DOUBLY TERMINATED QUARTZ CRYSTALS OCCURRING IN GYPSUM

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The specimens upon which this brief description is based were obtained by Mr. Cecil Carroll, a student in the University of Missouri, during the summer of 1927. At the suggestion of Mr. Walter D. Keller, one of his instructors, the specimens were given to the writer. The occurrence of doubly terminated quartz crystals in massive gypsum is so unusual that the following notes describing them have been prepared.

The material available for study consisted of about 100 loose crystals (See figure 1), and two hand specimens of the massive gypsum (alabaster), only one of which contained quartz crystals (Figs. 2 and 3). The locality where this material occurred is about one mile southwest of Acme, along the highway between Acme and Roswell, New Mexico. The crystals were found loose upon the outcrop of a gypsum bed. The fragment containing crystals was also a loose piece. The gypsum bed is in the Manzano series of red beds, which consists of alternating beds of gypsum (the individual beds of which rarely exceed 10 feet in thickness), red sandstone, and limestone. The stratigraphic position of the bed from which the specimens came is unknown.

The alabaster is fine-grained, and ranges in color from a salmon-pink, on what is assumed to have been a bedding plane surface, to a pale pinkish white, three-quarters of an inch from the surface. The coloring is not uniformly distributed in any portion of the specimen and has apparently been introduced into the gypsum, before the quartz. The color is due to very fine particles of hematite, and its distribution in the alabaster points to an introduction inward from the dark colored outer portion. It is probably that this darker side was adjacent to a red sandstone or shale member. The alabaster does not show any sand grains.

The quartz crystals range from .075 millimeter to two centimeters in length. A few single crystals are one centimeter long and four millimeters thick. Larger crystals occur in the lot, but they are either intergrown with other crystals, or have included others. In the one specimen of gypsum where the crystals are in place, the large clusters of crystals are found mainly in a zone

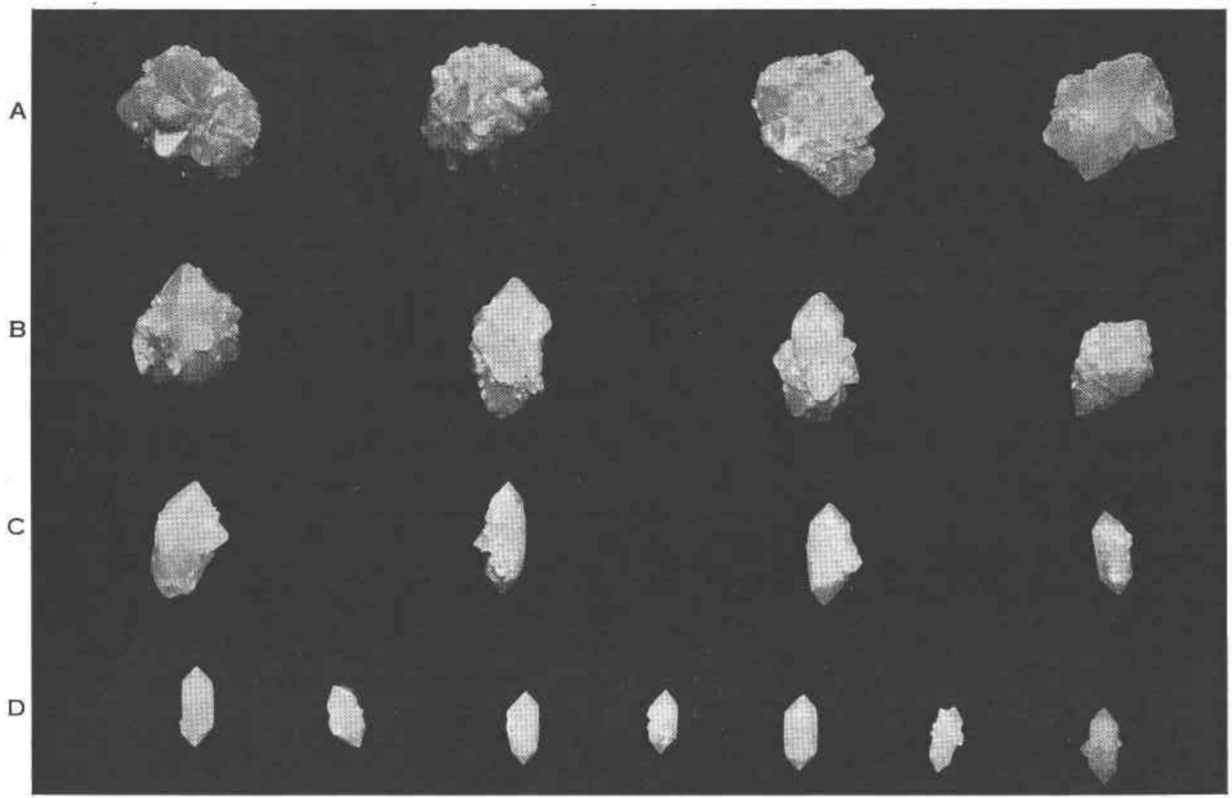

FIG. 1. Quartz crystals from gypsum, Acme, New Mexico. Row A, clusters of crystals. Row B, large crystals with included smaller ones. Row C, crystals with a few included smaller crystals. Row D, series of well developed smaller crystals. Note their symmetry. About natural size.

about 15 millimeters below the surface of the specimen. Beyond this zone isolated crystals, up to a centimeter in length, occur. Between this zone and the top, great numbers of small crystals are found.

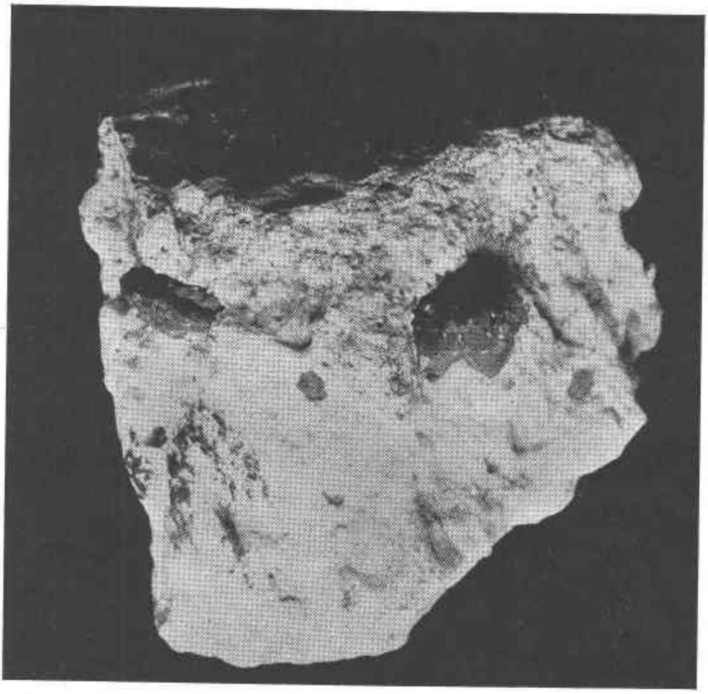

FIG. 2

Massive gypsum from near Acme, New Mexico, showing large clusters of crystals (row A, fig. 1) as well as individual crystals. Note the large clusters are near the top of the specimen. Numerous small crystals are in the gypsum above the clusters. Three or more prismatic crystals are in the lower part. About natural size.

The intergrown crystals take two predominating forms, one, in which a single crystal predominates and has grown about and included smaller crystals, and the other, in which the crystals are arranged in rude radiating clusters, often with one crystal, somewhat larger than the others. Often twelve or fifteen small single crystals are intergrown or clinging to a single large crystal. In one or two specimens, the crystals extend entirely through each

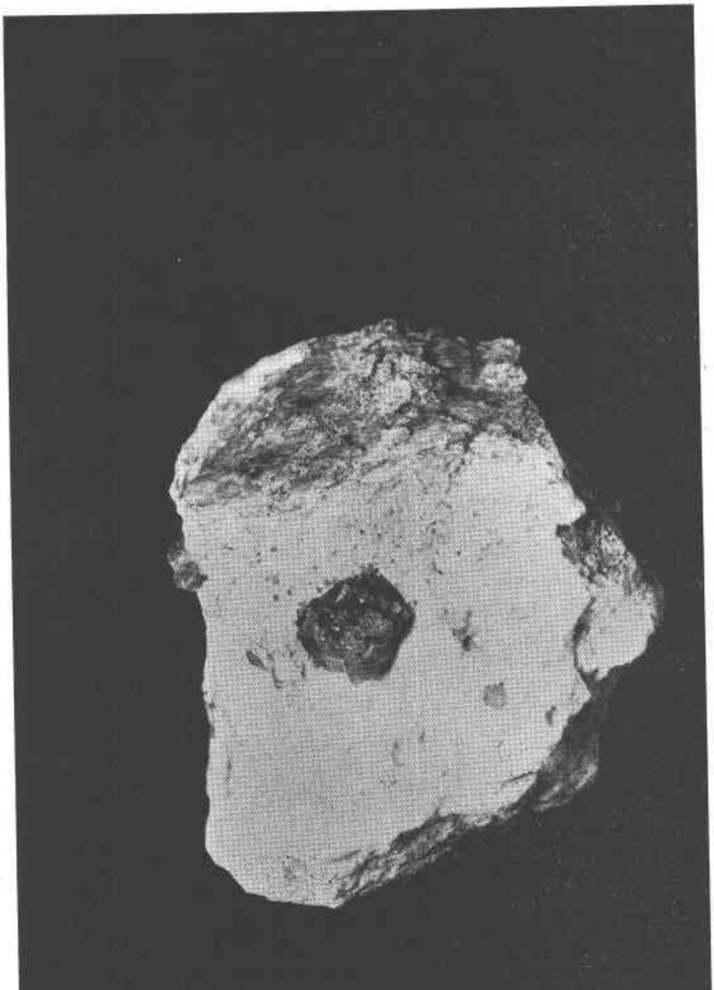

Fig. 3

Another view of figure 2. Note the numerous small crystals in the upper part of the specimen. Nearly natural size.

other. That the larger crystals have grown about the smaller is shown by the smaller size of that portion of the crystal within the larger. Most of the crystals are quite regular in shape but a few taper to the ends, due to incomplete growth. The prismatic faces are rough, due to being incompletely filled out. Although there are a few pits on the rhombohedral faces, they are usually bright and smooth, especially in the case of the plus rhombohedron. There is no regularity in the shape or position of the pits, as they represent the failure of the solutions to completely remove all the inclosing gypsum. Fracture surfaces parallel to *r* were noted on a few crystals. Some of these surfaces were so smooth as to simulate cleavage faces.

The quartz crystals correspond in color to that of the adjacent gypsum. They are dark red in the dark red gypsum near the surface, and become lighter in the lighter colored parts. A considerable difference in color was noted in the clusters, and in single large crystals, where the portion in the dark red gypsum was a deeper red than the part embedded in lighter colored gypsum. The very small crystals are clear and colorless. Those about 2 millimeters long are a light pink in the dark gypsum, the color increasing in intensity as the crystals become larger. Only rarely are crystals 3 to 4 millimeters long a dark color and these are in the darker colored portions

The color is due to included particles of hematite; particles that are residual after the removal of the gypsum. The very small crystals contain few particles, if any at all, and therefore, are colorless, even though they occur in the darker colored gypsum. Hence, both size of the crystal and its position in the gypsum are factors in determining its color. Some of the pits on the surface contain residual grains of hematite.

The crystals are all simple forms: hexagonal prisms, with what appear, at first, to be hexagonal pyramids on each end. The pyramid is actually due to the equal development of the plus rhombohedron *r* and the minus rhombohedron *z*. Not all the crystals show an equal development of the two rhombohedrons but this is a common occurrence. A careful search was made for the trigonal pyramid *s* or the trigonal trapezohedron *x*, but only a doubtful face on a single specimen was found. This face suggested that the crystals were right-handed. Distorted crystals are rare.

Some of the gypsum was dissolved and a considerable number of very small crystals obtained. A little clay, colored by the iron oxide, was the only other insoluble material. A study of these small crystals revealed, splendidly, the sequence in the development of the faces on the crystals. The very minute crystals were the plus rhombohedron *r*, as shown by their high luster. This was the only form on the crystals until they attained a length of 0.15 millimeter, when they had begun to develop the minus rhombohedron *z*. With increase in size, the minus rhombohedron grew faster, and, by the time the crystal was 0.5 millimeter long, both faces was nearly equally developed, resulting in fine small quartzoids. Continued growth produced larger quartzoids, or prismatic faces appeared forming elongated crystals. Subsequent growth was always dominantly on the rhombohedral faces and usually about equal on each. This is shown by essentially al the crystals being doubly terminated prismatic forms.

Near Artesia, New Mexico, where quartz crystals occur in a similar manner, a considerable number of the rhombohedral forms attain a diameter of over a centimeter. This remarkable occurrence is described in a separate paper by Tarr and Lonsdale.

Origin

These quartz crystals are evidently the result of solutions coming from the associated sandstones or possibly shales. The solutions penetrated the gypsum, and by replacing it deposited any silica they were carrying.

The included particles of hematite, the openings occupied by the quartz crystals, and the incompletely developed faces of the crystals, in contact with the gypsum, all point to replacement. The splendid series of crystals, from the simple plus rhombohedron to the final prismatic doubly terminated form likewise point to this later introduction of this quartz. None of the crystals show any evidence of attachment to any object, as they should if they were not formed by replacement.

Although quartz replacing gypsum is not a new type of replacement, the development of such fine doubly terminated crystals by its replacement is unusual. The study reveals, further, the sequence in which the successive faces made their appearance during the growth of the crystal, a fact of some value.

Inasmuch as the divalent calcium in the gypsum molecule is especially active in inducing the coagulation and precipitation of silica (which was undoubtedly transported as a colloid) the more rapid precipitation of the silica as quartz near the surface is explained.

Summary

Quartz crystals, showing the development of the plus and minus rhombohedrons on both ends of the prism, occur replacing massive gypsum at a locality near Acme, New Mexico. The sequence in the development of the various faces on the crystals is readily traced. Silica-bearing solutions entered the gypsum and replaced it by quartz crystals, which are colored by residual hematite from the gypsum.