SHORT COMMUNICATION

Expanding-lattice minerals from Shropshire.

UNUSUAL forms of expanding-lattice minerals have been found in a soil overlying the Cwm-mawr picrite in the Shelve area of south Shropshire, and their characteristics appear sufficiently distinctive to merit this preliminary note. The minerals occur in a brown earth near Woodgate, about ½ mile south of Corndon Hill.

In the (B)/C horizon of the profile pale yellowish-brown fibres and lath-shaped grains up to 4 mm. long resembling fragments of driftwood are fairly common: their form suggests that they are probably pseudomorphous after a fibrous mineral. In the partially weathered picrite underlying the profile there are cross-fibre veinlets of a mineral that when unweathered is green, but in the altered state is brown. The optical properties of the weathered fibres are closely akin to those of the soil mineral, and there seems no doubt that the latter represents the vein material in a more advanced state of alteration. Such veins appear to occur commonly and 'at Cwm-mawr, three-quarters of a mile west-north-west of Hyssington, weathered picrite traversed by half-inch veins of serpentine is seen' (Blyth, 1944). An examination of unweathered vein material from Woodgate and from Cwm-mawr shows that it is a fibrous chlorite with $a = 5{\cdot}3$ Å. as the fibre axis. The sharp basal reflections of 14·4 Å. periodicity are unaffected by heating below 600° C. or by treatment with glycerol, but heating at 700° C. shows changes in the relative intensities of the lower-order basal reflections characteristic of chlorites. The chlorite fibres have straight extinction and positive elongation, the refractive index being $1{\cdot}589 \pm 0{\cdot}003$ for light vibrating parallel to the fibre direction, and the fibre birefringence is approximately 0·004.

Microscopic examination shows that the soil mineral occurs in fibro-lamellar aggregates, slightly pleochroic in shades of yellowish brown, with the maximum absorption parallel to the length of the fibres. The refractive indices are variable but the maximum index is in the range 1·56–1·57 and the fibre birefringence is between 0·015 and 0·02. The zero, first, and second layers of the X-ray fibre pattern of air-dry material, separated from the soil after dispersion with Calgon (sodium hexametaphosphate), can be indexed on the basis of a cell with $a = 5{\cdot}3$ Å. (fibre axis), $b = 9{\cdot}2$ Å., $c = 15{\cdot}0$ Å., $\beta = 96$–$98°$. Reflections of type 00*l*, 0*k*0, 0*kl*, and *hkl* have been indexed. The occurrence of *hkl* reflections and reflections with $k \neq 3n$ shows that the layers are stacked in an ordered way. The long spacing of the fibres, 15 Å. in the air-dry state, is reduced to 10 Å. by heating at 110° C. and re-expanded to 15 Å. on rehydration. Treatment with glycerol alters the basal spacing to 18 Å. Throughout these changes a good fibre pattern is maintained, the gross features being unchanged although the details are altered.

The cation exchange capacity of 96 m.e. per 100 g. air-dry material has been obtained after saturation with calcium nitrate and replacement with magnesium nitrate solutions.

Another material in the weathering rock and the soil occurs as pale yellowish-brown waxy compound aggregates, but some grains show optical continuity and well-defined extinction directions. Many of the grains are lamellar owing to a well-developed cleavage and grains can be selected which give an excellent centred biaxial interference figure with $2V_\alpha$ 15–30°. The lamellar grains have straight extinction and pleochroism is slight with β and γ yellowish brown and α pale yellowish brown; the refractive indices are slightly variable but β is near 1·58 and the birefringence 0·02. Single-crystal rotation photographs about the normal to the lamellar faces show broad reciprocal lattice rods parallel to the rotation axis, which can be indexed on the basis of a hexagonal net with $a = 5{\cdot}3$ Å. or alternatively an orthogonal net with $a = 5{\cdot}3$ Å., $b = 9{\cdot}2$ Å. Oscillation photographs about an axis in the plane of the lamellar faces show a hexagonal array of diffuse spots (approximately the end projection of the *hk* rods) and a series of 00*l* reflections of a basal spacing of 15 Å. for air-dry material and 18 Å. for glycerol-treated material. There is also a considerable amount of less well-oriented material in each grain as the *hk* spots in each hexagon are joined by broad rings that follow constant θ lines. The X-ray data for the well-oriented material in these grains are consistent with a disordered stacking sequence of layers, the only regularity in addition to the equidistant stacking being the parallel alignment of the hexagonal *a*-axes of the half-layers of the mineral. On the basis of an orthorhombic structural unit, the well-developed cleavage is (001); the optic axial plane is (010) and the relationships between the crystallographic axes and the optical indicatrix are: $a = \gamma$, $b = \beta$, $c = \alpha$.

Caillière and Hénin (1951) have demonstrated the fibrous character and swelling properties of minerals classified as saponite, bowlingite, and diabantite. Fibre photographs taken here of saponite (bowlingite) from Cathkin Hills, Scotland, show an overall resemblance to those of the fibrous soil mineral but there are differences in detail. The lamellar soil mineral seems very similar to the layer-lattice silicate found to be a constituent of iddingsite (Brown and Stephen, 1959), but differs in that the soil mineral can be readily expanded by glycerol.

It is likely that the fibrous mineral and the lamellar mineral owe their crystallographic order to the inheritance of undisplaced structural units from their parent minerals and that the study of such pseudomorphs will give structural information about clay minerals that could not be obtained from X-ray powder photographs or electron diffraction.

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Blyth (F. G. H.), 1944. Quart. Journ. Geol. Soc. London, vol. 99 (for 1943), p. 187.
Brown (G.) and Stephen (I.), 1959. Amer. Min., vol. 44, p. 251.
Caillière (S.) and Hénin (S.), 1951. Clay Min. Bull., vol. 1, p. 138.

BOOK REVIEWS

Hawkes (H. E.). *Principles of geochemical prospecting.* Bull. U.S. Geol. Survey, 1957, no. 1000-F, pp. 225–355. Price 40 *c.*

Geochemical prospecting for minerals includes any method of mineral exploration based on systematic measurement of the chemical properties of a naturally occurring material. The purpose of the measurements is the location of geochemical anomalies or of areas where the chemical pattern indicates the presence of ore in the vicinity. Anomalies may be formed either at depth by igneous and metamorphic processes or at the earth's surface by agents of weathering, erosion, and surficial transportation.

Geochemical anomalies of deep-seated origin—primary anomalies—may result from (1) apparent local variation in the original composition of the earth's crust, defining a distinctive 'geochemical province' especially favourable for the occurrence of ore, (2) impregnation of rocks by mineralizing fluids related to ore formation, and (3) dispersion of volatile elements transported in gaseous form.

Anomalies of surficial origin—secondary anomalies—take the form either of residual materials from weathering of rocks and ores in place or of material dispersed from the ore deposit by gravity, moving water,