A BARITE-QUARTZ PHASE IN THE FIRESAND RIVER CARBONATITE, WAWA, ONTARIO[1]

E. WM. HEINRICH AND RICHARD W. VIAN[2]
Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan

Abstract

The Firesand River alkalic complex, 4.5 miles east of Wawa, Ontario is unusual in that it consists predominantly of carbonatite with a highly subordinate outer ring of mafic to ultramafic alkalic silicate rock. The carbonatite core is composite, with an inner core of rauhaugite encircled by sövite and silicate sövite. The ferruginous rauhaugite body, which appears to be pipe-like and vertical (in contrast to the sövite ring, which represents the accretion of a series of inward-dipping cone-sheet slices), is itself a composite of several texturally and mineralogically distinctive rocks. Among these is a barite-quartz-carbonate rock. This rock contains barite euhedra, quartz grain fragments deeply corroded by carbonate and broken euhedral smoky quartz crystals, some as long as three inches. Most of the quartz grains appear to have been metamorphosed, showing undullatory extinction, mosaic structure, and a strong parallel alignment of "bubble train" inclusions. Against the carbonate they are locally armored by rims of very fine-grained ferruginous apatite.

It is concluded that this unusual rock was formed by the carbonatization of a quartzite xenolith cut by small quartz veins into which were introduced barite, apatite and carbonate.

Introduction

The Firesand River carbonatite, which is 4.5 miles east of Wawa, Ontario, has been described by Parsons (1961). We visited the area in the fall of 1964 and collected the specimens on which this study is based.

The Firesand River complex is unusual among alkalic complexes in that it consists predominately of carbonatite with a highly subordinate outer ring of mafic to ultramafic alkalic silicate rock. It is nearly circular in plan, covering about 1.75 square miles. Keewatin greenstones, possible some Keewatin metasediments and Algoman granite are the chief country rocks. Outcrops of rocks of the complex are very sparse, and most of the information leading to Parsons' (1961) reconstruction of the intrusion was obtained from drill cores. Since his study was completed, a few prospect pits and a bulldozer road exposed the carbonatite in several additional places.

The central carbonatite body is composite, with an inner core of rauhaugite encircled by sövite and silicate sövite. The sövite ring appears to have resulted from the accretion of a series of inward-dipping cone-

[1]Contribution No. 283 from The Mineralogical Laboratory, The University of Michigan.
[2]Present address: Dept. of Geology, Kansas State University, Manhattan, Kansas.

sheet slices. The rauhaugite body, pipe-like and vertical, is itself a composite of several texturally and mineralogically distinctive rocks, but exposures are too few to permit their age relations to be deciphered.

Near the top of the central rauhaugite hill were found a few small blocks of a peculiar baritic carbonatite. These lay near a shallow pit in which only soil was exposed. A return search of the locality in 1966 yielded no additional material. Parsons (1961, p. 26) states "Barite is also reported in surface trenches but was not specifically noted by the author."

In addition to the new carbonatite variant, we were able to examine a previously unrecorded carbonatitic RE-Th vein about a mile northeast of the complex.

Petrology

The rock is conspicuous because of its high specific gravity and because of the quartz crystals (some smoky) that stud it here and there (Fig. 1). Actually two mineral associations are present:

1. A fine-grained greenish grey aggregate of ankeritic dolomite, chlorite and quartz.
2. A coarse-grained pink dolomite-barite-quartz rock.

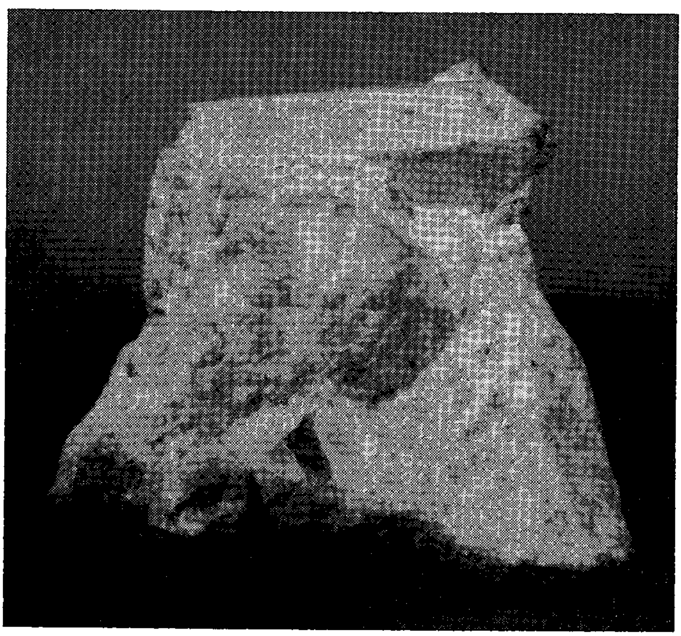

FIG. 1. Specimen of baritic carbonatite showing broken quartz crystal (nearly 3 inches long).

In the first variety under the microscope the most conspicuous units are highly irregular, deeply embayed quartz grains which display undulatory extinction and mosaic structure. In addition most are striated by subparallel lines of minute "bubble-train" inclusions. The orientation of these lines of inclusions is the same throughout a single thin section and is independent of the optical orientation of the quartz grains. It is clear that the quartz grains represent the remnants of an older quartzose rock with metamorphic characteristics and fabric. These grains have been partly replaced by carbonate (Fig. 2).

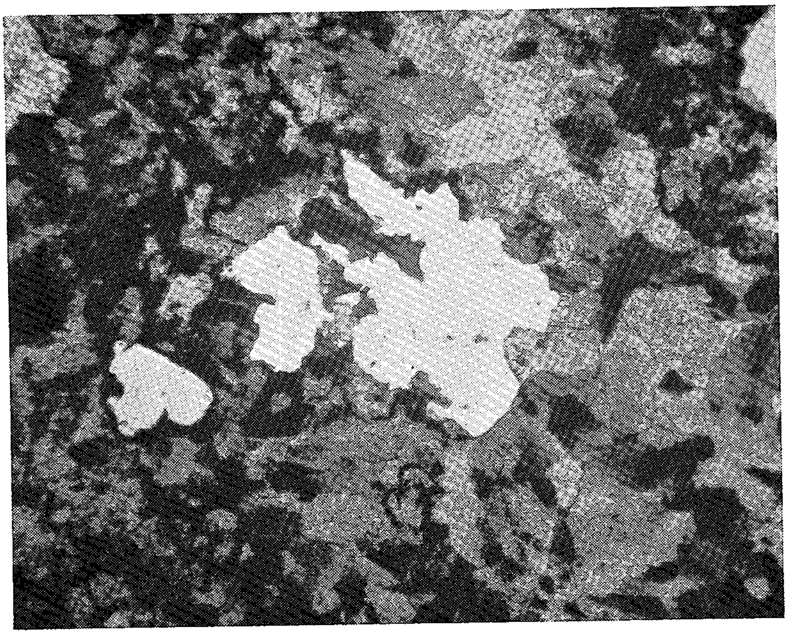

FIG. 2. Irregularly embayed quartz grains replaced by ankeritic dolomite. Polars crossed, ×30.

The ankeritic dolomite shows zones of variable iron content, some now brown owing to oxidation. Pyrite is a local accessory in aggregates with interstitial chlorite.

Most of the chlorite occurs as very fine-grained thin films that outline ghosts of an earlier unknown species that was completely replaced by dolomite (Fig. 3). The shape of the outlines suggests that the replaced mineral was tabular, possible micaceous. A few small vugs containing minute barite and chalcopyrite crystals occur in this rock.

The ankeritic dolomite-chlorite-quartz rock grades irregularly into the coarser-grained dolomite-barite-quartz aggregate. It is in this latter

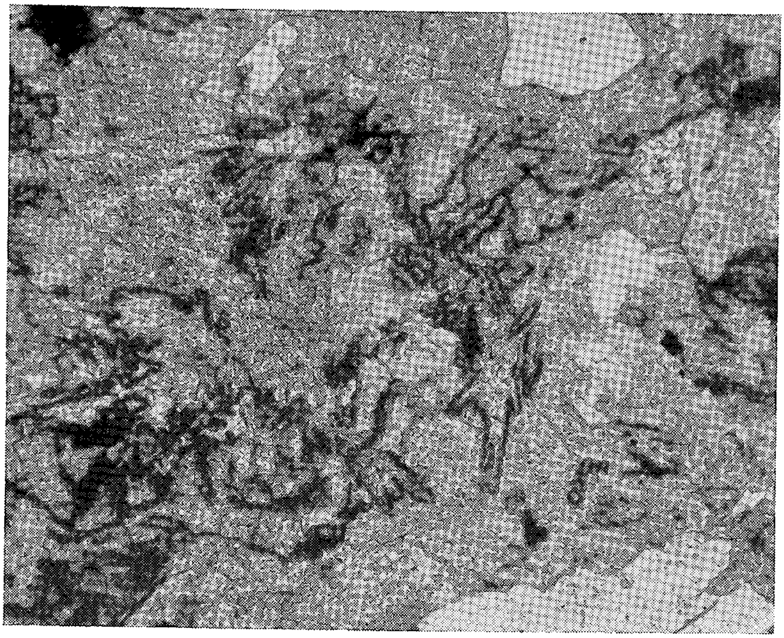

FIG. 3. Quartz grains (clear) in ankeritic dolomite matrix containing semi-radial clusters of "ghosts" of former tabular mineral now represented by outlines of very fine-grained chlorite. Polars not crossed, ×75.

variety that most of the quartz crystals appear (Fig. 1). Although superficially the crystals appear to be euhedral, close inspection reveals all are broken at the base with irregularly fractured bottoms. Thin sections also show that the crystals as well as accompanying grains of metamorphic quartz are corroded and embayed by carbonate, are fractured and veined by thin carbonate seams and are locally granulated, with most of the granulated parts of the crystals replaced by carbonate which selectively replaced the finer grained quartz. The quartz crystals, including their broken terminations, are completely enclosed in carbonate. They were formed in pre-carbonate time and were broken from their original walls prior to the introduction of the carbonate. Dr. Wm. C. Kelly of our department has noted that the quartz crystals are unusual in the paucity to near absence of vacuoles.

Barite forms euhedral tablets as much as an inch long. These too are corroded and marginally replaced by dolomite, although not nearly to the extent that the quartz grains and crystals have been attacked. Both the barite and the quartz are locally armored by thin shells of very fine-grained ferruginous apatite (checked by means of *x*-ray diffraction) (Fig. 4). In some places where quartz crystals have been partly replaced

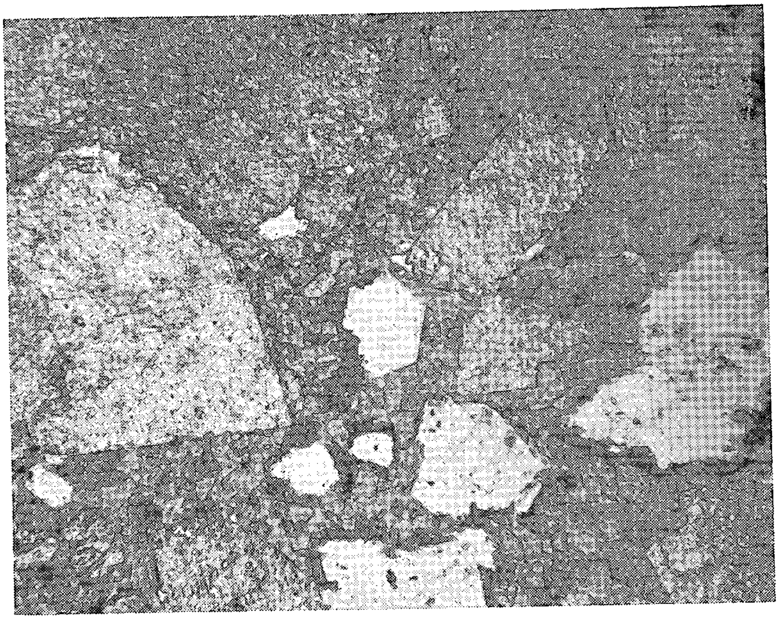

FIG. 4. Corroded quartz grains and crystals (armoured by fine-grained ferruginous apatite) and barite euhedra in matrix of dolomite. Polars not crossed, ×30.

by carbonate the original shape can be reconstructed owing to the relict shell of fine-grained apatite.

PARAGENESIS

From the textural relationships a sequence of relative age of the minerals may be determined. It is clear that the quartz grains and crystals are the oldest, indeed pre-carbonate in age. The barite also is pre-carbonate, forming euhedra which, however, are not broken and thus are younger than the quartz.

Stage I. (Pre-carbonatite stage)
1. Quartz grains and quartz crystals
2. Unknown (micaceous?) mineral now present as chlorite "ghosts".

Stage II. (Carbonatite stage)

Fine-grained rock	1. Ankeritic dolomite 2. Chlorite, pyrite
Coarse-grained rock	3. Barite 4. Ferruginous apatite 5. Dolomite 6. Chalcopyrite

Interpretation

In those carbonatites in which a quartzose phase is important, invariably this phase of mineralization is one of the youngest, if not the very last (see, for example, Heinrich & Shappirio, 1966). Such late-stage silicification is widespread and appears to be an example of "geochemical recycling" or "repetitive utilization" of silicon released from granitoid gneissic wall rock during early fenitization (Heinrich, 1967). In the Firesand River carbonatite the quartz has the following features that require explanation:

1. It is the earliest mineral of its assemblage;
2. It occurs both as grains and broken crystals;
3. It is highly localized and apparently very rare;
4. It displays metamorphic characteristics.

Quartzites that are cut locally by quartz crystal-bearing veins are associated with the iron formations in the Wawa area. The occurrence and characteristics of the quartz in the carbonatite suggests it represents the relicts of a disaggregated xenolith of a quartzite cut by small quartz crystal-bearing veinlets that was incorporated in the carbonatite and carbonatized through introduction of dolomite, barite and apatite.

References

Heinrich, E. Wm. (1967): *Geology of Carbonatites.* Rand-McNally and Co., Chicago, Ill.

——— & Shappirio, J. R. (1966): Alkalic rocks and carbonatites of the Arkansas River Canyon, Fremont County, Colorado, 3. The amethyst carbonatites. *Am. Mineral.* **51**, 1088–1106.

——— & Vian, R. W. (1966): A barite-quartz phase in the Firesand River carbonatite, Wawa, Ontario. (abs.) *Am. Mineral.* **51**, 1562.

Parsons, G. E. (1961): Niobium-bearing complexes east of Lake Superior. *Ontario Dept. Mines, Geol. Rept.* **3.**

Manuscript received March 8, 1967