

TABLE II. Distances from a tetrahedrally coordinated transition metal ion to near-neighbouring atoms in pentlandite and djerfisherite

Sample	M-S <sub>1</sub>	M-S <sub>2</sub> ( $\times 3$ )	M-M( $\times 3$ )	References
Pentlandite	2.15	2.25	2.52	Raj and Puri (1969)
Djerfisherite	2.29	2.31	2.76	Kerler <i>et al.</i> (1963)

Mössbauer parameters of tetrahedrally coordinated Fe are similar in djerfisherite and pentlandite, and no evidence is found that the octahedral sites are occupied by Fe in djerfisherite, as opposed to the additional singlet found in pentlandite Mössbauer spectra, which was attributed to Fe in those sites.

Thus our Mössbauer results support the structure proposed by Dmitrieva and Ilyukhin (1976) for djerfisherite.

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## Mossite discredited

MOSSITE was originally described by Brøgger (1897) from Berg, Råde, near Moss, Norway. The precise locality remains unknown but Brøgger (1906) assumed Berg or Elvestad in Råde. Lake Vannsjø, situated just east of Moss, is surrounded by a number of classic feldspar quarries which date back to 1870-80. The quarries were in dikes; the accessory minerals in the dikes were columbite, monazite, uraninite, and beryl (Bjørlykke, 1939). The dikes are presently inaccessible due to overgrowth and the use of some of them for the storage of refuse.

Mossite has been considered until now to be an iron niobate referred to the tetragonal tapiolite

group and having the ideal formula,  $\text{Fe}(\text{Nb,Ta})_2\text{O}_6$ . It has been considered the niobium analogue of tapiolite,  $\text{FeTa}_2\text{O}_6$ , and, together, mossite and tapiolite have been considered the tetragonal analogues of orthorhombic ferrocolumbite and ferrotantalite, respectively. Recently, it has been postulated that mossite does not exist as a valid species (Clark and Fejer, 1978). In addition, Moreau and Tramasure (1965) indicated that mossite is unlikely to occur in nature.

The existence of mossite as a legitimate species has long been doubted by various investigators. The original analysis had a  $\text{Ta}_2\text{O}_5:\text{Nb}_2\text{O}_5$  ratio of 118:116 and Schaller (1912) correctly noted that

the name mossite should never have been proposed for what was essentially a niobian tapiolite. This observation was further supported by the findings of Moreau and Tramasure (1965) and the observations of Clark and Fejer (1978). The proposed 'manganomossite' was discredited by Hutton (1959) as columbite. Hence, many investigators have surmized the invalidity of mossite and the present study confirms their observations.

The holotype mossite specimen was deposited in the Mineralogisk-Geologisk Museum, Oslo, Norway by W. C. Brøgger and H. Reusch. It is definitely part of Brøgger's analysed material (pers. comm. W. L. Griffin). Part of this holotype specimen was examined by X-ray diffraction and is in the orthorhombic tantalite group, not in the tetragonal tapiolite group. Five grains were separately X-rayed with no traces of reflections attributable to the tapiolite group. Three of the X-rayed grains were chemically analysed with an electron microprobe; one is inhomogeneous and the other two are essentially tantalian ferrocolumbite with Fe:Mn at 22:6 and Nb:Ta at 24:21. Hence the mineral analysed by Thesen in Brøgger (1906) is in the tantalite group and is properly termed a tantalian ferrocolumbite.

These results do not conform to Brøgger's findings. He had measured the few crystals at his disposal by goniometric techniques and found them to be tetragonal. They were not sacrificed for analysis, perhaps because he did not want to damage the best crystals. Recently, Professor H. Neumann of the Mineralogisk-Geologisk Museum in Oslo, Norway, examined part of the holotype material by X-ray diffraction and found a mixture of orthorhombic and tetragonal phases in the ratio of approximately 2:1 or 3:1. The powdered material used by Goldschmidt (1926) to measure the unit-cell of mossite was X-rayed and gave the pattern of a tetragonal phase only. Subsequently, Neumann (pers. comm.) made a semi-quantitative X-ray fluorescence analysis of the crystals used by Brøgger for his goniometric study. All three crystals showed a Nb<sub>2</sub>O<sub>5</sub>:Ta<sub>2</sub>O<sub>5</sub> ratio of the order of 1:10 by weight. More recently, one of the holotype grains was analysed by W. L. Griffin (pers. comm.) and found to be a Fe-Ta compound with only a little niobium.

Hence, the tetragonal crystals measured by Brøgger (1897), but not chemically analysed, are to be considered as tapiolite. The material chosen by Brøgger (1897, 1906) and analysed by Thesen

is likely to have consisted of both tapiolite and tantalite or columbite.

Another mossite sample was deposited by Brøgger in the Museum National D'Histoire Naturelle in Paris. A portion of this sample was also examined by X-ray diffraction and found to be in the tapiolite group. However, microprobe analysis of this sample indicates that it is a tapiolite with only 4-5% Nb<sub>2</sub>O<sub>5</sub>.

Mossite was also reported by Pryce and Chester (1978) from the Greenbushes tin deposit in Australia. A portion of their sample was obtained through the courtesy of M. W. Pryce. Of this concentrate, six grains were examined by X-ray diffraction; three are in the tapiolite group; one is in the tantalite group; one is a dravite; and one is a mixture of tantalite and strüverite. The three grains with tapiolite symmetry were analysed using an electron microprobe. They are quite inhomogeneous. The two which are less inhomogeneous are Fe-Ta compounds and therefore out of consideration as mossite.

In summary, mossite is not known to exist and has been discredited by the IMA Commission on New Minerals and Mineral Names. The holotype sample is partly in the orthorhombic tantalite group (tantalian ferrocolumbite) and partly also tapiolite. Mossite is therefore discredited.

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