SHORT COMMUNICATIONS

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Zoned muscovite from the Leinster Granite, S.E. Ireland

THE Caledonian Leinster Granite in S.E. Ireland, intruded at *c*. 400 Ma into a Lower Palaeozoic envelope, consists of five diapiric dome-like plutons (Units 1–5; Brindley, 1973). In the most northerly pluton (Unit I) Brück (1974), extending the work of Brindley (1954), defined five granite types arranged in a concentric manner within the pluton. Two are distinguished by the presence of large muscovite flakes. These muscovites show complex zoning in a manner that compares with that seen in, for instance, many plagioclase feldspars and pyroxenes. Zoning in muscovite has probably been overlooked in many granites.

The two muscovite-bearing granites are Type III (Brindley, 1954; Brück, 1974) and Type IV (Brück, 1974). Type III is an adamellite comprising quartz, plagioclase, microcline, biotite and muscovite with accessory tourmaline, apatite, zircon and rare topaz (Brindley, 1954; Brück, 1974; Brück and O'Connor, 1977). The large (up to 70 mm), widely-scattered muscovite crystals are often textually decussate. The similar Type IV granite is also characterized by large muscovites but contains, in addition, megacrysts of microcline.

Both the Type III and Type IV granites are peraluminous [$Al_2O_3/(CaO + Na_2O + K_2O) > 1$; e.g. Clarke, 1981]. An average value of 1.22 for this ratio may be calculated from the analyses of Brindley and Gupta (1974) and Brück and O'Connor (1977). Mineral assemblages also reflect the peraluminous nature of the granite.

The literature contains few descriptions of zoned mica. Normal zoning in phlogopite has been reported by Métais *et al.* (1962), Raskova (1981), Rimsaite (1969, 1971), and Rimsaite and Lachance (1966). Velde and Yoder (1977), Kwak (1981), and Wagner *et al.* (1987) describe sector zoning in the same mineral. Zoning due to the superposition of micas was noted by Brock (1974—Li-mica on muscovite), and Tatekawa (1975—muscovite on biotite). Zoned muscovite in the Leinster Granite was briefly recorded by Sollas (1891).

The following descriptions are based on the examination of muscovites collected from a quarry in Type III granite at Stepaside, Co. Dublin (Grid. Ref. O 318 224). Large (>25 mm) micas proved exceptionally difficult to extract because of fractures. Sections 0.1–0.3 mm thick, prepared by slicing along the cleavage, show the zones clearly.

Many individual micas display in excess of 100 discrete zones ranging in thickness from 0.01 to 0.2 mm. Variations in specimen thickness have no effect on zone geometry. At normal thin-section thickness (0.03 mm), zones are difficult to see. Any particular zone (or mica) may show one or more of the features described immediately below.

In the simplest case, zones define a simple concentric euhedral pattern (Figs 1*a* and 2*a*). In other cases, the outer boundary of a zone may thicken and thin in an undulatory manner (Fig. 1*b*). Obvious corrosion may affect a single zone only (Fig. 1*c*) or a sequence of zones (Fig. 1*d*). The corroded surface may be very irregular and may be marked by concentrations of inclusions (Figs 2*a*,*b*). In the central parts of some micas, zones may lack any straight edges or angled corners (Fig. 1*e*).

A number of features indicate or suggest interaction with other granite constituents during growth. The abrupt preferential thickening of zones on certain faces only (Fig. 1*f*) may reflect a space constraint. Quartz grains (0.1–1.0 mm) may be included in the outer parts of some muscovites. Zones may curve inwards to varying degrees

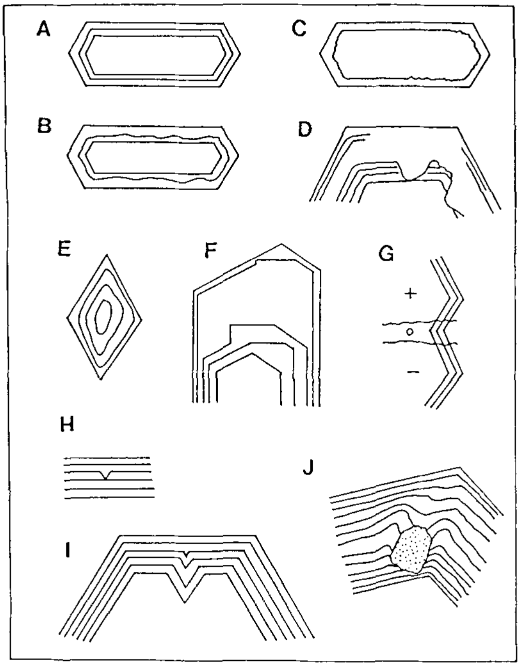

FIG. 1. Diagrammatic sketches of common varieties of muscovite zoning in the Leinster Granite.

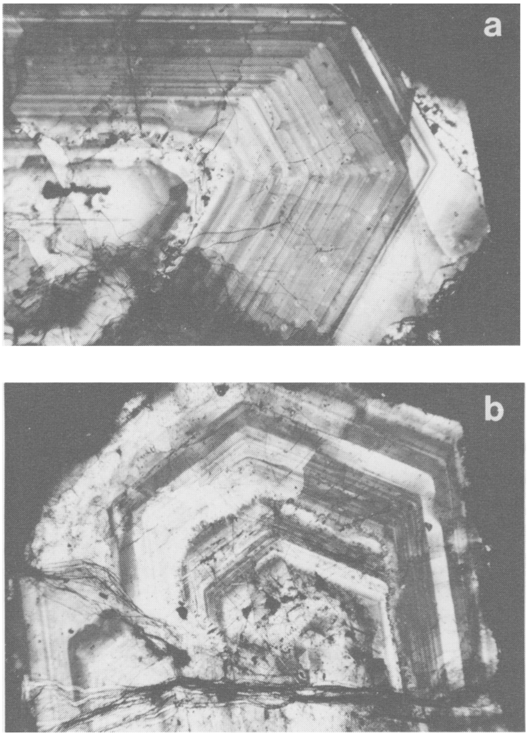

FIG. 2. (*a*) Concentric zones in muscovite. The haloes surround small zircon inclusions (magnification ×10). (*b*) Zoned muscovite with a major corrosion surface marked by a zone of inclusions (magnification ×5).

as they approach an inclusion and, where a quartz grain is completely surrounded, subsequent zones restore the euhedral mica shape (Fig. 1*j*). Zircon inclusions, often aligned parallel to zone boundaries, are very common (Fig. 2*a*).

In some micas, groups of zones bend inward at an angle of 30° or 60° into a 'suture zone' (Fig. 1g) across which there is a marked difference in extinction. The 'suture' itself does not go into extinction due to structural overlap of different domains. Small V-shaped notches may occur in individual zones in most crystals (Fig. 1*h*). In some micas, a group of zones may show a significant, inwardly directed, angular bend (Fig. 1*i*) which gradually reduces in magnitude outwards as succeeding zones restore a euhedral shape. These V-shaped features represent the temporary and incipient growth of additional faces.

It is clear from a preliminary regional inspection that zoning in muscovite is widely developed in the Leinster Granite. The Type III and Type IV Leinster granites are typical two-mica, peraluminous, S-type granites. It is likely that zoned micas are common in similar granites elsewhere. For example, euhedral muscovites from the Concord Granite, New Hampshire (U.C.D. collections) show similar if less pronounced zoning.

The origin of the large muscovites in the Leinster Granite remains a matter of debate. It has been argued that they are primary magmatic features (Sollas, 1893; Sweetman, 1987). It has also been proposed that they are of late, hydrothermal origin (Brindley, 1954; Brück and O'Connor, 1977). The incorporation of inclusions would seem to suggest a magmatic environment. Subtle changes in magma composition coupled with periods of disequilibrium and minor phase crystallization could explain many of the observations. Current research by the author on the petrography, optics, crystal structure and chemistry of the micas is aimed at resolving their growth history. However formed, the zoning of muscovite, as seen in the Leinster Granite, presents an additional, overlooked, means whereby the magmatic or hydrothermal evolution of a granite may be investigated.

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C. Walsh gave permission to collect from his quarry at Stepaside.

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Rhenium sulphide from the Coldwell complex, northwestern Ontario, Canada

RHENIUM ranks as one of the most highly dispersed elements, and reports of *bona fide* rhenium-based minerals are few (Vlasov, 1966). This short communication presents the first conclusive evidence for the occurrence of a naturally occurring rhenium sulphide.

The Re mineral occurs in a copper–platinum group element deposit hosted by a pegmatitic facies of the Two Duck Lake gabbro (Dahl *et al.*, 1986; Watkinson *et al.*, 1986). This gabbro intruded layered olivine gabbros that form the eastern margin of Center 1 of the Coldwell alkaline complex in northwestern Ontario (Mitchell and Platt, 1982).