Bulk sampling may be taken up in the next level of exploration. Pit-trench not included in the NQT
10	Detailed description of different sample media and sampling methods with photographs may be mentioned.	Elaborated & Incorporated in GR
11	Details of interpreted ore zones on the basis of Geological investigations may be given	Given in Section 6.2.6.4 & 7.1
12	Trench section drawings on suitable scale should be annexed if any	No trenching done
13	Whether any other agency has worked for gravel diamonds in the block area earlier Please incorporate the details if any.	No.
14	Please add the highlights and interpretations of various geophysical surveys undertaken	Incorporated in GR
15	A Cartoon 3D picture may also be generated from resistivity data which would be necessary to know the disposition of the favorable gravel zones for further investigation	This exercise can be attempted in next level of exploration with detailed and regular spacing of data.
16	Whether the present day younger alluvial terraces on surface have been sampled for any presence of KIMs or diamonds?	No younger alluvial terraces are observed with in the block.
17	The flow chart of stream sediment sample processing may be checked and corrections may be made.	Flowchart of SR, GSI followed
18	Cr ₂ O ₃ vs MgO, Al ₂ O ₃ vs Cr ₂ O ₃ , Na ₂ O vs Ca/(Ca+Mg) and Cr+Al vs Na plots for Chrome Diopside samples may be generated to compare with crustal pyroxenes and to assess the affinity to a peridotitic or diamond inclusion environment.	Al ₂ O ₃ vs Cr ₂ O ₃ & Na ₂ O vs Ca/(Ca+Mg) plots were already present in the GR. Rest two plots incorporated.
19	All the garnet grains may be plotted in Binary and triangular plots after Dawson & Stephens (1975) to compare their trend.	Attended

Sl no	Comments	Action taken
20	The additional EPMA data and interpretations sent through email have been checked and considered. Please incorporate these data in the final report.	Incorporated in GR
21	Details of Borehole and Remarks column may be added in the litho-log tables. Zones of sampling and other details may be mentioned in remark column.	Incorporated in GR
22	EPMA data may be rearranged in the table mineral wise and End Members may be calculated	Incorporated in GR
23	Please attend the corrections shown in the annexures. The rearranged with photo number and proper caption.	Attended
24	Chapter on Locality Index may be added	Incorporated in GR
25	The references in the text may be listed in Reference list.	Incorporated in GR
26	After attending necessary corrections and modifications, the final Geological Report along with annexures, images, shape files, pdf files and plates may be made ready for smooth uploading to the NGDR Portal, adhering to the schema as per MERT format of NGDR,	Attended

22. PLATES AND MAPS

List of Plates		
Plate 1	:	Representative grains of garnet, pyroxene, ilmenites other suspected minerals hand-picked for polished section preparation
Plate 2	:	a) Polished Section S1+18; b) &c) Garnets; d) Ilmenite; e) Schematic Diagram of Section S1+18
Plate 3	:	a) Polished Section S2-18; b) &c) pyroxenes (green); d) Garnets; e) Schematic Diagram of Section S2-18
Plate 4	:	a) Polished Section S3-18; b) &c) Garnets; d) Monazite(rounded) and pyroxenes; e) Schematic Diagram of Section S3-18
Plate 5	:	a) Polished Section S4-18; b) Garnets; c) Pyroxenes (last grain Cr-Diopside); d) Pyroxenes (2nd grain Cr- Diopside); e) Schematic Diagram of Section S4-18
Plate 6	:	a) Polished Section S5-18; b) Garnets; c) Garnet (rounded); d) Ilmenites; e) Schematic Diagram of Section S5-18
Plate 7	:	a) Polished Section S6-18; b) amphibole and pyroxene; c) Schematic Diagram of Section S6-18
Plate 8	:	a) Polished Section S7+18; a), b) &c) Garnets; e) Schematic Diagram of Section S7+18
Plate 9	:	a) Polished Section S8-18; b), c) & d) Pyroxenes (green, white, interference color), Garnets (light brownish) and ilmenite (black); e) Schematic Diagram of Section S8-18
Plate 10	:	BSE Images

List of Figures		
Figure 4.1	:	Location map of the study area
Figure 4.2	:	Mangalagiri block in Toposheet no. 65D/11
Figure 4.3	:	World famous diamonds from Krishna River alluvium, Guntur district, Andhra Pradesh, India (Source: www. andhra-rayalaseema-diamondmines.com)
Figure 4.4	:	Imagery Showing Krishna Basin Region, the Kolluru-Partiala alluvial tract
Figure 5.1	:	Geomorphology of the Krishna Basin area and Demarcated Palaeo Channels
Figure 7.1	:	Geological map of Mangalagiri block (1:50,000 scale; Source: NGDR)
Figure 9.1.3.1	:	Electrical resistivity Profile field photos in profile1 (near VES1) and profile 6 (near VES 20)
Figure 9.1.3.2	:	Vertical Electrical Sounding field photos in VES 4 and VES 15
Figure 9.1.3.3	:	Seismic refraction survey field photos Seismic point near VES 9 and Seismic point
Figure 9.1.6.1.1	:	Profiling points in google earth imagery
Figure 9.1.6.1.2	:	Graphical representation of Profile 1, showing resistivity versus latitude and longitude, with $AB/2 = 20$ and 30 .
Figure 9.1.6.1.3	:	Graphical representation of Profile 2, showing resistivity versus latitude and longitude, with $AB/2 = 20$ and 30 .
Figure 9.1.6.1.4	:	Graphical representation of Profile 3, showing resistivity versus latitude and longitude, with $AB/2 = 20, 30, 40$ and 50 .

List of Figures		
Figure 9.1.6.1.5	:	Graphical representation of Profile 4 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for $AB/2 = 20$ and 30.
Figure 9.1.6.1.6	:	Graphical representation of Profile 5 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for $AB/2 = 20$ and 30.
Figure 9.1.6.1.7	:	Graphical representation of Profile 6, showing resistivity versus latitude and longitude, with $AB/2 = 20$ and 30.
Figure 9.1.6.1.8	:	Graphical representation of Profile 7 (E–W) and two N–S profiles, showing resistivity as a function of latitude and longitude for $AB/2 = 20$ and 30.
Figure 9.1.6.1.9	:	Graphical representation of Profile 8, showing resistivity versus latitude and longitude, with $AB/2 = 20$ and 30.
Figure 9.1.6.2.1	:	Total 78 resistivity sounding points in google earth imagery
Figure 9.1.6.2.2	:	Graphical representation of VES 1
Figure 9.1.6.2.3	:	Graphical representation of VES 2
Figure 9.1.6.2.4	:	Graphical representation of VES 3
Figure 9.1.6.2.5	:	Graphical representation of VES 4
Figure 9.1.6.2.6	:	Graphical representation of VES 5
Figure 9.1.6.2.7	:	Graphical representation of VES 6
Figure 9.1.6.2.8	:	Graphical representation of VES 7
Figure 9.1.6.2.9	:	Graphical representation of VES 8
Figure 9.1.6.2.10	:	Graphical representation of VES 9
Figure 9.1.6.2.11	:	Graphical representation of VES 10
Figure 9.1.6.2.12	:	Graphical representation of VES 11
Figure 9.1.6.2.13	:	Graphical representation of VES 12
Figure 9.1.6.2.14	:	Graphical representation of VES 13
Figure 9.1.6.2.15	:	Graphical representation of VES 14
Figure 9.1.6.2.16	:	Graphical representation of VES 15
Figure 9.1.6.2.17	:	Graphical representation of VES 16
Figure 9.1.6.2.18	:	Graphical representation of VES 17
Figure 9.1.6.2.19	:	Graphical representation of VES 18
Figure 9.1.6.2.20	:	Graphical representation of VES 19
Figure 9.1.6.2.21	:	Graphical representation of VES 20
Figure 9.1.6.2.22	:	Graphical representation of VES 21
Figure 9.1.6.2.23	:	Graphical representation of VES 22
Figure 9.1.6.2.24	:	Graphical representation of VES 23
Figure 9.1.6.2.25	:	Graphical representation of VES 24
Figure 9.1.6.2.26	:	Graphical representation of VES 25
Figure 9.1.6.2.27	:	Graphical representation of VES 26
Figure 9.1.6.2.28	:	Graphical representation of VES 27
Figure 9.1.6.2.29	:	Graphical representation of VES 28
Figure 9.1.6.2.30	:	Graphical representation of VES 29

Figure 9.1.6.2.31	:	Graphical representation of VES 30
Figure 9.1.6.2.32	:	Graphical representation of VES 31
Figure 9.1.6.2.33	:	Graphical representation of VES 32
Figure 9.1.6.2.34	:	Graphical representation of VES 33
Figure 9.1.6.2.35	:	Graphical representation of VES 34
Figure 9.1.6.2.36	:	Graphical representation of VES 35
Figure 9.1.6.2.37	:	Graphical representation of VES 36
Figure 9.1.6.2.38	:	Graphical representation of VES 37
Figure 9.1.6.2.39	:	Graphical representation of VES 38
Figure 9.1.6.2.40	:	Graphical representation of VES 39
Figure 9.1.6.2.41	:	Graphical representation of VES 40
Figure 9.1.6.2.42	:	Graphical representation of VES 41
Figure 9.1.6.2.43	:	Graphical representation of VES 42
Figure 9.1.6.2.44	:	Graphical representation of VES 43
Figure 9.1.6.2.45	:	Graphical representation of VES 44
Figure 9.1.6.2.46	:	Graphical representation of VES 45
Figure 9.1.6.2.47	:	Graphical representation of VES 46
Figure 9.1.6.2.48	:	Graphical representation of VES 47
Figure 9.1.6.2.49	:	Graphical representation of VES 48
Figure 9.1.6.2.50	:	Graphical representation of VES 49
Figure 9.1.6.2.51	:	Graphical representation of VES 50
Figure 9.1.6.2.52	:	Graphical representation of VES 51
Figure 9.1.6.2.53	:	Graphical representation of VES 52
Figure 9.1.6.2.54	:	Graphical representation of VES 53
Figure 9.1.6.2.55	:	Graphical representation of VES 54
Figure 9.1.6.2.56	:	Graphical representation of VES 55
Figure 9.1.6.2.57	:	Graphical representation of VES 56
Figure 9.1.6.2.58	:	Graphical representation of VES 57
Figure 9.1.6.2.59	:	Graphical representation of VES 58
Figure 9.1.6.2.60	:	Graphical representation of VES 59
Figure 9.1.6.2.61	:	Graphical representation of VES 60
Figure 9.1.6.2.62	:	Graphical representation of VES 61
Figure 9.1.6.2.63	:	Graphical representation of VES 62
Figure 9.1.6.2.64	:	Graphical representation of VES 63
Figure 9.1.6.2.65	:	Graphical representation of VES 64
Figure 9.1.6.2.66	:	Graphical representation of VES 65
Figure 9.1.6.2.67	:	Graphical representation of VES 66
Figure 9.1.6.2.68	:	Graphical representation of VES 67
Figure 9.1.6.2.69	:	Graphical representation of VES 68
Figure 9.1.6.2.70	:	Graphical representation of VES 69
Figure 9.1.6.2.71	:	Graphical representation of VES 70
Figure 9.1.6.2.72	:	Graphical representation of VES 71
Figure 9.1.6.2.73	:	Graphical representation of VES 72
Figure 9.1.6.2.74	:	Graphical representation of VES 73
Figure 9.1.6.2.75	:	Graphical representation of VES 74
Figure 9.1.6.2.76	:	Graphical representation of VES 75

Figure 9.1.6.2.77	:	Graphical representation of VES 76
Figure 9.1.6.2.78	:	Graphical representation of VES 77
Figure 9.1.6.2.79	:	Graphical representation of VES 78
Figure 9.1.6.3.1	:	Seismogram of shot (split) 38.55m SW of VES 7-E W
Figure 9.1.6.3.2	:	Seismogram of shot (split) 212m E of VES 13-E W
Figure 9.1.6.3.3	:	Seismic locations (51) in google earth imagery
Figure 9.1.6.3.4	:	Seismic hodograph of two shots 245m SE of VES 3-N-D2-Shot 1 and 45m SE of VES 3-S-D1-Shot 3
Figure 9.1.6.3.5	:	Seismic hodograph of two shots 245m SE of VES 3-E-D2-Shot 4 and 245m SE of VES 3-W-D1-Shot 5
Figure 9.1.6.3.6	:	Seismic hodograph of seismic shot 53m W of VES 66-E-D2 shot 2
Figure 9.1.6.3.7	:	Seismic hodograph of seismic shot 400m SE of VES 3-N-D2-Shot 6
Figure 9.1.6.3.8	:	Seismic hodograph of seismic shot 400m SE of VES 3-W-D1-Shot 7
Figure 9.1.6.3.9	:	Seismic hodograph of two 5m NW of VES 38-N-D1-Shot 1 and 5m NW of VES 38-S-D2-Shot 2
Figure 9.1.6.3.10	:	Seismic hodograph of seismic shot 5m NW of VES 38-E-D1-Shot 3
Figure 9.1.6.3.11	:	Seismic hodograph of seismic shot 10m NE of VES 34-S-D1-Shot 4
Figure 9.1.6.3.12	:	Seismic hodograph of seismic shot 10m NE of VES 34-E-D2-Shot 5
Figure 9.1.6.3.13	:	Seismic hodograph of seismic shot 80m N of VES 38/100m E of VES 34-S-D1-Shot 2
Figure 9.1.6.3.14	:	Seismic hodograph of seismic shot 80m N of VES 38/100m E of VES 34-W-D1-Shot 3
Figure 9.1.6.3.15	:	Seismic hodograph of two VES 35-S-D2-Shot 1 and VES 35-N-D2-Shot 3
Figure 9.1.6.3.16	:	Seismic hodograph of seismic shot VES 35-W-D2-Shot 2
Figure 9.1.6.3.17	:	Seismic hodograph of seismic shot 10m SE of VES 36-N-D2-Shot 4
Figure 9.1.6.3.18	:	Seismic hodograph of two shots 10m SE of VES 36-E-D1-Shot 5 and 10m SE of VES 36-W-D2-Shot 6
Figure 9.1.6.3.19	:	Seismic hodograph of seismic shot 10m SE of VES 36-S-D1-Shot 7
Figure 9.1.6.3.20	:	Seismic hodograph of seismic shot 20m NW of VES 72-W-D2-Shot 8
Figure 9.1.6.3.21	:	Seismic hodograph of seismic shot VES 20-W
Figure 9.1.6.3.22	:	Seismic hodograph of two shots VES 70-NE and VES 70-SW
Figure 9.1.6.3.23	:	Seismic hodograph of two shots VES 70-SE and VES 70-NW
Figure 9.1.6.3.24	:	Seismic hodograph of two shots 88m N of VES 37-E and 88m N of VES 37-W
Figure 9.1.6.3.25	:	Seismic hodograph of seismic shot 88m N of VES 37-S-D1
Figure 9.1.6.3.26	:	Seismic hodograph of seismic shot 55m SW of VES 37
Figure 9.1.6.3.27	:	Seismic hodograph of two shots 36m N of VES37 -E and 36m N of VES37 -W
Figure 9.1.6.3.28	:	Seismic hodograph of two shots 36m N of VES37 -N and 36m N of VES37 -S
Figure 9.1.6.3.29	:	Seismic hodograph of two shots VES 69-NW-D2 and VES 69-SE
Figure 9.1.6.3.30	:	Seismic hodograph of seismic shot 184m E of VES 74
Figure 9.1.6.3.31	:	Seismic hodograph of two shots 50m E of VES 9-E and 50m E of VES 9-W
Figure 9.1.6.3.32	:	Seismic hodograph of two shots 50m E of VES 9-N and 50m E of VES 9-S
Figure 9.1.6.3.33	:	Seismic hodograph of two shots 19m W of VES 39-N-D2-Shot 1 and 19m W of VES 39-S-D1-Shot 2

Figure 9.1.6.3.34	:	Seismic hodograph of two shots 19m W of VES 39-E-D2-Shot 3 and 19m W of VES 39-W-D1-Shot 4
Figure 9.1.6.3.35	:	Seismic hodograph of two shots 15m NE of VES 68-E-D2-Shot 1 and 15m NE of VES 68-W-D1-Shot 4
Figure 9.1.6.3.36	:	Seismic hodograph of seismic shot 15m N of VES 68-S-D2-Shot 5
Figure 9.1.6.3.37	:	Seismic hodograph of seismic shot 93.22m N of VES 39-N-D2-Shot 7
Figure 9.1.6.3.38	:	Seismic hodograph of two shots 70m S of VES 29-E-D2-Shot 5 and 70m S of VES 29 W-D1-Shot 6
Figure 9.1.6.3.39	:	Seismic hodograph of seismic shot 70m S VES 29-S-D2-Shot 8
Figure 9.1.6.3.40	:	Seismic hodograph of two shots 85m SW of VES 48-E-D1-Shot 1 and 85 m SW of VES 48-W-D2-Shot 2
Figure 9.1.6.3.41	:	Seismic hodograph of two shots 85m SW of VES 48-N-D1-Shot 3 and 85 m SW of VES 48-S-D2-Shot 4
Figure 9.1.6.3.42	:	Seismic hodograph of seismic shot 84m SE of VES 48-E-D1-Shot 2
Figure 9.1.6.3.43	:	Seismic hodograph of seismic shot 84m SE of VES 48-W-D2-Shot 3
Figure 9.1.6.3.44	:	Seismic hodograph of two shots 84m SE of VES 48-N-D1-Shot 4 and 84m SE of VES 48-S-D2-Shot 5
Figure 9.1.6.3.45	:	Seismic hodograph of two shots 155m SE of VES 48-S-D2-Shot 6 and 155m SE of VES 48-N-D1-Shot 7
Figure 9.1.6.3.46	:	Seismic hodograph of seismic shot 155m SE of VES 48-W-D2-Shot 8
Figure 9.1.6.3.47	:	Seismic hodograph of two shots 28m S of VES4 -SE and 28m S of VES4-SW
Figure 9.1.6.3.48	:	Seismic hodograph of seismic shot 28m S of VES4-SS
Figure 9.1.6.3.49	:	Seismic hodograph of two shots 108m N of VES4 -E and 108m N of VES4 -W
Figure 9.1.6.3.50	:	Seismic hodograph of two shots 108m N of VES4 -N and 108m N of VES4 -S
Figure 9.1.6.3.51	:	Seismic hodograph of seismic shot VES 40-N-D1-Shot 1
Figure 9.1.6.3.52	:	Seismic hodograph of two shots VES 40-W-D2-Shot 2 and VES 40-E-D1-Shot 3
Figure 9.1.6.3.53	:	Seismic hodograph of seismic shot 70m SE of VES 40-S-D2-Shot 4
Figure 9.1.6.3.54	:	Seismic hodograph of seismic shot 70m SE of VES 40-W-D1-Shot 5
Figure 9.1.6.3.55	:	Seismic hodograph of seismic shot 70m SE of VES 40-N-D2-Shot 6
Figure 9.1.6.3.56	:	Seismic hodograph of seismic shot 70m SE of VES 40-E-D1-Shot 8
Figure 9.1.6.3.57	:	Seismic hodograph of two shots 35m N of VES32-E and 35m N of VES32-W
Figure 9.1.6.3.58	:	Seismic hodograph of two shots 35m N of VES32-S and 35m N of VES32-N
Figure 9.1.6.3.59	:	Seismic hodograph of seismic shot 57m E of VES 32
Figure 9.1.6.3.60	:	Seismic hodograph of two shots 240m NE of VES 33-N-D1-Shot 1 and 240m NE of VES 33-S-D2-Shot 2
Figure 9.1.6.3.61	:	Seismic hodograph of two shots 245m NE of VES 33-W-D1-Shot 3 and 245m NE of VES 33-E-D2-Shot 4
Figure 9.1.6.3.62	:	Seismic hodograph of seismic shot 180m NE of VES 33-W-D1-Shot 5
Figure 9.1.6.3.63	:	Seismic hodograph of two shots 12m NE of VES 18-E and 12m NE of VES 18-W
Figure 9.1.6.3.64	:	Seismic hodograph of two shots 12m NE of VES 18-N and 12m NE of VES 18-S
Figure 9.1.6.3.65	:	Seismic hodograph of two shots 30m E of VES 30-E and 30m E of VES 30-W

Figure 9.1.6.3.66	:	Seismic hodograph of two shots 27m S of VES 30-N and 27m S of VES 30-S
Figure 9.1.6.3.67	:	Seismic hodograph of seismic shot 70m W of VES 46-N-D2-Shot 1
Figure 9.1.6.3.68	:	Seismic hodograph of two shots 70m W of VES 46-W-D1-Shot 2 and 70m W of VES 46-E-D2-Shot 3
Figure 9.1.6.3.69	:	Seismic hodograph of seismic shot 26m SE of VES 47-S-D2-Shot 5
Figure 9.1.6.3.70	:	Seismic hodograph of seismic shot 26m SE of VES 47-W-D1-Shot 6
Figure 9.1.6.3.71	:	Seismic hodograph of two shots 298m E of VES12 -Rev -EW and 387m ESE of VES12-Fwd-EW
Figure 9.1.6.3.72	:	Seismic hodograph of two shots 308m NE of VES12 -Fwd -NS and 310m SE of VES12 -Rev-NS
Figure 9.1.6.3.73	:	Seismic hodograph of two shots 212m E of VES 13-E and 212m E of VES 13-W
Figure 9.1.6.3.74	:	Seismic hodograph of two shots 212m E of VES 13-N and 212m E of VES 13-S
Figure 9.1.6.3.75	:	Seismic hodograph of seismic shot 30m N of VES 42-S-D2-Shot 5
Figure 9.1.6.3.76	:	Seismic hodograph of seismic shot 30m N of VES 42-N-D2-Shot 6
Figure 9.1.6.3.77	:	Seismic hodograph of seismic shot 30m N of VES 42-E-D2-Shot 7
Figure 9.1.6.3.78	:	Seismic hodograph of seismic shot 30m N of VES 42-W-D2-Shot 8
Figure 9.1.6.3.79	:	Seismic hodograph of two shots 40m S of VES 42-S-D2-Shot 1 and 40m S of VES 42-N-D2-Shot 2
Figure 9.1.6.3.80	:	Seismic hodograph of seismic shot 40m S of VES 42-E-D2-Shot 4
Figure 9.1.6.3.81	:	Seismic hodograph of two shots 20m NW of VES 43-S-D2 and 20m NW of VES 43-N-D1
Figure 9.1.6.3.82	:	Seismic hodograph of seismic shot 20m NW of VES 43-E-D2
Figure 9.1.6.3.83	:	Seismic hodograph of seismic shot 88m S of VES 43-NE-D2
Figure 9.1.6.3.84	:	Seismic hodograph of seismic shot 115m S of VES 43-S-D2
Figure 9.1.6.3.85	:	Seismic hodograph of two shots 20m SE of VES 44-W-D2-Shot 4 and 20m SE of VES 44-E-D1-Shot 5
Figure 9.1.6.3.86	:	Seismic hodograph of seismic shot VES 16-S-D1-Shot 1
Figure 9.1.6.3.87	:	Seismic hodograph of two shots 15m N of VES 15-E and 15m N of VES 15-W
Figure 9.1.6.3.88	:	Seismic hodograph of two shots 15m N of VES 15-N and 15m N of VES 15-S
Figure 9.1.6.3.89	:	Seismic hodograph of two shots 9m S of VES 27-E and 9m S of VES 27-W
Figure 9.1.6.3.90	:	Seismic hodograph of two shots 9m S of VES 27-N and 9m S of VES 27-S
Figure 9.1.6.3.91	:	Seismic hodograph of two shots 38.55m SW of VES7-E and 38.55m SW of VES7-W
Figure 9.1.6.3.92	:	Seismic hodograph of two shots 51m S of VES26 -E and 51m S of VES26 -W
Figure 9.1.6.3.93	:	Seismic hodograph of two shots 51m S of VES26 -N and 51m S of VES26 -S
Figure 9.1.6.3.94	:	Seismic hodograph of two shots 61m SE of VES 25 -E and 61m SE of VES 25 -W
Figure 9.1.6.3.95	:	Seismic hodograph of seismic shot 61m SE of VES 25-N
Figure 9.1.6.4.1	:	Interpreted gravel locations by Geophysical investigations
Figure 10.1	:	Map showing drilled Boreholes
Figure 13.1	:	Map showing drilled Boreholes
- 286 -		

Figure 13.2	:	Detailed lithology of boreholes MGLBH01
Figure 13.3	:	Detailed lithology of boreholes MGLBH02
Figure 13.4	:	Detailed lithology of boreholes MGLBH03
Figure 13.5	:	Detailed lithology of boreholes MGLBH04
Figure 13.6	:	Detailed lithology of boreholes MGLBH05
Figure 13.7	:	Detailed lithology of boreholes MGLBH06
Figure 13.8	:	Detailed lithology of boreholes MGLBH07
Figure 14.1	:	Interpreted gravel location vs Drilled borehole locations
Figure 14.2	:	Comparison diagram with seismic data (35m N of VES 32-W) and BH-01 litho- log
Figure 14.3	:	Comparison diagram with seismic data (10m SE of VES 36 N-D2-Shot 4) and BH-02 litho- log
Figure 14.4	:	Comparison diagram with seismic data (61m SE of VES 25-N) and BH-03 litho- log
Figure 14.5	:	Comparison diagram with seismic data (38.55m SW of VES 7-W) and BH-04 litho- log
Figure 14.6	:	Comparison diagram with seismic data (30m E of VES 30-E) and BH-05 litho- log
Figure 14.7	:	Comparison diagram with seismic data (15m N of VES 15-W) and BH-06 litho- log
Figure 14.8	:	Comparison diagram with seismic data (85m SW of VES 48-W-D2-Shot 2) and BH-07 litho- log
Figure. 15.1 a	:	Water Washing
Figure. 15.1 b	:	Sun drying
Figure. 15.1 c	:	Packing and labelling
Figure. 15.1 d	:	Manual Sieving
Figure. 15.2 a	:	Jigging
Figure. 15.2 b	:	Panning
Figure. 15.3 a	:	Gravity separation by bromoform method
Figure. 15.3 b	:	Magnetic mineral separation by Electromagnetic method
Figure. 15.4	:	Flow chart of Methodology
Figure. 15.5	:	Cr ₂ O ₃ vs CaO Plot for Garnets (after Schultz, 1999)
Figure. 15.6	:	Na ₂ O vs TiO ₂ Plot for Garnets (source: McCandless & Gurney, 1989)
Figure. 15.7	:	MgO-FeO-CaO Plot for Garnets (J. B. Dawson & W. E. Stephens, 1975)
Figure. 15.8	:	Ca/(Ca+Mg) vs Na ₂ O Plot for diopside (after Moris et al., 1975)
Figure. 15.9	:	Al ₂ O ₃ vs Cr ₂ O ₃ Plot for diopside (after Nixon and Boyd, 1973)
Figure. 15.10	:	Triangular plot for clinopyroxenes showing Eclogitic Diamond inclusion field ((Fipke et al., 1989)
Figure. 15.11	:	CaO vs Cr ₂ O ₃ Plot (after Boyd et al., 1984)
Figure. 15.12	:	MgO vs TiO ₂ Plot for Ilmenites (after Haggerty, 1975)

23. ANNEXURES OR ENCLOSURES TO THE REPORT

List of Annexures		
Annexure-1	:	Resistivity Profiling with Twin Separation data
Annexure-2	:	Resistivity sounding data
Annexure-3	:	Seismic Refraction Survey
Annexure-4	:	Borehole litholog sheet
Annexure-5	:	EPMA Results
Annexure-6	:	Field photographs
Annexure-7	:	Reconnaissance map with Locations of Geology & Geophysical data collection
Annexure-8	:	Regional Drainage map

List of Tables		
Table 2.1	:	Technical persons engaged in exploration
Table 3.1	:	Quantum of Work – Mangalagiri (G4) Block
Table 4.1	:	Details of the area (Village name, District, State)
Table 4.2	:	The boundary coordinates of Mangalagiri block
Table 8.2.3.1	:	Stratigraphic succession from Shah et al., 2006.
Table 9.1	:	Instruments deployed for conducting the geophysical surveys
Table 9.1.5.1	:	The representative velocity ranges for various lithological units from IS 15681:2006 – Geological Exploration by Geophysical Method (Seismic Refraction Code of Practice)
Table 9.1.5.2	:	Velocity ranges for various lithological units as per drilling data in Mangalagiri block
Table 9.1.6.3.1	:	seismic data sheet for shot 212m E of VES 13-E W
Table 9.1.6.3.2	:	seismic data sheet for shot 38.55m SW of VES 7-E W
Table 9.1.6.3.3	:	Interpreted seismic data for shot 245 m SE of VES 3-N-D2-Shot 1.
Table 9.1.6.3.4	:	Interpreted seismic data for shot 245m SE of VES 3-S-D1-Shot 3
Table 9.1.6.3.5	:	Interpreted seismic data for shot 245m SE of VES 3-E-D2-Shot 4
Table 9.1.6.3.6	:	Interpreted seismic data for shot 245m SE of VES 3-W-D1-Shot 5
Table 9.1.6.3.7	:	Interpreted seismic data for shot 53m W of VES 66-E-D2-Shot 2
Table 9.1.6.3.8	:	Interpreted seismic data for shot 400m SE of VES 3-N-D2-Shot 6
Table 9.1.6.3.9	:	Interpreted seismic data for shot 400m SE of VES 3-W-D1-Shot 7
Table 9.1.6.3.10	:	Interpreted seismic data for shot 5m NW of VES 38-N-D1-Shot 1
Table 9.1.6.3.11	:	Interpreted seismic data for shot 5m NW of VES 38-S-D2-Shot 2
Table 9.1.6.3.12	:	Interpreted seismic data for shot 5m NW of VES 38-E-D1-Shot 3
Table 9.1.6.3.13	:	Interpreted seismic data for shot 10m NE of VES 34-S-D1-Shot 4
Table 9.1.6.3.14	:	Interpreted seismic data for shot 10m NE of VES 34-E-D2-Shot 5
Table 9.1.6.3.15	:	Interpreted seismic data for shot 80m N of VES 38/100m E of VES 34-S-D1-Shot 2
Table 9.1.6.3.16	:	Interpreted seismic data for shot 80m N of VES 38/100m E of VES 34-W-D1-Shot 3

Table 9.1.6.3.17	:	Interpreted seismic data for shot VES35-N-D2-Shot 1
Table 9.1.6.3.18	:	Interpreted seismic data for shot VES35-S-D2-Shot 3
Table 9.1.6.3.19	:	Interpreted seismic data for shot VES35-W-D2-Shot 2
Table 9.1.6.3.20	:	Interpreted seismic data for shot 10m SE of VES36-N-D2-Shot 4
Table 9.1.6.3.21	:	Interpreted seismic data for shot 10m SE of VES36-E-D1-Shot 5
Table 9.1.6.3.22	:	Interpreted seismic data for shot 10m SE of VES36-W-D2-Shot 6
Table 9.1.6.3.23	:	Interpreted seismic data for shot 10m SE of VES36-S-D1-Shot 7
Table 9.1.6.3.24	:	Interpreted seismic data for shot 20m NW of VES 72-W-D2- Shot 8
Table 9.1.6.3.25	:	Interpreted seismic data for shot VES 20-W
Table 9.1.6.3.26	:	Interpreted seismic data for shot VES70 NE
Table 9.1.6.3.27	:	Interpreted seismic data for shot VES70 SW
Table 9.1.6.3.28	:	Interpreted seismic data for shot VES70 NW
Table 9.1.6.3.29	:	Interpreted seismic data for shot VES70 SE
Table 9.1.6.3.30	:	Interpreted seismic data for shot 88m N of VES 37-E-D2
Table 9.1.6.3.31	:	Interpreted seismic data for shot 88m N of VES37-W-D1
Table 9.1.6.3.32	:	Interpreted seismic data for shot 88m N of VES37-S-D1
Table 9.1.6.3.33	:	Interpreted seismic data for shot 55m SW of VES 37-NE-D1
Table 9.1.6.3.34	:	Interpreted seismic data for shot 36m N of VES37-E
Table 9.1.6.3.35	:	Interpreted seismic data for shot 36m N of VES37-W
Table 9.1.6.3.36	:	Interpreted seismic data for shot 36m N of VES37-N
Table 9.1.6.3.37	:	Interpreted seismic data for shot 36m N of VES37-S
Table 9.1.6.3.38	:	Interpreted seismic data for shot VES69-NW-D2
Table 9.1.6.3.39	:	Interpreted seismic data for shot VES 69-SE
Table 9.1.6.3.40	:	Interpreted seismic data for shot 184m E of VES 74
Table 9.1.6.3.41	:	Interpreted seismic data for shot 50m E of VES9-E
Table 9.1.6.3.42	:	Interpreted seismic data for shot 50m E of VES9-W
Table 9.1.6.3.43	:	Interpreted seismic data for shot 50m E of VES9-N
Table 9.1.6.3.44	:	Interpreted seismic data for shot 50m E of VES9-S
Table 9.1.6.3.45	:	Interpreted seismic data for shot 19m W of VES 39-N-D2-Shot 1
Table 9.1.6.3.46	:	Interpreted seismic data for shot 19m W of VES 39-S-D1-Shot 2
Table 9.1.6.3.47	:	Interpreted seismic data for shot 19m W of VES 39-E-D2-Shot 3
Table 9.1.6.3.48	:	Interpreted seismic data for shot 19m W of VES 39-W-D1-Shot 4
Table 9.1.6.3.49	:	Interpreted seismic data for shot 15m NE of VES 68-E-D2-Shot 1
Table 9.1.6.3.50	:	Interpreted seismic data for shot 15m NE of VES 68-W-D1-Shot 4
Table 9.1.6.3.51	:	Interpreted seismic data for shot 15m N of VES 68-S-D2-Shot 5
Table 9.1.6.3.52	:	Interpreted seismic data for shot 93.22m N of VES 39-N-D2-Shot 7
Table 9.1.6.3.53	:	Interpreted seismic data for shot 70m S of VES29-E-D2-Shot 5
Table 9.1.6.3.54	:	Interpreted seismic data for shot 70m S of VES29 W-D1-Shot 6
Table 9.1.6.3.55	:	Interpreted seismic data for shot 70m S VES29 S-D2-Shot 8
Table 9.1.6.3.56	:	Interpreted seismic data for shot 85m SW of VES48-E-D1-Shot 1
Table 9.1.6.3.57	:	Interpreted seismic data for shot 85m SW of VES48-W-D2-Shot 2
Table 9.1.6.3.58	:	Interpreted seismic data for shot 85m SW of VES48-N-D1- Shot 3
Table 9.1.6.3.59	:	Interpreted seismic data for shot 85m SW of VES48-S-D2-Shot 4
Table 9.1.6.3.60	:	Interpreted seismic data for shot 84mSE VES48-E-D1-Shot 2
Table 9.1.6.3.61	:	Interpreted seismic data for shot 84mSE VES48-W-D2-Shot 3

Table 9.1.6.3.62	:	Interpreted seismic data for shot 84m SE of VES48-N-D1- Shot 4
Table 9.1.6.3.63	:	Interpreted seismic data for shot 84m SE of VES48-S-D2-Shot 5
Table 9.1.6.3.64	:	Interpreted seismic data for shot 155m SE VES48-S-D2-Shot 6
Table 9.1.6.3.65	:	Interpreted seismic data for shot 155m SE VES48-N-D1-Shot 7
Table 9.1.6.3.66	:	Interpreted seismic data for shot 155mSE VES48-W-D2-Shot 8
Table 9.1.6.3.67	:	Interpreted seismic data for shot 28m S of VES4-SE
Table 9.1.6.3.68	:	Interpreted seismic data for shot 28m S of VES4-SW
Table 9.1.6.3.69	:	Interpreted seismic data for shot 28m S of VES4-SS
Table 9.1.6.3.70	:	Interpreted seismic data for shot 108m N of VES4-E
Table 9.1.6.3.71	:	Interpreted seismic data for shot 108m N of VES4-W
Table 9.1.6.3.72	:	Interpreted seismic data for shot 108m N of VES4-N
Table 9.1.6.3.73	:	Interpreted seismic data for shot 108m N of VES4-S
Table 9.1.6.3.74	:	Interpreted seismic data for shot VES40-N-D1-Shot 1
Table 9.1.6.3.75	:	Interpreted seismic data for shot VES40-W-D2-Shot 2
Table 9.1.6.3.76	:	Interpreted seismic data for shot VES40-E-D1-Shot 3
Table 9.1.6.3.77	:	Interpreted seismic data for shot 70m SE of VES40-S-D2-Shot 4
Table 9.1.6.3.78	:	Interpreted seismic data for shot 70m SE of VES40-W-D1-Shot 5
Table 9.1.6.3.79	:	Interpreted seismic data for shot 70m SE of VES40-N-D2-Shot 6
Table 9.1.6.3.80	:	Interpreted seismic data for shot 70m SE of VES40-E-D1-Shot 8
Table 9.1.6.3.81	:	Interpreted seismic data for shot 35m N of VES32-E
Table 9.1.6.3.82	:	Interpreted seismic data for shot 35m N of VES32-W
Table 9.1.6.3.83	:	Interpreted seismic data for shot 35m N of VES32-N
Table 9.1.6.3.84	:	Interpreted seismic data for shot 35m N of VES32-S
Table 9.1.6.3.85	:	Interpreted seismic data for shot 57m E of VES32-W
Table 9.1.6.3.86	:	Interpreted seismic data for shot 240m NE of VES 33-N- D1-Shot 1
Table 9.1.6.3.87	:	Interpreted seismic data for shot 240m NE of VES 33-S- D2-Shot 2
Table 9.1.6.3.88	:	Interpreted seismic data for shot 240m NE of VES 33-W- D1-Shot 3
Table 9.1.6.3.89	:	Interpreted seismic data for shot 240m NE of VES 33-E- D2-Shot 4
Table 9.1.6.3.90	:	Interpreted seismic data for shot 180m NE of VES 33-W– D1-Shot 5
Table 9.1.6.3.91	:	Interpreted seismic data for shot 12m NE of VES 18-E
Table 9.1.6.3.92	:	Interpreted seismic data for shot 12m NE of VES 18-W
Table 9.1.6.3.93	:	Interpreted seismic data for shot 12m NE of VES 18-N
Table 9.1.6.3.94	:	Interpreted seismic data for shot 12m NE of VES 18-S
Table 9.1.6.3.95	:	Interpreted seismic data for shot 30m E of VES30-E
Table 9.1.6.3.96	:	Interpreted seismic data for shot 30m E of VES30-W
Table 9.1.6.3.97	:	Interpreted seismic data for shot 30m E of VES30-N
Table 9.1.6.3.98	:	Interpreted seismic data for shot 30m E of VES30-S
Table 9.1.6.3.99	:	Interpreted seismic data for shot 70m W of VES46-N -D2-Shot 1
Table 9.1.6.3.100	:	Interpreted seismic data for shot 70m W of VES46-W -D1-Shot 2
Table 9.1.6.3.101	:	Interpreted seismic data for shot 70m W of VES46-E -D2-Shot 3
Table 9.1.6.3.102	:	Interpreted seismic data for shot 26m SE of VES47-S-D2-Shot 5

Table 9.1.6.3.103	:	Interpreted seismic data for shot 26m SE of VES47-W-D1-Shot 6
Table 9.1.6.3.104	:	Interpreted seismic data for shot 308m NE of VES12
Table 9.1.6.3.105	:	Interpreted seismic data for shot 298m E of VES12
Table 9.1.6.3.106	:	Interpreted seismic data for shot 308m NE of VES12
Table 9.1.6.3.107	:	Interpreted seismic data for shot 310m SE of VES12
Table 9.1.6.3.108	:	Interpreted seismic data for shot 212 m east of VES 13-E
Table 9.1.6.3.109	:	Interpreted seismic data for shot 212 m east of VES 13-W
Table 9.1.6.3.110	:	Interpreted seismic data for shot 212 m east of VES 13-N
Table 9.1.6.3.111	:	Interpreted seismic data for shot 212 m east of VES 13-S
Table 9.1.6.3.112	:	Interpreted seismic data for shot 30m N of VES42-S-D2-Shot 5
Table 9.1.6.3.113	:	Interpreted seismic data for shot 30m N of VES42-N-D2-Shot 6
Table 9.1.6.3.114	:	Interpreted seismic data for shot 30m N of VES42-E-D2-Shot 7
Table 9.1.6.3.115	:	Interpreted seismic data for shot 30m N of VES42-W-D2-Shot 8
Table 9.1.6.3.116	:	Interpreted seismic data for shot 40m S of VES42-S-D2-Shot 1
Table 9.1.6.3.117	:	Interpreted seismic data for shot 40m S of VES42-N-D2-Shot 2
Table 9.1.6.3.118	:	Interpreted seismic data for shot 40m S of VES42-E-D2-Shot 4
Table 9.1.6.3.119	:	Interpreted seismic data for shot 20m NW of VES 43-S-D2
Table 9.1.6.3.120	:	Interpreted seismic data for shot 20m NW of VES 43-N-D1
Table 9.1.6.3.121	:	Interpreted seismic data for shot 20m NW of VES 43-E-D2
Table 9.1.6.3.122	:	Interpreted seismic data for shot 88m S of VES 43-NE-D2
Table 9.1.6.3.123	:	Interpreted seismic data for shot 115m S of VES 43-S-D2
Table 9.1.6.3.124	:	Interpreted seismic data for shot 20m SE of VES44-W-D2-Shot 4
Table 9.1.6.3.125	:	Interpreted seismic data for shot 20m SE of VES44-E-D1-Shot 5
Table 9.1.6.3.126	:	Interpreted seismic data for shot VES 16-S-D1-Shot 1
Table 9.1.6.3.127	:	Interpreted seismic data for shot 15 m north of VES15 -E
Table 9.1.6.3.128	:	Interpreted seismic data for shot 15 m north of VES15 -W
Table 9.1.6.3.129	:	Interpreted seismic data for shot 15 m north of VES15 -N
Table 9.1.6.3.130	:	Interpreted seismic data for shot 15 m north of VES15 -S
Table 9.1.6.3.131	:	Interpreted seismic data for shot 9m S of VES27 -E
Table 9.1.6.3.132	:	Interpreted seismic data for shot 9m S of VES27 -W
Table 9.1.6.3.133	:	Interpreted seismic data for shot 9m S of VES27 -N
Table 9.1.6.3.134	:	Interpreted seismic data for shot 9m S of VES27 -S
Table 9.1.6.3.135	:	Interpreted seismic data for shot 38.55m SW of VES7-E
Table 9.1.6.3.136	:	Interpreted seismic data for shot 38.55m SW of VES7-W
Table 9.1.6.3.137	:	Interpreted seismic data for shot 51m S of VES26-E
Table 9.1.6.3.138	:	Interpreted seismic data for shot 51m S of VES26-W
Table 9.1.6.3.139	:	Interpreted seismic data for shot 51m S of VES26-N
Table 9.1.6.3.140	:	Interpreted seismic data for shot 51m S of VES26-S
Table 9.1.6.3.141	:	Interpreted seismic data for shot 61m SE of VES 25-E
Table 9.1.6.3.142	:	Interpreted seismic data for shot 61m SE of VES 25-W
Table 9.1.6.3.143	:	Interpreted seismic data for shot 61m SE of VES 25-N

Table 9.1.6.4.1	:	Interpreted Gravel zones by geophysical investigations
Table 10.1	:	Borehole Co-ordinates and Collar details
Table 15.1	:	Details of generated Sub samples.
Table 15.2	:	Details of Magnetic flux intensity range and expected minerals
Table 15.3	:	EPMA results for Cr ₂ O ₃ vs CaO Plot
Table 15.4	:	EPMA results for Na ₂ O vs TiO ₂ Plot.
Table 15.5	:	Borehole Details of Garnets having mantle paragenesis
Table 15.6	:	EPMA results of clinopyroxene for Ca/(Ca+Mg) vs Na ₂ O Plot
Table 15.7	:	EPMA results of Spinel peridotite field- Al ₂ O ₃ vs Cr ₂ O ₃ Plot
Table 15.8	:	EPMA results of Cpx falling in eclogitic diamond inclusion field
Table 15.9	:	EPMA results of Group I eclogite Cpx given by MC Candles and Gurney
Table 15.10	:	Borehole Details of clinopyroxene grain showing mantle paragenesis
Table 20.1	:	Estimated gravel volume using borehole data

24. ANY OTHER INFORMATION

NIL

25. CERTIFICATE FROM THE QUALIFIED PERSON WITH NAME, DATE AND SIGNATURE.

Peer reviewer comment is attached.

REVIEW COMMENTS

Title: Reconnaissance Survey (G-4) for Diamond in parts of a Palaeo-Channel in Krishna Basin, near Mangalagiri, Guntur district, Andhra Pradesh.

1.	The draft hard copy of the report entitled “ Reconnaissance Survey(G-4) for diamond in parts of a Palaeo-Channel in Krishna Basin, near Mangalagiri, Guntur district, Andhra Pradesh was received on 28/07/2026 and reviewed. The review comments and modifications may be attended in order to improve the quality of the report.
2.	As the objective of the item is Reconnaissance Survey(G4), a Reconnaissance Map on 1:50,000 scale with block area, details of field observations, borehole data, Geophysical data and new findings etc may be attached as a plate.
3.	The Drainage maps on 1:50,000 scale should include the present Mangalagiri block area of investigation and its disposition with Krishna river drainage basin. Large Scale Geological map on 1:12,500 scale may also be attached incorporating outcrops, all Borehole data and other field details.
4.	The Toposheet No.65D/11 may be mentioned with the title in the cover page.
5.	The draft report may be thoroughly checked and typographical errors including subscript/superscript may be corrected.
6.	Please add Resource Estimate along with UNFC classification at Chapter 10.
7.	Modified Conclusion and Recommendations may be given at Chapter 11.
8.	A chapter on “ Expenditure ”- Chapter 12 may be added, followed by Reference, Locality Index, List of Figures, Tables, photographs, Annexures, and plates (Reconnaissance Map(1:50,000 scale) and Large Scale Map(1:12,500 scale)
9.	Please mention about block area covered during the investigation in the NQT table.
10.	As the aim of the item was to search for Diamond in palaeo-channel of Krishna basin, field components such as Pitting & Trenching and Bulk Sampling would have been required for processing and recovery of kimberlitic indicators and diamonds from favorable zones. Pitting & Trenching would be important to expose palaeo-channels and diamond bearing gravel deposits after identifying target areas through Geophysical survey.
11.	Detailed description of different sample media and sampling methods with photographs may be mentioned.
12.	Details of interpreted ore zones on the basis of Geological investigations may be given.
13.	Trench section drawings on suitable scale should be annexed if any.
14.	Whether any other agency has worked for gravel diamonds in the block area earlier. Please incorporate the details if any.
15.	Please add the highlights and interpretations of various geophysical surveys undertaken.

	(1) Resistivity profiling with twin separations: In the Mangalagiri block, eight resistivity profiles were carried out along the E-W direction following the block boundary. (2) Resistivity sounding(VES): A total of 78 nos. of Vertical Electrical Sounding(VES) were conducted to observe the continuity of resistivity zone and its persistence at depth to observe the presence of gravels within the subsurface. Since the various textures of alluvium, sand and gravels are intercalated within the sedentary strata, a qualitative and quantitative information obtained may be utilized to create a 3D Cartoon picture based on resistivity, thickness and depth of different strata. High resistivity zones may indicate gravel zones. How many high resistivity zones were demarcated for Seismic refraction Survey? (3) Seismic Refraction Survey: Seismic Refraction Survey was conducted at 51 locations in an area of 25.1 sq km. A total of 92 Hodographs were obtained to map underground structure safely and accurately. Out of 123 seismic shots in 22.6 sq km area in Mangalagiri Survey block, 25 gravel zones were delineated from Seismic Refraction data. These gravel zones were recommended for further drilling and confirmation. The geophysical surveys were effectively implemented to delineate the concealed gravel zones. (4) Borehole logging: Correlation of geophysical data/interpretation and borehole litho-logs may be corroborated in the report in view of identification of favorable zones for sampling and recovering positive indicators and diamonds. A Fence diagram may be prepared based on geophysical and borehole data to reveal the buried palaeo-channels, pinch-outs and lens shaped sediment deposits. The Fence diagram may be used to map Palaeo-channels by tracking coarse channel sands across borehole data. (5) It is observed from the seismic data that the litho-velocity ranging between 820-880 m/s correspond to the gravel zones associated with sand /mud. (6) Out of 25 Gravel sites selected by seismic shots, 7 locations were drilled and gravel zones at one or two levels were established efficiently.
16.	A Cartoon 3D picture may also be generated from resistivity data which would be necessary to know the disposition of the favorable gravel zones for further investigation.
17.	Whether the present day younger alluvial terraces on surface have been sampled for any presence of KIMs or diamonds?
18.	The flow chart of stream sediment sample processing may be checked and corrections may be made.
19.	<u>Indicator Mineral Survey:</u> Visual comparison of suspected kimberlitic indicators with that from known kimberlitic rocks may be effective in identifying and selecting suspected grains for SEM EDX/EPMA

studies.

More number of indicator minerals (Garnet, Chrome Diopside, Spinels and Picro-ilmenite) may be scanned quickly through SEM/EDX method and for further confirmation and quantitative analysis by EPMA studies.

Physical characteristics/mineral chemistry of positive kimberlitic indicator minerals for comparison :

- (i) **Garnets:** Garnets are very important indicators found in kimberlites/lamproites. The sizes vary from microscopic to +5mm. Some garnet grains are characterized by Kelyphitic border (reaction corona) around garnet crystals which form due to magmatic corrosion during ascent. The shapes of the garnets vary from angular to sub-rounded. They also exhibit vitreous lustre and conchoidal fracture with whitish mineral filling along cracks in fractured grains.

The colour of pyrope garnets from known kimberlites (Mainpur Kimberlite Field) vary from magenta (Calcium rich chrome pyrope (G-9) derived from Lherzolitic mantle source) to pinkish purple, to bright pink (Calcium poor Chrome rich G-10 garnets from Harzburgitic mantle source) to orange and orange red (low calcium iron-titanium G-1, G-2 category & iron, calcium rich eclogitic (G-3, 4 & 5) garnets (Dawson & Stephens, 1975). The kimberlitic pyrope garnets invariably show 60% to 90% pyrope content.

So physical comparison between Kimberlitic pyrope with suspected garnets will be required before going for mineral chemistry by EPMA.

- (ii) **Spinels:** Spinels are generally found as macrocrystal spinel and groundmass spinel. These spinels vary in colour from deep brown to opaque. Macrocrystic spinels are euhedral to anhedral in shape and exhibit reaction rim. Chemically, they vary in composition from chromite to chrome spinels showing chrome content between 25% to 65% and fall in Diamond Inclusion field in Cr_2O_3 -MgO and Cr_2O_3 - TiO_2 plots. These indicate probable derivative from a large depth of upper mantle.

However, surprisingly no kimberlitic spinel was recovered from the gravel zones during the investigation.

- (iii) **Picroilmenites:** This is a characteristic indicator mineral of kimberlite. It is jet black, brownish black to opaque in colour with metallic to submetallic lustre often develop reaction rim of leucoxene. These indicate high Cr_2O_3 (upto 7%) and high MgO (upto 15%) showing affinity to metasomatised upper mantle peridotite.

In the present area of investigation, no picroilmenite was identified.

Kimberlite indicator minerals (KIMs) can travel anywhere from a few hundred meters to over 50 to 100kms from their source. How far they go depends heavily on the transport medium (glaciers or rivers) and durability of specific mineral grain. Pyrope garnet and chromite are highly resistant to physical abrasion and chemical weathering. They survive long distant transport of 50km to 70km from source.

Mg-ilmenite (Picroilmenite) is moderately durable but prone to surface alteration over

prolonged exposure. It can travel long distance upto 45Km.

- (iv) **Chrome Diopside:** Chrome Diopside is a typical kimberlitic indicator which can travel upto few meters to upto 5km from the source rock. This is being softer and chemically fragile, it breaks down or weathers rapidly, indicating a short transport distance. This is a very important indicator as it is found near the source rock. This is typically vibrant chromium rich emerald green to bright grassy green variety of Diopside. The major part of the clinopyroxenes assemblage of Mainpur kimberlite Field, Chhattisgarh include calcic clinopyroxene belonging to the *depleted lherzolites of lithospheric upper mantle*. Most of these fall in the Cr diopside category with Cr_2O_3 varying from 1% to 3.47% averaging between 1.5% to 2%. A small portion (about 10% to 15%) of the calcic clinopyroxenes have analysed higher Fe_2O_3 (between 3.5 to 4.5%) and correspondingly lower Mg number (less than 0.84). Such clinopyroxenes also show $Na_2O > (Cr_2O_3 + Al_2O_3)$.
In the present area Chrome diopsides have been identified.

- (v) **Orthopyroxenes:** Orthopyroxene grains from Bahradih diatrema (Mainpur Kimberlite Field) are pale green, depleted low temperature lherzolite varieties similar to those in xenoliths from lithospheric upper mantle. These are characterised by high MgO (>35%) and high Mg number (between 0.86 and 0.89), negligible TiO_2 (between 0% and 0.31%) and very low CaO (0.26% and 0.52%). These minerals also analysed Cr_2O_3 between 0.33% and 0.46%, Al_2O_3 between 0.79% and 1.55% and Na_2O between 0% and 0.04%.

Orthopyroxene xenocrysts (macrocrysts) are grass green in colour. Numerous dull bottle green megacrystic enstatite grains have been recognised particularly in the Kodomali kimberlite of Mainpur Kimberlite, Chhattisgarh.

In the present area, no orthopyroxene was identified.

- (vi) **Diamonds:** Alluvial diamonds can travel dozens to hundreds of kilometers (upto 600kms) downstream from the original volcanic pipe, eventually settling in river beds or ocean beaches (such as along the coast of Namibia).

20.

Highlights of Mineral Chemistry:

During the investigation, a total of 132 grains have been analysed by EPMA. Out of which, 93 nos garnets and 39 nos pyroxenes have been analysed.

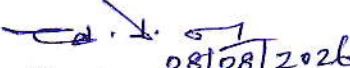
Ten grains of diopside show their mantle affinity. Two Chrome Diopsides fall in the Diamond inclusion field in CaO vs Cr_2O_3 plot of Boyd et al, 1984 indicating presence of nearby provenance within 5kms. Further work may be conducted to reach the source rock.

However, Cr_2O_3 vs MgO, Al_2O_3 vs Cr_2O_3 , Na_2O vs Ca/(Ca+Mg) and Cr+Al vs Na plots for Chrome Diopside samples may be generated to compare with crustal pyroxenes and to assess the affinity to a peridotitic or diamond inclusion environment.

The garnets analysed do not show any typical mantle affinity. One garnet shows 10.058% MgO with 37.593% pyrope content. This could be a magnesian almandine of G-5 category. Other garnets have analysed to be G0 and G4 categories in Cr_2O_3 -CaO

	plot. Few garnets with high Na₂O content plot in eclogite field on TiO₂-Na₂O plot. The garnets analysed do not give any clue for targeting kimberlite source rock. However, all the garnet grains may be plotted in Binary and triangular plots after Dawson & Stephens(1975) to compare their trend. The gravel materials were also processed but did not yield any diamond.
21.	The additional EPMA data and interpretations sent through email have been checked and considered. Please incorporate these data in the final report.
22.	Details of Borehole and Remarks column may be added in the litho-log tables. Zones of sampling and other details may be mentioned in remark column.
23.	EPMA data may be rearranged in the table mineral wise and End Members may be calculated.
24.	Please attend the corrections shown in the annexures. The photographs may be rearranged with photo number and proper caption.
25.	Chapter on Locality Index may be added.
26.	The references in the text may be listed in Reference list.
27.	After attending necessary corrections and modifications, the final Geological Report along with annexures, images, shape files , pdf files and plates may be made ready for smooth uploading to the NGDR Portal, adhering to the schema as per MERT format of NGDR.
28.	<u>Recommendations by the Peer Reviewer:</u> (i) The objectives of the item were to identify buried diamondiferous Palaeo-channels in Krishna Basin, near Mangalagiri, Guntur district, Andhra Pradesh, to understand spatial distribution, thickness and downward continuity of gravel beds and to estimate valuable diamond resources within the exploration area. The objective of the item has been achieved partially. (ii) An integrated approach was implemented through ground Geophysical exploration and scout drilling. Based on the geophysical data , out of 25 Gravel sites selected by seismic shots, seven locations were drilled and the boreholes successfully intersected gravel horizons at one or two levels between 5m and 40m below the surface and gravel zones were successfully established. (iii) Few positive kimberlitic indicators such as iron and calcium rich eclogitic garnets(G3, G4 category), Mg rich magnesian almandine(G-5 category) and few Chrome Diopside grains showing mantle affinity plot in the Diamond inclusion field in CaO vs Cr₂O₃ plot of Boyd etal,1984 indicating presence of nearby provenance within few kilometers. Further work may be conducted to reach the source rock if any. The garnets are not kimberlitic pyrope and do not show their sampling from typical lherzolitic/harzburgitic source. Further analysis of indicators will be required to ascertain the presence of Kimberlitic source. (iv) Systematic grid drilling is recommended in the block to reveal the buried

	palaeo-channels, pinch-outs and lens shaped sediment deposits. The Fence diagram may be used to map Palaeo-channels by tracking coarse channel sands across borehole data.
(v)	The most important objective was to estimate valuable resource within the area of exploration and to recommend the feasibility for further level of exploration.
(vi)	In order to recover diamonds/indicator minerals for resource estimation, it is recommended to carry out further Pitting & Trenching work and Bulk Sampling from gravel zones intersected in the boreholes. Shallow pits upto few meters deep may be excavated in dry season to target narrow diamond bearing gravel layers.
(vii)	Initial Bulk samples weighing upto 500kg may be treated to confirm the presence of microdiamonds or indicator minerals in the gravel sediments. In case of positive indication, further processing of bulk samples upto 100 tonnes may be carried out for early stage evaluation, preliminary grade estimation and checking for coarse stones.
(viii)	The bulk samples may be treated at Wajrakarur Diamond processing Facility of GSI, Anantapur district, AP or Diamond Processing Plant of NMDC at Majhgawan Mines, Panna, Madhya Pradesh.
(ix)	Further SEM EDX/EPMA studies of more number of Kimberlite Indicator Minerals(KIMs) will be necessary to ascertain the presence of primary source of diamond if any.
(x)	So, searching the primary source by tracking the indicators recovered from palaeo-channels of major distributary will be a difficult task because of multiple geomorphic cycles involved in the transport and thereby unfolding the geomorphic complexities of the area. However, search for diamondiferous gravel zones within palaeo-channels is very important and challenging as it requires lot of ground geological investigations.


 08/08/2026
 (Signature of Reviewer)

(Bijay Ketan Mishra)
 DDG(Retd.)