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Spherically arranged inclusions in post-tectonic garnet porphyroblasts: discussion of a comment by A. Spry

THE comment by Spry (1974) on our paper (Harvey and Ferguson, 1973) describing spherically arranged inclusions in garnet porphyroblasts from Renvyle, Connemara, Ireland, requires that we amplify some of the evidence that we presented at that time. It also raises some questions of more general significance in the study of metamorphic textures. Spry has attempted to interpret the textures we described within the framework of the structural and metamorphic chronology of Renvyle proposed by Cruse and Leake (1968). However, structural and stratigraphic correlation within Renvyle is greatly complicated by the presence of a major tectonic break (the Renvyle–Bofin Slide, op. cit., p. 32). For this reason we made no attempt in our original paper to interpret the textures within this framework, although we did attempt to do so in correspondence (1973) with Spry in order to facilitate discussion of some of the points he raised. In this note we will follow the same practice although we emphasize that our detailed study of the Renvyle rocks has not enabled us to correlate structures across the Renvyle–Bofin Slide with any confidence.

As a convention, then, we will refer to the schistosity described in Harvey and Ferguson (1973) as S_2 in order to discuss the alternative interpretation of the textures proposed by Spry. This interpretation is that 'garnet and some chloritoid crystallized at an early stage (post-tectonically to $?F_1$ but pre-tectonically to F_2, which gave rise to S_2) followed by syntectonic crystallization of matrix phyllosilicates (in F_2), which wrapped around the garnet. . . . Some chloritoid was bent against the rigid garnet during this episode. Post-tectonic metamorphism of a static annealing kind was accompanied by growth of a second generation of chloritoid. . . .' The textural features which, together, argue against this interpretation are:

1. The schistosity is defined by a dimensional orientation of white mica with subordinate chlorite and ilmenite. In thin section, chloritoid porphyroblasts, whatever their orientation with respect to the schistosity, show ilmenite inclusion trails that are continuous with lines of ilmenites in the matrix. The chloritoids also transect the schistosity, a feature commonly shown by post-schistosity porphyroblasts (although it is argued elsewhere in some detail—Ferguson and Harte, in press—that this feature is not in itself diagnostic of such porphyroblasts). All chloritoids that contain sufficient inclusions to allow judgement show these features, including those that appear to be bent against the garnet porphyroblasts. Furthermore, all chloritoids are similar in habit, twinning, colour, and inclusion characteristics. We therefore interpret the chloritoids as having grown later than the formation of S_2, and we find no evidence to support Spry's (apparently *ad hoc*) proposal of two distinct periods of chloritoid growth.

2. The fabric defined by ilmenite plates in the matrix can frequently be traced across

the margins and into the garnet porphyroblasts. Our observation of ilmenite plates that are partially enclosed within garnet does not support the view 'that the ilmenite plates project into chlorite that is derived from the garnet' (Spry, 1974, p. 724). Many of the plates project from white mica into garnet and, in general, their spatial relationship in the rock is independent of the chlorite distribution.

3. The chlorite deficient 'haloes' in the matrix immediately adjacent to the garnets (Harvey and Ferguson, 1973, figs. 2, 3, 4) are difficult to reconcile with pre-S_2 garnet growth. Spry (1974) makes no attempt to explain this feature although in a personal communication (1973) he interprets the haloes as resulting from pre-S_2 garnet growth, which produced a zone deficient in certain constituents, which zone was preserved as a chlorite-deficient area after the recrystallization of the matrix during F_2. We think this is unlikely as the haloes are often very uniform in thickness and mimic the garnet shape closely; that is, the haloes do not themselves appear to be deformed around the garnets.

Our most serious objection to Spry's interpretation is that it makes no attempt to account for the peculiar textural feature that was the *raison d'être* of our paper—the unusual arrangement of the ilmenite inclusions within the garnets. Spry's belief that porphyroblasts are unable to 'push aside' adjacent schistosity during their growth (Spry, 1969, p. 149) seems to have forced him into a rigid application of so-called textural criteria 'established in the literature'. Our present knowledge of crystal growth mechanisms during metamorphism, and of rock deformation in general, is far too inadequate to allow such inflexibility. We must constantly be prepared to revise, or even abandon, the 'established criteria' as new textural patterns and relationships are described, or new theoretical arguments are developed. The textural pattern under discussion is in the former category, and there seems little point in interpreting rock textures using established criteria if, in doing so, some new textural feature has to be ignored. In the latter category, Yardley (1974) has argued that Spry's theoretical objection is also invalid.

It remains to be seen whether our interpretation of this unusual inclusion geometry survives rigorous criticism. Any alternative interpretation must explain, in particular, why the inclusion geometry mimics the external shape of the porphyroblasts (Harvey and Ferguson, 1973, fig. 4 and p. 87). We hope that this discussion will re-focus attention in this direction.

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