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## THE PROPORTIONALITY OF QUARTZ IN MYRMEKITE: A CONTRIBUTION TO THE DISCUSSION

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Shelley's (1969) discussion of Phillips and Ransom's (1968) note on myrmekite formation is to significant extent concerned with my reply (Hubbard 1967a) to Garg's (1967) criticism of my paper on myrmekite development in Nigerian charnockites (Hubbard 1966).

The proposition I made in reply to Garg, that the exsolution of vein perthite/myrmekite and film perthite is distinct in time, mechanism and products, was discussed in some detail in a later paper which attempted to develop a theoretical model for exsolution myrmekite growth (Hubbard 1967b, the "forthcoming paper" of Hubbard 1967a, p. 921). In this model, vein perthite and myrmekite are envisaged as parallel phenomena both produced in an early exsolution involving nucleation at preferred sites, loci of lattice disarray. A close association of solute and vacancies is predicted in ternary alkalic feldspars. This exerts two conflicting controls on solute diffusion, the high probability of vacant neighbouring sites facilitates diffusion but the Johnson effect, the tendency for a vacancy to linger in the vicinity of the solute, tends to reduce the rate of diffusion. Due to the combined action of these, a vacancy concentration in excess of the thermodynamic equilibrium level might be expected to be retained in a cooling crystal in parts remote from vacancy sinks whilst essentially vacancy-free zones would develop around the annihilation loci. A parallel pattern would, by association, be imposed on the solute distribution, *i.e.* a diffuse distribution of solute in the remote zones and a concentration of solute around vacancy sinks. It is at this stage that I consider exsolution of plagioclase accompanied by quartz to take place at lattice disarray sites by the breakdown of "Schwanke's molecule"; to form vein perthite with quartz at internal lattice disarray sites and, given suitable foundation conditions, myrmekite at the crystal periphery. The disperse solute remote from the sphere of influence of these early nucleation sites must, as cooling continues and supersaturation increases, be precipitated without benefit of preferred nucleation sites. I have proposed that this exsolution takes place by a process akin to precipitation hardening in alloys, the initial stage of which involves a clustering of the solute ions to form domains coherent with the overall lattice. Such aggregation would foster substitutional and hence positional ordering with the result that, when the domains break away from the matrix lattice to form discreet

crystalline phases, platelets of "normal plagioclase" without accompanying quartz would be expected. A detailed discussion is given in Hubbard (1967b), p. 416-417.

My Figure 1 (1966) is interpreted by Shelley, following the theory of an exsolution origin for vein perthite, as indicating *initial* compositional inhomogeneity. I should interpret it rather as giving an indication of the distribution of the solute in the anion framework after the early exsolution phase of vein perthite formation. The zone devoid of film perthite around the vein perthite/quartz aggregate indicates the zone of attractive influence of the vacancy sink, now delimited by the vein perthite, on the solute/vacancies. The areas now characterised by film perthite are the zones outside the sphere of influence of the early nucleation sites where the domain type of precipitation operated. After completion of the initial exsolution, solute distribution will be inhomogeneous, the early precipitates being adjoined by solvent structure zones largely or completely exhausted of solute.

My studies of the petrographic features of perthite and myrmekite indicate that, once formed, they are very prone to component redistribution when subjected to stress. One result of this is a tendency to separation of the components of myrmekite, completely or partly, to form discrete quartz and plagioclase grains in the intergranular zone. My statement, quoted out of context by Shelley, that the proportion of quartz to plagioclase is low in some intergrowths, was made in description of deformed examples where postformational redistribution of components in both perthite (vein *and* film) and myrmekite is clearly displayed.

## REFERENCES

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