a lack of sericite in the specimens examined. Also there is no obvious depletion in silica.

The area occupied by the altered rocks is centred in a depressed tract of ground, largely devoid of outcrops, considered by Geikie (Macgregor *et al.*, 1925, 147) to conceal a volcanic vent, possibly an extension of the Meikle Bin vent. The strata underlying the lavas in this area include the Cementstone Group, which includes many beds of dolomitic limestone. The alteration could have resulted from the circulation of heated ground water resulting from intrusion of magma associated with Lower Carboniferous volcanicity in the Campsies.

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REFERENCES

DEER (W. A.), HOWIE (R. A.), and ZUSSMAN (J.), 1963. *Rock-forming Minerals*, **5**, *non-silicates*. London (Longmans).

KNOPF (A.), 1929. The Mother Lode system of California. *U.S.G.S. Prof. Paper* **157.**

MACGREGOR (M.), DINHAM (C. H.), BAILEY (E. B.), and ANDERSON (E. M.), 1925. The geology of the Glasgow district, 2nd edition. *Mem. geol. Surv. U.K.*

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Lawsonite pseudomorphed in Tauern greenschist

PSEUDOMORPHS after porphyroblasts of lawsonite have been found in greenschists within the Tauern window of the Austrian Alps. These rocks occur in the Pennine Mesozoic series, which has undergone metamorphism of Alpine age only. This is evidence that the greenschist facies was preceded by an earlier phase of Alpine metamorphism at higher pressure and low temperature.

The pseudomorphs were found on the northern side of Virgental, Ost-Tirol (47° 02′ N, 12° 19′ E), near the head of the River Isel. This locality is near the southern edge of the Obereschieferhülle—the Mesozoic series, equivalent to the Bündnerschiefer of Switzerland, which is exposed within the structural window and sheathes the older core of the Hohe Tauern.

The host rock is a blastomylonitic 'prasinite', in which small albite porphyroblasts lie amongst well foliated epidote, actinolite, chlorite, and minor calcite, biotite, sphene, and quartz. The pseudomorphs contain variable amounts of albite, epidote, chlorite, and calcite, with or without minor biotite. They are about 5 mm long, and are similar in general aspect to those described and illustrated by Ellenberger (1960) from the Savoie Alps.

The pseudomorphs, in particular those rich in chlorite and calcite, would be expected to deform easily under stress. Yet these pseudomorphs have retained their shape well while the groundmass is highly foliated. This would be explained if lawsonite remained stable until after the crystallization of the albitic groundmass, the rock passing through the lawsonite–albite facies. Such a hypothesis presupposes an earlier lawsonite-bearing assemblage. Rocks of prasinite mineralogy and texture commonly occur as a replacement of glaucophane–lawsonite schist and a similar origin for the Tauern prasinites is not unreasonable. The metamorphic history of these rocks is probably one of pressure reduction or temperature increase or both, moving from glaucophane–lawsonite facies, through lawsonite–albite facies, to greenschist facies.

Prasinites occur over a wider area than relict glaucophane–lawsonite rocks within the Bündnerschiefer series. These prasinites may, nevertheless, all have formed from glaucophane–lawsonite schist. Occurrences of pseudomorphs after lawsonite suggest that such an origin is more widespread than present glaucophane–lawsonite relics, particularly when association with low-temperature eclogites is taken into account. Such eclogites occur within the Obereschieferhülle of the southern Tauern. Eclogitic rocks are better developed in the Pennine Alps, and sometimes include pseudomorphs after lawsonite (Fry and Fyfe, 1971). The part of the Pennine Alps in which eclogites occur is also that part which is without relict lawsonite (Bearth, 1962 and 1966). It is likely that most of the Pennine Alps passed through glaucophane–lawsonite conditions on the way to greenschist, and that a common reason exists for the creation of eclogite and the destruction of glaucophane–lawsonite assemblages in one part of this area. The occurrence of both eclogite and pseudomorphs after lawsonite in the southern Tauern suggests that this hypothesis is applicable not just to the Pennine Alps, but in the Eastern Alps as well.

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REFERENCES

BEARTH (P.), 1962. *Schweiz. Min. Petr. Mitt.* **42**, 127–37 [M.A. **16**–100].
—— 1966. Ibid. **46**, 13–23 [M.A. **18** 65].
ELLENBERGER (F.), 1960. *Bull. Soc. géol. France*, ser. 7, **2**, 190–4 [M.A. **15** 564].
FRY (N.) and FYFE (W. S.), 1971. *Verhandl. Geol. Bundes-Anst. Wien* (Jahrgang 1971) **2**, 257–65.

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