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Metamict columbite re-examined

METAMICT columbite from Yinnietharra, Western Australia, was first described by Bowley (1923) as ‘manganomossite’ or possibly as ‘mangano-columbite’. In a later study, Hutton (1957) tentatively identified the mineral as metamict tantalite. In a more detailed chemical and X-ray diffraction study, Hutton (1959) identified the specimen as metamict columbite. A history of the nomenclature of the specimen as well as an excellent description of its physical, chemical and structural properties is found in Hutton’s (1959) study.

The cause for re-examination of the specimen is that it represents the only described occurrence of metamict columbite. Closely related orthorhombic, rare-earth, AB_2O_6 -type Nb–Ta–Ti oxides (e.g. euxenite, priorite, polycrase, and aeschynite) are often found in the metamict state, but columbite is not. The existence of a metamict columbite is of interest in that it may provide a key to the understanding of the process of metamictization. Of critical importance is the determination of whether the specimen in its pre-metamict form was indeed columbite and whether it consists of a homogeneous single phase.

Hutton (1959) in an effort to insure that only a single phase was analysed examined autoradiographs of a polished section and carefully prepared the sample for chemical analysis by electromagnetic fractionation. Still, some doubt as to the homogeneity of the specimen remained as the ‘Autoradiographs show that zonary distribution of radioactivity may or may not be present . . .’

Chemical analysis of the same specimen analysed by Hutton (1959) was repeated using an electron microprobe (ARL, Stanford University). The microprobe standards were metal oxides and museum specimens analysed by the Atomic Energy Commission for the late Dr. C. O. Hutton. H_2O was not determined. Results of the analyses are

summarized in Table I. As Hutton (1959) had indicated no inclusions of samarskite or other multiple Nb-Ta-Ti oxides were present; however, the microprobe analysis revealed distinct alteration zones intimately associated with unaltered material. The alteration zones are characteristically a translucent deep orange and chemically deficient in UO_2 and ThO_2 as compared to the opaque unaltered areas. The intimate association of the two zones would preclude their complete separation by electro-magnetic techniques.

TABLE I. *Chemical analysis of metamict columbite from Yinnietharra, Western Australia*

	Altered	Unaltered
MnO	9.99	10.00
FeO	6.69	6.44
UO_2	0.40	1.48
ThO_2	0.03	0.08
Nb_2O_5	40.19	41.17
Ta_2O_5	38.35	38.95
TiO_2	0.63	0.69
Total	96.28*	98.81*

* H_2O was not determined.

Thus, the composition of the original pre-metamict phase has been altered. X-ray annealing studies on altered metamict material have been shown to yield spurious results (Ewing, 1975) and in some cases there may be incipient recrystallization of the metamict phase (Ewing, 1974). The recrystallized phase may or may not be the original pre-metamict phase. Due to the intimate association of the altered and unaltered zones in the 'metamict columbite', it was not possible to relate the faint X-ray diffraction lines of the unheated material observed by Hutton (and observed by this author) to either of the regions exclusively. Thus, whether the crystalline phase is a pre- or post-metamict event cannot be determined.

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Department of Geology
University of New Mexico
Albuquerque, New Mexico 87131

RODNEY C. EWING

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