A BARITE VEIN CUTTING GRANITE OF SOUTHEASTERN MISSOURI

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Introduction

The barite vein described in this paper was discovered by the writer in 1922. Since then, he has paid several visits to the locality and collected more material for study. The vein occurs along the west face of the south opening in Schneider's granite quarry, which is about three-quarters of a mile north of Graniteville, Iron County, Missouri. The vein is developed for 100 feet or more along a fault fissure that strikes N. 78° W. and dips 78 to 80° N.E. The amount of movement along the fault plane is unknown, but the evidence indicates that it was not large. There are numerous other fault fissures in the quarry, some of which are parallel to the one containing the barite vein. Another set of fissures that strike a few degrees north of west also occurs. Some of these fissures are fault planes but others are evidently only major fissures in the granite

The quarry is opened in a coarse, red, slightly porphyritic granite. This granite is cut by a mass of granite porphyry that divides the quarry into two parts. The granite porphyry strikes parallel to the east-west set of faults and fissures. At the east side of the south pit of the quarry, there is another exposure of granite porphyry that is probably related to the larger mass immediately to the north. The granite has a fairly uniform texture and color. It is composed of microcline, plagioclase, orthoclase, quartz, and a little biotite (now largely altered to chlorite). The feldspars constitute 72.5 per cent of the rock and the quartz (with some minor minerals) the remainder. The minor minerals are pyrite, magnetite, hematite, fluorite, minute garnets, and a few shreds of muscovite.[1]

The Barite Vein

The barite vein is well exposed along the west face of the south quarry. The upper part of the vein is badly weathered, but much excellent material was secured for study from the lower parts and from newly opened portions.

The vein varies in thickness and does not exceed four inches in width at any point. It pinches out completely at some places along

[1] Tarr, W. A. and Neumann, L. M., A Study of the Effects of Heat on Missouri Granite: *Univ. of Mo. Bulletin, Eng. Exper. Station*, ser. 14, p. 13, **1914**.

the exposure. Usually, it is completely filled from wall to wall, but occasional cavities occur. Bladed crystals of barite form the walls of these cavities.

The important minerals of the vein, in the order of their abundance, are barite, pyrite, and fluorite. Two other minerals occur, one of which has been tentatively identified as saponite, a very rare hydrous magnesium aluminum silicate. The other is galena.

Most of the barite is of a dark red color (it strongly resembles red orthoclase) due to included hematite, but some of it is pink, flesh colored, white, or even transparent. The transparent variety always occurs as a portion of the interior of a crystal. The barite possesses its usual bladed form, which is the mode of occurrence that produces the rounded, bladed masses so common in residual barite deposits. The blades cross the vein from wall to wall, either straight across or diagonally.

The pyrite occurs as a thin coating (minimum thickness 0.2 mm.) along the wall of the vein, as large crystalline aggregates, and as small crystals included in the barite. The pyrite deposited on the vein wall is, on the inner surface, always covered with crystal faces. These crystals may attain a diameter of one and one-half inches, and crystal aggregates up to two inches are fairly common. The crystals show a radiating internal structure. The pyrite crystals in the barite are all small, one or two millimeters in diameter. The most common crystal forms are cubes, which may or may not be modified by octahedrons. A few cubes modified by pyritohedrons were noted, as were also a few fairly well developed pyritohedrons.

The fluorite occurs as crystals or crystalline masses. A few crystals one-half inch in diameter were found, but the majority were less than one-fourth of an inch. The fluorite is purple, yellow, and transparent. The purple fluorite is surrounded by the yellow, but the line between the two is sharp. The yellow color fades out into the transparent material. The cubic forms predominate, but some crystals are modified by octahedrons. A few distorted and flattened cubic forms were noted.

The galena occurs in small crystalline grains up to one-half inch across. Very little galena occurs in this vein, but it is fairly abundant in a parallel fissure in the east part of the quarry, where it occurs in crystals up to one-half inch across.

The discovery of what is believed to be saponite is interesting.

This rare mineral is reported from very few localities. It occurs in this vein in soft waxy masses, found in cracks and openings in the pyrite or between the pyrite and other minerals. It is very infusible, turns black on heating, does not react with cobalt nitrate, contains much water, and is insoluble. Saponite is reported by Dana to be decomposed by sulfuric acid, but if this mineral is so affected it is with much difficulty. Specific gravity tests show it to be slightly heavier than the values given by Dana, but this is probably due to the impossibility of removing all the pyrite.

Alteration of the pyrite by ground waters has formed a little gypsum, melanterite, limonite, and hematite. A thin coating of lead sulfate occurs on the galena, where it is associated with the pyrite.

Sequence of Mineral Deposition

The sequence of deposition of the three major constituents is (1) pyrite, (2) fluorite, and (3) barite and pyrite. Where galena occurs, its deposition followed that of the pyrite. The pyrite was deposited on the wall of the fault fissure, and may completely fill the vein. The larger crystals grew in the wide portions of the fissure. In places, there is only a thin skin of pyrite on the walls. Locally, if the wall rock was shattered, pyrite (or fluorite) was deposited in the granite.

The fluorite is next in age to the pyrite and was deposited on it (there is some evidence that the periods of deposition of these two minerals overlapped slightly). Fluorite was also deposited on the wall where no pyrite had been deposited.

The barite is the youngest of the three minerals, and was deposited on either or both of the others and also occasionally directly upon the granite wall. Throughout most of the period of barite deposition, pyrite was being deposited with it, as is shown by the inclusions of small pyrite crystals in the barite. During the early stages of barite deposition, it overlapped the fluorite deposition. As noted above, if galena occurs it is younger than pyrite.

The saponite is clearly later than all the other minerals, and its formation is probably connected with the weathering of the upper part of the vein. Its high water content and physical properties make it an impossible member of the original group of minerals. The detailed description and origin of the saponite will be given in another paper.

Other fissures in the quarry show pyrite mineralization. In Sheahan's granite quarry, about one-half mile south, veins in the granite contain fluorite, zinnwaldite, quartz, pyrite (abundant), and rarely molybdenite, galena, and magnetite. These veins show that mineralization has occurred in this and adjacent quarries.

Origin

It can scarcely be doubted that this barite-pyrite-fluorite vein cutting the granite can be other than magmatic in origin. The solutions evidently followed the fault fissure upwards and deposited their minerals in the open spaces along the fissure.

The solutions were rich in iron sulfides, as is shown by the abundance of pyrite of more than one generation. The red color of the barite is due to hematite, and is the typical color of the igneous rocks of southeastern Missouri. The fluorite may have been the result of reactions of HF with calcium salts, or it may have been carried as CaF_2. It is an extremely common constituent of magmatic waters. The barium may have been transported as the sulfide, chloride, or even fluoride. Its deposition as the sulfate would have been due either to reactions with sulfate solutions in the fissure or to the oxidation of the rising sulfide solution. Iron sulfide was still present in the solution as it was deposited simultaneously with the barite.

The argument that the barite in this vein was leached from the surrounding or overlying granite can scarcely have much weight. Granites are not leached to secure such a mineral. Furthermore, the presence of the fluorite and pyrite must be accounted for, and granite is no more a probable source for them than for barite. In short, these minerals were unquestionably deposited from warm waters that came from below.

The real significance of this barite vein lies in its occurring in the granite 15 to 20 miles from the important barite district of Washington County, Missouri. Some years ago, the writer[2] described these barite deposits, and at that time advocated a magmatic origin for the deposits. The paragenesis of the minerals in those deposits showed (1) quartz and chalcedony, (2) pyrite or marcasite, (3) galena and sphalerite, and (4) barite. This order was always the same whether all the minerals were present or not. For the minerals that occur in the barite vein in granite, the order is the same,

[2] Tarr, W. A., The Barite Deposits of Missouri: *Univ. of Mo. Studies*, vol. **3**, no. 1, 1918; The Barite Deposits of Missouri: *Econ. Geol.*, vol. **14**, 1919, pp. 46–67.

save for the overlapping of the pyrite and barite. No quartz or chalcedony occurs in this vein, and no fluorite occurs in the barite district to the north. The characteristics of the primary deposits in the barite district are those of the shallow-vein type, and the mineralogy of this barite vein in the granite indicates that it belongs to the same type.

The occurrence of the barite vein in the granite (which undoubtedly also occurs under the sedimentaries in the barite district of Washington County to the north) is confirmatory evidence of the conclusion, previously reached, that the solutions which deposited the barite in the dolomites of Washington County were of magmatic origin. The solutions depositing the vein and those responsible for the barite deposits to the north were undoubtedly similar, though as the latter deposits were stratigraphically higher the solutions depositing them were undoubtedly cooler. However, although both deposits are of magmatic origin, they may not have been deposited by solutions from the same part of the magma; which would account for the minor differences in mineralization.

The recent attempt by Dake[3] to account for these barite deposits by the time-worn method of concentration of barite during the weathering of dolomites, ignores so many fundamental chemical factors (the use of which he regards as leading to "much unsound geological reasoning") that his suggestions, which involve chemical laws in spite of his refusal to recognize them as such, belong with the long discarded views of Werner or Sandberger. He argues against an origin by rising solutions, but offers no source for the barium sulfate, iron sulfides, quartz, chalcedony, or galena, all of which must be adequately accounted for since they occur intimately associated. In fact, Dake offers no suggestion as to solvents, means of transportation, or precipitating agents. Nor does he discuss the paragenesis of the minerals, or explain why the deposits are restricted to the areas where they are found.

Other barite deposits in different formations occur in Missouri, and as these also are localized it would seem necessary to discover some agency capable of transporting large quantities of barium under restricted conditions in order to explain the occurrence of the barite deposits of the state. It is true the world over that localized mineral deposits, such as these barite deposits, are generally con-

[3] Dake, C. L., Geol. of Potosi and Edgehill Quadrangles, *Mo. Bur. of Geol. and Mines*, vol. **23**, 1930, pp. 198–208.

nected with igneous rocks. Recently, Adams[4] has advocated a hydrothermal origin for the barite in Alabama, where the deposits are similar to those of Missouri. These deposits have previously been regarded as residual concentrations.

Summary

This vein (with its simple mineralogy of barite, pyrite, and fluorite) cutting granite is believed to be of magmatic origin, and the solutions depositing it to have arisen from below along a fault plane. The discovery of such a vein in granite not many miles from the large important barite district to the north points to a magmatic source also for the barite in that region, as was advocated in 1916 by the author.

[4] Adams, G. I., Hydrothermal Origin of the Barite in Alabama: *Econ. Geol.*, vol. **26**, 1931, p. 772.