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HAÜYNITE FROM EDWARDS, NEW YORK

PETER LESSING[1], *Department of Geology, St. Lawrence University, Canton, New York, 13617*, AND C. MACDONALD GROUT, *St. Joe Minerals Corporation, Balmat, New York 13609.*

ABSTRACT

The first occurrence of haüynite from New York State is described. Chemical and X-ray analyses place this and other samples from the literature within restricted fields on a CaO-Na_2O-K_2O diagram. A minimum temperature of 500°C is for the Grenville marble at Edwards.

INTRODUCTION

The discovery of haüynite at Edwards, St. Lawrence County, New York, represents the first occurrence of this mineral in the state. As a result of this find, a study of the sodalite mineral group has been undertaken. A considerable diversity of opinion exists in the literature with regard to this group of minerals. The purpose of this paper is to describe the occurrence and geological significance of haüynite at Edwards.

The Balmat-Edwards district is well known for its economic zinc and talc deposits. The district is located in a northeast trending belt of Grenville marble approximately 12 miles long and from ½ to 2 miles wide. Detailed geology of the region has been published by Brown and Engel (1956) and Lea and Dill (1968).

OCCURRENCE

Haüynite was first discovered in the Edwards mine, Edwards, New York, in 1969. It is located in the D3 stope on the 2700 foot level, first mining sublevel. The original haüynite mass is within the ore zone and measures approximately 3 by 8 feet (Fig. 1). Surrounding the haüynite is a zone of pyritic actinolite, which in turn has a selvage of phlogopite. Large masses of high-grade sphalerite occurring in dolomitic marble are adjacent to the phlogopite. A smaller, but essentially identical mass of haüynite has recently been found adjacent to the original find. No granitic or pegmatitic intrusions are known in the immediate vicinity. Unfortunately, the haüynite area has now been mined out and the authors do not have access to more material.

A second occurrence has recently been located in the D4 ore body. This occurrence, on the 3100 foot level, second mining sublevel, is approximately 500 feet down dip from the initial discovery, but not in the same stratigraphic sequence. It occurs in a dolomitic marble containing minor diopside, calcite and anhydrite. Several small pegmatites are found in the

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[1] Present address: West Virginia Geological Survey, Morgantown, West Virginia 26505

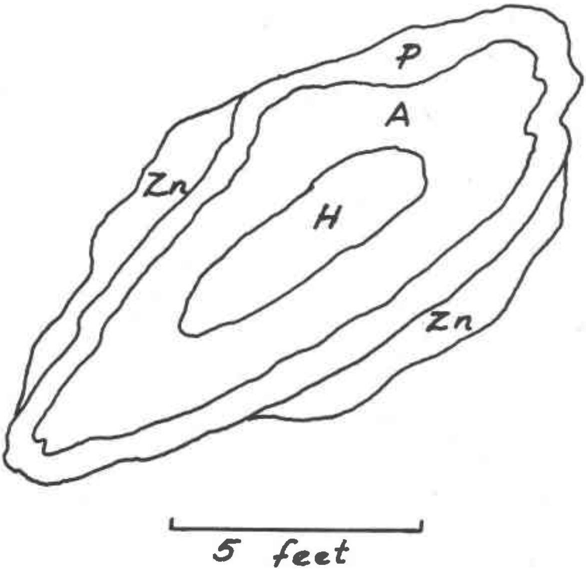

FIG. 1. Sketch of haüynite occurrence. H = haüynite, A = actinolite, P = phlogopite, Zn = sphalerite.

immediate area. No analytical work has been performed on this second occurrence.

PETROGRAPHY

Thin section petrography indicates that the haüynite occurs with calcite, actinolite, diopside, pyrite, and minor zircon. Pyrite (5%) occurs as anhedral, randomly scattered patches. Actinolite and diopside compose about 60 percent of the sample with diopside dominant. They are subhedral with no discernible orientation. Phlogopite is minor and usually occurs as a thin selvage around the haüynite. Anhedral grains of calcite represent about 5 percent and appear to be late in the paragenetic sequence filling interstices and cracks.

Haüynite ($n = 1.153 \pm 0.002$) occurs as anhedral grains ranging from <1 mm to 10 mm in size. It possesses a brilliant blue color in hand specimen and thin section with no apparent pleochroism. However, it does display abnormal interference colors of deep blue, green, and purple. Much of the haüynite is altered to an unidentified fine-grained material which lacks the characteristic blue color.

X-RAY AND CHEMICAL ANALYSES

A portion of the sample was crushed and sieved to 40–80 mesh. Pyrite was removed using methylene iodide. The remaining sample was separated in tetrabromoethane diluted with acetone. From this separation a concentrate of haüynite was recovered from which pure blue grains were separated under a binocular scope using a vacuum picker.

Part of the hand-picked material was analyzed by powder X-ray diffraction using Ni-filtered Cu radiation. The X-ray pattern agrees well with Taylor's (1967) data for haüynite. The unit cell measures 9.067 ±.002 Å. The lack of a (100) diffraction line indicates the sample has space group $P\bar{4}3n$ rather than $P\bar{4}3m$ (Taylor, 1967).

Several grains of pure blue material were chemically analyzed by electron microprobe.[1] The partial chemical analysis in weight percent is: K_2O 0.36, CaO 10.6, Na_2O 11.8, Cl 0.36, S 10.7, total. These values are averages of repeated scans over several grains. Electronprobe micrographs of the analyzed grains show abnormally high concentrations, or abnormal deficiencies, of specific elements in certain regions. For example, discrete areas of high Ca content show no S or Na. These regions, measuring from 80 to less than 5 μm are interpreted as inclusions of dipsoide and/or actinolite.

The combined chemical and X-ray data indicate the mineral is haüynite. Although S and SO_3 were not separately determined, the sulfide content is believed to be very low, because no H_2S fumes were detected upon treatment with nitric acid (Deer, *et al.*, 1963). The unit-cell dimensions versus K_2O content are consistent with Taylor's (1967) study.

Association with pyrite and carbonate at Edwards suggests that the haüynite might be sulfide-bearing (Rogers, 1938), but the above determination makes it clear that it does not have detectable sulfide, and that association is not a reliable guide to the presence of sulfide in haüynite.

DISCUSSION

Minerals of the sodalite group can be distinguished from one another by a variety of criteria (Taylor, 1967). Table 1 lists these criteria with some additional chemical data pertinent to this discussion. Index of refraction and density are not given in Table 1, because they are not reliable criteria. Unit-cell edge (a_0) would be a fairly reliable parameter, if it were not so dependent upon substitution by K (Taylor, 1967). The available data for sulfide-bearing haüynite (lazurite) are similar to the data for haüynite given in Table 1.

Figure 2 shows most available chemical analyses of the sodalite group (Deer, *et al.*, 1963; Taylor, 1967) plotted on a triangular grid $CaO-Na_2O-K_2O$. A few sodalite samples have been eliminated, since they only

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[1] Analysis by McCrone Associates, Chicago, Illinois.

TABLE 1. PROPERTIES OF THE SODALITE MINERAL GROUP

	Sodalite	Noselite	Haüynite
Space group	$P\bar{4}3n$	$P\bar{4}3m$	$P\bar{4}3n$
d (211)	3.63Å	3.71–3.73Å	3.71–3.73Å
d (100)	n.p.	9.10Å	n.p.
Cl	>5%	<1.5%	<1.5%
SO_3	<1%	>6%	>6%
CaO	<0.5%	<4.5%	4.5–11%
Color	blue	gray to colorless	blue to green

n.p. = not present

clutter the Na_2O apex. Each mineral species plots in a specific region limited by the dashed boundaries in Figure 2.

The maximum CaO content in noselite is 4.5 percent, which is equivalent to approximately one Ca ion per unit cell. Haüynite has a maximum CaO content of 11 percent, or approximately two Ca ions per unit cell. Likewise, haüynite and noselite are restricted to a maximum of approximately 1.2 K ions per unit cell. One sample in the sodalite field is recorded as noselite (Deer, *et al.*, 1963, analysis 1, Table 37, p. 295). It is anomalously low in CaO and with an analysis date of 1864 may be suspect. The only lazurite sample (L in fig. 2; Deer, *et al.*, 1963, analysis 6, Table 37, p. 295) plots well inside the haüynite field. The field boundaries may be modified by more analyses. Despite this uncertainty, it would be possible to determine which of the three minerals one is dealing with based solely on cation content.

PETROLOGICAL CONSIDERATIONS

The sodalite minerals commonly occur in undersaturated, alkali-igneous rocks and rarely in marble (Deer, *et al.*, 1963). Extensive geo-

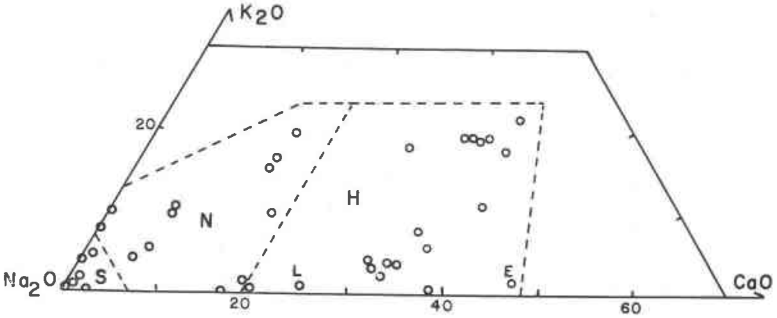

FIG. 2. Composition of the sodalite minerals based on cation content recalculated to 100 percent. S = sodalite field, N = noselite field, H = haüynite field, L = lazurite, E = Edwards haüynite. Tick marks at ten percent intervals.

logical mapping and detailed mineral investigations in the Balmat-Edwards district have been used to help unravel the petrogenesis. Doe (1962) has suggested temperatures of metamorphism at approximately 500°C using the sphalerite geothermometer. The Mg content in calcite yields minimum temperatures of 450°C (Lessing, unpublished data). Van Peteghem and Burley (1962) have shown that cancrinite forms below 475°C while noselite and haüynite are stable above this temperature. The occurrence of haüynite in marble at Edwards, along with other geothermometers (Engel and Engel, 1960) are consistent with a minimum metamorphic temperature of approximately 500°C.

Bradley (1964) has reported authigenic lazurite in a salt bed of the Green River Formation, Wyoming. The apparent inconsistency between Van Peteghem and Burley's (1962) phase relations and Bradley's (1964) authigenic occurrence can not at present be resolved by the authors. It is quite possible that both reports are correct and the stability relations are very dependent upon chemical composition and fluid pressure.

Acknowledgment

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