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POLYSYNTHETIC TWINNING IN DOLOMITE[1]

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It is not generally known that polysynthetic twinning is fairly common in dolomite. No mention of it is made, for example, in such standard works as Dana's *System of Mineralogy* and Miers' *Mineralogy*. Some authors [2,3] go so far as to say that the absence of polysynthetic twinning in thin sections distinguishes dolomite from calcite. The purpose of this article is to show that polysynthetic twinning is common in dolomite and also to show that by means of this twinning, dolomite may often be distinguished from calcite since the twinning-law for dolomite is different from that for calcite.

Five different twinning-laws have been established for dolomite. They are as follows: (1) twinning-plane $c(0001)$ or (111); (2) twinning-plane $a(11\bar{2}0)$ or $(10\bar{1})$; (3) twinning-plane $=m(10\bar{1}0)$ or $(2\bar{1}\bar{1})$; (4) twinning-plane $=r(10\bar{1}1)$ or (100); (5) twinning-plane $f(02\bar{2}1)$ or $(11\bar{1})$. Of these five twinning laws only the last one, as far as I can learn, is exemplified as polysynthetic twin-lamellae in dolomite. This type of twinning for dolomite was first described by Haidinger.[4] Since then it has been mentioned by Tschermak,[5] Leuze[6], Vogt,[7] Grünling,[8] and Redlich.[9]

With this introduction I shall now proceed to the description of such polysynthetically-twinned dolomites as have come under my notice.

[1] Paper presented at the ninth annual meeting of the *Mineralogical Society of America*, New York, Dec. 28, 1928.

[2] Winchell, *Elements of Optical Mineralogy*, 1st. ed., p. 144, *New York*, **1909.**

[3] Klockmann, *Lehrbuch der Mineralogie*, 7 and 8th ed., p. 457, *Stuttgart*, **1922.**

[4] *Annalen der Physik und Chemie*, vol. **63**, pp. 153–158, 1844.

[5] *Petr. u. Min. Mitth.*, (Neue Folge) vol. 4, p. 108, 1882.

[6] *Ber. d. XXVII Versamml. d. Oberrhein. geol. Verein.*, p. 81, **1894.**

[7] *Zeit. f. prakt. Geol.*, vol. **6**, p. 11, 1898.

[8] *Zeit. f. Kryst. u. Min.*, vol. **33**, p. 216, 1900.

[9] *Zeit. f. prakt. Geol.*, vol. **21**, p. 412, 1913.

DOLOMITE FROM THE TILLY FOSTER MINE, BREWSTER, N. Y.

My attention was first directed to polysynthetically-twinned dolomite in specimens collected by me at this famous mineral locality in 1908. The specimens are large grayish-white cleavage masses of dolomite up to 10 cm. in size associated with chlorite and chondrodite. The cleavages are usually regular and smooth, and more nearly resemble calcite than dolomite. The specific gravity of the mineral is 2.85 and since it contains both magnesium and calcium in large amounts, with a small amount of iron, it must be dolomite.

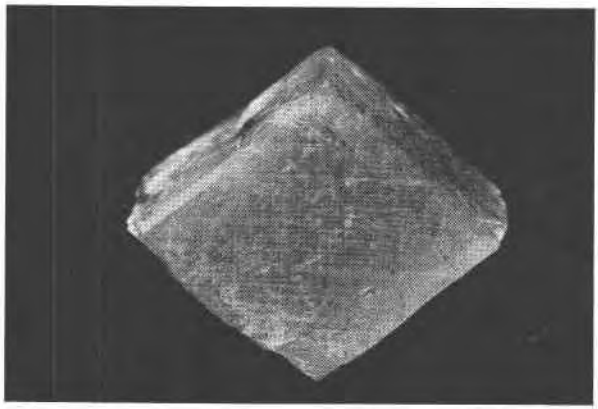


FIG. 1. (x3)—Cleavage rhombohedron of dolomite from the Tilly Foster Mine, N.Y., showing twin-striations. (weathered surface.)

On close examination, the cleavage surfaces of the dolomite show striations parallel to the short or long diagonals or sometimes both to short and long diagonals. Figure 1 shows the striations on a cleavage surface. Thin sections show conclusively that the apparent striations are thin twin-lamellae. With polysynthetic twinning parallel to $(02\bar{2}1)$ the striations appear parallel to the short diagonal on two faces and parallel to the long diagonal on one face, as shown in Fig. 3. It will be recalled that the unit positive rhombohedron $(10\bar{1}1)$ truncates the polar edges of the negative rhombohedron $(02\bar{2}1)$. (For comparison calcite with twinning parallel to $(01\bar{1}2)$ is shown in Fig. 2). Now the explanation of the variation in the position of the lamellae is that the twinning may be parallel

to either one, two, or three faces of the rhombohedron. The drawings of Figs. 5, 6, and 7 bring this out very clearly. Each of these three cases has actually been observed. If it is assumed that the three styles of twinning are equally common, the ratio between the

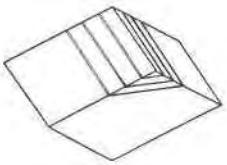


FIG. 2.—Calcite cleavage rhombohehron with polysynthetic twinning parallel to $(01\bar{1}2)$.

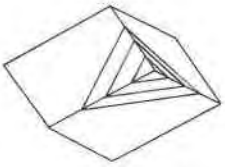


FIG. 3.—Dolomite cleavage rhombohedron with polysynthetic twinning parallel to $(02\bar{2}1)$.

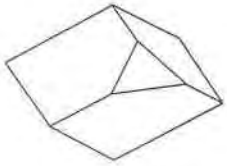
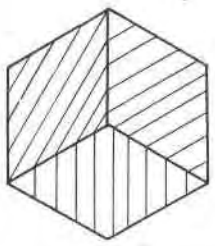


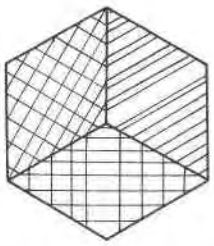
FIG. 4.—Dolomite cleavage rhombohedron with parting parallel to $f(20\bar{2}1)$, which is due to twinning.

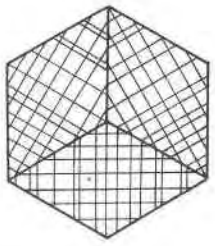
occurrence of striations, parallel to short diagonal, long diagonal, and both diagonals is as 3:1:5.

Some specimens of the dolomite show a well-defined parting parallel to $(02\bar{2}1)$ as illustrated in Fig. 4. The angle $r(10\bar{1}1):f(02\bar{2}1)$ on measurement gave 50°15′ (average of 10 measurements varying from 49° to $51\frac{1}{2}$°) as against the calculated value 50° 12′.

In thin sections this parting is also occasionally observed. The parting surfaces, which are dull in contrast with lustrous cleavage







Plans of the cleavage rhombohedron of dolomite showing polysynthetic twinning parallel to

FIG. 5.—One face $(02\bar{2}1)$

FIG. 6.—Two faces: $(02\bar{2}1)$ and $(\bar{2}021)$

FIG. 7.—Three faces $(02\bar{2}1)$, $(\bar{2}021)$, and $(2\bar{2}01)$.

faces, range up to 4 cm. None of the text-books or treatises make any mention of the parting. The parting is clearly the result of winning.

In thin sections cut parallel to the cleavage, twin-lamellae parallel both to the short and long diagonals are observed. The width of

the lamellae parallel to the short diagonal varies from 0.015 to 0.075 mm. As many as 50 lamellae may be counted in a space of 1 cm. Many of the lamellae are so thin that they show first order interference colors instead of the high order colors of the main part of the section.

Some specimens of the Tilly Foster dolomite show an irregular penetration twinning parallel to (0001) in addition to polysynthetic twinning parallel to $(02\bar{2}1)$. This twinning is recognized by the fact that the cleavage surfaces of the two individual members of the twin are in the same vertical zone [0001].

Dolomite from Providence, Rhode Island

A pure white cleavable dolomite associated with pale green talc from this locality, which was obtained from Ward's Natural Science Establishment, also shows polysynthetic twinning with the twin-plane $f(02\bar{2}1)$. In addition there is also penetration twinning with $c(0001)$ as the twin-plane. A detailed description of this dolomite would closely parallel that of the Tilly Foster dolomite except for the absence of parting and the difference in associated minerals. This mineral also greatly resembles calcite, but the polysynthetic twinning distinguishes it from that mineral at sight. The determination was confirmed by qualitative chemical tests for calcium and magnesium and by a specific gravity determination which gave 2.88. Fig. 8 is a photomicrograph showing twinning lamellae parallel both to the short and long diagonals. The lamellae parallel to the short diagonal are about 0.05 mm. wide.

Dolomite from Charlemont, Mass.

Euhedral iron-bearing dolomite (ankerite) crystals from $\frac{1}{2}$ cm. to $1\frac{1}{2}$ cm. in size, embedded in a talc-chlorite schist which occurs near Charlemont, Mass., show polysynthetic twinning parallel to $(02\bar{2}1)$ on cleavage surfaces. Except where inclusions are abundant the crystals (positive unit rhombohedra) are colorless, but on a weathered surface they are brownish.

A photomicrograph (see Fig. 9) of a thin section oriented parallel to $(10\bar{1}1)$ shows numerous twin-lamellae parallel to the short diagonal. In this occurrence the lamellae are about 0.05 mm. wide.

Dolomite from Foreign Localities

Several specimens of white cleavable dolomite from Moravia (the exact locality is not known) show narrow, but well defined

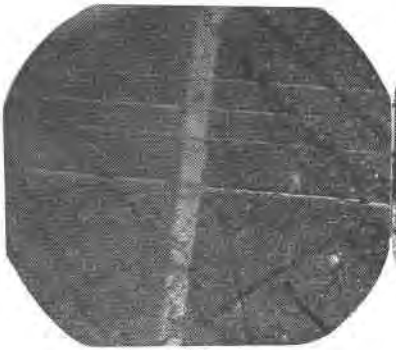


Fig. 8. (x57) Twin-lamellae in dolomite from Providence, R. I., Nicols crossed. The broad lamella is parallel to the short diagonal and the narrow lamellae, parallel to the long diagonal.

Fig. 9. (x24) Twin-lamellae in dolomite parallel to the short diagonal. Nicols crossed. Charlemont, Mass.

twin-lamellae parallel both to the short and long diagonals. These are large pieces with flat cleavage surfaces up to 6 by 8 cm. One specimen shows a small parting surface parallel to $(02\bar{2}1)$. They

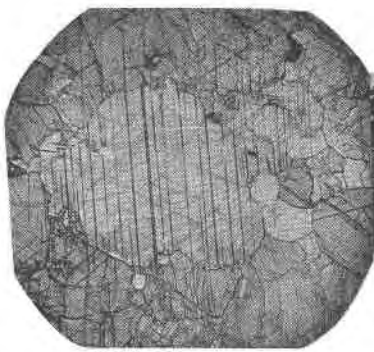


Fig. 10. (x8). Thin section of metamorphic dolomite rock from Tuckahoe, N. Y., showing twin lamellae parallel to the short diagonel.

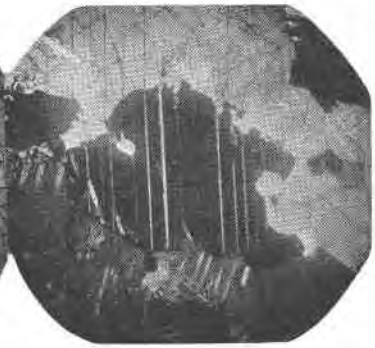


Fig. 11. (x8) The same with crossed nicols.

resemble calcite at first sight and are very much like the Tilly Foster and Providence specimens.

Cleavable ferriferous dolomite (ankerite) from Eisenerz, Styria, in our collections also shows on close examination numerous fine twin-lamellae parallel to both short and long diagonals.

Metamorphic Dolomite Rocks

On careful examination, the cleavage surfaces of the mineral grains of the metamorphic dolomites from the upper part of New York City, Tuckahoe, N. Y., Ossining, N. Y., Amity, N. Y., Salinas, Cal., near Hollister Cal., and several unknown localities show these twin-striations. The photomicrographs of Figs. 10 and 11 (from a specimen from Tuckahoe, N. Y.) give a good idea of the appearance of the twin-lamellae in thin sections. They are as well marked as the twin-lamellae in calcite grains of metamorphic limestones.

Petrographic Importance of Polysynthetic Twinning in Dolomite

The wide-spread prevalence of lamellar twinning parallel to $(02\bar{2}1)$ in metamorphic dolomite rocks gives this method of twinning a petrographic as well as a mineralogic importance. The presence of twin-lamellae furnishes us a good method of distinguishing dolomite from calcite. I have never found any of the polysynthetic twinning in the dolomite of sedimentary rocks. This fact makes it probable that the twinning is the result of pressure.