REPORT

ON THE FIRST PHASE OF

COPPER EXPLORATION

IN BLOCK-9

COVERING PARTS OF WILAYATS BARKA, NAKHL

AND WADI AL MAWEL, OMAN.

JANUAY, 2011

SUBMITTED BY:

FIVE SEAS INTERNATIONAL LLC,

MUSCAT, OMAN

TO THE MINISTRY OF COMMERCE AND INDUSTRY

TABLE OF CONTENTS

1. INTRODUCTION:

1-1: Background and Objectives:

This first phase of exploration was carried out based on the scope of works described in the geological report submitted to the Ministry of Commerce and Industry in August 2010. The objective of this activity was to decide whether to go for further exploration of phase second or not.

1-2: Accessibility to the Prospect Area:

Block-9 constitutes the northern part of the Samail Ophiolite Belt. It is situated in the western side of the Oman Mountains. It has an area covering about 396 sq km. The points number 2 and 3 of the study area are located in the tertiary wadi gravel, whereas points number 1 and 4 are in the hills composed of mantle sequence of ophiolite complex and limestone of Hawasina nappe, respectively. The area can be accessed from Muscat-Barka-Rustaq black top road up to Subaikhah diversion point and further to various places in the given area through Wadi Abiyad and Wadi Mawel. The Wadi Ash Sibaikh and Qalqal villages in the study area can be accessed from the Abiyad diversion point in Wadi Mawel. The distance from Muscat to Subaikhah village diversion point is about 139 km.

The prospect area forms a polygon bounded by lines joining the points given in table 1. Each point is expressed as UTM coordinates in WGS 84 spheroid.

Table-1

Point	UTM Easting	UTM Northing
1.	560486.06	2584827.9
2.	572043.41	2609077.7
3.	585561.39	2609903.2
4.	574210.42	2579668.3

The location map showing the boundaries of the surveyed area is given in figure-1. The topographical map and the 3 D image of the topography of the study area are shown in figures 2 and 3, respectively.

1-3: Team of the Geological Survey:

The members of team of geological fieldwork included Mr Naushad Ahmad Ansari, Senior Geologist, Mr. Farhan Siddiqui, Geologist, Mr. Majid Al-Abri, Junior Geologist, Mr. Mohammad Afsar, field coolie, all from the five Seas International LLC, Muscat, Oman.

1-4: Survey Period:

The fieldworks were conducted from 15 September to 14 January, 2011, for a total of four months. Initially, this first phase of activity was designed to be completed within a period of three months only, but it had to be extended for one more month due to holidays on festivals and celebrations of 40^{th} National Day.

1. GEOLOGY:

2-1: Regional Geology:

The geological domain in and around the vicinity of the prospect area is dominated by the ultramafic and mafic igneous rocks of Samail Ophiolite, sedimentary and metamorphic rocks of Hawasina Nappe, the sediments cover of tertiary and wadi gravel. The samail ophiolite is a fragment of oceanic lithosphere originating from the ocean floor of the Neo-Tethys during middle to late cretaceous. The samail oceanic crust got detached and thrust over the Arabian Platform. Within the Neo-Tethys, the oceanic samail basin offshore of Oman was an area of accretion where primary crust was formed at a spreading ridge. Seafloor spreading was interrupted when the stresses were reversed and convergence began between the Eurasian Plate to the northeast and the African-Arabian Plate to the southwest.

The samail ophiolite is one of the major features of the Oman Mountains. It extends from the south of the Musandam Peninsula to the Batain Coast, south of Ras al Hadd. It is a suitable target area for the discovery of additional volcanogenic massive sequence deposits. The stratigraphic sequence observed in ophiolite corresponds to the lithosphere forming processes at mid-oceanic ridges. The rocks of ophiolite complex consist mostly of tectonized peridotite (Harzburgite-rich mantle rocks), cumulate peridotite (Dunite-rich), layered gabbro, isotropic gabbro, sheeted dykes, basaltic pillow lavas and the sediments consisting of cherts and mud (black shale). The extrusive basaltic lavas are thinner but have great metallogenic importance. This sequence is formed by the products of submarine volcanic eruptions related to sea-floor spreading. They are overlain locally by manganiferous radiolarian sediments that mark the end of the oceanic accretion of the samail basin. The sequence of extrusive pillow lavas are further divided into two, namely the lower extrusives and upper extrusive volcanic rocks. The upper extrusives discomformably overlie lower extrusives with a thin interval of chert or mudstone in between.

The extrusive rocks of the samail ophiolite represent the best metallotects known in Oman for base and precious metals. Copper occurrences exist throughout the samail ophiolite. The associated mineralization most commonly resulted from hydrothermal processes, mainly at the end of the submarine volcanic cycle or during the period of quiescence. This mineralization is generally assigned to the Massive Sulphide Type and related to MORB (Mid-Ocean-Ridge Basalt).

Two major volcanic episodes are represented at the top of the ophiolite pile. The volcanic rocks generally belong to one of the two types of magmatism: the first is related to sea-floor spreading at the accretion ridge with material derived from large magma chambers; the second is of island-arc type with material derived from smaller magma chambers. The first episode is also called 'Geotimes' by certain authors.

Although, occurrences of fracture-filling or vein sulphides may be encountered throughout the samail ophiolite, but the interesting mineralization is localized. It occurs mainly at the top of the pillow lavas of the lower extrusives. Sulphide disseminations indicate localized hydrothermal activity. The major period of hydrothermal activity occurred at the end of this basal volcanic episode. It is at its peak that most of the massive-sulphide deposits are found. The end of this first volcanic episode is marked by the deposition of chert and mudstone. It was contemporaneous with a system of deep fracture which cut the ophiolitic pile; paleofractures that not only acted as pathways for the mineralized fluids, but also delineated sea-floor depressions where sulphides locally accumulated in the immediate vicinity of the hydrothermal vents. The top of the basalts was intensely fractured and impregnated by the sulphides and silica. These stockworks are characterized by sulphide veinlets and disseminations within a chloritized rock. Most of the massive sulphide deposits and the gossans resulting from their weathering are situated at the contact between lower extrusives and the upper extrusives. The fracture zones associated with the mineralization were reactivated during later tectonic and volcanic episodes, which explains the common presence of late intrusive complexes in the mineralized area.

More than 400 mineralized occurrences have been recorded in the Oman Mountains, although at present, a large number of these are considered as being of little economic interest. It is possible that later work may reveal new interesting targets. The Oman suphide deposits usually have low gold grade like most sulphide deposits associated with submarine tholeitic basalts.

The Hawasina sediments are subdivided into three parts, namely Umar Group, Oman Exotic and Hamrat Duru Group and they are underlain by Sumeini Group. The point number 4 of our study area falls in Oman Exotic (Kawr Group). It consists of distinctive rocks of shallow marine reefal limestone and dolomite. The color of these carbonate rocks is grey, black and yellowish. At places, these rocks appear to be massive. It is generally believed that this litho-unit was deposited above submarine volcanoes. It is often seen in the field underlain by volcanic rocks such as basalt or trachytes. The submarine volcanoes in turn overlay an island arc created during the break-up of Gondwana land. These carbonate rocks were overridden by the heavy hot ophiolite and many exotics have been metamorphosed to marble, at places.

The points number 2 and 3 of our study area lie in the tertiary wadi gravel. It is noticed that a number of wadis (valleys) traverse the given area and provide the only means to many outcrops in the prospect area. Most of the wadis are dry, but some have water flowing through them. The terrain of wadis is generally covered by terrace, alluvial fans and floodplain deposits consisting of boulders, cobbles, pebbles, gravels and sands. The wadi gravels are generally unconsolidated at the upper surface. The trend of most of the wadis in given area is east to west. They mostly appear to be structurally controlled as they follow at places fault planes.

2-1: Local Geology:

Geological fieldwork carried out in and around the study area reveals the presence of some interesting outcrops including rocks associated with volcanic eruptions in submarine environment, gossans, cherts and mudstones, mineralized zones and alteration zones associated with geological environment dominated by mafic rocks, particularly ophiolite sequences. The studies made at various locations are detailed as under:

A. At location number 1 (0580864 easting and 2593164 northing), a gossan is found developed. Leached and oxidized parts of quartz vein containing metallic sulphides are found scattered on the surface. Amidst these weathered and loosely disbursed broken fragments are found copper minerals like malachite and azurite. The measured dimensions of this gossan are 165 m in east-west direction and 150 m in north-south direction. The presence of this gossan provides clue to underlying mineralization of sulphides. The country rocks around this gossan appear to be mostly composed of basalts. However, at places, magnesite occurs along the fracture planes within the host rocks. The basalts are intensively fractured and impregnated with the precipitation of the mineral bearing hydrothermal fluids. The photo number 1 shows the existence of gossan.

Photo-1: showing the existence of a gossan.

B. At location number 2 (0580491 easting and 2593384 northing), the rocks-in-situ are exposed. They consist of basic extrusive lavas. They are fine grained and display at places aphanetic texture. They are blackish and graying in colour. Mafic minerals like pyroxenes and plagioclases are generally found in these rocks. The aphanetic texture of these fine grained basic rocks leads us to believe that these rocks represent pillow lava. They are mostly formed by the products of submarine volcanic eruptions related to sea-floor spreading. The photo number 2 shows these basaltic rocks.

Photo 2: exhibiting fractured basaltic extrusive rocks

C. At location number 3 (0581746 easting and 2593817 northing), the extension of the basaltic extrusive rocks of similar characteristics as observed in the aforesaid location number 2 is observed. These basaltic fine grained rocks are found overlain by the beds of radiolarian cherts and calcareous sedimentary rocks.
D. At location number 4 (0581573 easting and 2593857 northing), the radiolarian cherts and thinly bedded limestone intercalated with argillaceous rocks are found exposed. It is believed that these metallogenic sedimentrary rocks mark the end of the oceanic accretion of the Samail Basin.
E. At location number 5 (058275 easting and 2593239 northing), malachite, azurite and other copper sulphide and copper oxide minerals are found at the leached out surface indicating the presence of another gossan and also providing clue to the supergene enrichment of sulphide minerals beneath this oxidized zone.

Following the extension of this zone in the western direction, quartz veins bearing sulphide minerals are seen occurring within the parent strata of basaltic rocks. They are more or less parallel to the direction of shearing and laminations. They are at places quite continuous and go up to a length of hundred meters. But, at places, they thin out and trail off into the country rocks. The thickness of the mineralized veins is variable from 2 cm to 100 cm. In the immediate vicinity of these veins, alteration in the country rocks is observed.

The strike of the veins is concordant with strike of the laminations of the parent strata. It is generally in the east west direction with dips of the order of 62 degrees in south direction. However, variation in the strike and dip direction of the layers of the parent strata at places is noted. This variation may be attributed to the tectonic activity. The photo number 3 shows copper sulphides in the gossan.

Photo 3: showing veins bearing copper sulphide minerals.

F. At location number 6 (0579963 easting and 2593262 northing), the extrusive basaltic rocks are found overlain by the metalliferous radilolarian cherts. Moving further in the direction of west, signatures of the presence of gossan and volcanic litholgies were observed at locations such as 0579760 E and 2593783 N; 0579810 E and 2593867 N; and 0579057 E and 2594056N. The photo number 4 and 5 show these features.

Photo 4: showing copper sulphide minerals.

Photo 5: showing broken fragments of vesicular volcanic rock textures.

G. At location number 7 (0562233 easting and 2593178 northing), an outcrop is found exposed. The in-situ rocks consist mostly of meta-basic igneous rocks, serpentinites, meta-pelitic to meta-psammitic gneisses and schists with intercalations of meta-carbonates. The schists are quartz veined, at places. The schistosity planes are found well developed. The trend of the schistosity plane is north-south with dips of the orders of 55 degrees in western direction. The country rocks are jointed and fractured. They are well exposed on the bank of a wadi trending east-west and whose width goes upto 150m, at places. The rocks exposed on the other bank of the wadi at location (0580178 easting and 2593451 northing) are more or less similar in lithology and they dip in the opposite direction indicating that the wadi is structurally controlled and follows a fault plane. Broken rock fragments, breccias, meta-calcareous rocks, a great deal of rupturing and fracturing in the parents rocks, silicification and mineralization are observed along and in the near vicinity of the fault plane.

H. At location number 8 (0568053 easting and 2598919 northing), rocks of extrusive basalt containing largely pyroxene and plagioclase minerals are exposed. Following these rocks further in eastern direction, at location (0568124 E and 2598654 N), these quartz veined basalts are found bearing metallic sulphide minerals. The strike of the mineral bearing veins is generally north west to south east with dips in southern direction. The amount of dip varies from 15 to 58 degrees. These veins generally run parallel to the laminated planes of the parent strata. The photo number 6 shows the quartz veins in the mineralized zone. At locations (0598461 E and 2599130 N; 0575168 E and 2597938 N), mineralized and alteration zones are found indicating the presence of copper sulphide minerals. Photo number 7 shows the alteration zone.

Photo 6: showing the quartz veins in the mineralized zone.

Photo 7: showing quartz veins in altered zone.

I. At location number 9 (0575495 easting and 2592987 northing), rock types are largely comprised of dykes. They are mostly medium grained. They show a wide compositional range from mafic to acidic minerals. They are found intruding into the fine grained rocks of basaltic extrusives. Following these rocks in Wadi Abu Zahabah, the contact between the host rocks and the intruding rocks is observed, at places. The general direction of strike of these intruding dykes is north west to south east. At places, they are sub-parallel to each other. The photo number 8 shows the contact between intruding dyke and the parent basaltic host rocks.

Photo 8: exhibiting the contact between dyke and the host rock.

J. At location number 10 (0575824 easting and 2585770 northing), ultrabsic peridotite rocks consisting mostly of dunite are exposed. These rocks are greenish and yellowish in colors. The magnesite, asbestos, green schists and serpentinite are formed within this litho-unit of dunite due to weathering and alteration. The weathering leads to disintegration and formation of holes. Such holes and cavities are found well developed around this location. These rocks mark the top of the mentle sequence (tectonites) of Samail ophiolite.

The strike of the foliated planes within country rocks is north west to south east with dips of the order of 45 degrees in north eastern direction. However, variation in strike and dip of the rocks is observed at places. This variation may be attributed to tectonic activity. The parent rocks are seen jointed and fractured. The photo number 9 shows the characteristics of a dunite rock.

Photo 9: Dunite

K. At location number 11 (0568601 easting and 2590624 northing), ultramafic rocks consisting mostly of hurzburgite are found exposed. The color of these rocks is mostly gray or chocolate like. At places, thin litho-unit of schistose rocks and magnesite along the banding and fractures within hurzburgite is found occurring. These rocks appear to belong to the basal part of the mantle sequence (tectonites). The photo number 10 shows the schist and magnesite within hurzburgite.

Photo 10: Hurzburgite

L. At location number 12 (0574200 easting and 2580287 northing), a massive outcrop of shallow marine reefal limestone is found exposed. This location is close to the point number 4 of our prospect area. The color of this limestone is grayish, bluish and blackish. It is fossiliferous. It shows elephant skin like weathering. It belongs to Hawasina Nappe. It is believed that these deposits of limestone were deposited above submarine volcanoes and is often seen in the field underlain by volcanic rocks. These limestones were overridden by the heavy hot ultramafic igneous rocks of ophiolite complex. The contact between these limestones and mental sequence of ophiolites is observed in our study area. The contact between these two litho-units is tectonic. The photo number 11 shows shallow marine reefal limestone.

Photo 11: Shallow marine reefal limestone.

2. SAMPLE COLLECTION

A total of 34 samples were collected from the prospect area. Sample locations are given in figure-3. Samples were largely collected at intervals along grid lines trending North-South and East-West. But, this sample collection was hampered due to problems and restrictions put up by local inhabitants. While approaching point number 1 of the study area, the survey team came across some local People. They restricted team's forward march to the target. They did not cooperate to go further inside the valley leading to point number 1 of the given area. Consequently, the team could not collect samples from a part of the area in and around point number 1 of the block. This event hampered the time schedule and progress of the survey team. However, representative samples were collected from the prospective zones and also from the surrounding rocks in and around the study area. The area in the north could also not be sampled due to the thick cover of the wadi gravels.

3. Results of Exploration of Phase-I:

a. During the geological fieldwork carried out in the prospect area, gossans, mineralized zones, alteration zones, volcanic lithologies, volcano-metallic sediments were indentified at a number of places.
b. The dominant mineralization zone in the surveyed block extends in the East west direction for about 105 sq km. It is 26.5% of the concession area.
c. The assay results show Cu percentage at places up to …….

d. The results of the fieldwork confirm the prospectivity in the central part of the concession area. The area to the north of the block has a thick cover of wadi gravel. The rocks cropping out in the mountains to the south of the area are mostly consisting of the mental sequence of Samail Ophioloite.

4. CONCLUSION:

Based on the results of fieldwork and results of the chemical analysis of surface samples, it is concluded that 105 sq km is prospective and has the potential of economic interest.

5. RECOMMENDATION:

Based on the results of the first phase of exploration, it is recommended that the second phase of exploration should be taken up.

Phase-II: The detailed survey:

The results of the preliminary study define the scope of the detailed study. The activities for this second phase would include the following:

1. Topographical survey and Base Map production
2. Geological mapping
3. Geophysical Survey
4. Drilling and pit sampling
5. Sample analysis and determination of overall grade of the mineral.
6. Estimation of Reserves
7. Metallurgy testing
8. Geotechnical studies
9. Mine planning
10. Pit optimization
11. Feasibility study
12. EIA

1. METHODOLOGY FOR PHASE-II:

5.1 TOPOGRAPHIC SURVEY AND BASE MAP PRODUCTION:

A topographic survey of areas of interest in the concession area will be conducted by a qualified and experienced team using Advance total station, a surveying instrument and standard accessories. A denser network of observation points will be noted so as to record sharper topographical definitions. The survey data will be processed using appropriate GIS software to produce a topographic map at a scale of 1:500 with a contour interval of 1 m with all ground features and definitions. This map will also be used to develop a mining plan and calculation of reserves.

5.2 GEOLOGICAL MAPPING:

It will entail a comprehensive geological survey to produce a detailed geological map of areas of interest in the concession area at appropriate detailed scale. The map will exhibit detailed geology of the area including lithology, structure and alteration pattern.

GEOPHYSICAL SURVEY

Five Seas international will employ an integrated approach in exploring for VMS deposits. Landsat imagery and aeromagnetic data will be used to its best to target area and then ground geophysics and geological reconnaissance mapping and geochemistry will be deployed to define the drill targets. Copper deposits respond well to TEM (Time-Domain electromagnetic), IP (Induced polarization) and magnetics, in cover situations down to at least 150m. Geophysical expressions will be a reliable indication of the extents of massive sulphide mineralization and resource potential. Therefore, regional exploration will focus on areas of higher IP chargeability.

5.3 DRILLING:

It is envisaged either to drill 10 to 12 boreholes based on the geophysical anomalies together with geological studies. The drilling method employed will be rotary drilling using water as fluid with conventional diamond core drilling rig and RC drill testing (Reverse circulation). Core samples will be logged geologically and geo-technically according to the best in the industry practice.

Each drilling cross section will be studied and a geological model will be prepared in a 3D modeling software.

5.4 ANALYSIS OF ORE SAMPLES:

The drill hole samples collected from boreholes will be chemically analysed. The basis and the procedure will be the same as adopted in a standard modern laboratory. The chemical tests will be to analyse the percentage of copper and other related elements.

The presence of tracer elements in the ore that may have an impact will be ascertained. The ore quality will be confirmed in conjuction with the earlier analyses results.

5.5 RESERVE ESTIMATION:

Upon completion of the drilling program, the results will be fully examined and cross-sections extended as appropriate to define the resource. Further, proper resource model will be prepared. Results and all related supporting documents will be compiled in a report.

5.6 METALLURGY TESTING:

Depending on the nature of the ore, samples will be collected from drill hole to study the metallurgical behavior of the ore. This data will be used for optimizing the resource model.

5.7 GEOTECHNICAL STUDY:

A geotechnical study will be carried out to study the ground condition for mining. Details of geotechnical parameters will be decided based on the type of mining and ground condition in the vicinity of ore body

5.8 Mine planning.

After the completion of Geotechnical studies and hydrological studies piot designing and scheduling will be taken up. Design analysis will be conducted based on the geological modeling of ore body followed by pit optimization. Further to it, pit will be designed based on optimization which includes Haul road designing, Dump designing and LOM calculations.

5.8 EIA:

Environmental Impact assessment will be taken up based on biophysical studies, socio-economic studies etc.

5.9 FEASIBILITY STUDY:

A Feasibility study will be made to evaluate the ore body to its economic potential. This will include study on project planning, infrastructure, process plant, financial modeling, risk analysis etc

TIME SCHEDULE:

TIME SCHEDULE:

- ❖ Phase-II: 12 to 16 months

BUDGET FOR OWNER'S DEVELOPMENT COSTS 16Months

All in US$
Note; costs at $1.00=RO 2.60

Type		Months	Unit Rate	Rate
Offices	***Management***			
Personnel	Package			
Head Office - Project manager		16.0	$7,800	$125,000
Sr.Geologist + Geologist Graduate Geo		16.0	$6,200	$99,000
Mine Surveyor + Team		14.0	$2,600	$36,000
Helpers - 2 Numbers		16.0	$800	$13,000
Exploration Geo		9.0	$6,500	$59,000
Accounts / Admin		16.0	$1,000	$16,000
Other Costs	Assumed			
Office rental		16.0	$2,600	$42,000
Communications		16.0	$650	$10,000
Vehicles - Maintenance		16.0	$900	$14,000
Vehicles - Fuel		16.0	$1,300	$21,000
Travel & Accom		14.0	$2,000	$28,000
Contractor Accom (VTEM Team)		3.0	$6,000	$18,000
Food - VTEM Team		3.0	$1,300	$4,000
Vehicle - Rent VTEM		3.0	$2,000	$6,000
Medical for All		16.0	$250	$4,000
Vehicle Hire		9.0	$780	$7,000

Food & Accom for drillers	6.0	$4,000	$24,000	
				$/month
		Total	$526,000	$44,000

Other Activities			
Engineering			
Environmental Consultant - EIA	3.0	$6,500	$20,000
Metallurgist	8.0	$2,600	$21,000
Reserve Estimation			
Consultant	3.0	$12,000	$36,000
Mine Planning & BFS			
Consultant	4.0	$12,000	$48,000
Mining Machineries & Infra			
Capital Cost Estimate			$4,000,000
		Total	$4,125,000

Exploration expenditure will involve:	
1. Surface and Geological Mapping- 2000m @$125	$250,000
2. Detailed evaluation of deposits - 2500m @$125	$281,250
3. Geophysical Survey - VTEM	$1,331,818
4. Surveys-grid- drill holes- total meter assumed 7500m@150	$1,125,000

5. Metallurgy		$150,000
6. Resource modeling & mine planning		$100,000
7. Further extension program and contingencies		250000
	TOTAL	$3,488,068

		Value	Premium
Fire and Perils	0.15%	$1,750,000	$2,625
Motor Vehicle	4%	$100,000	$4,000
PL			$1,000
Money			$500
Fidelity			$1,000
WMC			$2,655
Total			$11,780

Total expenditure will involve: Pre- Production Cost = US $ 8186018 /-

6. REFERENCES:

A book entitled, 'Geology and Mineral Wealth of the Sultanate of Oman', and a Mineral Occurrence and Metallogenic Map of North Oman on 1:500,000 scale, published by the Ministry of Petroleum and Minerals, Directorate General of Minerals, Sultanate of Oman have been consulted while making this proposal.

Figure 1: Location map of the copper block-9

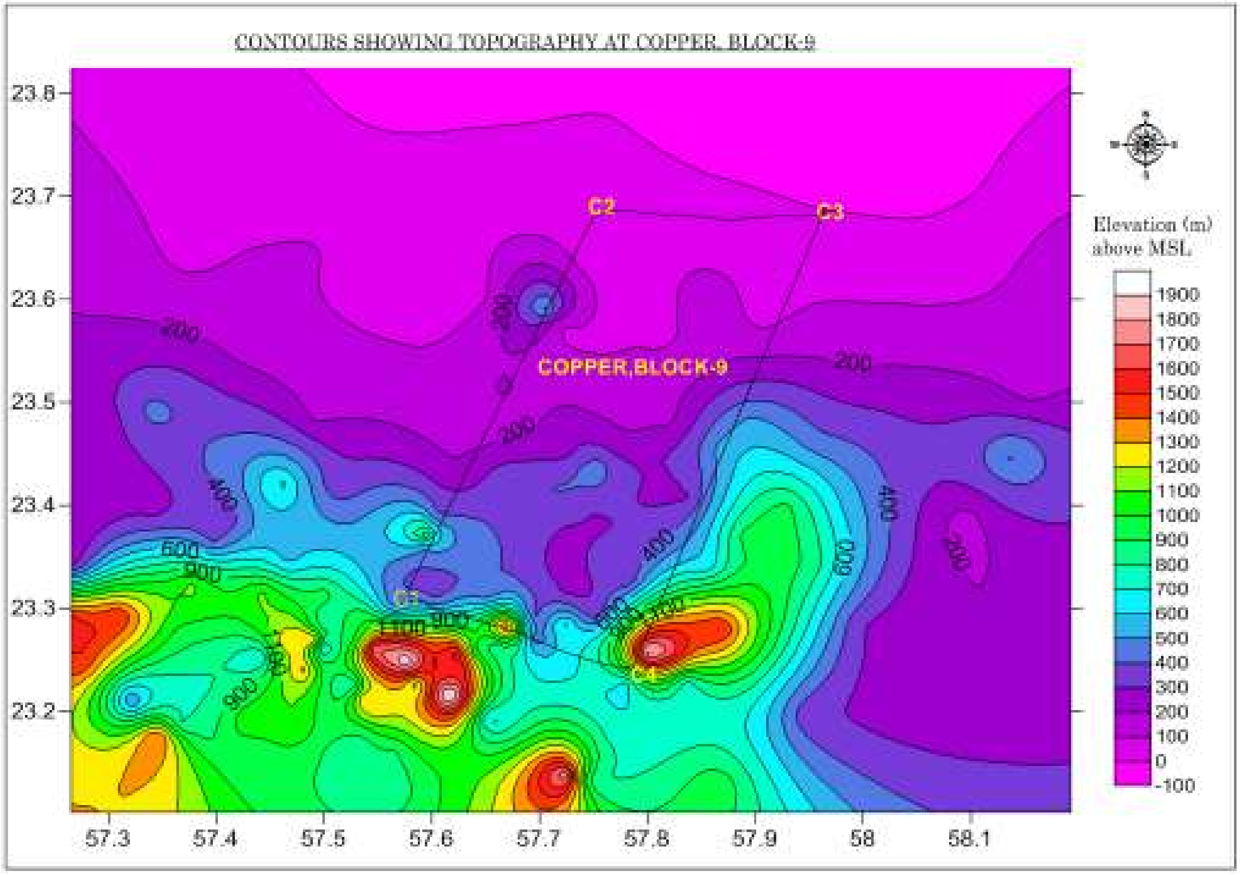

Figure 2: showing topographic map

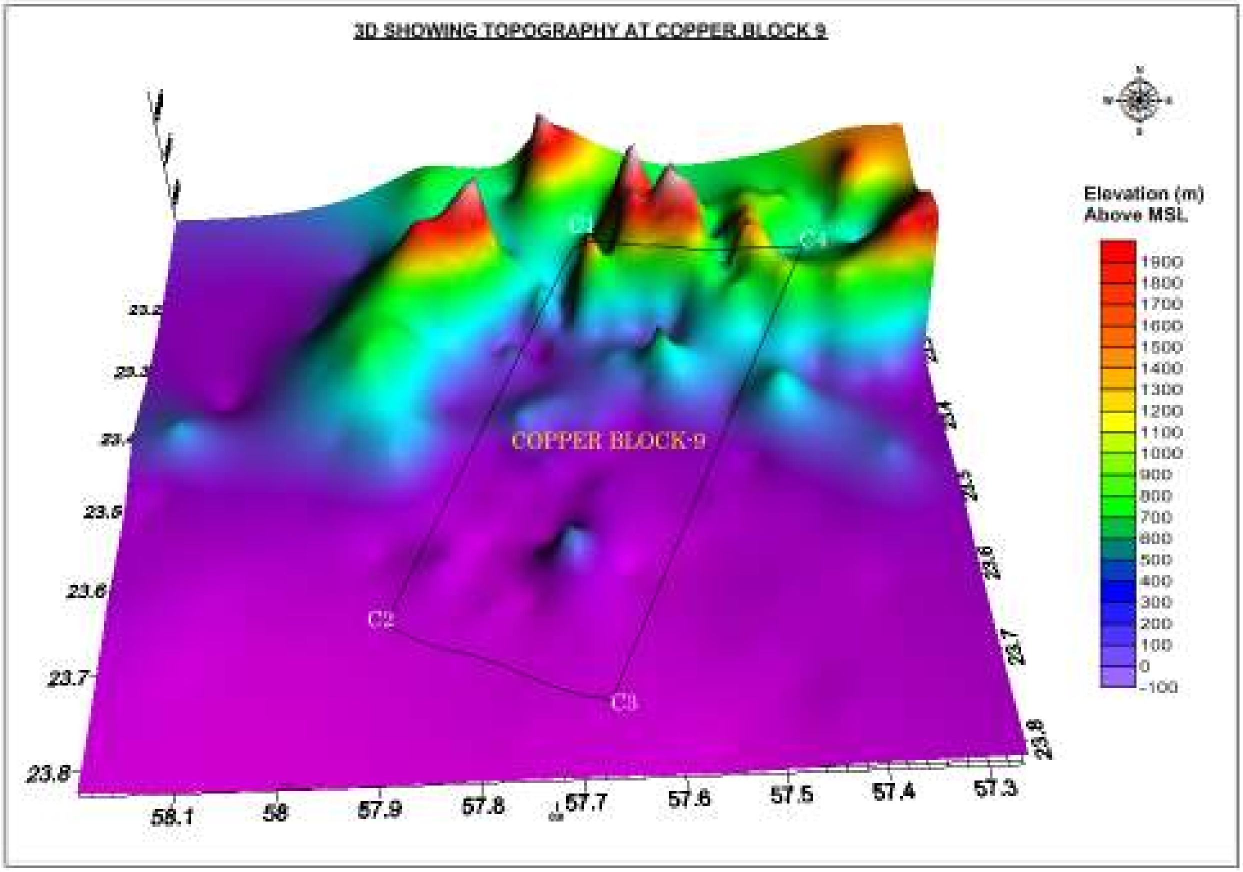

Figure 3: Showing 3 D image of the topography

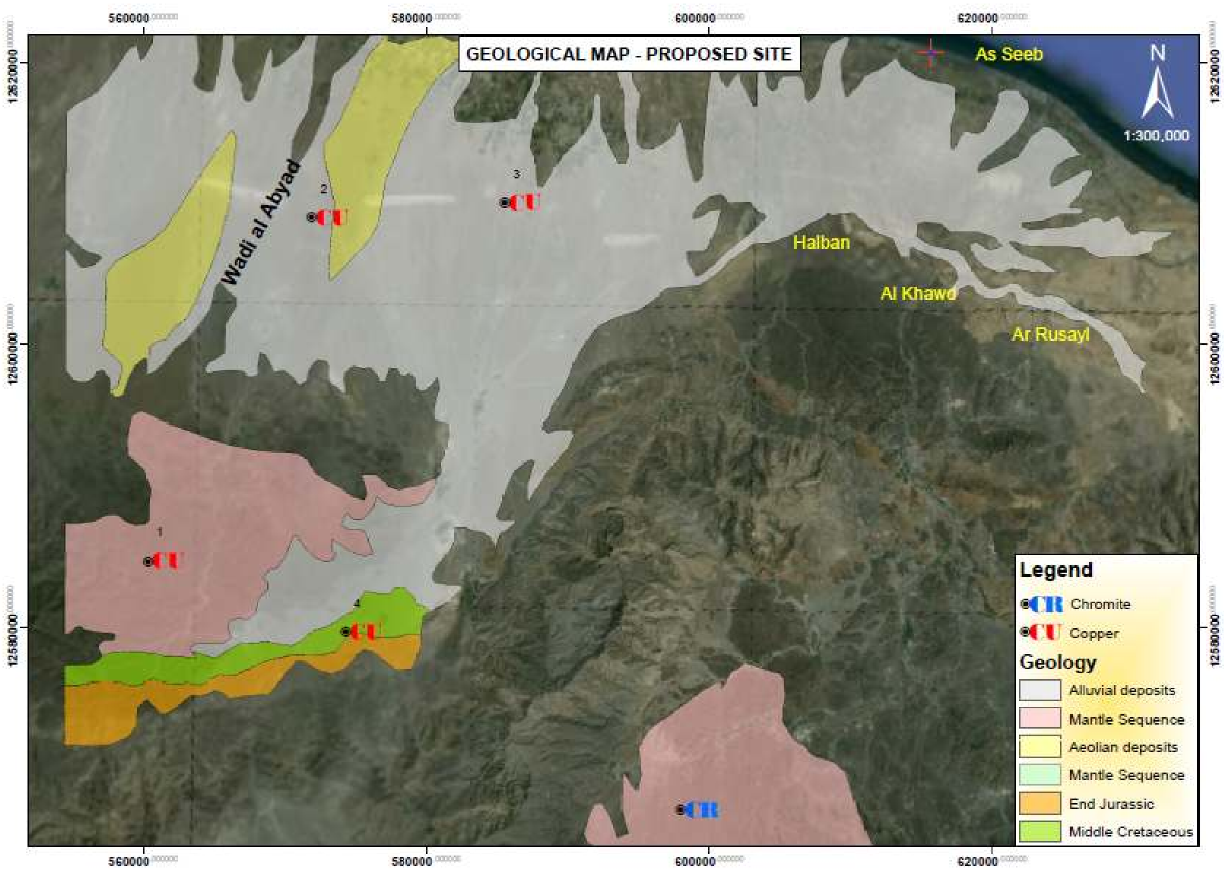

Figure 4: Geological map of the copper block-9

Figure 5: Location map of samples.