QUARTZ PARAMORPHS AFTER TRIDYMITE AND CRISTOBALITE*

ROBERT S. MOEHLMAN, *Harvard University.*

In the course of microscopic examination of some Miocene volcanic rocks southwest of Ouray, Colorado, abnormal forms of quartz were observed which are believed to be the result of inversion from tridymite and cristobalite. The paramorphic quartz occurs in the Burns quartz latite and associated rocks, two miles west of Red Mountain.

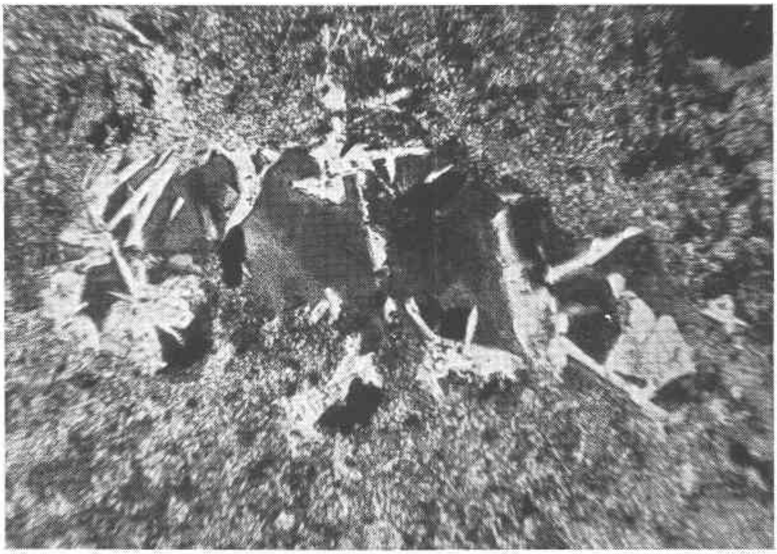

FIG. 1. Magnification 85×.

Vesicles are rare in the Burns flow, but gas cavities present in one locality contain microscopic plates of quartz (Figure 1); interstitial to the quartz plates is an aggregate of fine sericite. That the plates were not an original, abnormal crystallization of quartz is shown by the discordance of the plates with respect to the present crystal orientation. A single plate may be made up of two or three quartz individuals, and conversely, one quartz individual may form two plates at an angle to each other. It is thus apparent that the quartz is pseudomorphic after some pre-existing platy mineral

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whose form it has inherited. The platy mineral is believed to be tridymite, one of the polymorphous forms of silica, which characteristically occurs in such plates in the vesicles of lavas. Similar structures of quartz have been described by Geijer and attributed to inversion from tridymite.[1]

Another abnormal form of quartz was observed in the vesicles of a highly altered amygdaloidal lava associated with the massive quartz latite of the Burns formation. Rosette-growths of quartz

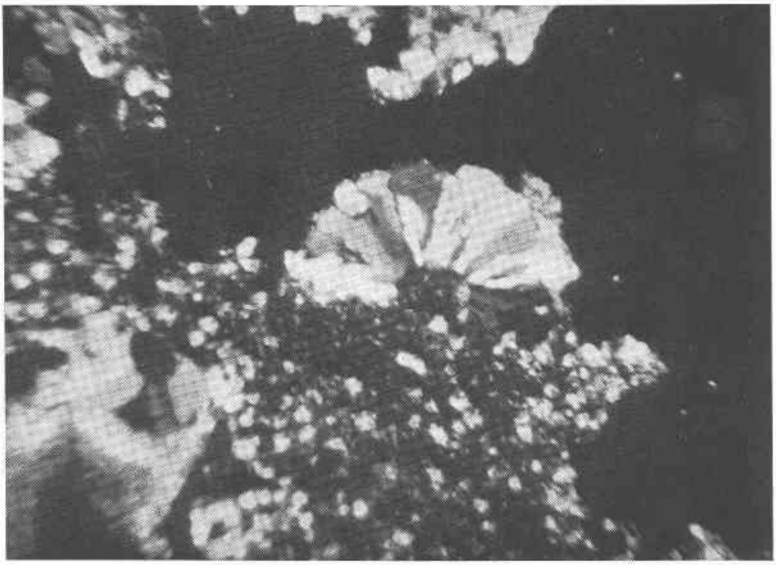

FIG. 2. Crossed Nicols. Magnification 60×.

perched on the walls of vesicles are believed to be the result of inversion from cristobalite (Figure 2). Bascom has pictured a similar growth of quartz in altered pre-Cambrian (?) rhyolite, which Iddings attributed to inversion from a higher temperature form of quartz.[2]

Both tridymite and cristobalite are metastable forms of silica at ordinary temperatures, but in most cases inversion to the stable

[1] Geijer, Per, On Poikilitic Intergrowths of Quartz and Alkali Feldspar in Volcanic Rocks: *Geologiska Föreningens I, Stockholm Förhandlingar,* Bd. **34,** Häft I, pp. 70–73, 1913.

[2] Bascom, F., *U. S. Geol. Survey,* Bull. **136,** The Ancient Volcanic Rocks of South Mountain, Pa., Plate 27, 1896.

form, quartz, is indefinitely postponed. The transformation of tridymite or cristobalite to quartz has never been accomplished in the dry state in the laboratory. The inversion from tridymite has been performed in a water solution of sodium carbonate or by use of a sodium tungstate flux; the inversion from cristobalite in a water solution of sodium carbonate.[3] In the area here described, it was doubtless the presence of alkaline waters carrying silica which facilitated inversion. Both rocks in which the paramorphic quartz is found are considerably altered, silicified and sericitized.

Although the stability ranges of tridymite and cristobalite as determined in the laboratory are 870–1470°C. and 1470–1710°C., respectively, it must be emphasized that their formation does not necessitate such high temperatures. In the words of Larsen, "The presence of tridymite or cristobalite in a rock gives no indication of the temperature of crystallization as these forms can, and commonly do, form below 870°."[4]

[3] Sosman, R. B., Properties of Silica, Chemical Catalog Co., *New York*, pp. 76–77, **1927.**

[4] Larsen, E. S., The Temperature of Magmas: *Am. Mineral.*, vol. **14,** p. 87, 1929.

PROCEEDINGS OF SOCIETIES

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences of Philadelphia, June 6, 1935

Dr. Joseph L. Gillson presided at a stated meeting of the society, 41 members and 35 visitors being present.

Mr. Arndt reported the results of the Rocks and Minerals Association National Outing of the Philadelphia district, held Sunday, May 19th, to Vanartsdalen's quarry, Perkiomenville, and Phoenixville.

Dr. Gillson described the Fifth Annual Field Conference of Pennsylvania Geologists, held on May 31, June 1st and 2nd, with headquarters at the Academy of Natural Sciences. Nearly 100 persons were registered as participating in the excursions described in a 43-page guide book.

Other excursions described, and specimens obtained were: by Louis Moyd to Howellville, Bridgeport (malachite), and the Perkiomen mine (ankerite); Albert Ackoff to Mauch Chunk (carnotite); Alexander Fleming, Jr., to Blue Ball (chalcopyrite, quartz, calcite), Beartown (cacoxenite); Leonard A. Morgan to Bedford, N.Y. (stibnite, beryl, smoky quartz) and Prospect Park, N.J. (chabazite and natrolite).

Mr. Henry E. Millson demonstrated a few of the new micro-chemical methods of mineral analysis developed by Dr. J. Adam Watson of Edinburgh University and