COPPER DEPOSITS OF JHARKHAND

The largest reserves/resources of copper ore are in the state of Rajasthan (53.81%) followed by Jharkhand (19.54%) and Madhya Pradesh (18.75%). Copper reserves/ resources in Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Telangana, Uttarakhand and West Bengal accounted for remaining 7.9% of the total all India resources.

Singhbhum Copper Belt

Geology-

The Singhbhum Copper Belt/Singhbhum thrust belt, located in Jharkhand forms an arcuate highly deformed linear zone in the Singhbhum Crustal Province and is well known as one of the most potential copper bearing stretches of India. According to Sarkar, et al. (1988), the ore mineralisation within the Singhbhum Copper Belt has taken place in more than one rock type, most related to the Dhanjori volcanics. In the richest Mosaboni-Badia section, it is in the chlorite schists and within a 'soda feldspar' rich zone of metasomatism. They further add that detailed structural studies have indicated that within the Singhbhum Copper Belt, sulphide mineralisation is mainly stratabound, occurring within certain stratigraphic horizons adjacent to Dhanjori volcanics, although it is structurally controlled on macroscopic to microscopic scales. The predominant chalcopyrite – pyrite – pyrrhotite and cuprite ore mineral assemblage is concentrated along massive to braided veins, stringers, dissemination, discordant to sheet like bodies. Ore is localised in both S_2 and S_3 foliations, while down-dip lineations, 'puckers' and gentle folds control the trends of the richer ore shoots. Lineations observed parallel to the shoots include, elongated boudins, slickensides, grooves, mineral lineations, etc.

On a regional scale the Singhbhum Thrust marks a sharp change in the metamorphic grade and trend of the sequences on either side. To the south, with the exception of the 'older metamorphics', the sequences are generally of greenschist facies rocks with a structural trend from around 30°, to north-south in the south. To the north, across the shear, they change to a generally east-west trending suite of amphibolite facies, with the development of sillimanite (Sarkar, et al., 1971).

The mines of the Singhbhum Copper Belt are operated as the Indian Copper Complex, owned by Hindustan Copper Limited.

Mosabani

In the vicinity of the Mosaboni mine, garnetiferous mica schists, phyllites, quartzites and quartz-kyanite schists of the Chaibasa Formation (Singhbhum Group), have been thrust over metamorphosed mafic volcanics of the Dhanjori Formation to the south. Rocks within the shear zone are highly sheared and mylonitised equivalents of siliceous rocks, quartzites and granites, and are characterised by soda rich feldspars (Khan, 1976). The shear zone itself varies from a few hundred metres to 2.5 km in width and contains slices of sheared Dhanjori epidiorite and quartzite, sometimes accompanied by kyanite-hornblende-mica schist and soda-feldspathised schist. It dips on average at 30°NE, generally varying from 25° to 30°, although in places it gets up to 50°. Schistosity, strain slip cleavage and shear planes are developed throughout the thrust zone in the mine. The S_2 foliation within the thrust zone is sub-parallel to the S_3 shear planes (Johnson, 1973).

Mineralisation at Mosaboni is found close to the footwall of the thrust belt in two sheet like lodes that each average around 1.8 m in thickness and are generally 12 m apart. These are known as the 'Main Lode' and the 'West Lode', representing the hangingwall and footwall lodes respectively. They parallel the structural planes of the shear and follow two well defined shear channels over an aggregate length of around 5 km, with barren/poorly mineralised intervals in the plane of the lode between the ore shoots. The width of the mineralised lode varies from a few cm's to 11 m within these lodes (Khan, 1976; Johnson, 1973). Known mineralisation extends down plunge for at least 2.6 km (Sarkar, et al., 1971).

These lodes are confined to a zone of quartz-biotite-chlorite schist within the 'soda granite' and is regarded to post date the soda-metasomatism. The West Lode occurs about 50 m above the contact between the 'soda granite' with the underlying, 40 m thick sheared and feldspathised Dhanjori epidiorite, the base of which defines the lower limit of the shear (Johnson, 1973). The lodes consist of sheeted orebodies formed by sulphides infilling close spaced inter-locking fractures and by occasional massive sulphide pods and bands. These fractures and bands are defined by the S2 and S3 foliations. The orebodies at Mosaboni generally have sharp boundaries, although elsewhere they may also have assay limits. Some blebs of disseminated sulphides and small stringers may occur between the two lodes. Individual orebodies/shoots within th lodes vary in strike length from a few tens of metres to >1000 m, but are generally more extensive down-plunge (Temby, 1978; Johnson, 1973).

The sulphide minerals consist predominantly of chalcopyrite, followed by pyrite and pyrrhotite, accompanied by magnetite and minor pentlandite, millerite, violarite, sphalerite and molybdenite. The gangue minerals are quartz, biotite, chlorite and sericite in variable proportions (Sakar, et al., 1971). Magnetite-apatite are also occasionally gangue minerals. Quartz veins are not always mineralised. The sulphides are enriched in Co, Ni, Ti and V, as are the rocks of the Singhbhum Shear Zone, a relationship that has been quoted to support the derivation of metals from the rocks of the shear zone (Johnson, 1973).

Surda

Surda is some 6.5 km to the north-west of Mosaboni, and again is found close to the footwall of the shear zone. The thrust belt is around 1 km wide at this point, with a similar dip to that at Mosaboni and is within similar rocks (Johnson, 1973).

In 1973 there were seven sheeted lodes that were being tested and/or exploited. Six were called 'Hangingwall Lodes', developed in sheared quartzite and quartz-chlorite-biotite schist. One lode occurs within epidiorite below the thrust and is termed the 'Footwall Lode'. However nowhere are there more than three at any one interval. The ore zone has a strike length of 1800 m, and is up to 35 m wide. The average lode width is 7 m, and the dip from 35 to 45°NE. Each lode exhibits several sheet like orebodies formed by sulphides infilling irregular fractures. The fractures are not as closely spaced, nor are the individual orebodies as distinct as at Mosaboni, with assay boundaries (Johnson, 1973; Sarkar, et al., 1988).

Mineralisation is more commonly associated with quartz lenses and veins than at Mosaboni. The mineral assemblage is similar to that at Mosaboni, with the exception of the presence of uraninite associated with magnetite-apatite in four of the hangingwall lodes (Johnson, 1973).

Rakha

Rakhais around 15 km to the north-west of Mosaboni. Ore occurs as disseminations, stringers and veinlets, massive sulphide veins and replacement patches in different structural units and lithologies. The richer zones forming lodes alternate with lean to barren widths of up to 2 m. Nine such lodes with strike lengths of 200 to 300 m and widths of 1 to 9 m occur in an en echelon pattern with sinistral overlaps that follow along strike and down the dip of 40°NE. This pattern leads to the overlap of two to three lodes at a given point. The lodes exhibit pinch and swell structures in gentle antiforms and synforms with a down-dip, north-easterly plunge (Sarkar, et al., 1988). In addition to copper, Rakha averages 0.011% Mo, 0.08% Ni, 0.01% Co, 100 ppm Sn, 2 g/t Ag and 0.2 g/t Au. Co values tend to be fairly constant between the various mines, although Ni and Mo vary considerably.

Pathargora

Pathargora is between Mosaboni and Surda, being 3 km to the NNW of Mosaboni, and forms part of the same mineralised zone as those two deposits. In 1973 there were two lodes known, one on the contact between the 'soda granite' and the epidiorite, while the second was within the epidiorite. The latter is called the 'Footwall Lode'. Mineralisation is almost continuous with the Mosaboni block, although the lodes are not directly correlatable. Pathargora is separated from Surda by the Pathargora Fault, a cross fault with a displacement of 2.5 km (Johnson, 1973). Mineralisation varies from a few cm's in width, to as much as 12 m, and dips from 30 to 45°NE (Sarkar, et al, 1988).

Jaduguda

Jaduguda is approximately 5 km to the north-west of Rakha. The individual lenses of mineralisation average 2.5 m in width, ranging up to 5 m, and have a strike length of 1100 m. Mineralisation is found within the shear zone, as at the copper mines. Most of the other uranium mines have very low Ni and Mo, although Jaduguda averages 0.21% Ni, 0.035% Mo and 0.013% Co (Temby, 1978).

As with copper the uranium is structurally controlled. Uraninite occurs as micro veinlets in meta-sediments in the thrust and along joint planes, and sometimes as minute disseminations in the host rock. The most favourable host rocks are mylonitised chlorite-sericite schist, granular chloritic rocks, quartzite, apatite-magnetite, tourmalinite, quartz-magnetite breccia, biotite schist and sheared magnetite-quartzite. Ore zones occur as en echelon lenses up to 20 m thick, but averaging 2 to 3 m, and up to 100 m in length. They are confined to well defined zones along the thrust sub-parallel to the foliation in the host rock. In general uranium and copper ore lenses are separate, although usually close together. Typically sulphides are found towards the footwall of the thrust, with uranium in the hangingwall of the mineralised zone. In the eastern copper mines some uranium is found in the copper lodes, as well as in separate lodes in the hangingwall.

At Jaduguda chalcopyrite is subordinate (Johnson, 1973).Apatite-magnetite mineralisation is also found within the shear zone, again occurring in veins, lenses and dissemination within biotite-chlorite host rocks. These veins are generally from 0.5 to 10 m in thickness and have been mined for both iron and apatite. They appear to be found mostly in the central to south-eastern part of the belt, while uranium is more common in the central section (Temby, 1978).

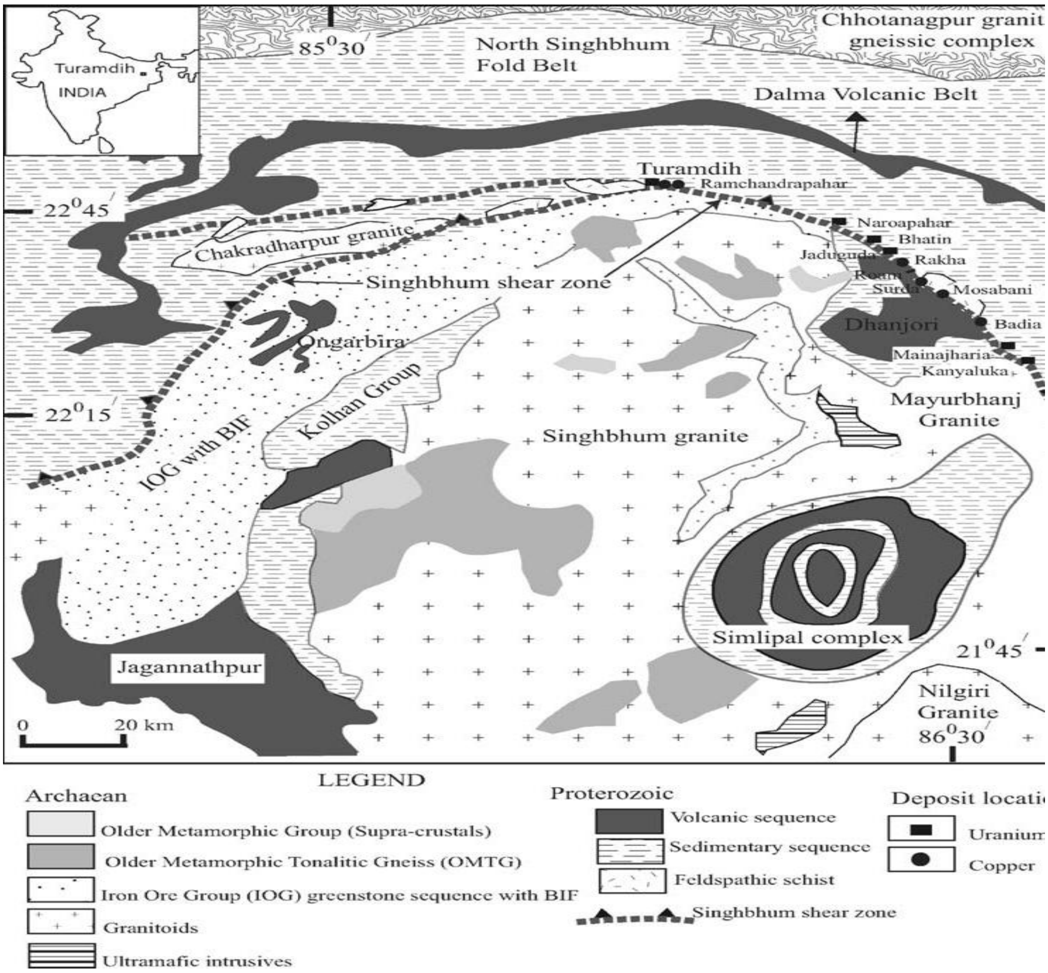

Figure-Simplified geological map of Singhbhum Shear Zone (after Saha, 1994)

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