PROPOSAL FOR RECONNAISSANCE SURVEY (G-4) FOR POLYMETALS (Cu-Pb-Zn & Au-Ag) IN HALDWANI BLOCK (56.62 Sq. Km), DISTRICT- NAINITAL, UTTARAKHAND

COMMODITY: POLYMETALS (Cu-Pb-Zn & Au-Ag)

BY

MINERAL EXPLORATION & CONSULTANCY LIMITED
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SEMINARY HILLS
NAGPUR, MAHARASHTRA

PLACE: NAGPUR

DATE: 14.02.2025

SUMMARY OF THE BLOCK FOR RECONNAISSANCE SURVEY (G-4)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	Haldwani Block
	Exploration Agency	Mineral Exploration & Consultancy Limited (MECL)
	Commodity	Polymetals (Cu-Pb-Zn & Au-Ag)
	Mineral Belt	Lesser Himalayas
	Completion period with the entire Time schedule to complete the project	15 months
	Objectives	The objectives of current program would be: 1. Preparation of Geological map at 1:12,500 Scale. 2. To collect surface (Bedrock) samples for analyses of Polymetals and associated minerals (PGEs). 3. To delineate alterations zones and prove the mineralized potential by bedrock sampling for the outcrops, pitting, trenching and scout drilling. Scout drilling holes to be planned at convenient intervals, in the blocks exposing sections of Volcanics-Porphyry granite contact, alteration zones and the overlying quartzites and carbonate units and associated rocks and to study their lateral and vertical relationship. 4. To upgrade the block in G-3 and facilitate the state govt. for auctioning of the block.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	Work will be carried out by the proposed agency.
	Name/Number of Geoscientists	02 Geoscientist
	Expected Field days (Geology, surveyor)	240 Geologist Field days
1.	**Location**	The proposed block area for G-4 falls under the

<table>
<tr><td></td><td></td><td>majorly under Survey of India Toposheet number 53O/11. The prominent nearby villages are Kathgodam Amritpur, Salri, Amiya, Naukuchiatal, Pandeygaon, Vijraula, Siloti Pandey, Barjala, Jangliyagaon of Nainital district. Haldwani Block covers 56.62 sq.km and well-connected via road and rail network (Kathgodam & Haldwani), and via air from Pantnagar airport, which is 60 km from the block. Nearby tourist places are Nainital, Bhimtal Naukuchiatal and Saat Taal.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td><table>
<tr><th>LABEL</th><th>LONGITUDE</th><th>LATITUDE</th></tr>
<tr><td>A</td><td>79.5486610°E</td><td>29.3275676°N</td></tr>
<tr><td>B</td><td>79.5909431°E</td><td>29.3581509°N</td></tr>
<tr><td>C</td><td>79.6498334°E</td><td>29.3241953°N</td></tr>
<tr><td>D</td><td>79.6500026°E</td><td>29.2906484°N</td></tr>
<tr><td>E</td><td>79.5487553°E</td><td>29.2902487°N</td></tr>
</table></td></tr>
<tr><td></td><td>Villages</td><td>Kathgodam Amritpur, Salri, Basuli, Banana, Amiya, Chunoti, Naukuchiatal, Pandeygaon, Vijraula, Siloti Pandey, Pinshela, Barjala, Jangliyagaon</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>Nainital</td></tr>
<tr><td></td><td>District</td><td>Nainital</td></tr>
<tr><td></td><td>State</td><td>Uttarakhand</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometers)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>56.62 Sq. Km</td></tr>
<tr><td></td><td>Forest Area</td><td>No Reserved Forest and Wild life sanctuary area.</td></tr>
<tr><td></td><td>Government Land Area (Bilanam)</td><td>Data not available</td></tr>
<tr><td></td><td>Charagaha</td><td>Data not available</td></tr>
<tr><td></td><td>Private Land Area</td><td>~ 10 Sq. Km</td></tr>
<tr><td></td><td>PM Gatiskti</td><td>
The block falls in the Nainital District of Uttarakhand State.
The block is free from the eco-sensitive zone and wildlife sanctuary area.
The block mostly falls in a forest area.
The block is free from ASI monuments.
The block is free from major/minor mineral mining leases.
</td></tr>
</table>

3.	**Accessibility**	
	Nearest Rail Head	Kathgodam Railway Station is 26 km from the center of the Block
	Road	The Bhimtal-Bhowali Motorable road passes near the block and bifurcate to Naukuchiatal and Amiya and Jangliyalgaon through metaled roads.
	Airport	Pantnagar Airport, Udam Singh Nagar is the nearest airport, about 40 km.
4.	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	The region's drainage system, shaped by the dendritic to sub-parallel patterns with major rivers like the Kosi, Gaula, Dabka, and Baur flowing southward. These perennial rivers, fed by rainfall and springs, show high seasonal variability due to monsoons. Tectonic lakes such as Naini Lake, Bhimtal, and Naukuchiatal form closed basins, aiding groundwater recharge. The steep terrain and loose sediments make the area prone to landslides and flash floods during heavy rainfall. The rivers ultimately feed into larger systems like the Ramganga and Ganga, playing a crucial role in the region's hydrology and ecology.
	Rivers/ Streams	Kalsi and Gola River.
5.	**Climate**	
	Mean Annual Rainfall	Most of the rainfall occurs during the southwest monsoon season (June to September). Some rainfall also occurs during the winter months due to western disturbances. The mean annual rainfall is about **1,500 mm to 2,000 mm** per year. • Monsoon (June–September): Contributes about 70-80% of the annual rainfall. • Winter (December–February): Light rainfall or snowfall due to western disturbances. • Pre-Monsoon (March–May): Occasional showers. • Post-Monsoon (October–November): Minimal rainfall.
	Temperatures (December-June) (Minimum-Maximum)	The area experiences fairly temperate climate with warm summers and cold winters. Particularly, the valley floor is warmer. Winter spans from November to March. The area experiences an appreciable amount of rainfall during the monsoons which ranges from the

		middle of June to end of September. The prevailing climate is sub-tropical below altitudes of 1,200 m from March to June, whereas in areas above 1,600 m, the temperature is comparatively lower, a few places experience snowfall during the winters. By and large the area is forested. The vegetation consists mainly of Sal, Pine, Oak, Buruns, Kaphal and Deodar, Surai in the higher altitudes. The slopes support prolific growth of dense mixed forest of pines and some other trees too with some bushy and shrubby vegetation occurring here and there.
6.	**Topography**	
	Toposheet Number	53O/11
	Morphology of the Area	The proposed area exhibits rugged mountainous terrain with steep slopes, deep valleys, and glacially carved basins. The region includes elevated ridges, structural valleys, and tectonic lakes like Bhimtal, and Naukuchiatal, formed by geological uplift and erosion. Altitudes range from 400 meters in foothills to over 2,600 meters at peaks such as Naina Peak and Snow View Point. The district's topography is shaped by faulted and folded rock formations, influencing drainage patterns and relief. Major rivers like the Kosi, Gaula, and Dabka originate at higher elevations, carving deep gorges and V-shaped valleys as they flow southward. Soil types vary from alluvial deposits in plains to rocky, glacial, and residual soils in highlands. The region is geologically dynamic, prone to landslides, soil erosion, and seismic activity, making it an ecologically sensitive zone.
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K)	NGDR
	Geochemical Map	NGDR
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Data not available
8.	**Justification for taking up Reconnaissance Survey/ Regional Exploration**	The proposed area, located in an orogenic wedge of the Lesser Himalayas, features a complex stratigraphy where the Bhimtal and Ramgarh formations are intruded by the Amritpur Granite. Intense tectonic

		activity, thrust faults, folding, and syn-kinematic granite emplacement, has created conduits for hydrothermal fluids. Geochemical data reveal robust anomalies (~2000 ppm Cu, ~2250 ppm Zn, ~350 ppm Pb, ~10 ppm Ag), indicating a polymetallic hydrothermal system. Its reworked signature is comparable to deposits like the Iberian Pyrite Belt and Tasmanian-type VMS deposits. Consequently, a comprehensive Reconnaissance Survey (G-4) is essential to delineate alterations zones, high-priority targets and assess the area's mineral potential.

PROPOSAL FOR RECONNAISSANCE SURVEY (G-4) FOR POLYMETALS IN HALDWANI BLOCK, DISTRICT- NAINITAL, UTTARAKHAND

1.1.0 PREAMBLE

1.1.1 Polymetallic commodities, including base metals such as copper, lead, and zinc, along with precious metals like silver and gold, are integral to India's industrial and economic development. These metals are vital for key sectors such as infrastructure, electronics, automotive, renewable energy, and jewelry. As one of the world's fastest-growing economies, India's demand for these metals continues to rise, fueled by rapid urbanization, industrial expansion, and technological progress. However, due to limited domestic reserves and production constraints, the country remains heavily dependent on imports to meet its growing demand.

1.2.0 INDIA'S POLYMETALLIC DEMAND

1.2.1 India's demand for polymetals is driven by rapid industrialization, infrastructure development, and growing consumer markets. The country is a major consumer of copper, lead, zinc, silver, and gold, with increasing demand across multiple sectors. In 2021-22, India produced 4,83,994 tonnes of refined copper, 1,91,185 tonnes of primary lead, and 7,75,808 tonnes of zinc. However, it remains heavily import-dependent for copper ore, lead concentrates, and silver, with imports of silver reaching 4,422 tonnes. The domestic consumption of refined copper is expected to rise from 0.6 kg to 1 kg per capita, driven by electric vehicles, renewable energy, and infrastructure projects. India's self-sufficiency in zinc (100%) and lead (100%) is notable, while its reliance on copper imports (44% deficit) highlights supply chain challenges. The country remains one of the largest importers of gold, with significant demand from the jewelry and investment sectors. Future trends indicate a rising demand for base and precious metals, with policy initiatives promoting domestic production and exploration.

1.3.0 BACKGROUND

1.3.1 India possesses significant reserves of polymetallic minerals, including copper, lead, zinc, silver, and gold. However, production is concentrated in a few key states, with Rajasthan leading in lead, zinc, and silver production. The latest available figures highlight India's reliance on domestic and imported resources to meet its growing industrial demand.

a) COPPER

i. **Reserves**: India has an estimated 46 million tonnes of copper ore reserves, mainly in Rajasthan, Madhya Pradesh, and Jharkhand.

ii. **Production**: In 2021-22, refined copper production stood at 4,83,994 tonnes, a 33% increase from the previous year. Rajasthan is the leading producer, followed by Madhya Pradesh and Jharkhand.

b) LEAD & ZINC

i. **Reserves:** India has approximately 766.49 million tonnes of lead-zinc ore, with Rajasthan holding nearly 89% of the total reserves.

ii. **Production**: Rajasthan dominates lead and zinc production, with 16.29 million tonnes of ore treated in 2021-22. The metal content extracted was 2,10,659 tonnes of lead and 8,26,020 tonnes of zinc.

c) SILVER

i. **Reserves**: Silver is primarily extracted as a by-product from lead-zinc mining, with limited standalone reserves.

ii. **Production**: India produced 6,47,140 kg of silver in 2021-22, an 8% decline from the previous year.

d) GOLD

i. **Reserves**: India's gold reserves are relatively modest, with primary deposits found in Karnataka (Kolar Gold Fields) and Andhra Pradesh.

ii. **Production**: In 2021-22, India produced 9,931 kg of gold, marking a 34% increase from the previous year.

Table No. 1.1: State-wise Production Comparison

State	Copper (Tonnes)	Lead (Tonnes)	Zinc (Tonnes)	Silver (Kg)	Gold (Kg)
Rajasthan	16,338,461 (Ore)	2,10,659	8,26,020	6,47,140	-
Madhya Pradesh	3,57,000 (Ore)	-	-	-	-
Jharkhand	1,14,000 (Concentrate)	-	-	-	3,682
Karnataka	-	-	-	-	9,931
Andhra Pradesh	-	-	-	-	849

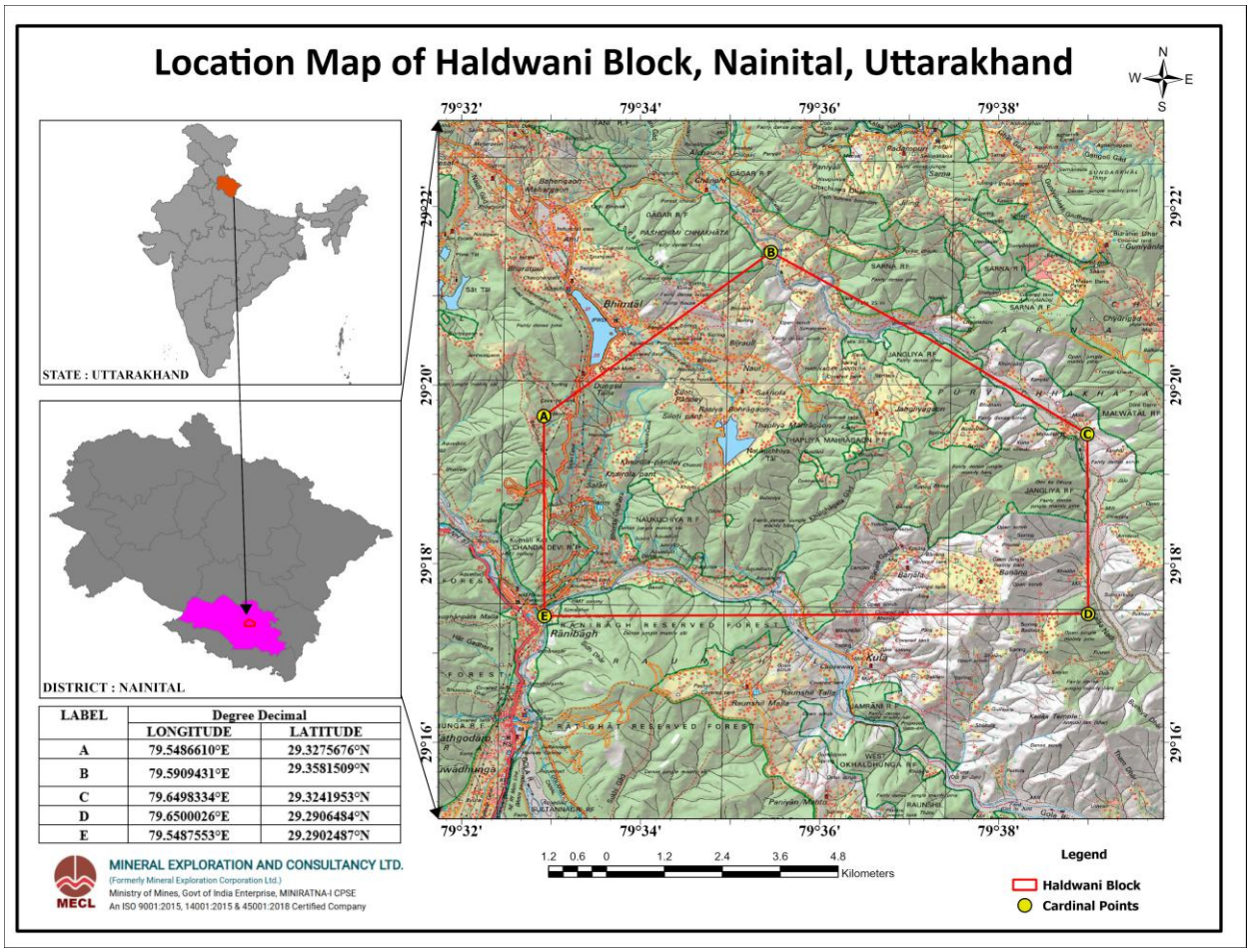
1.4.0 UTTARAKHAND

1.4.1 Uttarakhand has reported occurrences of copper, lead-zinc, and silver, particularly in Dehradun and Pithoragarh districts. However, there is no significant commercial production of polymetallic minerals in the state. The state has potential for base metal deposits, but exploration and development remain in the early stages. While Rajasthan leads in production, Uttarakhand's mining activities are still focused on exploration. Exploration programs under NMET fund could open its the potential in the Himalayan Mineral belt.

2.0.0 INTRODUCTION

2.1.0 BLOCK DESCRIPTION

2.1.1 The Haldwani Block area falls in Survey of India Toposheet No. 53O/11 and covers an area of 56.62 sq.km in and around villages Kathgodam Amritpur, Salri, Amiya, Naukuchiatal, Pandeygaon, Vijraula, Siloti Pandey, Barjala, Jangliyagaon of District: Nainital, Uttarakhand. The block is situated in Lesser Himalayas. The block's location in the toposheet is provided in **PLATE-I.** The coordinates of the block's corner points, in both Degree Decimal and UTM formats, are presented in Table No. 1.1.



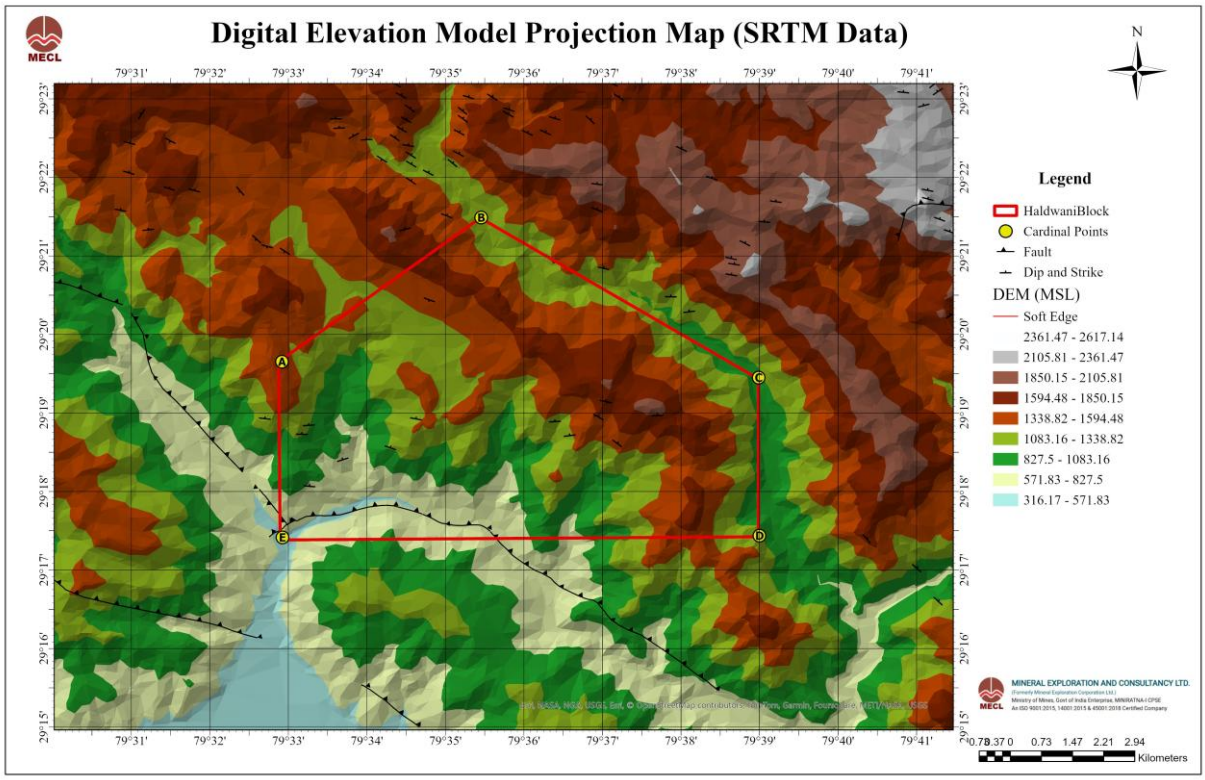
Text Figure 2.1 : Location Map of the Haldwani Block shown on Toposheet 53O/11.

Table No. 2.1: Co-ordinates of Corner Points of Haldwani Block.

LABEL	Degree Decimal		UTM (44N)	
	LONGITUDE	LATITUDE	X(E)	Y(N)
A	79.5486610°E	29.3275676°N	455938.6	3244920.91
B	79.5909431°E	29.3581509°N	459778.2	3248024
C	79.6498334°E	29.3241953°N	464932.6	3243527
D	79.6500026°E	29.2906484°N	464947.6	3240261
E	79.5487553°E	29.2902487°N	455948.4	3240229

2.2.0 LOCATION AND ACCESSIBILITY

2.2.1 The proposed Blocks falls in Nainital district and part of the Kumaon Himalayas. The Nainital district is bordered by Almora district to the north, Udham Singh Nagar district to the south, and Champawat district to the east. The Haldwani Block is well connected from Haldwani city via Haldwani-Nainital-Bhimtal Road. The Block is situated approximately 20 km from Haldwani city. Kathgodam is the nearest railway stations. Panta-Nagar Airport of Nainital is the nearest airport about 60 km away from the block. The important tourist places nearby the proposed block are Nainital, Bhimtal, Naukuchiatal and Saat Taal.



Text Figure 2.2 : Digital Elevation Projection Profile of the Haldwani Block (SRTM Data)

2.3.0 PHYSIOGRAPHY

2.3.1 The proposed area lies on the Lesser–Himalaya succession of Kumaun, immediately to the north of the Siwaliks. The main topographic feature of the area is the imposing ridge, trending roughly NW-SE circumference by Gaula River from Northern-eastern to Southern-eastern side, numerous spurs branch off in majorly north-west directions from this main ridge. Rugged topography, so characteristic of the Himalaya and typical of any young fold and thrust belt.

2.3.2 The area exhibits a rugged mountainous terrain with steep slopes, deep valleys, and glacially carved basins. The region is characterized by elevated ridges, structural valleys, and tectonic lakes, formed due to geological uplift and erosional processes. The altitude varies from 400 meters in the foothills to over 2,600 meters at peaks like Naina Peak (Cheena Peak) and Snow View Point. The region is structurally controlled, with faulted and folded rock formations

influencing the drainage pattern and topographic relief. The major rivers, including Kosi, Gaula, and Dabka, originate from the higher elevations and flow southward, carving deep gorges and V-shaped valleys. The soil composition ranges from alluvial deposits in the lower plains to rocky, glacial, and residual soils in the highlands. The district is prone to landslides, soil erosion, and seismic activities, making it a geologically dynamic and ecologically sensitive region.

2.3.3 The climate is tropical monsoon type, modified to some extent by the effects of altitude and the situation of the area in the continental interior. Winter is fairly severe with occasional snow falls between December and March. Summer season starts in April and the outdoor activities can best be done upto the end of April-June, when the monsoon breaks out. The rain is generally heavy and continues upto early September. The mean annual rainfall is about 1500-2000 mm. The drainage of the area is of consequent type, with Dendritic pattern and slightly rectangular at places.

2.3.4 The drainage system of area is primarily controlled by the hilly terrain of the Lesser Himalayas, resulting in a dendritic to sub-parallel drainage pattern. The region is drained by major rivers such as the Kosi, Gaula, Dabka, and Baur, which originate in the higher altitudes and flow southward towards the plains. These rivers are perennial, fed by rainfall and springs, but exhibit high seasonal variability due to monsoonal influence. The presence of tectonic lakes like Naini Lake, Bhimtal, and Naukuchiatal indicates closed basin drainage systems in some areas, contributing to groundwater recharge and acting as local catchments. The steep slopes and loose sediments make the region susceptible to landslides and flash floods, especially during heavy rainfall. The rivers of the district ultimately contribute to larger river systems like the Ramganga and Ganga, playing a crucial role in the hydrology and ecology of the region.

2.4.0 LAKES

2.4.1 The lakes of Nainital district, are referred as the jewels of the Kumaon region, are known for their astonishing landscape, ecological significance, and cultural importance. The Naini-Lake, a crescent-shaped water body spanning 0.48 square kilometers, with a maximum depth of 28 meters, nestled in the Nainital town and surrounded by seven hills. About 23 kilometers away lies Sattal, a cluster of seven interconnected freshwater lakes covering 0.1 square kilometers, known for rich biodiversity and birdlife. Bhimtal Lake, located 22 kilometers from Nainital, is an oval-shaped lake spanning 0.47 square kilometers, it has a small island with an aquarium at its center and a maximum depth of 18 meters. Naukuchiatal, or the nine-cornered lake, stretches across 0.98 square kilometers and is one of the deepest lakes in the region, with a maximum depth of 40 meters, offering a tranquil setting for adventure activities. These lakes,

fed by underground springs and rainwater, support diverse aquatic ecosystems and are integral to the region's ecology and tourism. However, they face threats from pollution, siltation, and encroachment, prompting ongoing conservation efforts to preserve their pristine beauty and ecological balance. Together, these lakes form the lifeline of Nainital, enchanting visitors with their charm and sustaining the local environment and culture. Only Naukuchiatal is in the center of the Haldwani Block, other lakes are in the proximity of the block.

2.5.0 FLORA & FAUNA

2.5.1 The area exhibits rich biodiversity with diverse flora and fauna due to its varied altitudes and climatic conditions**.** The forests range from broadleaf oak and rhododendron at mid-altitudes to deodar, pine, and fir in higher regions**,** while alpine meadows (bugyals) support seasonal wildflowers and medicinal plants. The region is home to wildlife such as leopards, Himalayan black bears, barking deer, and gorals**,** along with a vibrant avian population including the Himalayan Monal (state bird of Uttarakhand), Khalij Pheasants, and Steppe Eagles**.** Reptiles like the King Cobra and Himalayan Pit Viper, along with the rare Himalayan Salamander**,** inhabit the dense forests and wetlands. Lakes and rivers like Naini Lake, Bhimtal, and the Kosi River sustain Mahseer fish, catfish, and snow trout. However, deforestation, habitat loss, and climate change pose significant threats to this fragile ecosystem, highlighting the need for conservation efforts in the region.

3.1.0 REGIONAL GEOLOGY

3.1.1 The proposed area is characterized by a complex geological framework shaped by a prolonged history of sedimentation, magmatic activity, and tectonic deformation. The Bhimtal Formation forms the foundational unit, comprising thick sequences of quartzites, phyllites, mafic volcanics, and volcanic flows, dated to the Paleoproterozoic (~1860 Ma) Mandal et al. (2019). These lithologies exhibit features such as current bedding and pillow structures, indicative of shallow-water deposition, alongside evidence of hydrothermal alteration and sulfide mineralization. Overlying or adjacent to this unit is the Ramgarh Formation, composed of schists, gneisses, and quartz-feldspar porphyry, which records significant metamorphism and structural reworking. The stratigraphic sequence is further complicated by the intrusion of the Amritpur Granite, a heterogeneous suite of granitic rocks, including hornblende granite, biotite granite, granite porphyry, and muscovite granite, dated to 1900 ± 100 Ma (Mandal et al., 2019). These granitic bodies intrude along major thrust contacts, marking significant structural discontinuities and contributing to the region's dynamic tectonic evolution.

3.1.2 The tectonic evolution of the proposed area has played a pivotal role in shaping its mineralization potential. Thrusting and folding events have extensively reworked the primary sedimentary and igneous sequences, creating fluid pathways that facilitated the deposition of hydrothermal ore bodies. The juxtaposition of diverse lithologies, particularly at major

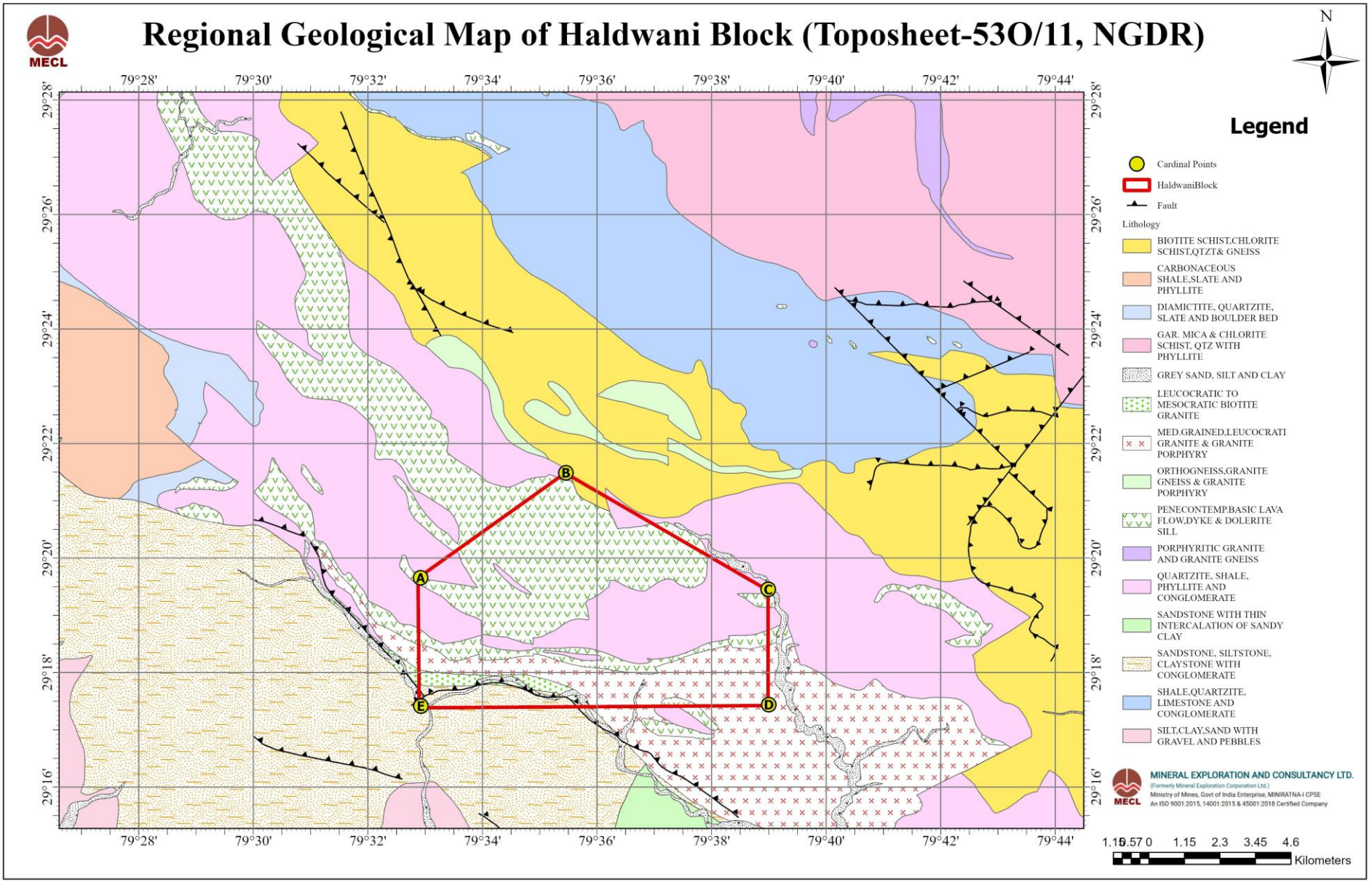
structural discontinuities such as the thrust contacts between the Bhimtal and Ramgarh formations and the intrusion of the Amritpur Granite, provided favorable conditions for the concentration of copper, lead, zinc, and associated base metals.

3.1.3 Modern geochemical surveys have identified anomalies that, when integrated with structural mapping, highlight the strong control exerted by the region's tectonic fabric on mineralization patterns. This interplay of lithological diversity, structural complexity, and alteration features underscores the area's potential for further exploration.

Table- 3.1: Litho-stratigraphic classification of Lesser Himalayans's Haldwani-Bhitmal Area.

Age	Formation	Lithology
Ediacaran	Krol Formation	Black and red shale, sandstone, cherty limestone
Cryogenian	Blaini Formation	Gray and black shale, sandstone, and dolomite
Neoproterozoic	Nagthat Formation	Muddy sandstone
<800 Ma	Chandpur Formation	Muddy sandstone and mudstone
~1860 Ma	Rautgara Formation (Bhowali Quartzite & Bhimtal Volcanics equivalent)	Quartzite, mafic sill, volcanic rocks
1900 ± 100 Ma	Amritpur Granite	Granite-granodiorite augen gneiss
Paleoproterozoic	Ramgarh Formation	Schists, gneisses, quartz-feldspar porphyry

Text Figure 3.1 : Regional Geological Map of Kumaun Lesser Himalayas, Valdiya (1980)



Text Figure 3.2 : Regional Geological Map of Haldwani Block at 1:50,000 (NGDR).

3.2.1 GEOLOGY OF THE BLOCK (56.62 Sq. km, Nainital District)

3.2.2 The Haldwani Block is characterized by a complex geological framework influenced by sedimentation, magmatic activity, and tectonic deformation. The main litho-formations present in the area include the Bhimtal & Bhowali Quartzites, Nagthat Formation, Ramgarh Formation, Amritpur Granites, and Lower Siwaliks.The Ramgarh Formation, exposed in the northernmost part of the block, has limited exposure and comprises biotite schist, chlorite schist, quartzite, and gneiss. The Nagthat Formation consists of quartzite, shale, phyllite, and conglomerate. These lithologies represent a sequence of sedimentary deposits that have undergone significant deformation. The Block geoological map is shown in Text Figure 3.5.

3.2.3 The Amritpur Granites, collectively known as the Amritpur Granite Complex, include: Leucocratic to mesocratic biotite granite (Biotite granite). Medium-grained leucocratic granite & granite porphyry (Granite porphyry). These granitic intrusions, dated to 1900 ± 100 Ma (Mandal et al., 2019), are significant magmatic features contributing to the structural framework of the region. The Bhimtal-Bhowali Quartzites and associated volcanic rocks are Paleoproterozoic (~1860 Ma) and include penecotemporaneous basic lava flows, dykes, and dolerite sills. The Lower Siwaliks are exposed in the southwestern part of the block and comprise sandstone, siltstone, claystone, and conglomerate. Below is the strtaigraphy of the area, modified after Mandal et. al. 2019.

Table- 3.2: Litho-stratigraphic classification of Haldwani-Bhitmal Area (after Mandal et. al. 2019**).**

Formation/Unit	**Lithology**	**Age**
Lower Siwaliks	Sandstone, siltstone, claystone, conglomerate	Miocene-Pliocene
Nagthat Formation	Quartzite, shale, phyllite, conglomerate	Neoproterozoic
Ramgarh Formation	Biotite schist, chlorite schist, quartzite, gneiss	Paleoproterozoic
Thrust contact with the overlying Ramgarh Formation		
Amritpur Granite Complex	Biotite granite, leucocratic granite, granite porphyry	1900 ± 100 Ma

Formation/Unit	Lithology	Age
Intrusive contact with Bhimtal Volcanics along a major thrust contact		
Bhimtal & Bhowali Quartzites	Quartzite, mafic sills, basic lava flows, dolerite dykes	~1860 Ma

3.2.4 **GEOCHEMICAL DATA**

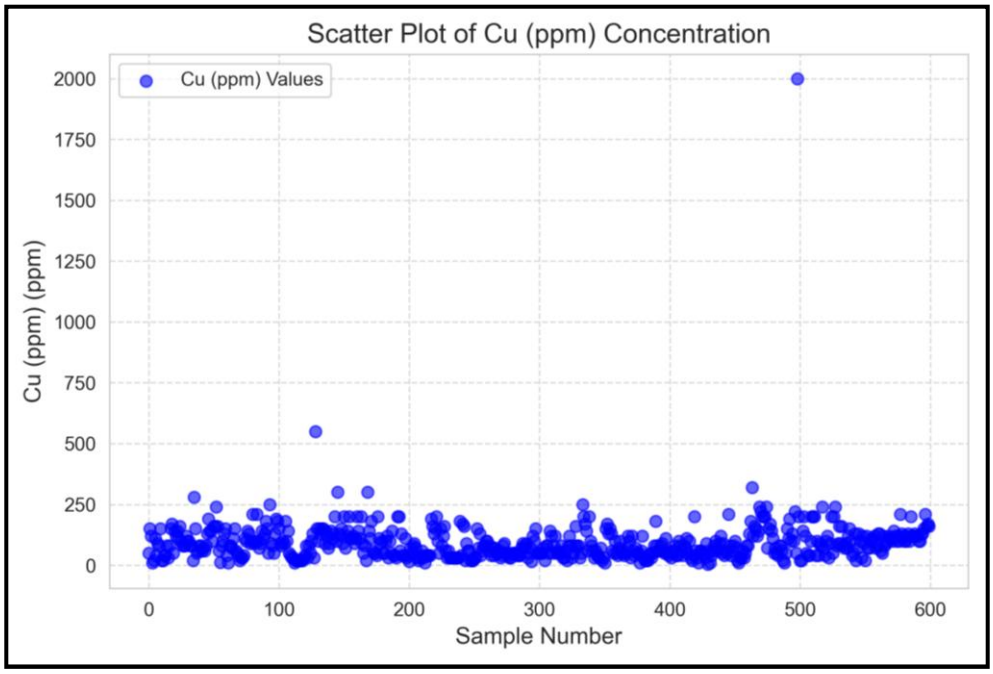
3.2.5 The geochemical analmaly map prepared by S. Kapoor, 1972-73(GSI), is shown in text fig. 3.6. The geochemical survey in the Bhimtal-Bhowali area revealed significant variation in copper concentrations, ranging from background levels of ~10 ppm to over **2000 ppm** in anomalous zones. The highest copper values were detected in basic and ultrabasic rock units, where chalcopyrite and secondary copper minerals were present. The spatial distribution of copper suggests a strong correlation with hydrothermal activity, particularly in areas with sulfide-bearing veins and altered rock units. Structural controls, such as faults, sheared zones, and fractures, appear to have played a critical role in localizing copper mineralization. The presence of copper in altered phyllitic and quartzitic units further supports the possibility of multi-phase mineralization events influenced byhydrothermal processes. The scatter graph is shown with variation in copper values in Text Figure 3.1.

3.2.6 Lead values in the analyzed soil and rock samples displayed a sporadic distribution, with concentrations typically ranging from 10 ppm to **350 ppm**, but some anomalies reaching up to **500 ppm** in localized zones. Unlike copper, which shows a broader dispersion, lead mineralization appears more restricted and structurally controlled, primarily occurring within quartz veins, phyllitic zones, and fault-related alteration zones. The observed lead enrichment is often associated with secondary oxidation products in weathered zones, suggesting supergene enrichment processes. Additionally, the presence of galena and other lead sulfides in fractured quartz veins further supports the hypothesis of lead being mobilized and precipitated along tectonic weaknesses within the area. The scatter graph is shown with variation in lead values in Text Figure 3.2.

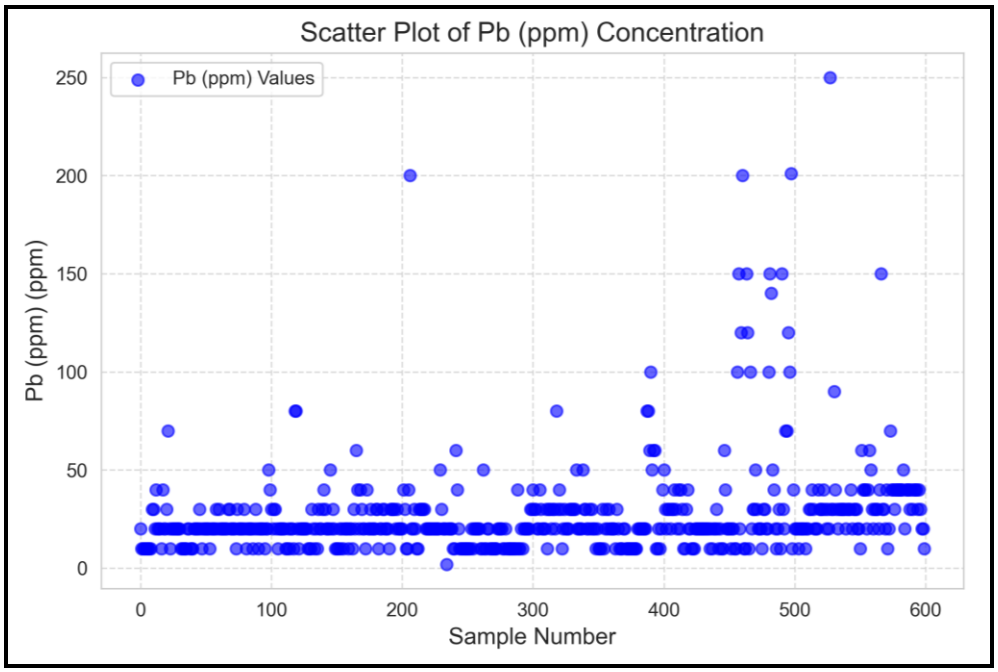
3.2.7 Zinc concentrations exhibited the widest range of variability, with values fluctuating between 50 ppm and over **2250 ppm,** indicating substantial sulfide mineralization. The highest zinc anomalies were detected in phyllitic and quartzitic rock units, often occurring alongside lead, suggesting a Pb-Zn genetic association. Zinc mineralization is primarily linked to the presence of sphalerite, which occurs as disseminations or vein-filling deposits in

hydrothermally altered zones. The spatial association of zinc with lead and copper suggests a polyphase mineralization history, potentially linked to multiple episodes of fluid migration and structural deformation. The widespread zinc enrichment highlights the area's potential for base metal exploration, warranting further investigation through detailed geochemical and geophysical surveys. The scatter graph is shown with variation in zinc values in Text Figure 3.3.

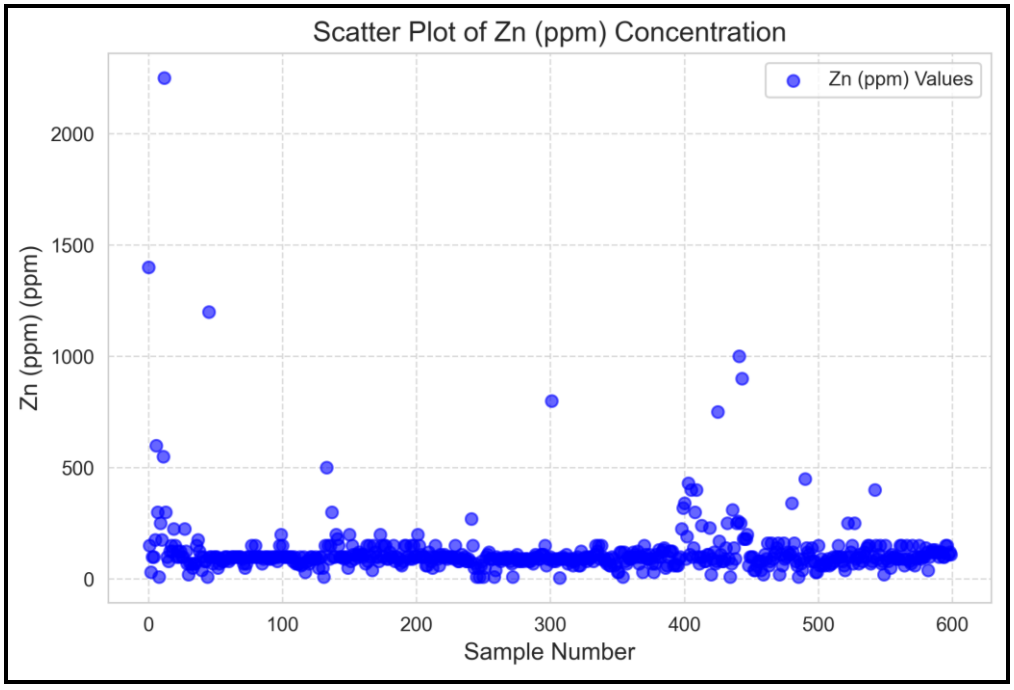
3.2.8 In addition to base metal values, geochemical studies also recorded **10 ppm of silver (Ag)**, while gold was below the detection limit of **10 ppm**, due to the limitations of the instruments present, as the analysis was conducted in 1972-73. Furthermore, samples were collected for **PGE analysis** in the view of litho-units such as **basic to ultrabasic rock types** within the Bhowali volcanics. However, the results were not updated in the reports.



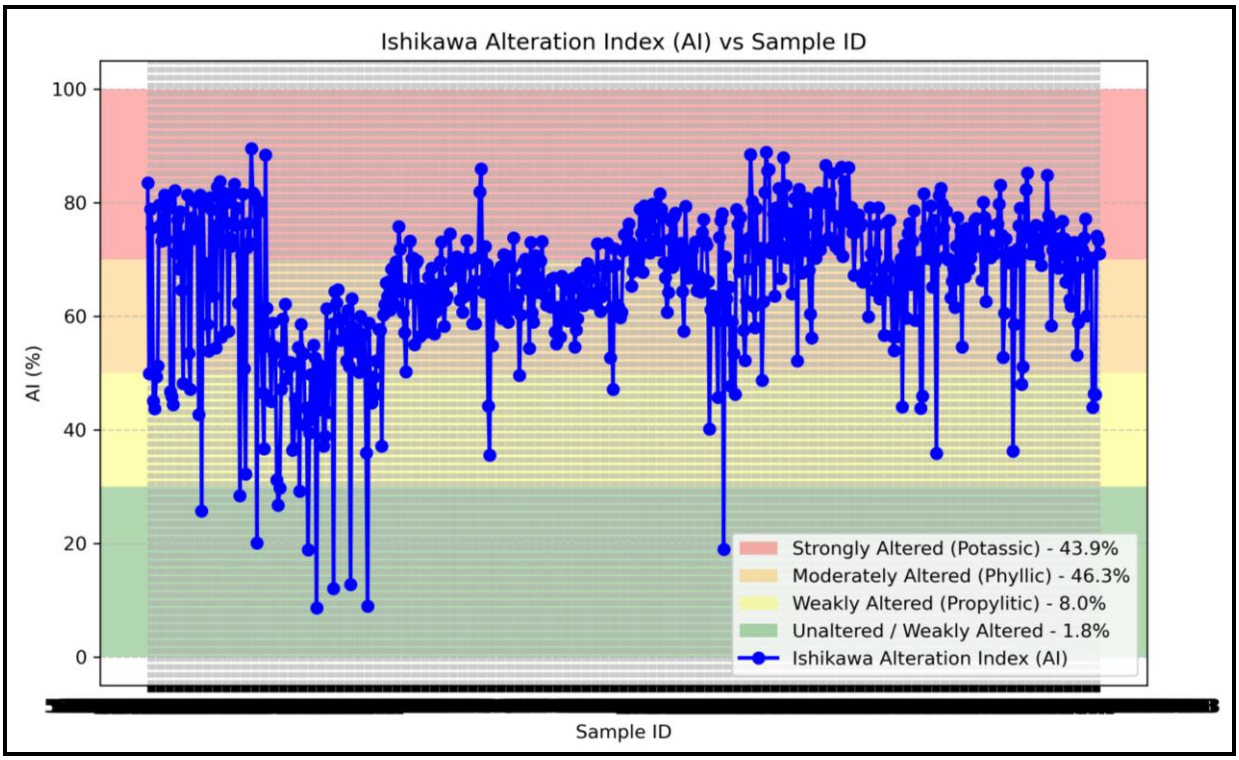
Text Figure 3.1 : Scatter graph of Copper (Cu) values vs Sample number.



Text Figure 3.2 : Scatter graph of Lead (Pb) values vs Sample number.



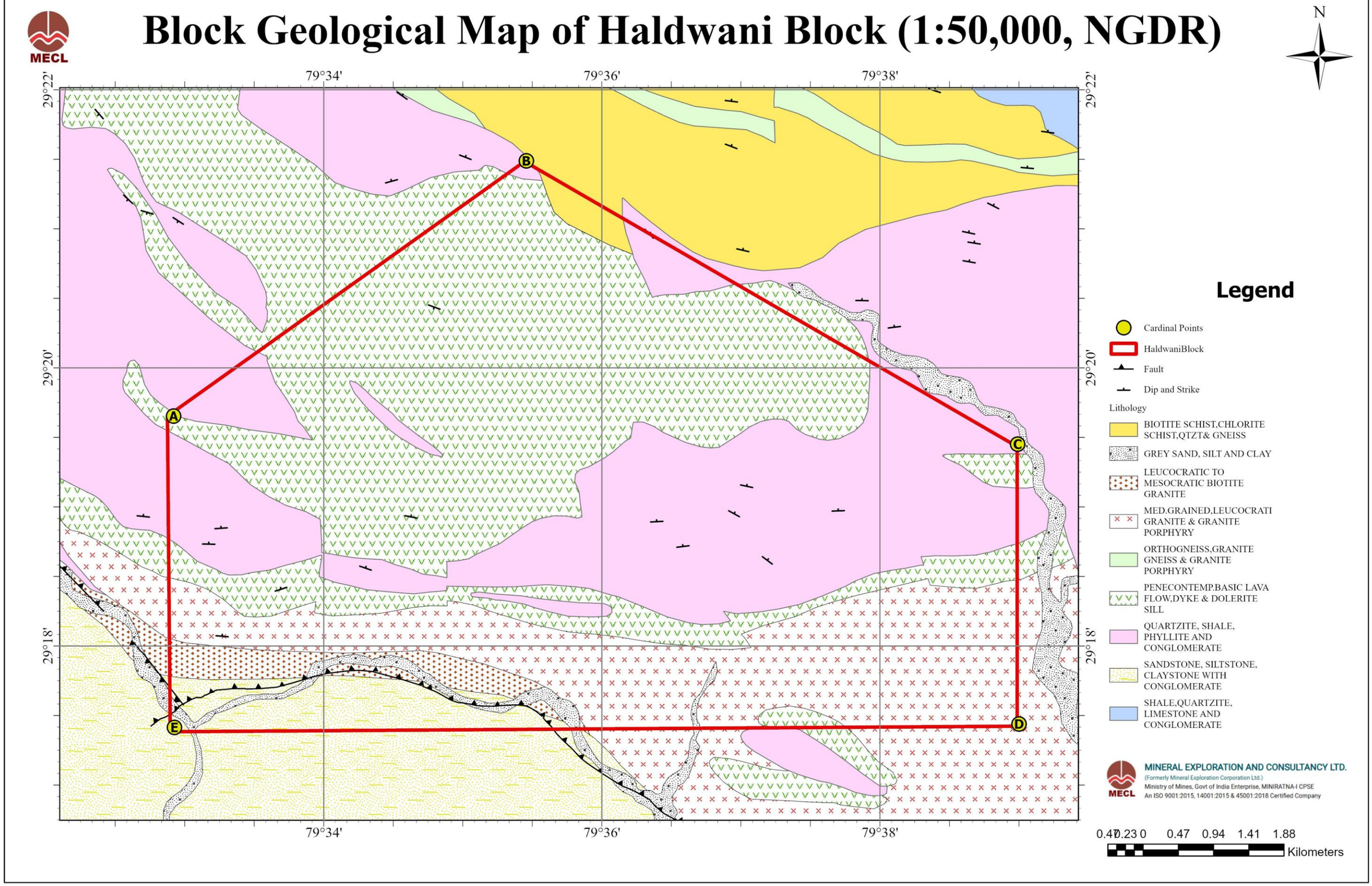
Text Figure 3.3 : Scatter graph of Zinc (Zn) values vs Sample number.



Text Figure 3.4 : The Ishikawa Alteration Index(AI), Vs. Sample Number (by Ross R. Large).

3.2.9 The Ishikawa Alteration Index (AI), developed by Ross R. Large, has been applied here using geochemical data from the GSI report by S. Kapoor (1972–73). The results primarily fall within the strongly potassic to propylitic alteration zones, indicating the alteration affinity of the area. Here, as soil samples are taken for the plot, it is mainly showing the secondary dispersion of the area, but not the actual litho-units alterations. However, since the analyzed samples are all soil samples, it is important to acknowledge that their interpretation may differ from rock samples due to secondary dispersion and mixing processes.

Block Geological Map of Haldwani Block (1:50,000, NGDR)



Text Figure 3.5: Block Geological Map of Haldwani Block at 1:50,000 (NGDR).

Geochemical Anomaly Map by S. Kapoor 1972-73 (After GSI)

MECL

N

79°34'
79°36'
79°38'
29°22'
29°20'
29°18'

A
B
C
D
E

Legend

- Cardinal Points
- HaldwaniBloc
- Dip and Strike
- Fault

Basemetal Anomaly

- Cu (0-300 PPM)
- Cu (500-2000 PPM)
- Pb (0- 350 PPM)
- Zn (550 - 2250 PPM)
- Zn (0-500 PPM)

MINERAL EXPLORATION AND CONSULTANCY LTD.
(Formerly Mineral Exploration Corporation Ltd.)
Ministry of Mines, Govt of India Enterprise, MINIRATNA-I CPSE
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0.47 0.23 0 0.47 0.94 1.41 1.88
Kilometers

Text Figure 3.6: Geochemical Anomaly Map by S.Kapoor (1972-73), GSI. Geological map at 1:50,000 (NGDR).

4.1.0 PREVIOUS WORK / BACKGROUND INFORMATION

4.1.1 The areas such as Amritpur, Galpakot, Bhimtal-Bhowali, and the Kimkhet–Khansyun belonging to Nainital district, has been investigated since British period. Early and subsequent studies in the region have established lithological units of quartzites, phyllites, granites, and basic to ultrabasic rocks. These formations have been observed with with sulphide mineralization and hydrothermal alteration processes, due to this they are probable hosts for copper and other base metals.

4.1.2 Early Investigations (Late 19th to Mid-20th Century)

4.1.3 The initial groundwork in the region was laid in the late 19th century by researchers such as Middlemiss (1880 and 1890), who documented the basic lithological units—granites, microgranites, and volcanogenic sequences—in the Amritpur and Bhimtal-Bhowali areas. Middlemiss's observations on the abnormal superposition of older and younger rock units provided the first hints of a complex tectonic regime that might be conducive to mineralization. Later, during the mid-20th century, Nautiyal (1943–44) refined the stratigraphic framework by grouping the quartzites of Bhimtal-Bhowali with the Ramgarh Formation. His work not only clarified the stratigraphy but also suggested a possible tectonic transport of granitic blocks, which later proved relevant in understanding the emplacement of copper-bearing sulphide minerals.

4.1.4 Base Metal Exploration (1950–1970)

4.1.5 Building on early observations, several geologists conducted regional mapping and preliminary exploration in the 1950s and 1960s. Researchers including Kharakwal (1951), Srivastava (1951), or Pande et al. (1963) contributed to recognizing the presence of ancient copper workings in the Amritpur area. During the 1960s, Raina and Dungrakoti (1966) were among the first to report sulphide mineralization in the Galpakot region. Their studies identified minerals such as chalcopyrite, pyrite, and galena, suggesting that copper, along with lead and zinc, was being concentrated along structural conduits. This phase of work laid the groundwork for understanding the potential of the region for base metal deposits.

4.1.6 Detailed Geochemical and Structural Studies (1970–1990)

4.1.7 Jangpangi et al. (1970) undertook preliminary geochemical appraisals, confirming anomalies in copper, lead, and zinc across several blocks, including Kimkhet and Khansyun. Concurrently, hydrogeochemical studies by Chattopadhyaya and Saran (1968) provided insight into the dispersion of base metals and established that the anomalies were likely related to a syngenetic mineralization process. Significant contributions during this period also include Desai's work on the spillite-keratophyre-soda granite association in the

Ranibagh-Amritpur area. His research linked the magmatic evolution of the region to the observed mineralization, while Varadrajan's (1978), K–Ar dating of the Amritpur Granite refined the timing of magmatic events that could be associated with copper and base metal deposition. Chatterjee (1979) further emphasized the role of structural controls by showing that the granites were synkinematic, meaning their emplacement was contemporaneous with deformation, a factor that often promotes the formation of hydrothermal ore bodies.

4.1.8 **Recent Work and Current Understanding (1990s–Present)**

4.1.9 More recent investigations have continued to validate the earlier findings. Detailed geochemical surveys in the Amritpur and Galpakot areas have recorded significant copper anomalies—with values in some zones reaching up to 2000 ppm Cu along with lead and zinc, though sporadically distributed, are also present in anomalous concentrations. These studies suggest the basic and ultrabasic rocks are hosts for mineralization, where copper is mainly associated with chalcopyrite within quartz veins and altered basic rocks. Additionally, the elevated levels of nickel and cobalt in certain areas point to a polymetallic character in the mineralization. Although the analytical results for Platinum Group Elements (PGEs) are not included in Kapoor's (1972–73) report, the author recommended analyzing a few samples for PGEs from the Bhimtal-Bhowali volcanics, as their potential association with mafic and ultrabasic rocks further enhances the overall exploration potential of the area.

4.2.0 OBSERVATION AND RECOMMENDATIONS OF PREVIOUS WORK

4.2.1 Previous work indicates that the area exhibits significant copper, lead, and zinc anomalies, with values reported Copper (Cu) - 2000 ppm, Lead (Pb) - 250 ppm, Zinc (Zn) - 2250 ppm, and Silver (Ag) - 10 ppm, all associated with sulphide mineralization and hydrothermal alteration within a lithologically diverse framework of quartzites, phyllites, granites, and basic to ultrabasic rocks. These geochemical and structural indicators, combined with elevated nickel and cobalt levels and potential associations with platinum group elements (PGEs), suggest the area's polymetallic potential. Based on these findings, it is recommended to advance to a Reconnaissance Survey (G-4 stage) that focuses on delineating prospective targets through expanded geochemical sampling and detailed structural mapping, with an emphasis on analyzing selected mafic and ultrabasic rock samples for platinum group elements to comprehensively evaluate the polymetallic potential of the area.

4.3.0 JUSTIFICATION

4.3.1 The proposed area is geologically complex and highly prospective for polymetallic mineralization. The region comprises of an intricate stratigraphic sequence, including the Bhimtal and Ramgarh formations intruded by the Amritpur Granite Complex, that creates a

mosaic of rock types ideal for fluid flow and mineral deposition. Intense tectonic processes have produced a structurally complex environment with thrust faults, folds, and syn-kinematic granite emplacement. These features have generated conduits for hydrothermal fluids and potential pathways for magmatic segregation, particularly favouring the concentration of copper, zinc, lead, nickel, cobalt, and platinum group elements (PGEs).

4.3.2 Geochemical studies have revealed significant anomalies, with surface values reaching approximately 2000 ppm Cu, 2250 ppm Zn, 350 ppm Pb, and 10 ppm Ag, indicative of a hydrothermal system. These anomalies occur within quartzites, phyllites, granites, and basic to ultrabasic rocks, which together provide an ideal setting for both hydrothermal and magmatic mineralization processes. The elevated base-metal concentrations, along with associated sulphide mineralization and hydrothermal alteration, underline the area's polymetallic potential and support its affinity with world-class reworked VMS deposits.

4.3.3 Situated in an orogenic wedge (tectonic load) setting of the Lesser Himalayas (An Yin, 2006), the proposed block exhibits a reworked hydrothermal signature analogous to deposits in the Iberian Pyrite Belt, Sullivan, Flin Flon, and Oleniy Log. Although these deposits formed originally as syn-tectonic VMS systems, they were later modified by crustal shortening, intense thrusting, and folding, resulting in confined, enriched ore bodies with subdued surface expressions. Moreover, the proposed Haldwani block’s association of S-type granites with mafic volcanics and its pronounced Cu–Zn–Pb–Ag anomalies also correlate its characteristics with Tasmanian-type VMS deposits.

4.3.4 Given these integrated geological, structural, and geochemical observations, a comprehensive Reconnaissance Survey (G-4) is recommended. A systematic exploration programme, with large scale geological mapping, geochemical sampling, detailed structural mapping, and targeted geophysical investigations, with few scout drill holes, will be essential to delineate high-priority targets, and improve the understanding of mineralization controls, and evaluate the economic viability of the area for VMS, SEDEX, or orogenic deposit models.

4.3.5 **TECTONIC CONTROLLED MINERALZIATION**

4.3.6 The tectonic evolution of the Haldwani Block has significantly influenced its mineralization potential. Thrusting and folding events have extensively reworked the sedimentary and igneous sequences, creating favorable conditions for mineral deposition. The presence of major thrust contacts between the Bhimtal, Nagthat, and Ramgarh Formations, along with the intrusion of the Amritpur Granite Complex, provides a favorable setting for base metal mineralization, including copper, lead, and zinc. The previous geochemical surveys highlight mineral anomalies, indicating a strong structural control over mineralization. The interplay of lithological diversity, structural complexity, and hydrothermal alteration suggests high

exploration potential. A G-4 level survey is essential to delineate high-priority exploration targets with the expanded geochemical sampling, geological mapping in Large scale, detailed structural analysis, Geophysical investigations, particularly focused on basic and ultrabasic units that may host platinum group elements (PGEs).

4.4.0 OBJECTIVE

4.4.1 The exploration is proposed with the following objectives:

a) Preparation of Geological map at 1:12,500 Scale.
b) To collect surface (Bedrock) samples for analyses of Polymetals and associated minerals.
c) To delineate alterations zones and prove the mineralized potential by bedrock sampling for the outcrops, pitting, trenching and scout drilling. Scout drilling holes to be planned at convenient intervals, in the blocks exposing sections of Volcanics-Porphyry granite contact, alteration zones and the overlying quartzites and carbonate units and associated rocks and to study their lateral and vertical relationship.
d) To upgrade the block in G-3 and facilitate the state govt. for auctioning of the block.

4.5.0 PROPOSED EXPLORATION SCHEME

4.5.1 In accordance with the objective set for Haldwani Block, the following scheme of exploration has been formulated. The details of different activities to be carried out are presented in subsequent paragraphs.

4.5.2 **GEOLOGICAL MAP**

4.5.3 The geological map (1:12,500 scale) will be prepared based on structural data, surface samples, drill core-log etc. carried out during G-4 stage. This map will be used as base map for future work.

4.5.4 **SURFACE SAMPLES (PRIMARY SAMPLES):**

4.5.5 During large-scale mapping, samples will be collected from sulphide-bearing rocks to delineate alteration zones, including prophyllic, phyllic, argillic, and potassic areas, in proximity to the potential polymetallic deposit. Field-portable XRF instruments will also be employed for rapid, on-site geochemical screening, which will aid in identifying optimal sampling locations for further analysis.

4.5.6 **DRILLING**

4.5.7 After surface geological mapping and geochemical sampling, the alteration zones will be identified. To evaluate the potential of the mineralized zones along strike and dip, a few scout boreholes ~10 Borehole (BH) with atleast a depth of 100 meters will be planned in 56.62 Sq.

km of the block area. This will target shallow-level intersections of ore body to confirm the mineralized horizons and reveal the structural complexity in proximity to the MBT zone.

4.5.8 LABORATORY STUDIES

4.5.8.1 CHEMICAL ANALYSIS:

4.5.8.1.1 For polymetallic exploration in hydrothermal deposits (particularly in VMS or orogenic gold systems), it is essential to analyze both major and trace elements. Major oxides such as SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, and TiO_2, and P_2O_5%, with SO_3%, & LOI% provide insight into the mineralogical changes associated with hydrothermal alteration, and will help in delineating the alterations zones of potassic alteration (K-feldspar and biotite), phyllic alteration (sericite and quartz), propylitic (chloritic) alteration zones (iron and magnesium). Trace elements especially Cu, Zn, Pb, Ag, Au, As, Sb, Mo, Co, Ni, and REEs are critical for defining metal halos and assessing the polymetallic potential.

4.5.8.1.2 A comprehensive analytical program will be employed and using MECL's advanced laboratory instruments. Major oxides will be determined using X-ray Fluorescence (XRF), while trace elements will be quantified by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). AAS and fire-assy techniques will help in identification of Base-metals (Cu-Pb-Zn), Gold (Au), Silver (Ag) and PGEs elements. Mineralogical (characterization and to confirm the presence of alteration minerals, X-ray Diffraction (XRD) and Electron-Probe Micro-analyser (EPMA) are invaluable. Field-portable XRF instruments also provide rapid, on-site geochemical screening to guide detailed investigations. This integrated approach ensures that alteration zones are accurately mapped, aiding in the targeting of high-priority areas within a polymetallic hydrothermal system.

a) **Primary Samples**- All the primary samples including bedrock, stream and soil samples will be analyzed from NABL accredited laboratory form the below metioned methods i.e.,
b) **ICP-MS studies** will be done on (30 Nos) of samples to know the presence of trace elements and REE.
c) **XRF studies** of (50 Nos) major oxides for identification of basic to ultra-basic aphanitic rocks.
d) **AAS**: AAS is a sensitive analytical technique used to quantify base metals (Cu, Zn, Pb). It is rapid, cost-effective, and ideal for routine analysis, the Basemetals will be identified using this technique. Although it may be less

effective for ultra-trace levels of precious metals i.e. Gold and PGEs, so that will be done through fire-assay only.

e) **FIRE-ASSAY:** The fire-assay or gravimetric method widely regarded as the standard for determining precious metals such as gold, silver, and PGEs. This technique involves fusing the sample with fluxes to separate the precious metals from the bulk matrix, followed by cupellation to isolate and accurately measure them. Few samples of Gold, Silver and PGEs will be analysed by the fire-assay methods.

4.5.8.2 **PHYSICAL ANALYSIS**

a) **XRD studies** will be done on (20 Nos) of samples to know the presence of mineral phases.

b) **Petrological Studies:** Petrological studies will be done on around (20 Nos) of rock specimen.

c) **Mineragraphic Studies:** Mineragraphic studies will be done on around (20 Nos) of rock specimen for polymetals.

4.6.0 QUANTUM OF WORK

The details of the quantum of work block in Haldwani Block have been furnished below:

Table No 4.1: Summarized Details of the proposed quantum of work

Proposed Nature of Quantum for Reconnaissance Survey (G-4) for Polymetals in Haldwani Block, District: Nainital, Uttarakhand			
Sl. No.	**Item of Work**	**Unit**	**Proposed Quantum of work**
1	**Large Scale Geological Mapping** (at 1:12,500 Scale)	sq. km	56.62
2	**Geochemical Sampling**		
	Surface sampling	Nos.	290
3	**Geophysical Studies**		
	I.P.-cum-Resistivity, S.P. & Magnetic (8-12 Line Km)	Nos	2
4	**Pitting and Trenching**		
	a) Trenching	Cu. m	100
	b) Trench Sampling	Nos	100
5	**Exploratory Drilling**		
	a) Drilling (core) Scout drilling (10 BH)	Meters	1000
	b) Borehole core samples (primary)	Meters	110
6	**Laboratory Studies**		
	A. Primary Samples (Surface (BR+SSS)) + BH Core + Trench)		
	a) Rapid Geochemical Analysis by AAS method: (Cu-Pb-Zn-Ag	Nos.	250

Proposed Nature of Quantum for Reconnaissance Survey (G-4) for Polymetals in Haldwani Block, District: Nainital, Uttarakhand			
	b) Gold Analysis by Fire-assay: Au	Nos.	70
	c) For PGEs (ICP-MS Ni-S Fire assay Technique): PGEs	Nos.	30
	d) IC-PMS; 34 Elemental Study - As, Sb, Mo, Co, Ni, Sn, Hf, Nb, Ta, Ge, W, Ti, Zr, Se, Te, Cs, Y, Rb, Sr, Ba and REEs: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu.	Nos.	150
	e) XRF Analysis; Primary for major oxides i.e., SiO_2%, Al_2O_3%, Fe_2O_3%, MnO%, MgO%, CaO%, Na_2O%, K_2O%, P_2O_5%, TiO_2%, SO_3%, & LOI%.	Nos.	40
	f) External Check sample (10 % of Primary samples) for analysis	Nos.	54
7	**Physical Studies**		
	a) XRD studies	Nos	20
	b) Petrographic Studies	Nos	20
	c) Mineragraphic Studies	Nos	20
	d) EPMA Studies of Sulphides phases	Nos	05
8	**Report Preparation (5 Hard copies with a soft copy)**	Nos.	01

5.1.0 BREAK-UP OF EXPENDITURE

5.2.0 Tentative Cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. OM No. 61/1/2018/NMET dated 31st March 2020. The total estimated cost is **Rs. 567.84 (say, in lakhs).** The summary of tentative cost estimates for Reconnaissance Survey (G-4 Level) is given in **Table – 4.2.** Detailed cost sheet for proposed Reconnaissance Survey (G-4) for Polymetals is given as **Annexure No. I.**

Table-4.2: Summary of Cost Estimates for Reconnaissance Survey (G-4 Level) Exploration

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Work	1,10,73,277.60
2	Pitting & Trenching	11,15,550.00
3	Drilling	2,27,94,418.40
4	**Sub total**	**4,46,89,489.10**
5	Geologist at HQ	**8,10,000.00**
6	Laboratory Studies	7,03,275.00
7	**Sub total**	**15,13,275.00**
9	Report	13,91,411.52
10	Peer Review	30,000.00
11	Proposal Preparation	5,00,000.00
12	**Sub total**	**19,21,411.52**
13	**Total**	**4,81,24,175.62**
14	GST (18%)	86,62,351.61
Total cost including 18% GST		**5,67,86,527.23**
SAY, in Lakhs		**567.87**

7.0.0 TIMELINE

7.1.0 The proposed exploration program envisages geological mapping, surface sampling, drilling, sample preparation and laboratory studies, which will be completed within 06 months, geological report preparation with peer review will take 06 months. Therefore, a total of **15 months** is planned for completion of the entire proposed program in view of tough Himalayan hilly and rugged terrain and other climatic difficulties. Tentative Time schedule/action plan for proposed Reconnaissance Survey (G-4) for Polymetals is given in **Annexure No. II.**

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6. NGDR website, Hosted by GSI, Ministry of mines, Government of India.
7. Earth Data website by Nasa.
8. USGS DATA.

LIST OF PLATES

1. Plate-I: Location map of Haldwani Block, District-Nainital, Uttarakhand.
2. Plate-II: Digital Elevation Model Projection Map with proposed Block (SRTM Data).
3. Plate-III: Block Geological map showing proposed Block (Source: NGDR).
4. Plate-IV: Geochemical anomalies map showing proposed Block (Source: NGDR).

Cost Estimate of Reconnaissance Survey (G-4 Stage Exploration) For Polymetals in Haldwani Block, Districts: Nainital, State: Uttarakhand
Total Area - 56.62 sq km; Completion Time -15 Months, Review after 6th Month, Drilling 500 m, BH 05 Nos

S.N	Item of Work	Unit	Rates as per NMET SoC 2020-21			Estimated Cost of the		Remarks
			SoC-Item -Sl No.	Rates as per SoC	Rate@3.35 times for Himalya region	Qty.	Total Amount (Rs)	
A	**GEOLOGICAL WORK**							
a	Charges for Geologist at field for Large scale mapping (1: 12,500), Surface sampling and drilling	day	1.2	11,000	36,850	240	88,44,000	
b	Labour Charges for Geologist;	day	5.7	526	1,762	480	8,45,808	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
c	Charges for Sampler for geochemical, channel samples	one sampler per day	1.5.2	5,100	17,085	44	7,51,740	
d	Labour Charges for Sampling Work; Base rate - Rs. 526/ per day	day	5.7	526	1,762	176	3,10,130	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
e	DGPS Survey for BH fixation & RL determination	Per Point of observation	1.6.2	19200	64,320	5	3,21,600	05 Core Drill BHs
	Sub-Total A						**1,10,73,278**	
B	**PITTING AND TRENCHING**							
a	Excavation of Trenches upto 2.0 m depth	Cu m	2.1.1	3,330	11,156	100	**11,15,550**	
C	**GEOPHYSICAL SURVEY**							
a	I.P.-cum-Resistivity, S.P. & Magnetic	8-10 Line km	3.4b	14,48,693	48,53,122	2	**97,06,243**	
D	**DRILLING**							
1	Core Drilling up to depth of 300 m - Hard Rock	m	2.2.1.4a	11,500	38,525	500	1,92,62,500	
2	Land / Crop Compensation (in case the BH falls in agricultural Land)	per BH	5.6	20,000	67,000	5	3,35,000	
3	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	6,700	5	33,500	
4	Transportation of Drill Rig & Truck associated per drill	Km	2.2.8	36	121	2,314	2,79,068	Approx 1157 km from Nagpur to Haldwani Block
5	Monthly Accomodation Charges for drilling Camp	month	2.2.9	50,000	1,67,500	4	6,70,000	
6	Drilling Camp Setting Cost	Nos	2.2.9a	2,50,000	8,37,500	1	8,37,500	
7	Drilling Camp Winding up Cost	Nos	2.2.9b	2,50,000	8,37,500	1	8,37,500	
8	Road Making (Hilly Terrain)	Km	2.2.10b	32,200	1,07,870	5	5,39,350	
	Sub-Total C						**2,27,94,418**	
E	**Sub Total A to C**						**4,46,89,489**	
F	**Charges for Geologist at HQ for data processing**	**day**	**1.3**	**9,000**		**90**	**8,10,000**	
G	**Charges for Geologist at HQ for Remote Sensing Studies processing**	**day**	**1.3**	**9,000**		**20**	**1,80,000**	
H	**LABORATORY STUDIES**							
1	**Chemical Analysis**							
i)	**Primary Samples Surface (BR+SSS)+ Trench + BH Core Samples**							**Total Sample = 540 (Surface-290, Trench-110, BH- 100)**
a)	Rapid Geochemical Analysis by AAS method: Cu-Pb-Zn-Ag	Nos	4.1.7a	2,506		250	6,26,500	Surface samples (BR+SSS)-150, Trench-50, BH Core-50
b)	Gold Analysis by Fire-assay: Au	Nos	4.1.5a	2,380		70	1,66,600	Surface samples-30, Trench-20, BH Core-20
c)	For PGEs (ICP-MS Ni-S Fire assay Technique): PGEs	Nos	4.1.5d	11,800		30	3,54,000	Surface samples-10, Trench-10, BH Core-10
d)	IC-PMS; 34 Elemental Study - As, Sb, Mo, Co, Ni, Sn, Hf, Nb, Ta, Ge, W, Ti, Zr, Se, Te, Cs, Y, Rb, Sr, and REEs: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu.	Nos	4.1.14	7,731		150	11,59,650	Surface samples(BR)-100, Trench-20, BH Core-30
e)	SiO2%, Al2O3%, Fe2O3%, MnO%, MgO%, CaO%, Na2O%, K2O%, P2O5%, TiO2%, SO3%, & LOI% by XRF	Nos	4.1.15a	4,200		40	1,68,000	
ii)	**External check samples (10%)**							
a)	External Check Sample (10 % of Primary samples) for analysis by AAS method: Cu-Pb-Zn-Ag	Nos	4.1.14	2,506		25	62,650	
b)	External Check Sample (10 % of Primary samples) for analysis by Gold Analysis by Fire-assay of Au	Nos	4.1.7a	2,380		7	16,660	
c)	External Check Sample (10 % of Primary samples) for analysis by For PGEs (ICP-MS Ni-S Fire assay Technique): PGEs	Nos	4.1.5d	11,800		3	35,400	
	External Check Sample (10 % of Primary samples) for analysis by IC-PMS; 34 Elemental Study	Nos	4.1.14	7,731		15	1,15,965	
d)	External Check Sample (10 % of Primary samples) for analysis by SiO2%, Al2O3%, Fe2O3%, MnO%, MgO%, CaO%, Na2O%, K2O%, P2O5%, TiO2%, SO3%, & LOI% by XRF	Nos	4.1.15a	4,200		4	16,800	
2	**Physical & Petrological Studies**							
i)	Preparation of thin section	Nos	4.3.1	2,353		20	47,060	
ii)	Complete petrographic study report	Nos	4.3.4	4,232		20	84,640	
iii)	Preparation of polish section	Nos	4.3.2	1,549		20	30,980	
iv)	Complete mineragraphic study report	Nos	4.3.4	4,232		10	42,320	
v)	Digital Photographs	Nos	4.3.7	280		10	2,800	
vi)	XRD Study	Nos	4.5.1	4,000		20	80,000	
	EPMA study of the Sulphide phases and PGEs	Nos	4.4.1	8,500		5	42,500	
	Sub-Total -H						**7,03,275**	
I	**Total E+F+G+H**						**4,63,82,764**	
J	**Geological Report Preparation**	**5 Hard copies with a soft copy**	**5.2**	For the projects having cost exceeding Rs 300 Lakh, A minimum of Rs 9.0 Lakh or 3% of the work whichever more and Rs 10000/- per each additional copy			**13,91,412**	EA has to submit the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.
K	**Peer review Charges**		**As per EC decision**				**30,000**	
L	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	**5 Hard copies with a soft copy**	**5.1**	**2% of the Cost or Rs. 5.00 Lakhs whichever is lower**			**5,00,000**	EA has to submit the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal.
M	**Total Estimated Cost without GST**						**4,83,04,176**	
N	**Provision for GST (18% of L)**	**%**					**86,94,752**	GST will be reimburse as per actual and as per notified prescribed rate
O	**Total Estimated Cost with GST**						**5,69,98,927**	
						or Say Rs. , In Lakhs:	***569.99***	

Note:	
a	Trenching/Pitting dimensions are tentative may vary depending upon the geology and field conditions
b	2nd level of work shall be carried out after review of 1st level work i.e. Geological mapping, geochemical sampling and analysis
c	Payment for Hyperspectral Data for Remote Sensing Analysis shall be made as per actual

Note - If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execusion of the project by NEA on its own, a Certifiate regarding non

Time Schedule for Reconnaissance Survey (G-4 Stage Exploration) For Polymetals in Haldwani Block, Districts: Nainital, State: Uttarakhand

		1	2	3	4	5	6		7	8	9	10	11	12	13	14	15
1	Camp Setting																
2	Geological Party Days																
3	Sampling																
4	Sample Preparation																
5	Laboratory Studies																
6	DGPS survey /BH Fixation							Review									
7	Core Dilling																
8	Core Sample Preparation																
9	Camp Winding																
10	Geologist Party days, HQ																
11	Geological Report Writing																
12	Peer Review																

* Commencement of project will be reckoned from the day the exploration acreage is available along with all statutory clearances
* Time loss on account of monsoon/agricultural activity/forest clearance/local law and order problems will be addition to above time line

Block Geological Map of Haldwani Block (1:50,000, NGDR)

MECL

N

79°34' 79°36' 79°38'

29°22' 29°20' 29°18'

A B C D E

Legend

- Cardinal Points
- HaldwaniBlock
- Fault
- Dip and Strike

Lithology

- BIOTITE SCHIST,CHLORITE SCHIST,QTZT& GNEISS
- GREY SAND, SILT AND CLAY
- LEUCOCRATIC TO MESOCRATIC BIOTITE GRANITE
- MED.GRAINED,LEUCOCRATI GRANITE & GRANITE PORPHYRY
- ORTHOGNEISS,GRANITE GNEISS & GRANITE PORPHYRY
- PENECONTEMP.BASIC LAVA FLOW,DYKE & DOLERITE SILL
- QUARTZITE, SHALE, PHYLLITE AND CONGLOMERATE
- SANDSTONE, SILTSTONE, CLAYSTONE WITH CONGLOMERATE
- SHALE,QUARTZITE, LIMESTONE AND CONGLOMERATE

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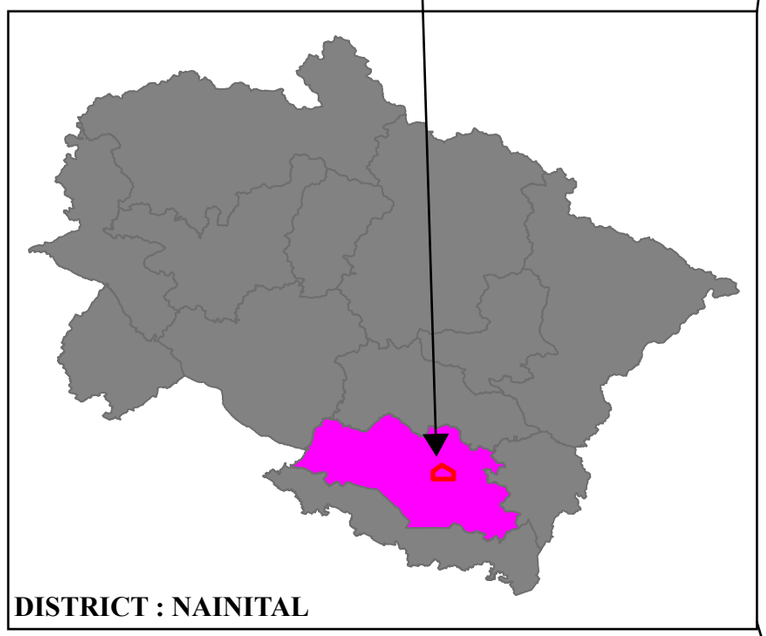
0.47 0.23 0 0.47 0.94 1.41 1.88
Kilometers

Location Map of Haldwani Block, Nainital, Uttarakhand



LABEL	Degree Decimal	
	LONGITUDE	LATITUDE
A	79.5486610°E	29.3275676°N
B	79.5909431°E	29.3581509°N
C	79.6498334°E	29.3241953°N
D	79.6500026°E	29.2906484°N
E	79.5487553°E	29.2902487°N

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