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ON THE OCCURRENCE OF NATIVE COPPER IN DECCAN TRAPS

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Introduction: The occurrence of native copper in the form of specks, plates and dendritic growths in Deccan Traps has long been known. Palmer (1924, p. 166) has described native copper occurring as leaves on a fault plane in Sylhet trap below Mawsamai (24°14′15″ : 91°44′) south of Cherrapunji. Small thin plates of native copper have been noted along joint planes in black trap obtained from a well south of Beh village (22°16′ : 69°28′) in Halar District, Gujarat.

Roy (1960, p. 441) has recorded the occurrence of filiform, platy native copper up to a few cm across in amygdaloidal and compact reddish Deccan trap in an excavation for a dam across the river Moj about 3 km south-east of Bhayavadar (21°51′ : 70°15′) railway station, Saurashtra. Native copper occurs along joints and fracture planes and as vesicular infillings, or as replacement in tuff and breccia. Specks of native copper of the size of pin heads have been noted in vesicular basalt obtained out of a well 2½ km WNW of Virpur (21°51′ : 70°42′) railway station, Gujarat (Dunn and Jhingran, 1965, p. 95). Thin veins of native copper have been observed in an excavation in Deccan traps near Kolhapur (16°42′ : 74°12′) and also in a railway cutting 11.5 km from Kolhapur (Dunn and Jhingran, 1965, p. 117). Small flakes of shining metallic copper 2 to 5 mm across are reported in some of the cavities in amygdular basalt near Jalakwadi (17°24′ : 73°45′) in a quarry excavated for the Koyna project (Dunn and Jhingran, 1965, p. 119).

Early in 1971, N. Venkoba Rao, Geologist, Department of Mines and Geology, noticed the occurrence of native copper in vesicular Deccan trap in a quarry near Handigund (16°25′ : 75°5′), Belgaum District. Native copper was seen on joint planes and as filaments in the amygdales. This incidentally happens to be the only recorded occurrence of native copper in Mysore State.

All the above mentioned occurrences of native copper have come to light accidentally while examining the traps exposed in quarries. No one to our knowledge has seriously attempted searching for copper in the vast terrain covered by Deccan traps.

The object of the present note is to record the mode of occurrence of native copper in Deccan trap near Handigund, Belgaum district and incidentally to speculate on the possibility of coming across significant concentration of metallic copper in certain favourable horizons in Deccan trap.

The Handigund occurrence: Native copper is seen in a quarry south west of Handigund, a village in Raibag Taluk, Belgaum district. The quarry is about 4 km north of the 21st milestone on Mudhol-Chikkodi road. Native copper occurs in one of the following three forms: (1) as thin foils along joint planes, (2) as vesicular infillings, and (3) as disseminated grains in basalt.

The basalts of Handigund are olivine-free tholeiites exhibiting ophitic to subophitic texture. The chief constituents are plagioclase, pyroxene and iron oxide. Among the secondary minerals epidote and quartz are important. Primary glass is changing over to palagonite. The plagioclase is labradorite ranging in composition from $Ab_{50}An_{50}$ to $Ab_{42}An_{58}$. It occurs both as phenocrysts and as microcrysts in the groundwass. Twinning is very common and zoning is absent.

The common pyroxene found in these rocks is augite. The crystals of augite are usually smaller than those of feldspar, and occur as subhedral grains. Twinning is

absent. Extinction angle $Z \wedge c = 38°\text{-}42$; optically + ve; $2V = 60°$. Rarely brownish coloured titanaugite is observed. It is distinguished from normal augite by its faint pleochroism. Augite (including titanaugite) forms about 40% of the rock. Iron oxide group of minerals consists of magnetite, haematite and maghemite. Epidote is seen replacing augite but its occurrence is very limited. Small anhedral grains of quartz are restricted to the matrix. The amygdales are filled by chalcedonic silica, zeolites, calcite and green earth. The zeolites noticed are heulandite, chabazite and natrolite.

Magnetite, haematite, maghemite and native copper have been identified under the ore microscope. Magnetite occurs as euhedral to subhedral grains. The colour varies from grey to greyish brown. Native copper is not found in association with magnetite. Maghemite occurs as subhedral to anhedral grains. It is bluish grey in colour. Irregular veins of haematite cut across the mineral. Haematite occurs as irregular veins replacing maghemite. It is also seen along 111 (octahedral) planes of magnetite undergoing martitization. It is white to greyish white in colour. It is distinctly anisotropic under crossed nicols.

Native copper occurs along joint planes in the trap as films and thin laminae. It is also seen as vesicular infillings, sometimes replacing chabazite. It occupies the 'core' of the amygdale. No cleavage pattern is observed. The colour on the freshly polished surface is rose red which changes to reddish brown on exposure. It is isotropic under crossed nicols and is not found associated with any other ore minerals like magnetite, martite or haematite.

Native copper in basic lavas: Cornwall (1956, p. 617) has listed some 30 occurrences of native copper some of which are of commercial importance. The most notable occurrence is that of the Keweenavan peninsula of Lake Superior region. Here native copper occurrs in a volcanic pile of flows of basalt with several intercalated zones of felsic conglomerate. Three types of copper lodes have been distinguished: (1) conglomerate lodes, (2) amygdaloidal lodes, and (3) fissure veins. In all these the chief mineral noticed is native copper. The amygdaloidal lodes occur in the upper permeable parts of flows which are fragmental. The tops are reddish owing to included haematite. Native copper occupies the vesicles along with quartz, calcite, epidote, chlorite, sericite and zeoloites. The lodes average 13 feet in thickness and contain from 0.6 to 1.5 per cent copper. The veins in the trap are noted for their mass copper—one single mass is reported to have weighed 500 tons! The six deposits in laves have yielded together over 5 billion pounds of copper.

Native copper is described as occurring as bunches and joint fillings in the basaltic rocks of Blue ridge region, Appalachia. The barren rocks are stated to be dark grey, but when ore-bearing are yellow green in colour and epidotic. Where the ore occurs the rocks are fractured and epidotized. The close association of epidote with copper mineralization is indicated as characteristic of this region (Weed, 1911, p. 116).

Cornwall (1956, p. 619) has classified the copper-bearing lavas into two categories, (1) primary disseminations of copper mostly in the native state that crystallised as the lava solidified, and (2) epigenetic concentrations that are in or adjacent to permeable zones in the lava sequence. The massive flows contain from 10 to 400 ppm of copper. Certain flows are stated to be characteristically rich in copper. Moderate concentrations are seen in pegmatitic segregations that occur in some of the flows.

Lee and Kim (1970) have described the occurrence of native copper in basalts

interlayered with sediments of Jurassic to Cretaceous age. 140 samples have analysed on an average 0.102 copper which is ten times the average copper content of normal basalt. The flow surfaces are described as having a brick red colour due to oxidation of iron. Copper mineralization is considered to be syngenetic during the crystallization of magma, the metal being carried in the form of volatiles to the top of the flow.

Native copper and haematite are particularly abundant in the layered amygdaloidal flows in Vancouver island, British Columbia. Native copper occurs as blebs in amygdoloidal prehnite (Surdam, 1968, p. 961).

Nearly 50 per cent of the copper occurrences in Iran are related to volcanic or volcanic-sedimentary sequences. Amygdaloidal flows contain native copper and zeolites. Wall rock is propylitized and epidotized. The deposits are considered hydrothermal (Bazin and Hubner, 1969, p. 10).

Discussion: The above brief summary of recorded occurrences of native copper in basaltic rocks has been attempted to focus attention on the need for taking a closer look at the Deccan lavas which cover an extent of nearly 200,000 sq miles and attain a thickness of over 3,000 m at places. It is possible that detailed geochemical investigation of these lavas is likely to disclose particular flows with a higher content of copper than the rest.

The invariable association of native copper with lavas, and copper sulphides with intrusives, is itself suggestive of the lavas being the source of copper rather than a remote intrusive rock. The absence of sulphides is to be ascribed to the loss of sulphur during extrusion. The burial of the permeable lava sequence with its interbedded water-deposited sediments would account for the entrapment of considerable quantities of water which would get heated up and driven out during compaction. It is reasonable to expect deposition of native copper from such leached solutions ascending from below.

Structures in Deccan traps like breccias, pipes, and ash beds which have an influence in providing channel ways for ore deposition require to be examined more closely than hitherto.

There is an old recorded occurrence of native copper in India which does not appear to have been followed up in recent years. Lydekker (1883, p. 334) has recorded the occurrence of masses of native copper from the bed of the lower part of the Zangskar river. Several of such masses are stated to have occurred in the form of water-worn nodules reaching 22 lbs in weight! He was, however, unable to trace the source. The range of hills as well as the river flowing through it are known by the name Zangskar range and Zangskar river. According to Cunningham (1859, p. 234), the name Zangskar is derived from *Zangs*, the Tibetan name for copper or brass. This occurrence appears promising and requires closer examination. The source of the native copper nodules is likely to be traced to the trap rocks forming part of the Zangskar sequence.

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