

# Base Metals in Sudan

Republic Of The Sudan  
Ministry of Minerals



Geological Research  
Authority of the Sudan  
(GRAS)

## Forward

Base metals mineralization in Sudan was known since ancient times. Around the 18th Century, natives of Darfur region used to smelt copper from Hofrat en Nahas area utilizing clay furnaces. Russegger, an Australian, geologist in 1838 stated that the locals obtained the ore, which was located in a pure native state from a vein, 2 feet beneath surface.

Base metals have been reported from nearly 70 places in Sudan. A great number of these occurrences are closely related to the greenstone belts. A brief account is given hereafter for some of well-known occurrences that have received more attention.

## Hofrat en Nahas Copper-Gold Deposit:

The old mine of Hofrat en Nahas is located in southern Darfur State 09°45' N and 24°18' E. It is slightly over 200 miles away from Ed Da'en nearest point on the railway line (Fig. 1, Loc. 7).

## Geology:

The area is underlain by Precambrian metamorphic complex intruded by

Precambrian to Paleozoic mafic and acid intrusives. The metamorphic complex includes biotite and hornblende gneisses, migmatitic acid gneisses, and biotite-chlorite schists.

## Origin and Mode of Occurrence

The ore is a vein-type mineralization forming lodes and mineralized zones related in origin to granitic intrusions.

## Ore evaluation

Company	Period	Bore holes Total depth	Ore reserve estimate
Nile Congo Divide Syndicate	1922	10/ 1028 m	6 MT @ 3 to 5 % Cu (90 m depth)
	1925	10/1028 m	
Geological Survey Depart.	1957	15/ 786 m	10,183,000 tons at 2.778%Cu
	1959	15/ 786 m	
Nippon Mining Co.	1965	9/ 1400 m	Sulphide ore (766,000 tons) , oxide ore (291,000) tons
	1966	9/ 1400 m	
U.N.D.P United Nation Development Programme	1967	23 /3400m	20 MT @ 5% cu ( 200m depth)
	1973	23/3400m	
U.N.D.P Development Exploration Depart.	1971	18/ 220m	6,109,440 tons @ 2.01%Cu, 1.6 ppm Au, 165 ppm Ag, 1150 ppm Mo
	1973	18/ 220m	
Chevron Resources Company	1979 – 1981	28 bore holes	6 MT @ 2% Cu and 1.6 g/t Au

Exploration and evaluation of Hofrat en Nahas deposits were carried intermittently as from 1922 up to 1981. The results are shown on the above table. Nevertheless, it is worth mentioning that copper mineralization is associated with a linear structural feature that extends for over 100km. Excluding Hofrat en Nahas area, still there are some large IP and geochemical anomalies along the mineralized belt waiting to be investigated by drilling. One anomalous area, for example Jebel Waranja, extends for 4 Km, and has a width of 1.2 Km. The mineralized zone of Hofrat

en Nahas mainly occupies an area of 350m x 725m SE and adjacent to the airstrip. A borehole (27x80) drilled about 1 km southwest of this zone showed ore grade mineralization. Therefore, the potential of Cu resources for the area may be in excess of ten million metric tons (Chevron, Resources 1980)

## I- Ariab Area

### **HASSAI VMS:**

"Hassaï South: a single lens some 1,400 m long and 520 m wide, dipping 60°S and extending for 550 m at least. Geophysical surveys indicate possible extensions to over 700 m. The upper oxide portion has been mined as gold-bearing silica barite SBR ore, with supergene ore grading over 5% copper at the base of the pit. Resources estimates for Hassaï South are:

- Indicated: 26.5 Million tonnes at 1.38% Cu and 1.57 g/t Au

- Inferred: 15.3 Million tonnes at 1.03% Cu and 1.27 g/t Au

HadalAwatib:-  
The largest of the known deposits, although apparently broken into multiple lenses at HadalAwatib East, West and North. All of which have supported mining of gold ore from all the oxide zone, for total production in excess of 1 Million oz. The total strike length exceeds 2,000 m, with widths of up to 100 m. Depth extensions have been drill-tested to 400 m with geophysical signature down to at least 800 m. Dip is sub-vertical. Sulphide resources (excluding oxide) for HadalAwatib East are:

- Indicated : 54.2 Mt @ 0.99% Cu, 1.11 g/t Au

- Inferred : 13.25 Mt @ 1.23% Cu, 1 g/t Au

3 main ore domains identified:

HADE-Main, HADE-North, HADE-East

### **HADAYAMET:**

The geological model is defined as an accumulation of multiple lenses globally orientated N070 and dipping 70°N. Overall dimensions of the deposit are 700 m of length, recognised in the sulphide zone up to 300 m in length and up to 130 metres of thickness with a vertical extension of 250 m. The massive sulphide resources in Hadayamet are classed as inferred resources, and content significant Zn and Ag values (excluding Oxide, include Zn sulphide resources).

- Inferred : 7.6 Mt @ 1.01% Cu, 0.93 g/t Au

Other deposits such as Taladeirut, Adassedekh, Oderuk and Onur have been subjected to minimal drill testing at this stage, but interpretation of geophysical data suggests strike lengths of a few hundred metres,

## 2-Abu Samar Mineralized Area

Abu Samar area (Fig. 1), located in south Red Sea Hills some 250km SW of Port Sudan, became known since the 1950 for small-scale manganese ore mining. Between 1977 and 1983, the Geological and Mineral Resources Department (GMRD), the predecessor of GRAS in collaboration with Bureau de Recherches Geologiques et Minieres (BGRM) executed a joint exploration program in that area. They reported the discovery and evaluation of a substantial massive sulphides and barite ores.

### **Geological Setting:**

Abu Samar massive Sulphide bodies are hosted by paragneisses of Late Protozoic volcano-sedimentary rocks.

The rocks had been subjected to intense deformation, migmatization and regionally metamorphosed to high grade amphibolite

facies. Thermal metamorphism following the emplacement of granitoids, has affected parts of the area.

### **Abu Samar Massive Sulphides :**

Detailed gravimetric survey, diamond drilling and petrographic studies have proved the existence of volcanogenic massive sulphide ore bodies. Pyrite, pyrrhotite, sphalerite, chalcopyrite and galena constitute the major components. Minor molybdenite, realgar, bismuthinite, silver, jacobsonite and cubanite are noted. The ore minerals are mostly coarse-grained occurring as lit-par-lit bedded aggregates or disseminated crystals in the host rocks. They have been encountered for up to 265m in depth. The aggregate thickness ranges between 20 to 25m and of 200m strike length.

### **Abu Samar Massive Sulphides Ores Evaluation:**

Ore reserves calculation, estimated the ore tonnage in the range of 2.13 to 3.64 million metric tons. However, Abu Samar and some other minor occurrences seem to be related to Pan African volcano-sedimentary sequence. Chemical Ore analysis performed on the Ore samples, returned the following average values: Zn (5.1%), Cu (0.6%), Pb (0.59%) and Ag (72-81ppm). In addition, the

ore contains gold of a grade decreasing with depth from (0.84 g/t in the 30 to -70m section), (0.58 g/t in the -70 to -150m section) to (0.13 g/t in -150 to -300m section).

#### **Barite**

The barite calculated reserves are confined to the upper oxidation zone (down to -40m) with an estimated total reserve of 420,000 metric tons @35% BaSO<sub>4</sub>

### **3- Jebel Ayub Wolfram Deposit**

J. Ayub mineralization is hosted by leucocratic granite intruding the volcano-sedimentary rocks of the Tolik Series. Hydrothermal alteration resulted in a wide spread greisenization effect on Jebel Ayub. The area was mapped in detail and sampled by trenching, pitting, percussion and diamond drilling. Field and laboratory studies [GRAS and BRGM, 1983] proved the presence of the ore minerals scheelite, wolframite and

huebnerite within the quartz veins and the greisens.

#### **Ore Evaluation:**

The total ore reserve amounts to 2.5 million metric tons, 1.75 Mt of which is indicated and the rest as inferred, with a grade of 0.1% WO.

### **3- Jebel Ayub Wolfram Deposit**

The Pb-Zn mineralization is about 4 miles NE of Kutum town in Northern Darfur State [Lat. 14°14'N, Long. 24°39'30"E] Kutum [Fig. 1] is about 65 miles north El Fasher, the State capital.

#### **Geology**

The area is occupied mainly by regionally metamorphosed schists and gneisses flanked by granitic rocks from the south and basaltic dome-shaped hills from the north and the east. The granites and their associated dykes, pegmatites and quartz are hosting the mineralization.

#### **Mineralization**

The ore was mined and smelted intermittently by the natives as from the turn of the 9th century until 1917. The studies of mineralization and the geology of the area were carried out during the

period of [1959-1961]. Twenty trenches have been dug and sixteen boreholes were drilled totaling 2668ft. in depth. The sulphide ore consist mainly of galena, sphalerite and pyrite, with minor amounts of chalcopyrite and silver. The ore minerals occur in veins ranging for few to 20 inch in thickness and extend down to more than 200 ft. their general trend is NW with a steep SW dip. The mineralization is believed to have formed after hydrothermal solutions of granitic origin. Chemical analysis on some non-oxidized zones returned the range of values: Pb [up to 65.6%], Zn [up to 26.2%], Fe [14 to 22.9%], S [4.1 to 12.2%], Cu [0.03 to 0.1%]. Thus further exploration work is needed for more detailed evaluation of the deposit.

## 5- Tagoteb

Fig. 1, Tagoteb is an extensive gossaneous bodies along a NNW-trending zone at least 1700m long. The bodies cap made up of three hills of brecciated silicified material containing abundant disseminated limonite along fracture fillings and as boxworks. The northly hill called Jebel Tagoteb

(Lat. 17°33' Long. 36°14') measures about 600×500m and thus has a large tonnage potentiality. Limited drilling carried out in the area, had intersected abundant pyrite and chalcopyrite. No reserve estimation is made as yet.

## 6-North Eastern Nuba Mountains

In the NE Nuba Mountains [Fig. 6] 450km SW of Khartoum, there are a number of gossanous anomalies of Cu, Cu-Zn, or Cu-Ni-Zn and Ag (BGR report, 1984). Follow-up investigations were made and few drill holes were sunk in Um Takatik zone.

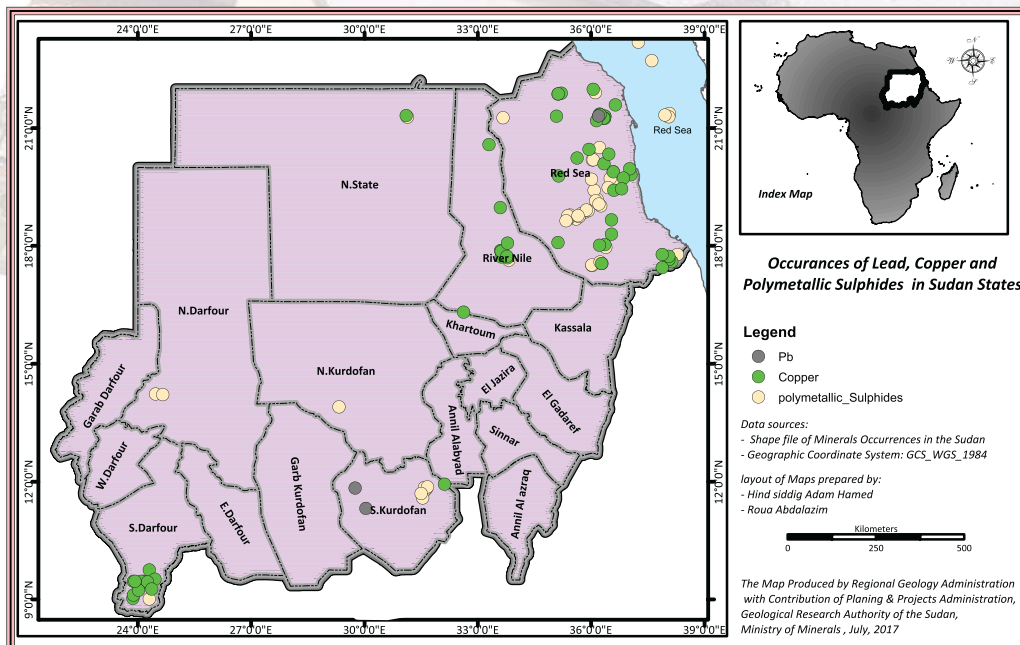
NE Nuba Mountains region is built up predominantly of a NE-trending Late Proterozoic volcano-sedimentary sequence which is affected

by an important NNE-SSW shear zone. The gossans are concentrated mainly in the southwestern part of the area. They are regarded as being derived from a volcano-sedimentary rock sequence through processes similar to these generated Ariab and Abu Samar Polysulphides deposits in the Red Sea Hills region in eastern Sudan.

## 7-Red Sea Hot Brines

Chemical analysis of samples from cores recovered from the Red Sea Hot Brines namely Atlantis II, show a high content of base metals [copper and zinc] and silver. About 2 billion tons of

ore are indicated with an average grade of 0.2% Cu, 0.7% Zn, and 0.3ozAg per ton. There is a minor gold associated with the deposit @ 0.05 oz/ ton.



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