MONTEBRASITE FROM EIGHT MILE PARK, FREMONT COUNTY, COLORADO*

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In 1911 Schaller described a member of the amblygonite group from a pegmatite on Eight Mile Park, west of Canon City, Fremont County, Colorado (Schaller, 1911, 1912), proposing for it the name natramblygonite, which he later withdrew because of etymological objections, and substituted for it fremontite (Schaller, 1914, 1916). In the amblygonite group, (Li,Na)$AlPO_4$ (F,OH), the now generally accepted nomenclature is:

	Li>Na	*Na>Li*
F>OH	amblygonite	(not known)
OH>F	montebrasite	natromontebrasite

Thus fremontite (Table 1, Anal. A), in which Na:Li=1.7:1 and OH >F, becomes natromontebrasite and possesses the dubious distinction of having been referred to under three different names within 40 years. The occurrence on Eight Mile Park is the only one known, and it was found there only in one place in the Meyers Quarry pegmatite.

Table 1

	A	*B*
Li_2O	3.21	5.02
Na_2O	11.23	6.23
Al_2O_3	33.59	35.77
P_2O_5	44.35	45.87
F	5.63	tr.
H_2O	4.78	7.04
K_2O	0.14	n.d.
	102.93	
O=F	2.37	
	100.56	99.93

A. Natromontebrasite, Meyers Quarry pegmatite, Eight Mile Park, Fremont Co., Colo. Analyst—W. T. Schaller (1911).

B. Montebrasite, Meyers Quarry pegmatite, Eight Mile Park, Fremont Co., Colo. Analyst—Alice S. Corey.

A few fragments of natromontebrasite were collected by the senior

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author in the summer of 1946, and its paragenesis has been described (Heinrich, 1948). In June 1951 the senior author discovered several specimens of an amblygonite-group mineral in a new opening in the Meyers Quarry pegmatite, and in the summers of 1952 and 1953 much more material was uncovered. The identity of the mineral was checked by means of an x-ray powder photograph.

The new cut was made in the south side of the Meyers Quarry pegmatite near its western end along a small gulch 200 feet southeast of the original fremontite locality, as shown on the map of the western part of the pegmatite (Fig. 22, p. 582, Heinrich, 1948). The amblygonite mineral and its associates were exposed on bench of the cut along its eastern wall.

The pegmatite in the cut, like much of the Meyers Quarry deposit, is indistinctly zoned. Remnants of small core pods of large microcline crystals are exposed, but most of the pegmatite consists of a granitic to subgraphic, variably grained, quartz-microcline aggregate, together with small quartz pods, microcline blocks, muscovite books and masses of intergrown quartz-muscovite.

The cleavelandite-red muscovite pegmatite, in which the montebrasite occurs, is restricted to the margins of one of the microcline core pods, forming an irregularly bounded unit whose contacts transgress the fabric of the microcline-quartz rock. The cleavelandite pegmatite includes corroded and veined relicts of microcline crystals as much as six inches long.

The main minerals in the cleavelandite rock are (in approximate order of abundance): cleavelandite, fine-grained bronze to red muscovite, quartz, microcline, tourmaline, green muscovite in large books, beryl, monebrasite, spessartite and apatite. The rock originally consisted chiefly of microcline and quartz with subordinate crystals of spessartite, books of greenish muscovite, masses and rude crystals of montebrasite, blocks and crystals of yellow beryl, tourmaline crystals, and a few crystals of apatite. All of these show replacement, corrosion and veining by cleavelandite and the fine-grained bronze muscovite, which itself replaces cleavelandite.

Montebrasite occurs mainly as chalky white, rounded, single-crystal masses with scallopy margins, averaging about 1½ inches in length, although some pieces and a few rudely faced crystals as much as six inches long appear. Forms noted are *a* (100), *b* (010) and *c* (001) (Fig. 1). The mineral is markedly twinned both megascopically (Fig. 1) and microscopically (Fig. 2), into two individuals of about the same size and in some pieces polysynthetically as well (Fig. 2).

Most of the rounded pieces occur in reddish brown cleavelandite and are separated from the feldspar by a thin but conspicuous, fine-grained,

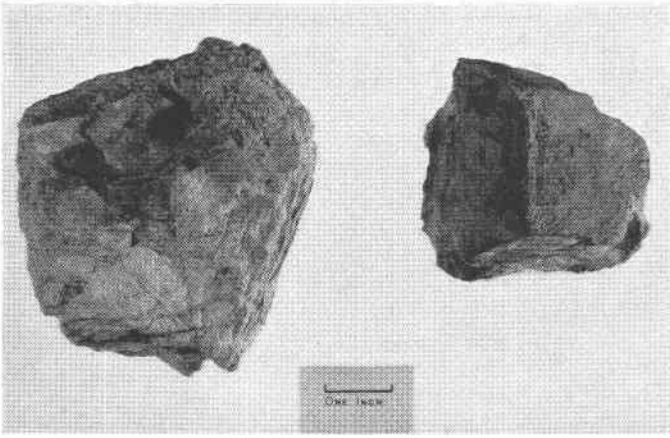
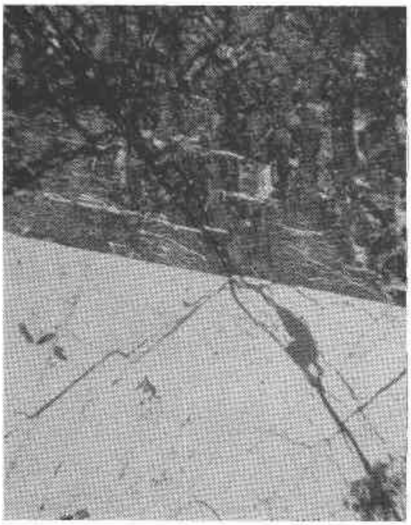


FIG. 1. Rude crystals of montebrasite, Meyers Quarry pegmatite, Eight Mile Park, Colorado. Crystal at left twinned.

dark brown shell. Under the microscope the shell (Fig. 3) is seen to consist usually of two parts—an outer zone of fine-grained muscovite stained by hematite and an inner unit of brown cryptocrystalline material that has very low birefringence and a general index of refraction considerably



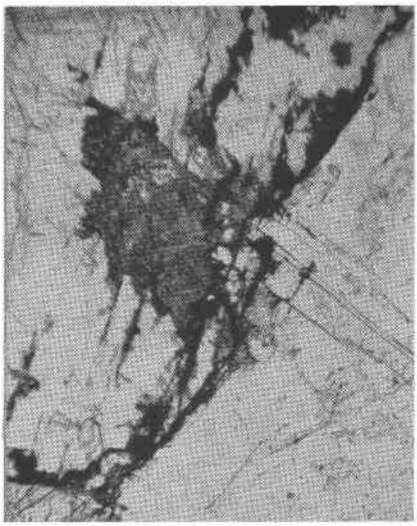


FIG. 2 (left). Photomicrograph of twinned montebrasite from Eight Mile Park, Colorado. Nicols crossed, ×22.

FIG. 3 (right). Fine-grained, dark brown alteration of montebrasite, Eight Mile Park, Colorado. Nicols not crossed, ×22.

below both the montebrasite and muscovite. This material apparently has formed as a byproduct in the replacement of the phosphate by muscovite or by cleavelandite, for it corrodes the montebrasite marginally and extends into it in veinlets along and across twin boundaries and cleavages. Attempts to identify the fine-grained material by x-rays proved unfeasible owing to extensive contamination by iron oxide. However, the alteration is apparently similar to that described by Quensel (1937) for amblygonite from Varuträsk, Sweden, and from its optical properties the fine-grained mineral may well be a clay.

The sequence of mineral formation is:

A. Magmatic
1. Microcline, spessartite, apatite, quartz
2. Green muscovite, beryl
3. Black tourmaline

B. Hydrothermal
4. Blue tourmaline
5. Green tourmaline
6. Red tourmaline
7. Montebrasite
8. Cleavelandite, quartz, bertrandite (?)
9. Bronze muscovite, clay mineral
10. Hematite

C. Minor fracturing

D. Supergene
11. Local leaching
12. Calcite crusts in vugs

The composition of the original natromontebrasite (*A*) is compared with that of the newly-discovered amblygonite mineral (*B*) in Table 1. Although the analysis of the new material has a slight deficiency of alkalies and a slight excess of H_2O over that required by the theoretical composition (the latter is not uncommon in amblygonite analyses), the two minerals differ considerably in their Na-Li and OH-F ratios. In the newer material the Na:Li ratio is 1:1.7 and this mineral is thus montebrasite and is not identical with the natromontebrasite of the original find.

As early as 1893, Des Cloiseaux (1893) pointed out that two distinct members of the amblygonite family occurred at the same locality, Montebras in Soumans, Central Plateau, France. Others who have demonstrated the presence of more than one type or generation of amblygonite in a single pegmatite or in related pegmatites include Landes (1925) in the Buckfield, Maine, pegmatites; Quensel (1937) in the Varuträsk pegmatite, Sweden; Palache et al. (1943) in the Newry, Maine, pegmatite and Dana (1873) and Palache et al. (1943) in the Hebron, Maine, pegmatite.

Thus it appears that occurrence of two or even more generations (Varuträsk has three) of amblygonite with distinct compositional differences may not be rare in single pegmatites or related pegmatites. The data are as yet insufficient to indicate any systematic relationship between composition and paragenetic position (Heinrich, 1953).

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The International Union of Crystallography in collaboration with Consejo Superior de Investigaciones Cientificas will hold a symposium on "Structure on a scale between the atomic and microscopic dimensions" in Madrid, Spain, April 2 to 7, 1956. The results obtained by various well-known and new techniques including *x*-ray and electron diffraction and microscopy will be discussed. Those wishing to present papers should send the title and a 10 line abstract to the program chairman prior to January 1, 1956: Prof. A. Guinier, Conservatoire National des Arts et Metiers, 292 Rue St. Martin, Paris (3e), France. Two I.U.Cr. Commissions (Crystallographic Apparatus and Crystallographic Teaching) will also hold meetings during this period. Further information may be obtained from the secretary of the local committee: Dr. M. Abbad, Serrano 118, Madrid, Spain.

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