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The nickel telluride mineral melonite from the Jaduguda uranium deposit, Singhbhum Shear Zone, Bihar, India

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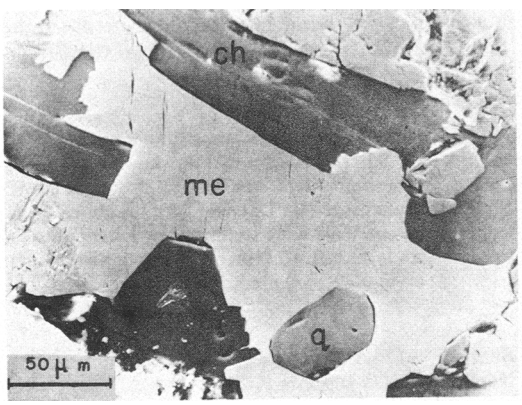
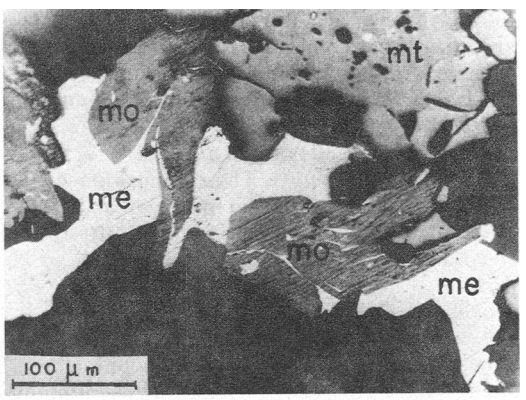
SUMMARY. The rare nickel telluride mineral melonite is identified from Jaduguda uranium ore, Singhbhum Shear Zone, Bihar, India. Its physical, optical, chemical, and paragenetic characteristics are described. The composition as obtained by EPMA is $NiTe_{1.66}Bi_{0.06}$ or approximately $Ni_3(Te,Bi)_5$. The association of melonite with molybenite in this ore deposit is unusual, since melonite is generally associated with tellurides of gold and silver. This is the first reported occurrence of melonite from India.

DURING the course of an intensive mineralogical study of uranium prospects from parts of Singhbhum Shear Zone, Bihar (Rao, 1977), the rare nickel telluride mineral melonite was identified in a few samples from the Jaduguda uranium mine. Though several telluride minerals have been reported from different parts of the Singhbhum Shear Zone, melonite has not previously been reported. This occurrence is also new to India.

Occurrence. The mineral which was later identified as melonite has been observed in a few samples of an apatite-magnetite vein from the 0-metre level as well as in a millerite-rich sample from 165-metre level in the Jaduguda uranium mine. In the former it is closely associated with molybdenite and occurs as fracture fillings in the form of coarse xenomorphic grains and flakes in a matrix of apatite, magnetite, chlorite, and quartz (figs. 1 and 2). Veinlets traversing cracks and cleavages in molybdenite are also common (fig. 2). In the 165-metre level sample it occurs as skeletal particles in chalcopyrite associated with molybdenite, gersdorffite, and millerite.

Physical and optical properties. The mineral has perfect (0001) cleavage, is very soft, and takes a scratch-free polish with difficulty. The Vickers microindentation hardness varies between 67 and 76 kg/mm^2 with an average of 73 kg/mm^2.





FIGS. 1 and 2. FIG. 1 (*left*). Xenomorphic grain of melonite (me) showing (0001) cleavage. Flaky chlorite (ch) euhedral quartz (q) are the other associated minerals. Secondary electron image taken in ETEC SEM. FIG. 2 (*right*). Association of melonite (me) with flaky molybdenite (mo) and granular magnetite (mt) are the other associated minerals. Veinlets of melonite occupy cleavage in molybdenite.

The colour in polished sections is creamy white, tarnishing to brown on long exposure. It shows faint bireflectance. The reflectivity is high, slightly greater than that of pyrite. The spectral reflectivity values measured with a photoelectric device developed in the Ore Dressing Section, BARC, are illustrated in fig. 3. The reflectivity spectrum is characterized by a sharp increase in reflectivity with wavelength between 500–600 nm.

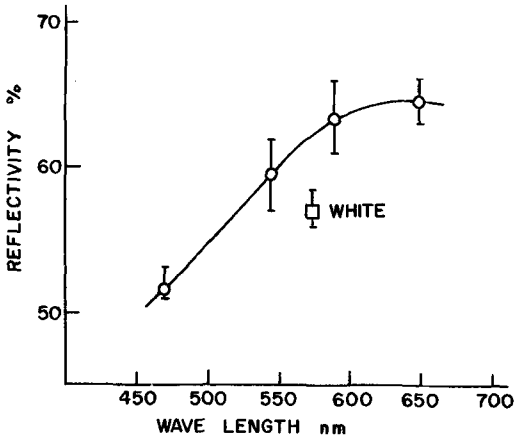


FIG. 3. Spectral reflectivity curve of melonite.

Under crossed polars it shows vivid polarization colours dominated by a violet tinge, which is clearly seen with nearly crossed polars. Larger grains show spindle-shaped twin lamellae, perhaps resulting from deformation during polishing. No internal reflections are observed.

Identification. The physical and optical properties resemble those of the nickel telluride mineral melonite (Vlasov, 1966, p. 691; Uytenbogaardt and Burke, 1971, p. 252; Ramdohr, 1969, p. 420). The identification is confirmed by the wavelength dispersive X-ray fluorescence spectrum of one grain taken in a ETEC Scanning Electron Microscope, which showed that nickel and tellurium are the essential constituents of this mineral.

Chemical composition. The composition of the Jaduguda melonite obtained in a Geoscan EPMA, after corrections for atomic number, absorption and fluorescence factors is Te 75.02%, Ni 20.78, Bi 4.20. It recalculates to $NiTe_{1.66}Bi_{0.06}$ or approximately $Ni_3(Te,Bi)_5$.

According to Ramdohr (1969, p. 419) melonite is a member of the $NiTe$–$NiTe_2$ solid solution series and is often close to $NiTe$. At 450 °C a continuous solid solution series is known to exist between $NiTe_2$ join. The presence of bismuth reflects the studies by Peacock and Thompson (1946) have shown the composition of melonite to be $NiTe_2$ and the reported analyses also correspond to the $NiTe_2$ composition (Vlasov, 1966, p. 691; Strand, 1975; Ebner, 1978).

The composition of Jaduguda melonite is Ni_3Te_5 ignoring Bi. Thus it is a member of the $NiTe$–$NiTe_2$ solid solution series, and the composition falls at the point $NiTe_2 = 80\%$ in the $NiTe$–$NiTe_2$ join. The presence of bismuth reflects the common occurrence of several bismuth telluride minerals in other parts of the Singhbhum Shear Zone.

Melonite from Jaduguda shows more intense anisotropism and vivid polarization colours compared with melonites from elsewhere (Uytenbogaardt and Burke, 1971, p. 252). The relatively higher content of nickel may explain these non-typical optical properties.

Paragenesis. Melonite commonly occurs in (i) gold and silver ores of vein associations, (ii) metasomatic aureoles associated with other tellurides and (iii) high-temp. copper-nickel deposits of non-volcanic origin (Ramdohr, 1969, p. 419; Ebner, 1978). Chalcopyrite is a common associate of all known occurrences of melonite whereas pyrite is generally conspicuous by its absence. The occurrence in Jaduguda is unique in that it is not associated with any gold and silver tellurides, but with molybdenite.

Several telluride minerals have been reported from copper deposits of parts of Singhbhum Shear Zone; these are wehrlite, tetradymite (Sarkar and Deb, 1969), volynskite (Narasimhan and Rao, 1976), and suspected krennerite and calaverite (Rao *et al.*, 1967). In all these occurrences molybdenite is also a common associate of telluride minerals. Further, melonite has been observed only in the Jaduguda area where no other telluride mineral has so far been reported. This is perhaps related to the fact that nickel mineralization is more intense in the Jaduguda area than in other parts of the Singhbhum Shear Zone.

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