GRANULITES AT GRUINARD BAY

SIRS, —— Davies' (1977) paper prompts me to comment on one of his statements and to report some evidence concerning the metamorphic history of the gneisses at Gruinard Bay.

Davies makes the important observation that there is more than a single age-group of early Scourian felsic gneisses in this part of the Lewisian complex, and he draws attention to the complexities of their tectonic and intrusive evolution. By contrast, apparently he considers their metamorphic history to have been relatively simple, stating that the area "is characterized by amphibolite facies gneisses and agmatite complexes which do not display evidence of previous granulite facies metamorphism" (Davies 1977, p. 189). Although Davies cites four other works in support of his own observation (Peach *et al.* 1907; Sutton and Watson 1951; Giletti *et al.* 1961; Moorbath and Park 1972), his statement conflicts with several published references to the occurrence of 'relict granulites' in this area (Park 1970; Moorbath and Park 1972; Cresswell and Park 1973; Holland and Lambert 1973), particularly that of Moorbath and Park, p. 54.

Unfortunately, this difference of opinion cannot be resolved fully by reference to the published record, for it seems that whenever any details of the 'granulite' lithologies have been presented, they refer specifically to basic rocks (Cresswell and Park 1973, p. 80; Holland and Lambert 1973, p. 55) and, because of the difficulties associated with the interpretation of the pyroxenes from basic igneous intrusions, it is perhaps arguable that they might have been misidentified as relict granulite assemblages (c.f. Bowes 1962, Park 1970). To my knowledge, so far only Park (1970) has intimated that there might be other, more conclusive, mineralogical evidence for the occurrence of granulites. He states (1970, p. 393) that in addition to some of the basic rocks, "the country rocks also show evidence of relict granulite facies assemblages", but no details are given. Therefore, although Park (written comm. 1976) also reports that Crane's (1972) thesis includes mention of replaced pyroxenes in some of the quartzo-feldspathic gneisses, there is as yet no supporting published information which could be used to challenge Davies' more recent statement.

My own observations relevant to this issue were made in 1975 and concern a fresh road cut (c. 80 m. long) located on the east side of the A832 road [NB 963 914], just north of the road bridge across the Gruinard river. The outcrop is marginally within the area surveyed by Davies (1977, fig. 1), but lies just outside Crane's (1972) area. The northern part of this outcrop is occupied by typical granulite-facies two-pyroxene, quartzo-feldspathic gneisses, though the pyroxenes are in various stages of alteration. In hand specimen, the feldspars have a typical dark greenish charnockitic colouration, and the quartz is dark. Four samples were collected and the approximate modal composition (volume percent) of the one containing the least altered (i.e. virtually fresh) pyroxenes (Sample No. GB75/21) is: pleochroic hypersthene 12%, diopsidic clinopyroxene 7%, quartz 24%, plagioclase (An_{26-32}, optically determined) 48%,

ilmenite 5%, biotite 2%, actinolitic amphibole 1%, accessory zircon and apatite <1%. K-feldspar occurs solely as exsolution 'blebs' in the strongly antiperthitic plagioclase, which is only incipiently altered. Using Streckeisen's (1967) classification, the rock is a quartz-diorite; had the mafic minerals been biotite and hornblende it could properly have been termed a tonalite. The pyroxenes are only slightly altered: adjacent to plagioclase, the clinopyroxenes have a narrow rim of blue-green amphibole, whilst the orthopyroxenes show minor changes along cracks and cleavages, and marginally, to a fine grained mixture dominated by recognizable talc and tremolite ± opaques; there is sometimes an outer rim of blue-green amphibole ± opaques, or biotite + opaques. Larger ilmenite grains elsewhere are invariably surrounded by fringes of biotite. In the three more altered samples, the relict orthopyroxenes often have a distinctive talc ± chlorite (and/or serpentine?) core surrounded by a quite separate inner corona of radially arranged tremolite and an outer rim of either blue-green actinolitic amphibole ± opaques or biotite + opaques. In two of these three samples, the modal proportions of mafics: quartz: plagioclase remain approximately the same as in sample No. GB75/21. The remaining sample has approximately 5% mafics, 45% quartz and 50% plagioclase. It has a leuco-quartz-diorite composition, and is more acid than the others. None contains any K-feldspar except that produced by exsolution of the plagioclase.

The knowledge that some of the quartzo-feldspathic gneisses at Gruinard Bay were once in granulite facies is of potential significance for two main reasons. First, although the reconnaissance nature of my own survey does not allow me to make a direct correlation between these rocks and any of the granulites of the central region, previous work would suggest that they might represent high grade effects of the Badcallian metamorphic episode in this part of the southern region (Moorbath and Park 1972; Cresswell and Park 1973). Second, now that Davies has recognized that two quite distinct early Scourian gneiss groups exist, the fact that the charnockitic gneisses vary compositionally from quartz-diorite to leuco-quartz-diorite suggests that they belong to the earlier 'tonalite' suite. This will now need to be tested with some care, as will the possibility that (some of) Davies' later granodiorite suite might similarly have undergone granulite facies metamorphism.

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