

## Ashtonite, a strontian mordenite

ASHTONITE, a supposed new zeolite from '5 miles from Penticton, on road to Keremeos, British Columbia' was first described by Poitevin (1932). The optical properties were similar to those of mordenite, but the mineral was described as a new species on the basis of a chemical analysis that differed from that of mordenite in having a higher calcium content. The resulting formula contained twice the number of large cations as is present in mordenite and in fact was incompatible with tectosilicate requirements. No other data have appeared in the literature except that Hey (1950) quoted a private communication from F. A. Bannister indicating that ashtonite may be identical with mordenite. Davis (1958) has confirmed that ptilolite, flokite, and arduinite are identical with mordenite.

One of us, D. S. C., through the courtesy of the Geological Survey of Canada, obtained a sample of the type material and found that the X-ray pattern from this sample agrees with that of mordenite. Hey (pers. com.) has subsequently confirmed that an X-ray pattern obtained by Bannister also agrees with mordenite. The specimen of type material, catalogue number O.U. 15076 now held in the Geology Department, University of Otago, consists of a radiating acicular zeolite, varying in colour from colourless to white, lilac, or brick red as described by Poitevin. It would appear to have been collected from a vuggy cavity in a felsic segregation in a more mafic rock.

TABLE I. X-ray powder diffraction data on 'ashtonite', indexed on a cell with a  $18.12 \pm 0.03$ ,  $b$   $20.44 \pm 0.03$ ,  $c$   $7.52 \pm 0.02$  Å. Cu-K $\alpha$  radiation, Ni filter, 114.8 mm diameter camera

<i>hkl</i>	<i>I</i>	<i>d</i> meas.	<i>d</i> calc.	<i>hkl</i>	<i>I</i>	<i>d</i> meas.	<i>d</i> calc.	<i>hkl</i>	<i>I</i>	<i>d</i> meas.	<i>d</i> calc.
110	5	13.5 Å	13.56 Å	222	1	3.293	3.287	841	1	1.999	1.996
200	7	9.12	9.06	530	10	3.221	3.199	680	$\frac{1}{2}$	1.953	1.950
111	5	6.63	6.57	441	1	3.103	3.090	2.10.1	$\frac{1}{2}$	1.929	1.927
130	2	6.42	6.38	531	1	2.938	2.943	860	2	1.885	1.886
021	2	6.09	6.06	402	4	2.894	2.892	392	$\frac{1}{2}$	1.852	1.850
201	3	5.79	5.78	152	1	2.741	2.735	4.10.1	$\frac{1}{2}$	1.809	1.808
221	1	5.05	5.03	621	2	2.703	2.702	1.11.1	$\frac{1}{2}$	1.797	1.795
131	1	4.867	4.862	370	1	2.641	2.628	932	1	1.718	1.717
330	5	4.530	4.519	461	2	2.561	2.560	6.10.0	$\frac{1}{2}$	1.695	1.692
420	2	4.148	4.140	442	4	2.522	2.517	514	1	1.663	1.663
150	8	4.009	3.987	641	$\frac{1}{2}$	2.457	2.457	753	$\frac{1}{2}$	1.648	1.647
241	2	3.846	3.829	223	$\frac{1}{2}$	2.349	2.350	534	$\frac{1}{2}$	1.622	1.620
002	1	3.773	3.759	172	$\frac{1}{2}$	2.285	2.287	843	1	1.598	1.596
112	1	3.619	3.662	191	1	2.161	2.158	6.10.2	1	1.544	1.543
151	1	3.524	3.522	390	$\frac{1}{2}$	2.127	2.125	593	2	1.527	1.526
202	9	3.487	3.472	513	2	2.053	2.050	991	1	1.477	1.477
060	8	3.389	3.406	063	1	2.020	2.018	405	1	1.428	1.427

The zeolite is intimately associated with calcite. The X-ray powder pattern is essentially identical with that of mordenite. The first fifty-one lines are listed in table I and agree well with the data of Harris and Brindley (1954) for mordenite from Aros, Isle of Mull, Scotland.

Calcite occurs as films along cleavages and grain boundaries, and as minute inclusions in the mineral, from which it could not be completely separated in spite of repeated centrifuging in a bromoform-acetone mixture. A new analysis has been completed on carefully concentrated 'ashtonite' (table II, column B). This has been

TABLE II

	A	B	C		D	
SiO <sub>2</sub>	63.30	63.92	65.76	Si	19.83	} 23.99
				Al	4.16	
Al <sub>2</sub> O <sub>3</sub>	11.74	11.37	11.70			} 2.98
Fe <sub>2</sub> O <sub>3</sub>	0.50	trace	—	Ca	1.01	
				Sr	0.23	
CaO	9.54	4.66	3.12	Na	1.56	
				K	0.18	
MgO	0.39	trace	—			
SrO	—	1.27	1.31	H <sub>2</sub> O	15.05	
BaO	0.21	*	—	ΣCa, Sr, Na <sub>2</sub> , K <sub>2</sub>	= 2.11	
Na <sub>2</sub> O	3.28	2.60	2.67		A	B
K <sub>2</sub> O	0.42	0.46	0.47	α	1.481	1.479 ± .002
H <sub>2</sub> O	10.42	14.56	14.97	β	1.482	—
CO <sub>2</sub>	—	1.28	—	γ	1.486	1.481 ± .002
Total	99.80	100.12	100.00	D <sub>expt</sub>	—	2.15
				D <sub>calc</sub>	—	2.16

A. Ashtonite, Analyst Poitevin, 1932.

B. Ashtonite = Mordenite. Anal. A. Reay.

C. Analysis B recalculated calcite free.

D. Column C recalculated on the basis of 48 oxygens per half-unit cell.

\* Not detected by X-ray fluorescence analysis.

adjusted for 2.91% calcite (table II, column C). Apart from slight excess water, the resulting atomic proportions conform with the conventional mordenite formula (Ca, Sr, Na<sub>2</sub>, K<sub>2</sub>)<sub>4</sub>Al<sub>8</sub>Si<sub>40</sub>O<sub>96</sub> · 28H<sub>2</sub>O, with the addition of Sr to the *W* group cations usually cited.

It is difficult to explain Poitevin's analysis. Almost certainly, his specimen contained significant calcite, which may account for the excessive CaO, although this should have produced a deficient summation in the absence of a CO<sub>2</sub> determination. In any case, ashtonite is clearly a mordenite with an interesting but not excessive strontium content.

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## A preliminary note on eucolite from Oldoinyo Lengai, Tanzania

IN the preliminary account of the geology of the active carbonatite volcano Oldoinyo Lengai, northern Tanzania, Dawson (1962) recorded the presence of sodalite-group minerals and aegerine in the phonolite and nephelinite lavas; they have subsequently been found in ejected plutonic blocks in the pyroclastics that form the bulk of the volcano. The presence of these minerals, together with high (Na+K)/Al ratios in some of the lavas, indicates that the rocks have agpaitic affinities. This evidence has been reinforced by the finding of the agpaitic mineral eucolite in two blocks of melanocratic syenite collected by the writer on the lower, southern slopes of the volcano in 1966. The cherry-red, xenomorphic eucolite is associated with nepheline, cancrinite, orthoclase, sodic pyroxene, wollastonite, apatite, sphene, and pyrrhotine. The agpaitic coefficient (Na+K)/Al of one of the eucolite-bearing syenites is 1.84.

The eucolite is optically negative;  $\epsilon$   $1.612 \pm 0.001$ ,  $\omega$   $1.616 \pm 0.001$ . The X-ray powder pattern is almost identical with that for eudialyte from SW. Greenland (A.S.T.M. Powder Diffraction File 8-355) save for slight, but consistent, peak shifts; the three strongest lines are at 2.85, 3.40, and 4.30 Å.

The agpaitic paragenesis at Oldoinyo Lengai is of interest since agpaitic rocks are not normally found in genetic association with carbonatites (Heinrich, 1966). This is also the first record of a mineral of the eudialyte-euolite series in East Africa.

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