Pumpellyite in Snowdonian soils and rocks

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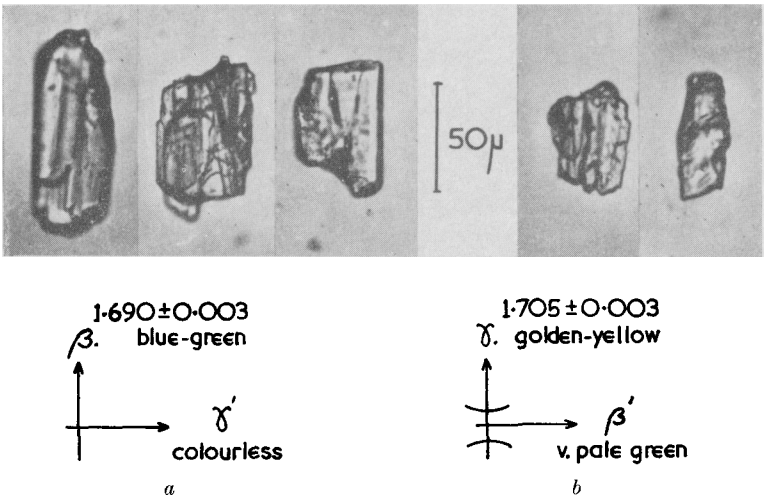
[Read 17 September 1964]

Summary. Detrital grains, noted during the mineralogical examination of certain Snowdonian soils, have been identified as varieties of the mineral pumpellyite: the source of one variety has been located in dolerites exposed in the area, and the identity of this variety confirmed by X-ray analysis.

DURING the mineralogical examination carried out by one of us (D. A. J.) of a number of Snowdonian soils from Nature Conservancy experimental plots in the uplands of the north-western Conway valley, occasional grains of a distinctive mineral were noted. These occur in the heavy mineral fraction (sp. gr. $> 2{\cdot}95$) and take the form of small (usually $< 100\ \mu$) single prismatic fragments with cleavage traces parallel to their length (fig. 1*a*), and occasional divergent aggregates. They show straight extinction, and are elongated parallel to β, although predominantly length fast. They have the pleochroic scheme: β blue-green ($= 1{\cdot}690 \pm 0{\cdot}003$), α and γ colourless. The grains usually show grey to yellow birefringence colours and an excentric obtuse biaxial interference figure with slight dispersion ($r < v$). According to Milner (1962) and Coombs (1953), these properties conform generally with those of a mineral of the pumpellyite series (fig. 2).

A second variety was also noted in the heavy mineral separates from the same group of soils. This differs in being elongated parallel to γ, and having the pleochroic scheme: γ golden yellow ($= 1{\cdot}705 \pm 0{\cdot}003$), β and α very pale blue-green (fig. 1*b*). These grains show anomalous low blue-grey to brown birefringence colours, and often give a centred biaxial interference figure ($2V_\alpha =$ approx. $10°$) displaying strong dispersion ($r \ll v$). This second variety is similar to one described by Coombs (1953, p. 129). Grains with properties intermediate between these two varieties have also been found.



a *b*

FIGS. 1*a* and 1*b*. Varieties of detrital pumpellyite.

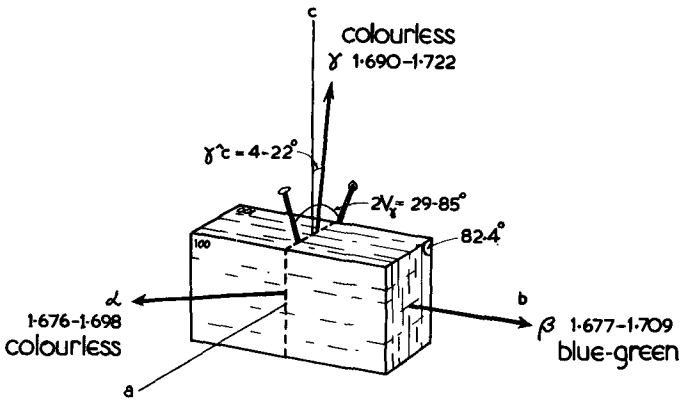


FIG. 2. Optical orientation of pumpellyite based on data from Coombs, 1953.

A source for the first variety of pumpellyite was subsequently located in the gabbroid and marginal portions of dolerite intrusions at Bwlch y Ddeufaen in the Conway valley (SH 724715). It occurs as stellate and radiating groups of bladed crystals (fig. 3) associated with zoisite, clinozoisite, prehnite, calcite, and chlorite, either in vesicles or apparently replacing plagioclase feldspar. The second variety of pumpellyite, however, has not so far been recognized in any thin-sections of rocks from Snowdonia.

A separation of the mineral from a Bwlch y Ddeufaen dolerite has been examined by one of us (D. F. B.) by X-ray diffraction, using powder photographs obtained on Philips 11·48-cm cameras at the Nature Conservancy, Bangor. The material as separated was found to consist of chlorite with a mineral giving an X-ray pattern diagnostic

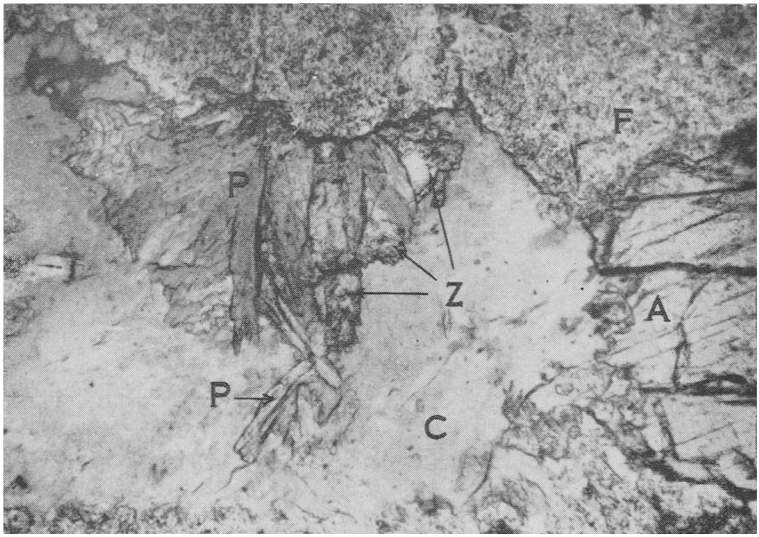


FIG. 3. Pumpellyite in a dolerite. Ordinary light ×75. A—augite; C—chlorite; F—plagioclase; P—pumpellyite; Z—zoisite.

of pumpellyite, closely comparable with that given by Coombs (1953, p. 121).

Pumpellyite, first described by Palache and Vassar (1925), is a mineral series of affinities with lawsonite and the epidote group. A known paragenesis is in rocks that have undergone low-grade regional metamorphism (Deer, Howie, and Zussman, 1962, p. 233), but Coombs (1953) notes that the mineral can also form under conditions of strong shearing stress without high temperatures, as shown by Hutton (1937) and Amies (1950) in New Zealand. In Snowdonia, dolerites intruded into Ordovician volcanic rocks and shales, such as those at Bwlch y Ddeufaen (Billingshurst, 1930), are often considerably faulted and deformed by shearing stress.

During the present study, the mineral has only been recorded in soils and dolerites from the west side of the lower Conway valley, and

has not so far been recognized from any other localities in Snowdonia. There appear to have been no previous records of the detrital mineral in Britain, although a mineral recorded under the name of chloropite (Edelman, 1933) and subsequently identified as pumpellyite (Langenberg and de Roever, 1955) has been shown to be relatively common in the Quaternary deposits of the Netherlands. As a rock mineral, this is an addition to the few known British occurrences. Pumpellyite has been described partially replacing plagioclase in spilitic lavas of Ordovician age at Builth, mid-Wales (Nicholls, 1958), and, also as a plagioclase replacement, in altered Ordovician spilitic lavas adjacent to outcrops of glaucophane schist and serpentinite in Ayrshire (Bloxam, 1958).

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