This new type of twin can be specialized into ten subtypes depending on the hand of the twinned individuals and on the relation between the polarity of the *a*-axes in the twinned axial systems. These subtypes are represented in fig. 2. The present twin or intergrowth corresponds to subtype 8. The subtypes are analogous to those in Japan Law twins. It may be noted that the designation of the twin law as $\{30\bar{3}2\}$ is correct only for subtypes 5, 6, and 8. It would be $\{03\bar{3}2\}$ in subtypes 3, 4, and 7. In the remaining subtypes planes of both $\{30\bar{3}2\}$ and $\{03\bar{3}2\}$ are in opposition across the twin plane.

A number of twin laws of the $\{h0\bar{h}l\}$ type are known in high-quartz, including the Sardinian $\{10\bar{1}2\}$, Esterel $\{10\bar{1}1\}$, Belowda $\{30\bar{3}2\}$, Cornish $\{20\bar{2}1\}$, and (doubtful) $\{30\bar{2}1\}$ laws. All can have geometrical equivalents in low-quartz. Of these, only the Sella $\{10\bar{1}2\}$ and Reichenstein-Grieserntha1 $\{10\bar{1}1\}$ laws have hitherto been described. The high-quartz Belowda $\{30\bar{3}2\}$ law was recognized by Drugman (1928) in a number of specimens from Belowda Beacon and Wheal Coates in Cornwall and from the Esterel Mts., France.

The writer is indebted to Dr. Richard V. Gaines for an opportunity to examine the specimen.

Department of Geological Sciences,
Harvard University,
Cambridge, Massachusetts.

CLIFFORD FRONDEL

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Reconnaissance of the prehnite stability field

PREHNITE is common as a late-stage mineral in the veins and amygdales of basic igneous rocks, and it occurs on a regional scale in rocks of the prehnite–pumpellyite facies, which form under (P,T) conditions between those of the zeolite facies on the one hand, and the greenschist and glaucophane schist facies on the other. Prehnite also occurs in thermally metamorphosed impure limestones, and in some hydrothermal veins.

Earlier experimental work was reported by Coombs *et al.* (1959), who synthesized prehnite from glasses of prehnite, prehnite$+4SiO_2$, and epidote compositions at pressures of 2 to 5 kb, and temperatures of 320° to 460° C. At low temperatures, the phases obtained included hexagonal anorthite, xonotlite, thomsonite, hydrogarnet, and epistilbite, whilst at high temperatures anorthite (An), wollastonite (Wo), idocrase, and wairakite were found. Although Coombs *et al.* (1959, p. 85) clearly realized that prehnite (Prn) does not break down in this way under metamorphic conditions, both they and Merrin (1962) seem to have considered the stability field of prehnite to be limited at high temperature by reaction (1):

$$\mathrm{Prn} \leftrightharpoons \mathrm{An}+\mathrm{Wo}+\mathrm{H_2O} \tag{1}$$

and they located the approximate position of the univariant curve. In fact, the assemblage $\mathrm{An}+\mathrm{Wo}+\mathrm{H_2O}$ is unstable at any point within the stability fields of grossular (Gr) plus quartz (Qz) or zoisite (Zo) plus quartz, since:

$$\mathrm{An}+2\mathrm{Wo} \rightarrow \mathrm{Gr}+\mathrm{Qz} \tag{2}$$

$$3\mathrm{An}+\mathrm{Wo}+\mathrm{H_2O} \rightarrow 2\mathrm{Zo}+\mathrm{Qz} \tag{3}$$

and reaction (1) is therefore metastable (Strens, 1965, p. 466), since the conditions under which it occurs are known to lie within the stability fields of both Zo+Qz and Gr+Qz (Newton, 1966). When prehnite is seeded with zoisite, reaction (4) occurs:

$$5\mathrm{Prn} \leftrightharpoons 2\mathrm{Gr}+2\mathrm{Zo}+3\mathrm{Qz}+4\mathrm{H_2O} \tag{4}$$

the suppression of which in early experimental work was presumably attributable to the failure of zoisite to nucleate in the run times used.

Method. Natural prehnite containing 5 mole % of iron (III) prehnite was ground to $< 20\ \mu$, and seeded with 1 % zoisite ground to $< 5\ \mu$. Seeds of other phases were not added, as An, Wo, Gr, Qz, and hematite (Ht) nucleate easily. The mixture was sealed in gold capsules with excess water, and run in rod bombs at temperatures and pressures known within 5° C and 0·05 kb respectively. The products were identified by microscopic examination in appropriate immersion oils and by X-ray methods. Since faint lines that do not appear on diffractometer traces can often be recorded on film, powder photographs were taken of mixtures showing less than 50 % reaction.

A weight-change method (Weill, 1963) was also used to locate the univariant curves of reactions (4), (6), and (7). A mixture of reactants and products, one phase being present as a weighed single crystal, was run at constant (P,T) for $7{\cdot}0 \pm 0{\cdot}3$ days, and the change in weight of the crystal was plotted against the temperature. The run was then repeated at a different temperature. Ideally, the equilibrium temperature (that at which zero weight change occurs) can be located very accurately by this method, which permits 0·01 % reaction to be detected. Nucleation difficulties are overcome, and reversibility is established, but side reactions can occur that are difficult to detect except by direct observation of the products, which requires 1 to 10 % reaction. For this reason, a combination of conventional and weight-change methods has been used in this work.

TABLE I. Results of hydrothermal runs

Run	P(kb)	T (°C)	Time (days)	% reacted	Products
1	2·00	300	92	2	Prn, ? zeolite
2	2·02	352	60	5	Gr, Ht, Qz, Prn
3	2·03	407	31	10	Gr, Zo, Qz, Ht, (Prn)
4	2·00	497	30	50	Gr, Zo, Qz, (Prn)
5	2·00	550	32	90	Gr, An, Qz, (Zo, Prn)
6	2·00	598	29	100	Gr, An, Qz
7	1·50	400	59	10	Gr, Zo, Qz, Ht, (Prn)
8	1·06	400	59	10	Gr, Zo, Qz, Ht, (Prn)
9*	2·00	300	32	100	Prn, ? zeolite

* Prehnite glass seeded with prehnite and zoisite. Metastable phases shown thus: (Prn).

Results. Details of the runs are given in table I. No difficulty was experienced in interpreting the results of runs made at temperatures exceeding 450°, in which most of the prehnite had reacted. The runs at 400° all yielded clear evidence of prehnite breakdown, but hematite was produced by a side reaction. The run at 357° gave ambiguous results, since the products were Gr+Ht+Qz rather than Gr+Zo+Qz, indicating that the iron component of the prehnite reacted preferentially, whilst the aluminium component remained stable. Reaction (5) is thought to represent the process as accurately as any that can be written:

$$\text{Fe-Prn}+2\text{Al-Prn} \leftrightharpoons 2\text{Gr}+\text{Ht}+3\text{Qz}+3\text{H}_2\text{O} \qquad (5)$$

The upper stability limit of pure (Al) prehnite has therefore been set at 380±25° C at 2 kb. The slope of the univariant curve of reaction (4) was calculated as −7° per kb using estimated entropies for Prn, Zo, and Gr. The univariant curves of reactions (4) and (6) meet at approximately 0·1 kb and 390° C, implying reaction (7):

$$4\text{Zo}+\text{Qz} \leftrightharpoons 5\text{An}+\text{Gr}+2\text{H}_2\text{O} \qquad (6)$$

$$2\text{Prn} \leftrightharpoons \text{An}+\text{Gr}+2\text{H}_2\text{O} \qquad (7)$$

The combined effect of reactions (4) and (5) was studied by the weight-change method, using weighed single crystals of quartz. The results obtained with zoisite (0·12 Fe^{3+} per formula unit) could not be interpreted, but reversal was achieved at $355\pm10°$ C and $2{\cdot}00\pm0{\cdot}05$ kb when clinozoisite (0·36 Fe^{3+}) was used. When allowance is made for the effect of reaction (5), it is clear that reaction (4) will occur at a temperature slightly in excess of 355°, in reasonable agreement with the value of $380\pm25°$ found above.

The upper stability limit of zoisite+quartz (6) was found to be > 500, $< 550°$ C at 2 kb, in agreement with an earlier weight-change determination of $525\pm10°$ (Strens, 1965) on zoisite containing 0·08 Fe^{3+}, but slightly higher than Newton's (1966) figure of $510\pm15°$ C at 2 kb.

The lower stability limit of prehnite at 2 kb is provisionally placed near 300° C, in view of the appearance of an unidentified phase of low index and birefringence (possibly a zeolite) in runs 1 and 9 (table I). If correct, this indicates a comparatively narrow thermal stability range for prehnite, and implies that the thickness of prehnite-bearing rocks will be large only in regions of low geothermal gradient.

School of Physics,
The University,
Newcastle upon Tyne, 1.

R. G. J. Strens

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A new occurrence of priderite

Until recently, priderite was only known in the locality where it was originally found, as a rare accessory in the leucite-rich volcanics of the West Kimberley area, Western Australia (Norrish, 1951; Prider, 1960). According to Norrish, the formula of priderite can be written as A_{2-y} $B_{8-z}O_{16}$ where A stands for K^+ and Ba^{2+}, and B represents Ti^{4+}, Fe^{3+}, and Al^{3+}; y is of the order of unity, while z remains very small. In the