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Mineralogy of polymetallic sulphide mineralization in Archaean greenstones at TISK-USGAO, Goa, India

Goa is predominantly occupied by the Archaean supracrustals which are considered to be the northwestern extensions of the Shimoga–Dharwar schist belt. The lithounits constituting this belt in Goa, are included under the Goa Group[1] which comprises four formations. The oldest, Barcem Formation is dominated by metavolcanics at places pillowed with subordinate agglomerates, red tuffs and phyllites. The remaining three formations namely Sanvordem, Bicholim and Vagheri are predominantly composed of metagreywacke-argillites, calcareous-mananiferous- and ferruginous-sediments which are overlain by metagreywacke-metavolcanics. The Anmod Ghat Trondhjemitic Gneiss dated at 3400 ± 140 Ma forms the basement for the supracrustal assemblage of Goa Group[2]. The latter is emplaced by syntectonic Chandranath Granite dated at 2650 ± 100 Ma associated with first cycle of folding[3]. The Goa Group is traditionally correlated with Chitradurga Group of the Dharwar Supergroup[3].

The Tisk-Usgao area is predominantly occupied by metasediments (banded hematite quartzites) and interlayered metavolcanics. These are intruded by a mafic-ultramafic complex[4,5]. A large part of the area has a thick soil and vegetation cover. The metasediments are traversed by a NW–SE trending prominent shear zone which extends over a distance of

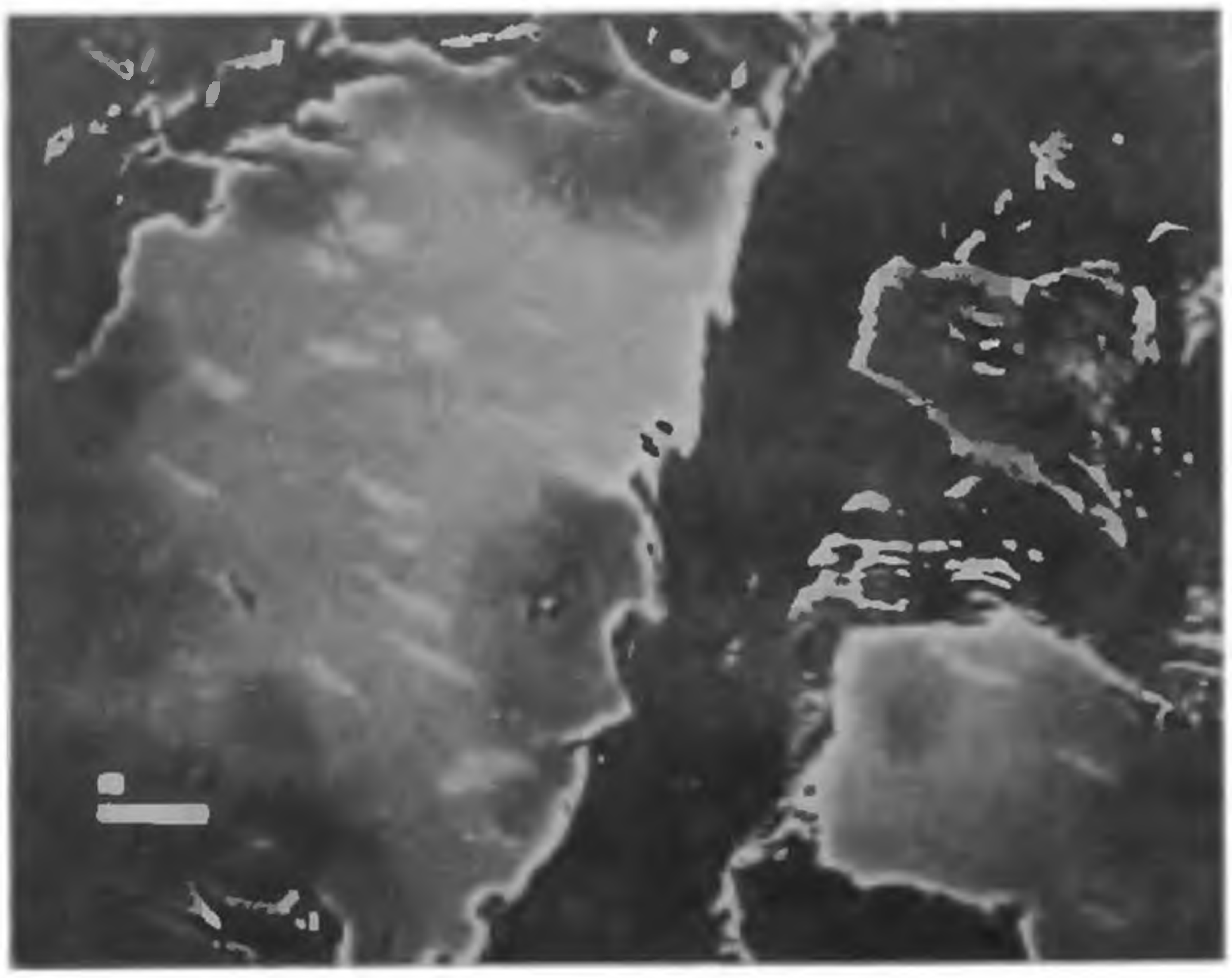

Figure 1. Bright exsolution lamellae of pentlandite in pyrrhotite medium grey intergrown with pyrite darker grey (Bar = 100 μm).

Figure 2. Euhedral Co-gersdorffite light grey in association with pyrite darker grey (Bar = 100 μm).

over 15 km with a maximum width of about 2 km between Ovalem and Gurkhem. The shear zone is in general along the axis of the NW trending antiformal fold discernable on the aerial photograph. It is overturned towards SW and is plunging due to NW[6]. Along the shear zone the greenstones are crushed, at places pulvurized and have developed a mylonitic fabric which is characterized by a well-developed foliation that dips towards SE by 30 to 40° and contains a distinct down-dip lineation defined by aggregates of fine quartz and sericite.

The sulphide mineralization is confined to the quartz-calcite veins within the mylonite zone[7,8]. The veins form a branching pattern, pinching swelling along the dip and across it. They vary in thickness from less than 5 mm to over 30 cm. The intersection of veins is a favourable locale of sulphide mineralization. The sulphides occur as lenticles, segregations, clots, stringers, disseminations and also as thin veinlets within quartz-calcite veins.

The sulphides were studied under incident light and were analysed by standard electron probe technique at CSIRO, Australia. The ore assemblage comprises pyrite, pentlandite, chalcopyrite, pyrrhotite with minor galena and millerite. Pyrite is predominant in the mineral assemblage. It belongs to two generations. Pyrite I is massive and occurs as megacrysts which exhibit compositional zoning. It is invariably fractured and shows intergrowth with chalcopyrite. It contains higher Co (0.78–1.23%) and As (0.17–0.75%) and lower Ni (0.05–0.39%) than pyrite II. The latter is fine-grained, interstitial and spongy in appearance and at places replaces pyrite I. In comparison to pyrite I it is richer in Ni (0.81%) and has insignificant concentrations of Co and As. Chalcopyrite contains 32–33% Cu, the remainder being Fe. Pentlandite occurs as discrete grains and also as exsolution lamellae in pyrrhotite (Figure 1) which is replacing pyrite I. Pentlandite contains 31–39% Ni and about 6% Co. Some samples contain Ni- and Co-sulpharsenides. Ni-gersdorffite shows intergrowth with pentlandite. The former contains 21–24% Ni and 8–9% Co. Co-gersdorffite occurs as euhedral crystals (Figure 2) in association with pyrite I and is invariably zoned. Galena and millerite have restricted occurrence and are generally associated with pentlandite.

The petrography and mineral chemistry are consistent with CO_2-rich hydrothermal fluids as ore carriers. The presence of epidote and millerite indicates as a first approximation a temperature below 300°C for the ore solutions. The fracture zones served as feeders through which the fluids were channelized towards the surface.

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