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.

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References

Coombs (D. S.), Ellis (A. J.), Fyfe (W. S.), and Taylor (A. M.), 1959. Geochimica Acta, vol. 17, p. 53.
Merrin (S.), 1962. Ph.D. Thesis, Pennsylvania State University.
Newton (R. C.), 1966. Amer. Journ. Sci., vol. 264, p. 204.
Strens (R. G. J.), 1965. Min. Mag., vol. 35, p. 464.
Weill (D. F.), 1963. Amer. Min., vol. 48, p. 944.

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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

Australian lavas, priderite is associated with leucite, magnophorite (a potassium richterite), and titaniferous phlogopite. It appears as well-formed crystals that were noticed, though misinterpreted as rutile, at the time of the first investigation (Wade and Prider, 1940). Though commonly very fine, the crystals can reach 1×0·5 mm in the coarser wolgidites.

In an electron microprobe study of the Leucite Hills volcanics from Wyoming, Carmichael (1967) found that certain facies of these lavas contained priderite. The Leucite Hills volcanics have chemical compositions and a mineralogy very similar to that described in Australia. Most phases have very analogous compositions, and it is reassuring to see that the same accessory minerals appear.

The object of the present note is to report the occurrence of priderite in a minette whose composition and mineralogy show undeniable similarities with both the Leucite Hills and the West Kimberley rocks, but whose conditions of crystallization were quite different from those well-known lavas, reflecting a different geological situation.

Petrography of the minette. The minette in which priderite was found occurs as an intrusive sheet in the metamorphic formation of the 'schistes lustrés', and outcrops west of the little hamlet of Sisco, north of Bastia in the island of Corsica. The rock displays a chilled margin, and does not show any signs of subsequent metamorphism. It intruded the schists after the last metamorphic and tectonic events affected the area. The dike is probably of Cenozoic age.

A detailed petrographic study of this minette has recently been published (D. Velde, 1967) and only the essential features of its composition will be summarized here. The rock shows phenocrysts of phlogopite and altered olivine in a groundmass of potash feldspar, phlogopite, and potassium richterite (closely related to the type magnophorite). Calcite and sphene are the most conspicuous accessories. Two bulk rock analyses have been published; both show very high K_2O percentages (10·0 and 9·6 %), low Na_2O (1·03 and 1·45 %), and the TiO_2 contents are respectively 1·14 and 1·36 %. Both C.I.P.W. norms show acmite, but sodium metasilicate appears in only one of them.

Priderite occurs as very rare plates that appear almost opaque under the microscope. A very careful examination shows, nevertheless, a weak pleochroism, from purple to dark wine colour, and parallel extinction. These crystals are usually automorphic, with a hexagonal outline. Priderite was probably among the last phases to crystallize and is commonly associated with calcite. The usual dimensions of the plates are 0·04×0·005 mm.

In order to isolate the mineral, the rock was crushed and the finest fraction (less than 0·08 mm diameter) was centrifuged in heavy liquids: first in Rohrbach solution to eliminate feldspar, quartz, calcite, phlogopite, and most of the amphibole; then through Clerici solution to eliminate all traces of amphibole and most of the sphene and anatase.

The heavy concentrate then contained anatase, some sphene, ilmenite, and priderite. Enough priderite was hand-picked under the microscope, selecting those grains that had hexagonal outlines, to make a powder X-ray photograph. This agreed well with the data published by Norrish for the original priderite, establishing beyond doubt the identity of the Corsican mineral.

Conclusion. The occurrence of priderite in the minette from Sisco is not surprising. In an earlier paper (D. Velde, 1967) many similarities have been identified relating the Australian rocks and the minette: the presence of potassium richterite, phlogopite, and olivine altered to a montmorillonite. The main difference in mineralogy is the absence of leucite in the Sisco minette, a feature that most likely reflects the difference in occurrence between truly volcanic lavas and a hypabyssal rock. The chemical compositions, in the three occurrences, are certainly similar: in all cases the priderite bearing rocks are alumina-deficient and alkali-rich but sodium-poor.

The presence of priderite would then, as does the existence of magnophorite, reflect this particular composition. I have been able to identify it optically, together with magnophorite, in leucite-rich volcanics from Smoky Butte, Garfield County, Montana,[1] rocks very similar to the Leucite Hills lavas. Furthermore, it is most likely present in the richterite bearing verites recently described by Hernandez-Pacheco (1964) and Fuster-Casas and Gastesi-Bascuñana (1964) in the Murcia province of southern Spain. Attempts to separate a mineral occurring in very fine plates in a verite from Fortuna (Murcia) have so far been unsuccessful, but the optical properties tend to indicate that they are priderite.

In the absence of an electron probe, no guess can be made about the composition of the priderite from Sisco.

Wadeite ($Zr_2K_4Si_6O_{18}$, Prider, 1939) has been searched for, but seems absent from the Corsican minette. Zirconium has been detected among the major trace elements, using X-ray fluorescence techniques. However, the amount of ZrO_2 present would be on the order of 0·04 %,

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[1] A brief description of the Smoky Butte lavas is to be found in R. E. Matson (1960). This author, however, does not mention either the amphibole or the priderite, both present in some of the facies he describes.

roughly 5 or 6 times less than in the Leucite Hills rocks (Carmichael, 1967). Wadeite is a rare if constant accessory in Wyoming, and even if it were present in the Sisco rock, it would therefore be difficult to detect.

Carmichael (1967) commented on the absence of an iron–titanium oxide phase in most of the Leucite Hills volcanics. The madupites are the only rocks containing a titanium-bearing magnetite. Wade and Prider did not mention the occurrence of either magnetite or ilmenite in their description of the west Kimberley lavas. In Sisco, titanium is found in the magnesium silicates, but is also expressed as ilmenite, rare but present, sphene and anatase, both abundant, and priderite. The presence of these various phases was confirmed by X-ray diffraction. Anatase occurs as small, sometimes automorphic crystals, often surrounding xenomorphic relics of sphene. Ilmenite appears very fresh in reflected light, but is strongly corroded.

It would then appear that ilmenite and sphene crystallized early, anatase and priderite later, crystallization being too rapid for equilibrium to be attained.

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References

CARMICHAEL (I. S. E.), 1967. Contr. Min. Petr., vol. 15, pp. 24–66.

FUSTER-CASAS (J. M.) and GASTESI-BASCUÑANA (P.), 1964. Estudios Geologicos, vol. 20, pp. 299–314.

HERNANDEZ-PACHECO (A.), 1964. *Ibid.*, vol. 20, pp. 265–270.

MATSON (R. E.), 1960. Petrography and petrology of Smoky Butte intrusives, Garfield County, Montana. Unpublished M.Sc. Thesis, Montana State University.

NORRISH (K.), 1951. Min. Mag., vol. 29, pp. 496–501.

PRIDER (R. T.), 1939. *Ibid.*, vol. 25, pp. 373–387.

—— 1960. Journ. Geol. Soc. Australia, vol. 6, pp. 71–118.

VELDE (D.), 1967. Bull. Soc. franç. Min. Crist., vol. 90, pp. 214–223.

WADE (A.) and PRIDER (R. T.), 1940. Quart. Journ. Geol. Soc., vol. 96, pp. 39–98.

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