THE AMERICAN MINERALOGIST, VOL. 46, MARCH–APRIL, 1961

NOTES AND NEWS

AN OCCURRENCE OF SAPONITE NEAR SILVER BAY, MINNESOTA

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Introduction

Saponite and saponite-like minerals (thalite) were described from the flows of the north shore of Lake Superior by some of the first geologists in the area (Winchell, 1900). These minerals subsequently escaped attention until 1954 when a high concentration of a white clay mineral was discovered in altered basaltic flows during the construction of the Reserve Mining Company's taconite plant at Silver Bay, Minnesota. This clay mineral was first definitely identified as saponite by Whelan at the University of Minnesota, utilizing *x*-ray diffraction.

Following the discovery of the saponite near Silver Bay, field work by Lepp showed that saponite is acutally a common minor constituent of the Keewanawan flows of the north shore of Lake Superior. The saponite occurs in amygdules and in fracture zones in these volcanics. It varies in color from white to tan to light green and is usually associated with one or more of the zeolites, and with calcite and quartz. Its occurrence as a lining or rim in certain amygdules suggests that it may be an alteration product of one or more of the zeolites.

The laboratory work described in this paper was done by Whelan at the University of Utah. The mineralogic and chemical analyses reported herein were all conducted on saponite from the Silver Bay locality, because this was the best source of pure material.

Optical and Physical Properties

The saponite is white but is sometimes stained to a very light tan. It has a soapy feel and a hardness of two. Its specific gravity, as determined with a Berman microbalance, is 2.10+0.02. While crushing saponite fragments for laboratory studies, several were found to contain round, frosted, quartz fragments up to 1 mm. in diameter. These were removed by hand-picking. The crushed and ground saponite contained less than two per cent impurities, chiefly on unidentified tabular mineral, barely visible under high magnifications. The saponite is anisotropic with a mean index of refraction of about 1.49 and moderate birefringence. It exhibits a radial fibrous to matted fibrous habit under the petrographic microscope and an irregular habit under the electron microscope.

X-RAY DIFFRACTION DATA

The saponite was first identified from a powder photograph taken at the University of Minnesota. Later work was done at the University of Utah with a Norelco high-angle diffractometer utilizing CuK_α radiation. A depression mount was used to hold the sample. The data from the Minnesota saponite, together with a pattern of saponite from Cathkin near Glasgow, Scotland (Faust and Murata, 1953) are given in Table 1. Treatment of an oriented smear with ethylene glycol expanded the basal (001) refraction of the Minnesota saponite to 18.0 Å.

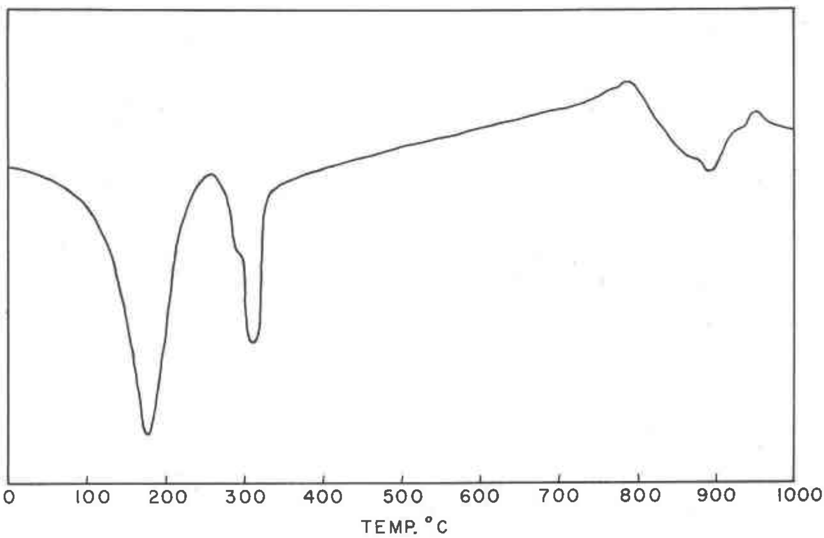

FIG. 1. DTA curve, Silver Bay saponite.

This saponite would have an approximate structural formula of $Mg_{3.0}Al_{0.6}Si_{3.4}O_{10}(OH)_2 \cdot nH_2O$, X=0.6. The analyses indicate that calcium is the exchangeable interlayer ion.

DIFFERENTIAL THERMAL ANALYSIS

The DTA curve of this saponite is shown as Fig. 1. The first endothermic reaction (175° C.) represents the loss of interlayer water. The second endothermic reaction (310° C.) probably represents the loss of water coordinated around interlayer ions. This reaction occurs at a higher temperature than is usual for montmorillonite-type minerals. Usually the loss of coordinated water is represented by a break on the high temperature side of the first endothermic reaction. The two low temperature endothermic reactions make the DTA curve of this saponite similar to curves of vermiculite (Grim, 1953, p. 199). Several runs were

TABLE 1. *X*-RAY POWDER DATA FOR SAPONITE DRIED AT ROOM TEMPERATURE (Cu/Ni; 1.5418 Å)

Saponite, Silver Bay, Minnesota			Saponite, Cathkin near Glasgow, Scotland (Faust and Murata, 1953)			
d(Å)	I*	Notes	*d*(Å)	I	Notes	Miller Indices
15.0	100		14.8	vs		(001)
			7.71	m	Broad	(002)
4.93	54		5.14	m	Broad	(003)
4.58	100		4.59	ms	Broad	(110)(020)
			4.34	vvf		
3.71	32		3.79	vw		(004)
3.04	88		3.09	m		(005)
2.969	90					
2.660 }			2.613	m		
	96	Broad Band	2.545	m	Diffuse	(200)
2.436 }						
2.287	28					
2.136	20					
1.875	20		1.852	vvf		
1.725	28		1.747	w		(150)
			1.703	w		(310)
1.670	12					
1.599	8					
1.530	10		1.543	s	Broad	(060)
			1.498	vvvf		
1.423	8		1.458	vvvf		
1.361	20					
1.326 }			1.327	m	Broad	(260)
	40					
1.311 }						
			1.278	vvvf	Broad	(400)
			0.999	vvvf	Diffuse	
			0.890	vvvf	Broad	(550)(390)

* Intensities of 00*l* reflections based on oriented aggregates.

CHEMICAL COMPOSITION

A spectrochemical analysis was made with the following results:

Major: Mg, Si, Al, Ca.
Minor: Fe, Mn.
Trace: Co, Ni (Determined semiquantitatively as 0.04%).
Not Found: Sb, As, Ba, Be, Bi, B, Cd, Cr, Cb, Cu, Ga, Sn, Ti, W, V, Zn, Zr.

A partial wet analysis is given in Table 2.

TABLE 2. CHEMICAL ANALYSES

	Silver Bay Saponite		Thalite, Knife River, Minn. (Winchell, 1900) (P-168)
SiO_2	42.8		42.38
Al_2O_3	6.2		7.37
MgO	25.2		23.29
CaO	4.9		5.82
Loss on ignition+120° C.	9.1		7.80
H_2O^-	11.9		10.38
Fe (total)	0.35	Fe_2O_3	2.65
		K_2O	0.19
		Na_2O	0.36
Total	100.45		99.94

Analyst: Lester Butcher.

made to determine if impurities were responsible for the 310° C. reaction. Impurities were not the cause, as this reaction was reproducible both as to temperature and size in samples over 98 per cent saponite.

Infrared Absorption Spectrum

The infrared absorption spectrum was determined on a Perkins Elmer Model 21 double-beam spectrometer with a NaCl prism. One mg. of saponite per 400 mg. infrared grade potassium bromide was used for disks. The spectrum is not definitive. Bands are as follows: O-H stretch, 3.0; O-H bend 6.18; and broad silicate bands at 9.7 and 10.25. This spectrum is generally comparable to those of other montmorillonite-type minerals.

Summary and Conclusions

Saponite of the composition $Mg_{3.0}Al_{0.6}Si_{3.4}O_{10}(OH)_2 \cdot nH_2O$, $X=0.6$, Ca/2, occurs in the Keweenawan basalt flows at Silver Bay and elsewhere along the north shore of Lake Superior. Its fibrous habit indicates that it may have formed by the alteration of a fibrous zeolite.

Acknowledgment

The laboratory work done on this saponite was done incidental to a larger clay mineral project supported by the Research Fund, University of Utah.

References

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