

SHORT COMMUNICATIONS

MINERALOGICAL MAGAZINE, DECEMBER 1994, VOL. 58, PP. 679-681

Chemical composition and structural formula of manganooan sugilite from the Wessels Mine, Republic of South Africa

THE gemological description of Wessels Mine sugilite published by Shigley *et al.* (1987) did not contain a chemical composition of the described polycrystalline material. Subsequently, purer, coarsely crystalline sugilite specimens from the Wessels Mine have become available (Von Bezing *et al.*, 1991). This note reports for the first time a complete chemical analysis of pure sugilite from this locality (Dunn *et al.* 1980; Clark *et al.*, 1980; Olivier *et al.*, 1983; Armbruster and Oberhänsli, 1988; Dixon, 1985, 1989). Because of the quantity of material it also was possible to determine the H_2O^+ and H_2O^- for sugilite by a non-gravimetric technique specific for water, and determine the specific Fe^{2+} content with a wet chemical determination by colorimetric titration.

The specimen consisted of transparent to translucent sugilite crystal fragments and crystal aggregates up to 1 cm in size, some embedded in a matrix of a light brownish-white mineral that is not positively identified (possibly pectolite). Several sugilite grains were removed and mounted and polished for microprobe analysis. The remaining material was hand picked and then pulverized to produce the sample to be used for the other analytical techniques. A variety of analytical methods was used to determine all the significant constituents present in the pulverized split of sugilite, including: major elements by X-ray fluorescence (XRF) (Taggart *et al.*, 1987); lithium by inductively-coupled plasma atomic emission spectroscopy (ICP-AES) (Lichte *et al.*,

1987); specific water analyses by Karl Fisher titration (Jackson *et al.*, 1987); ferrous iron by colorimetric titration (Peck, 1964; Jackson *et al.*, 1987). Analyses of the mounted and polished fragments for major and minor elements were performed on the electron microprobe (EMP). Based on the XRF and EMP analyses it is concluded that, despite the purity of the material, there was still some contamination in the pulverized sample. Calcium, for example, shows up in the XRF analysis of the pulverized split but none was detected in the EMP sample. Subsequent scanning electron microscope (SEM) observation of the pulverized sugilite sample with semiquantitative energy dispersive X-ray, indicated the presence of occasional fragments of a Ca:Mn:silicate with 1:1:2 elemental wt.% ratios, (possibly bustamite). Assuming that all the CaO contamination in the sample was from the 1:1:2 phase, all 1.91% of the CaO, as well as the appropriate 1.91% MnO and 3.82% SiO_2 were mathematically removed from the chemical analysis. This subtraction of the contaminant from the analysis of the pulverized split required a proportional increase in the Li_2O and FeO determinations that were performed on the same split. The other major element determinations were taken from the EMP analysis of the polished material. The resulting combined analysis is given in Table 1.

Using the CHEMICAL COMPUTATIONS program (Kampf, 1992), the chemical data for

TABLE 1. Chemical analysis of manganooan sugilite from the Wessels Mine, Republic of South Africa

Constituent	Weight percent	Atoms/molecules of water in formula
SiO ₂	69.9	12.0
Al ₂ O ₃	0.4	0.08
Fe ₂ O ₃	11.3	1.46
FeO*	0.79	0.11
Na ₂ O	6.2	2.1
K ₂ O	4.7	1.0
Mn ₂ O ₃ †	2.1	0.28
Li ₂ O	4.41	3.05
H ₂ O ⁺ (essential)	0.439	0.252
H ₂ O ⁻ (moisture)	0.07	‡
Total	100.30	

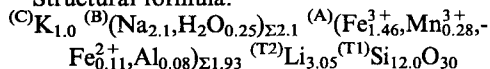
* By titration

† Considered Mn³⁺ based on Ambruster (1988)

‡ Non-structural moisture eliminated from formula calculation

manganooan sugilite were used to calculate a structural formula by analogy with the crystal chemistry of milarite (Forbes *et al.*, 1972; Černý *et al.*, 1980) and the crystal chemistry of double-ring silicates (Ambruster and Oberhänsli, 1988). The formula was calculated based on 30 oxygen atoms in the Si₁₂O₃₀ portion of the formula. Oxygen, bound in what is presented here as molecular water in the B site (Kato *et al.*, 1976, Murakami *et al.*, 1976, Černý *et al.*, 1980), was not included in the O₃₀ tally.

Structural formula:



Acknowledgements

We thank LAVULITE Inc. for providing the coarsely crystalline sugilite fragments that made this work possible; the following U.S. Geological Survey researchers for their assistance in carrying out the chemical analyses: Jim Crock, Larry Jackson, and Elaine Brandt; and Anthony Kampf of the Los Angeles County Museum of Natural History for making the CHEMICAL COMPOSITIONS program available. We also thank Michael Brownfield and Richard Erd for valuable criticism of the manuscript.

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- [Manuscript received 18 January 1994]
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KEYWORDS: manganooan sugilite, Wessels Mine, Republic of South Africa

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MINERALOGICAL MAGAZINE, DECEMBER 1994, VOL. 58, PP. 681–685

Causes of the purple and pink colours of manganooan sugilites from the Wessels mine, South Africa

THE occurrence of manganooan sugilite at the Wessels Mine near Kuruman, South Africa, has been described by Wilson and Dunn (1978), Dunn *et al.* (1980), de Villiers (1983), Dixon (1985), and more recently by von Bezing *et al.* (1991). A detailed chemical analysis of this material (Taggart *et al.*, 1994) is available elsewhere in this issue. Shigley *et al.* (1987) discussed the gemological properties of this material, and reported that although most manganooan sugilite from the Wessels mine is purple, it also occurs very

rarely with a reddish purple colour (commonly described as pink). While illustrating a visible-range absorption spectrum of the purple variety, they did not give any detailed explanation for the cause of the material's attractive colour. The present article provides this explanation.

Materials and methods

Two samples, representative of both colours of manganooan sugilite, were selected for this spectro-