ENTAXY OF TRIDYMITE IN THE GANGUE OF A Pb-Cu-Zn OCCURRENCE

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Abstract

Tridymite identified in the gangue of Dunbrack Prospect, Musquodoboit River, Halifax County, Nova Scotia, shows in addition to twinning in six-sided sectorial pattern an "ornamentation" in alternating sectors. This "ornamentation" consists of a distinct crystalline phase, with an axial angle $2V_z \sim 30°$ as against $2V_z \sim 17°$ of the main part of the composite crystal. The intergrowth of the two crystalline phases is regular and oriented.

The term entaxy is suggested for such intergrowths.

Résumé

La tridymite détectée dans la gangue de Dunbrack Prospect, Musquodoboit River, Halifax County, Nova Scotia, revèle, en addition à un maclage à six secteurs, une ornementation en secteurs alternés. Cette "ornementation" consiste en une phase cristalline distincte, ayant un angle axial de $2V_z \sim 30°$ tandis que la partie principale du cristal composé a un angle axial de $2V_z \sim 17°$. L'interposition des deux phases cristallines est régulière et orientée.

Le terme entaxie paraît convenir pour de telles interpositions.

Alternate sectors in six-sided tridymite trillings from Dunbrack Prospect (Friedlaender 1968) frequently show an additional subdivision (Fig. 1). At first I considered this "ornamentation" an indication of complex twinning. U-stage measurements showed, however, that this interpretation is not tenable (Fig. 2).

My findings are as follows:

1) the main part of the composite crystals consists of a phase with an axial angle $2V_z \sim 17°$ (range 11°–23°, average 16.9°).

2) the material of the subdivision has always a markedly larger axial angle than the surrounding main part: $2V_z \sim 30°$ (range 23°–36°, average 29.8°); it consists thus of a distinct crystalline phase, different from that of the main part. The additional subdivision can therefore not be explained by twinning.

3) the acute bisectrices of the six sectors of the main part of the composite crystal and those of the additional subdivision parts coincide. The intergrowth of the two crystalline phases is regular and oriented. We have

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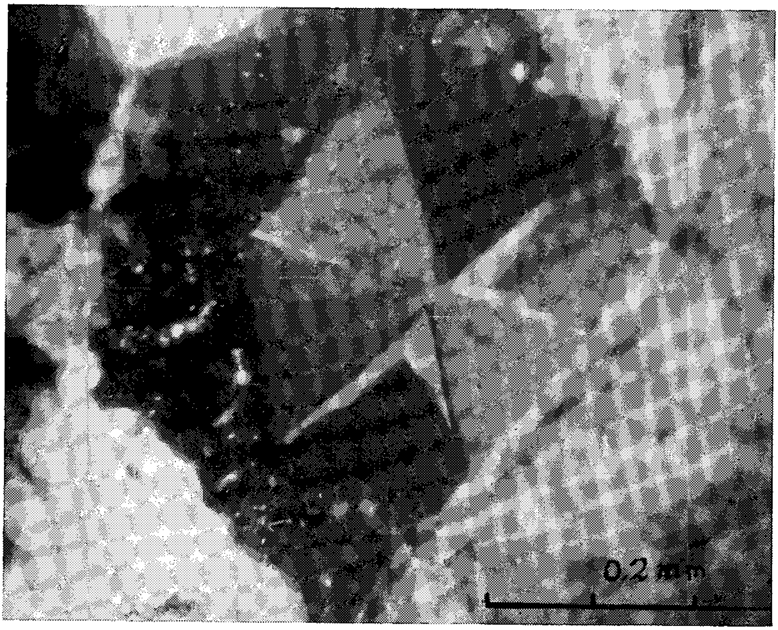

FIG. 1. Tridymite trilling in mineralized granite, Dunbrack Prospect, Nova Scotia. Crossed Polars. Photograph taken on the Universal stage. On the stereographic projection Fig. 2, the sectors are numbered clockwise. Sectors 2 (bottom) and 5 are black in this photograph. V-shaped divergent parts are in the three alternating sectors 2, 4, 6. The grey material adjoining sectors 6 and 1 is malachite.

thus a regular oriented intergrowth between two different crystalline phases. The term entaxy is suggested for such intergrowths.

Composite crystals with this type of entaxy are present in each of 30 thin sections from specimens collected at the dump of Dunbrack Prospect. The composite crystals generally measure between 0.1 mm and 1 mm. Almost invariably they are rimmed by a zone of minute inclusions and surrounded by fibrous chalcedony-like material, the optical properties of which match those of lussatite.

The designation tridymite for the crystalline phases making up the composite crystals is based on optical and morphological observations (optical properties indicating orthorhombic symmetry; refractive indices lower than those of quartz, in the range of those of lussatite-chalcedony; birefringence slightly lower than that of quartz; conspicuous twinning and, in particular, six-sided sectorial trillings). It would be desirable to check the designation with x-rays. With the exception of one weak line (d = 3.7231 Å), I found only lines of quartz. This may be due to unsuccessful separation.

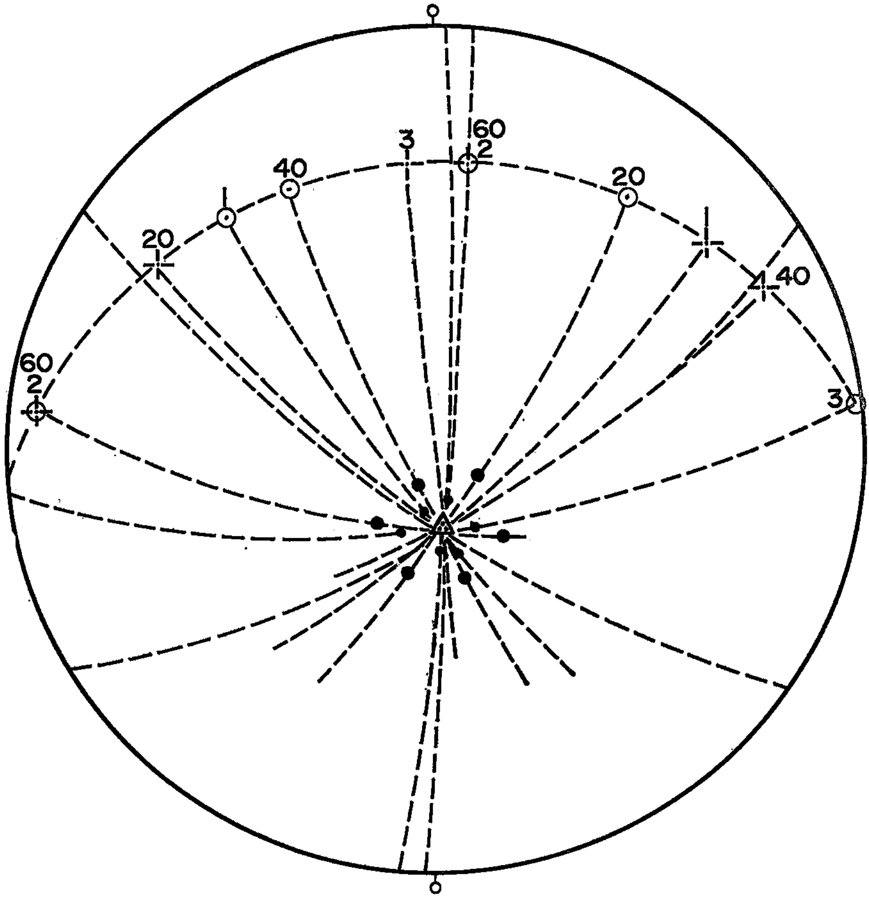

FIG. 2. Stereographic projection of the composite tridymite crystal shown in Fig. 1 before transformation and correlation. The numbers 1 to 3 refer to the six sectors—numbered clockwise. The poles of the sectors 1 and 4, 2 and 5, 3 and 6 coincide. On the photograph Fig. 1, sectors 2 and 5 are black. The V-shaped divergent parts in sectors 2, 4, 6 are designated 20, 40, 60 respectively. ⊙ = X, + = Y, △ = Z, ● = opt. axes.

In addition to the composite crystals, the quartz from the gangue of the Dunbrack Prospect shows certain features which have so far either passed unnoticed or were dismissed as "twinning" and which seem to be regular intergrowths of two distinct crystalline phases.

I would like to mention, in particular, these features:

1) lamellae in not well defined arrangement, forming an angle of ± 106° when viewed in the direction of the acute bisectrix, but in the same optical orientation. The width of the lamellae lies between 0.001 mm,

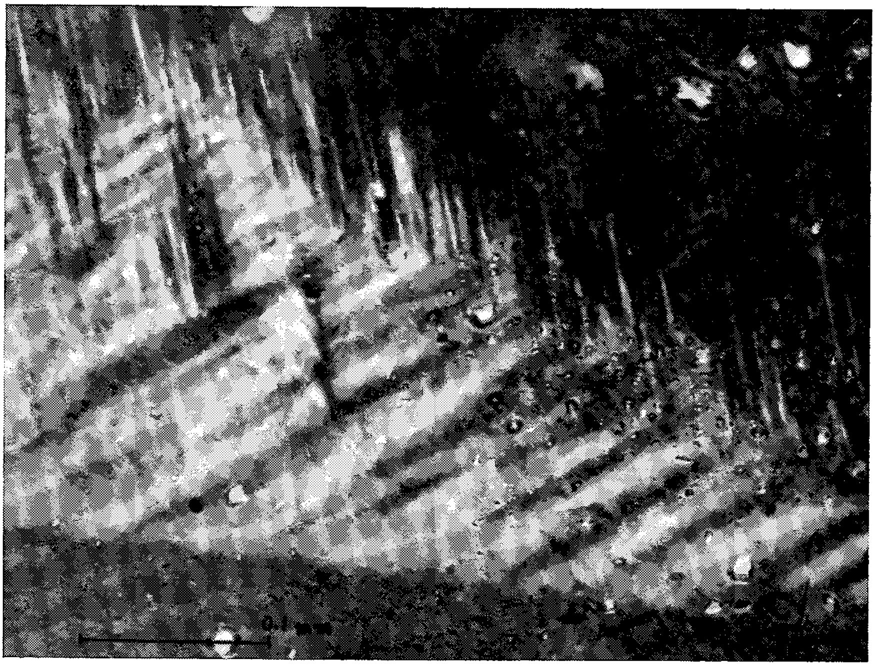

FIG. 3. Tridymite lamellae in quartz, Dunbrack Prospect, Nova Scotia. Crossed Polars. Quartz is at darkness position, the white lamellae are tridymite.

or less, and 0.04 mm; the axial angle $2V_z \sim 36°$; the acute bisectrix coincides with the optical axis of the surrounding quartz. Fig. 3 is a photograph of such an entaxy of tridymite in quartz; Fig. 4 is a stereographic projection of this intergrowth.

2) a frame-like arrangement formed by three coplanar laths of ± equant dimensions (length $\sim$ 0.7 mm, width $\sim$ 0.08 mm) the lateral laths are linked to the central part in an angle of approximately 130°. The axial angle of the material making up the laths is $2V_z \sim 22°$. The acute bisectrices of the three laths coincide and have the same orientation as the optical axis of the surrounding quartz.

3) parallel laths in quartz resembling polysynthetic twinning lamellations. The width of the laths lies in the range of the micron up to 0.04 mm. The material is biaxial, $2V_z \sim 23°$. The orientation of the acute bisectrix coincides with that of the optical axis of the surrounding quartz (Friedlaender 1970). No difference in refractive index has been observed between the material of the laths and the surrounding quartz. Observations by Bambauer, Brunner & Laves (1961) on lamellae in quartz from Madagascar may be recalled here.

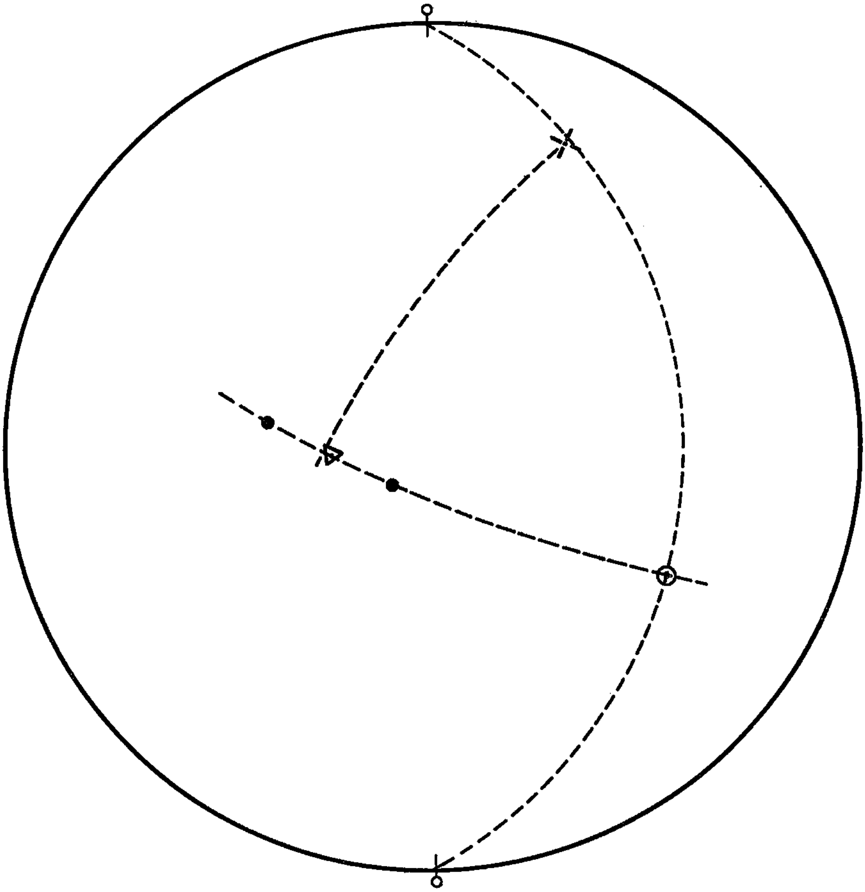

FIG. 4. Stereographic projection of the tridymite lamellae shown in Fig. 3. △ Position of the optical axis of the surrounding quartz and of the bisectrix Z of the tridymite which has an axial angle $2V_z$ 36°5′. ⊙ = X, + = Y of the tridymite lamellae, ● = opt. axes.

The small Pb–Cu–Zn occurrence in Devonian granite known locally as Dunbrack Prospect is located approximately 3½ miles NNW of Musquodoboit Harbour on the SW bank of the Musquodoboit River, Halifax County, Nova Scotia (44° 49′ 10″ N; 63° 11′ 30″ W). The occurrence is mentioned in a number of publications (Messervey 1929; Alcock 1930; Sabina 1964) and two reports on it are held in the files of the Nova Scotia Department of Mines but there is no detailed account of the geology.

Tridymite is not considered a normal constituent in a Pb–Cu–Zn mineralization but it might be less exceptional than it now appears. We should keep in mind that the gangue minerals of ore occurrences are frequently dealt with in a cursory way.

The intergrowth of different types of tridymite within one composite crystal could perhaps, in part, account for the divergence of optical and *x*-ray data (Kuno 1933; Flörke 1961; Frondel 1962; Sosman 1965) and explain the fact that tridymite, even from the same preparation, may show variations in specific gravity, refractive index and *x*-ray pattern (Flörke 1967, p. 193).

It may tentatively be inferred that slight changes in temperature conditions and in the distribution of impurities has resulted in the formation of different polymorphs. I have not been able to establish the sequence of formation of the two types of tridymite—with $2V_z \sim 30°$ and with $2V_z \sim 17°$.

The entaxy of tridymite in quartz may have formed in different ways (tridymite relict in quartz; tridymite introduced into quartz; tridymite exsolution in quartz). The devlopment of fine lamellae (width ~ 0.001 mm) of tridymite in quartz seems to indicate exsolution.

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