ZEOLITIC ROCKS IN THE WICHITA MOUNTAINS, OKLAHOMA

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Introduction:

During the recent W. P. A. Mineral Survey of Oklahoma, directed by the Oklahoma Geological Survey, numerous specimens from various localities in the state were collected. Many of these samples later were studied in the laboratory by the senior writer and among these were discovered the zeolitic rocks. Studies of these were made jointly by the writers and the results form the subject of this paper.

Location:

The zeolites occur in SW-SW-SW of Sec. 6, T. 4N., R. 18W., Kiowa County, Oklahoma. This area is in the western part of the Wichita Mountains, a group of Pre-Cambrian hills of granite (or granophyre), gabbro and anorthosite, and diabase dikes.

Occurrence of the Zeolites:

The zeolites are found in a fine-grained reddish rock which is exposed on the south side of a low hill of Pre-Cambrian anorthosite. Small granite stringers cut the latter in a few places. The zeolite rock is irregular in areal extent but has a measurable width of approximately 150 feet where it crosses the road. Higher up the hill it has a greater width which could not be readily ascertained. A definite thickness of 27.5 feet was measured with a hand level; an additional 16.5 feet was taken directly above this, but it could not be determined conclusively to be in place. The maximum possible thickness at this locality would thus be 44 feet. The surrounding region has not been investigated and it is not known whether other outcrops of zeolite rock are present in this area.

The contact of this rock with the anorthosite is an irregular surface, as indicated by small knobs of anorthosite surrounded by the massive red zeolite rock. This surface certainly represents an erosional unconformity, possibly one of great duration. Rounded inclusions of anorthosite in the zeolite rock prove the earlier age of the former, although the exact age of the zeolite rocks cannot be determined from this occurance.

In the side of a pit in the zeolite outcrop a layered structure is quite noticeable. There are three horizontal massive bands, each approximately two feet thick, and these are underlain by red zeolite reck which does not show any apparent banding.

Mineralogical Description:

The zeolite rocks are fine-grained and are purplish-red to brick-red in color. Rounded and elongate cavities are common in certain portions of the rock, and these usually are filled with small calcite crystals; sometimes they are lined with small needle-like clusters or rounded globular aggregates of natrolite, and occasionally with transparent colorless trapezohedrons of analcite. The rock contains many calcite veins and stringers, varying in width from a few millimeters to half an inch. Small grains of a black non-magnetic opaque mineral are scattered throughout the rock.

The characteristic acicular habit of natrolite makes its identification possible with the binocular microscope. These thin colorless needles are usually in small divergent tufts, each individual being not more than 0.3 mm. long. Under the petrographic microscope its identity was confirmed by the following data: extinction, parallel to the elongation; positive elongation; first order gray birefringence; index of refraction, 1.48-1.50; and one direction of cleavage parallel to the elongation.

A second crystal habit of natrolite found in this locality is quite different from that named above and is less characteristic. This type consists of small globular aggregates and rounded bunches; less frequently there are individual pellets which are usually not more than 0.3 mm. in diameter. Each spherule was found to be composed of symmetrically arranged natrolite needles diverging from a single center. A striking feature to be noted is a concentric banding which appears when a globule is broken open.

Colorless and transparent analcite showing trapezohedral form occurs in cavities with a diameter of approxmately 0.25 mm. Optical constants were determined as follows: index of refraction, 1.48 to 1.49; first order gray birefringence; and complex twinning.

The major portion of the thin sections examined is composed of a dark reddish-brown "groundmass" which appears to be homogeneous and is either isotropic or nearly so. The reddish color is undoubtedly due to iron oxide impurities. Calcite, disseminated and in the form of veinlets, is a common constituent.

A slide made from a specimen 20 feet above the base of the reddish rock contains a large proportion of zeolites, not as good crystals, but as irregular aggregates in the cavities of the rock. The zeolite appears to be natrolite and usually shares part of its cavity with calcite.

Chemical Composition of the Rock:

The zeolites, when isolated, gelatinize readily with HCl. Furthermore, a considerable gelatinization takes place when a sample of the red rock which does not show macroscopic specimens of zeolites is boiled with the acid. This indicates that much of this rock is composed of fine fragments of zeolites.

Incomplete chemical analyses of two specimens of the zeolite rock show considerable variation in carbonate content. Qualitative tests show Ca, Mg, Fe, Al, Na, SiO_2, CO_2, and H_2O present in considerable amount. K and Cl were also found in small quantities, the Cl being water soluble. From the mineralogical studies the Fe appears to be present as hematite and gives the red color to the rock; the Mg and Ca are in the form of carbonates; while the Na, K, Al, SiO, and H_2O compose the zeolites—natrolite and analcite. Quantitative analyses are now being made but at this time are incomplete; however, it is clear that the rocks are composed almost entirely of zeolites and carbonates. In some of the layers the zeolites predominate and these could be called calcareous zeolite-rocks, while in other layers the carbonate predominates, forming zeolite-carbonate rocks.

Origin of the Zeolites:

Zeolites usually occur in basic igneous rocks. Assuming the ones here studied are of this type, the layering may be interpretated as lava flows poured out on the irregular erosional surface of the anorthosite. Fragments of anorthosite could easily have been incorporated by such a viscous flow as inclusions. However, the lack of igneous minerals, or their undoubted decomposition products, and the high percentage of calcite is strong evidence

against an igneous origin. It is difficult to see how igneous rocks can be altered to, or replaced by masses which are now mainly carbonates, especially when there is no direct microscopic or other evidence of such replacement.

On the other hand, the layering could be stratification and the anorthosite fragments could have been pebbles on the floor of a sedimentary basin, perhaps a lake. The zeolites may have been chemically precipitated from these waters. Such occurrences are rare but sedimentary zeolite of this type have been reported by Bradley (1) in the Eocene Green River lacustrine sediments and were explained by the reaction of saturated NaCl solutions on pyroclastics; Ross (2) found layers of sedimentary analcite in a "fossil" playa at Chloride, Arizona, and interpreted them as being formed by the reaction of saline waters on clay aluminum silicates.

In conclusion, the writers believe the zeolitic-carbonate rocks of the Wichita Mountains are sedimentary in origin. For those in which the carbonate minerals predominate, the name "zeolitic limestone" is here suggested. When zeolites predominate and carbonates are of lesser importance the name "calcareous zeolite-rock" is thought to be the best descriptive term.

1. Bradley, W. H., "Occurrence and Origin of Analcite and Meerschaum Beds in the Green River formation of Utah, Colorado, and Wyoming," U. S. Geol. Sur. Prof. Paper 158, 1929, pp. 1-7.

2. Ross, C. S., "Sedimentary Analcite," Am. Mineralogist, Vol 13, 1928, pp. 195-197.