SHORT COMMUNICATIONS

MINERALOGICAL MAGAZINE, SEPTEMBER 1976, VOL. 40, PP. 787–8

Porphyroblastesis and displacement: some new textural criteria from pelitic hornfels—a comment

SAGGERSON (1974) has described the deflection of matrix S-surfaces around porphyroblasts in a hornfels from near Penge, Transvaal. He has interpreted these microstructures as being due to replacement and displacement of the matrix by the growing porphyroblasts. He has also reported an order of crystallization of the porphyroblastic minerals. We present alternative explanations for both these aspects.

Displacement versus deformation: (1) Saggerson has assumed that no deformation resulted either from the 'regional tilting and local disturbances associated with faulting' (Saggerson, 1974, p. 793), or from the thermal metamorphism itself. A small bulk strain (as little as 1 %) involving elongation in the direction of the original sedimentary lamination could produce much higher strains around local heterogeneities, such as porphyroblasts, porphyroblast coigns (p. 795), and areas between two close porphyroblasts (pp. 795, 796). The existence of such a small bulk strain would be difficult to disprove, and could explain all the deflection microstructures observed. Saggerson argued that the matrix deflections around porphyroblasts are not tectonic because 'disturbance is rarely symmetrical and not necessarily in the same sense' (p. 795). However, this argument assumes a simple relationship between external forces and microscopic strains—a most unlikely situation in such heterogeneous rocks.

(2) Even if no bulk deformation of the rock has been imposed externally, two internal processes may lead to local strains: volume changes between solid reactants and products in the porphyroblast-producing reactions; and bulk volume change due to thermal expansion of the metamorphic aureole as it was heated to a higher temperature than the confining rocks further away from the intrusion; if relaxation of this expansion were not equal in all directions, internal deformation may have resulted.

(3) Regardless of the possible deformation effects mentioned in (1) and (2) above, Saggerson's observations and photomicrographs can be used to argue strongly against the displacement hypothesis. The fact that generally S_i inclusion trails remain undeflected (indicating growth by replacement of the matrix), whereas S_e may be deflected, demonstrates that S-surfaces were not displaced during the growth of most of the porphyroblasts. Whatever mechanism produced the deflections operated after growth was largely complete. This is inconsistent with the displacement hypothesis, but consistent with deformation moulding the matrix around local heterogeneities, namely porphyroblasts.

Order of crystallization: The reported 'existence of a recognizable sequence of crystallization (cordierite–biotite–staurolite–biotite–chloritoid)' (Saggerson, 1974,

p. 793) appears to be based on the usual criteria of moulding, inclusion, and partial inclusion of one mineral by another, although these criteria are inadequate for establishing an order of crystallization (Shand, 1950, pp. 105–16). They can tell us only about the relative order of *conclusion* of crystallization, not its initiation. This principle applies to both igneous and metamorphic rocks. For example, a porphyroblast and all its inclusions may have nucleated at the same time; whereas the included minerals formed many stable nuclei, the porphyroblast mineral formed only one, and grew much faster than the other grains, thus enclosing them. Similarly, the occurrence of mineral A moulded on mineral B tells us only either that A finished crystallizing after B (they could have nucleated synchronously), or that both minerals finished crystallizing together on impingement, B retaining a relatively stable crystal form against A (cf. Kretz, 1966). Mutual inclusion and partial inclusion of several minerals of a compatible metamorphic assemblage (e.g. Harte and Johnson, 1969; Vernon, 1968) show that variable nucleation sites, coupled with variable growth-rates, can lead to contrasting inclusion and moulding relationships, where all grains are growing at the same time. Simultaneous growth of metamorphic minerals, rather than an order of crystallization, avoids the necessity for repeated metasomatic events to account for the unique appearance of a mineral of chemical composition radically different from the bulk of the rock (Carmichael, 1969).

School of Earth Sciences, Macquarie University R. H. VERNON
North Ryde (Sydney), N.S.W. 2113, Australia C. MCA. POWELL

REFERENCES

CARMICHAEL (D. M.), 1969. *Contr. Min. Petr.* **20**, 244–67.
HARTE (B.) and JOHNSON (M. R. W.), 1969. *Scottish Journ. Geol.* **5**, 54–80.
KRETZ (R.), 1966. *Journ. Petrology*, **7**, 68–94.
SAGGERSON (E. P.), 1974. *Min. Mag.* **39**, 793–7.
SHAND (S. J.), 1950. *Eruptive Rocks*. London (Murby).
VERNON (R. H.), 1968. *Journ. Petrology*, **9**, 1–22.

[*Manuscript received 11 April 1975*]

MINERALOGICAL MAGAZINE, SEPTEMBER 1976, VOL. 40, PP. 788–90

Ortho- and clino-pyroxenes from the granulites of Namakkal, Tamil Nadu (Madras), India

CHEMICAL analyses of fourteen pyroxenes from pyroxene granulites and pyroxenites suggest equilibrium conditions were attained at about 650 °C in this part of India.

Namakkal (78° 10′ E., 12° 50′ N.) lies in the Taluk of Salem District, Tamil Nadu (formerly Madras) and contains granulites intruded by pyroxenites containing two