

## MINERALOGICAL NOTES

## BUERGERITE, A NEW SPECIES OF TOURMALINE

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The name buergerite is proposed for any tourmaline that has, as its major component, the idealized end member  $\text{NaFe}_3^{3+}\text{Al}_6\text{Si}_6\text{B}_3\text{O}_{30}\text{F}$ . Buergerite is chemically related to the schorl end member as follows:



A ferric tourmaline from Mexquitic, San Luis Potosí, Mexico, has the following composition, which supersedes the one previously reported (Mason *et al.*, 1964):  $\text{SiO}_2$  33.86,  $\text{B}_2\text{O}_3$  10.86,  $\text{Al}_2\text{O}_3$  30.79,  $\text{TiO}_2$  0.55,  $\text{Fe}_2\text{O}_3$  17.62,  $\text{FeO}$  1.27,  $\text{MnO}$  0.13,  $\text{MgO}$  0.13,  $\text{CaO}$  0.69,  $\text{Na}_2\text{O}$  2.46,  $\text{K}_2\text{O}$  0.07,  $\text{H}_2\text{O}^-$  none,  $\text{H}_2\text{O}^+$  0.40, F 1.86, sum 100.69 - ( $\text{O}=\text{F}_2$  0.78) = 99.91%. Spectrographic examination (by N. H. Suhr) shows Sr, Ba, Cr, Be, Ni, Co, V less than 0.01%, Zn less than 0.1%.

Tourmaline requires special analytical methods. After fusion with  $\text{Na}_2\text{O}_2$  in platinum at 500° C. (Belcher, 1963),  $\text{H}_3\text{BO}_3$  was used to remove fluorine, then  $\text{CH}_3\text{OH}$  to remove most of the boric acid, before hydrochloric acid dehydration of the  $\text{SiO}_2$ . Boron contamination of the ammonia group oxides was determined by the curcumin method of Heyes and Metcalfe (1963). Manganese, calcium and magnesium were separated as usual with persulfate, oxalate, and phosphate respectively.

Boron was determined after  $\text{Na}_2\text{O}_2$ - $\text{Na}_2\text{CO}_3$  fusion, leaching with water, filtration, and a  $\text{CaCO}_3$  precipitation, by second derivative potentiometric acid base titration of the filtrate using mannitol (Frank, 1963). All precipitates and residues were combined, ignited at low temperature, mixed, and examined for boron with curcumin. About 3 per cent of the boron in the sample was retained by the residues, so that failure to examine them would have caused appreciable error.

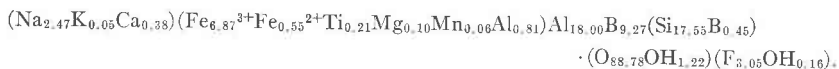
Fluorine was determined, after  $\text{Na}_2\text{O}_2$  fusion and steam distillation from phosphoric acid, by thorium nitrate titration (Ingamells, 1962).

For sodium and potassium, a sample was dissolved in dilute nitric acid after  $\text{LiBO}_2$  fusion (Ingamells, 1964), and the flame photometer was used. Colorimetric determinations of Fe, Al, Ti, and Mn on the same solution gave values which agree within 1 per cent with those obtained in the detailed analysis.

Ferrous iron was determined by the pyrophosphate method (Inga-

mells, 1960), and confirmed by an Fe K absorption-edge study by E. White (priv. comm.), who estimates that more than 90 per cent of the iron is in the ferric state.

It is known that the structure of tourmaline contains 150 atomic sites per cell. On this basis (Donnay, 1964), the cell content of the Mexquitic mineral is



The crystals have short prismatic habit and show the forms  $\{11\bar{2}0\}$ ,  $\{30\bar{3}0\}$ ,  $\{10\bar{1}1\}$ ,  $\{02\bar{2}1\}$ . Goniometric measurements gave  $c/a=0.4521$ . Single crystal and diffractometer data gave  $a$  15.873,  $c$  7.187 Å, standard deviation 0.002 Å,  $c/a=0.4528$ . The mineral has a distinct prismatic cleavage, in contrast to the very poor cleavage usually reported for tourmaline. A plot of  $c$  vs.  $a$  shows that this tourmaline falls outside the usual series limits (Mason *et al.*, 1964, Fig. 1).

Crystals are dark brown, almost black, with a bronze schiller and a yellow-brown streak. Optically uniaxial, negative, with  $\omega=1.735$ ,  $\epsilon=1.655$  (both  $\pm 0.003$ ), birefringence 0.080 (nearly twice the maximum previously reported for tourmalines), pleochroic with  $\omega$  yellow-brown,  $\epsilon$  very pale yellow.  $G=3.31 \pm 0.01$  (higher than other tourmalines).

Material with similar unit cell and composition ( $a$  15.860,  $c$  7.173 Å) has been synthesized hydrothermally by Mr. Randolph Barton, Jr., in Professor H. Eugster's laboratory at the Johns Hopkins University.

The type material has been deposited in the American Museum of Natural History (specimen no. 35468), New York, N. Y.

The name honors Professor M. J. Buerger, Massachusetts Institute of Technology, in whose laboratory much work on the structure of tourmaline has been carried out. The Commission on New Minerals and Mineral Names, I.M.A., has approved the name in advance of publication.

## REFERENCES

- BELCHER, C. B. (1963) Sodium peroxide as a flux in refractory and mineral analysis. *Talanta* **10**, 75-81.
- DONNAY, GABRIELLE (1964) Deriving the formula of a mineral from its chemical analysis. *Am. Mineral.* **49**, 1490-1491.
- FRANK, ANDREW J. (1963) Titrimetric determination of boron in boron silicides. *Anal. Chem.* **35**, 830-832.
- HEYES, M. R. AND J. METCALFE (1963) The boron-curcumin complex in trace boron determinations. *U.K.A.E.A. Production Group Rept.* **251** (S).
- INGAMELLS, C. O. (1960) A new method for 'ferrous iron' and 'excess oxygen' in rocks, minerals, and oxides. *Talanta* **4**, 268-273.
- (1962) The application of an improved steam distillation apparatus to the determination of fluorine in rocks and minerals. *Talanta* **9**, 507-516.
- (1964) Rapid chemical analysis of silicate rocks. *Talanta* **11**, 665-666.
- MASON, B., GABRIELLE DONNAY AND L. A. HARDIE (1964) Ferric tourmaline from Mexico. *Science* **144**, 71-73.