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THE PROPORTIONALITY OF QUARTZ IN MYRMEKITE: A DISCUSSION

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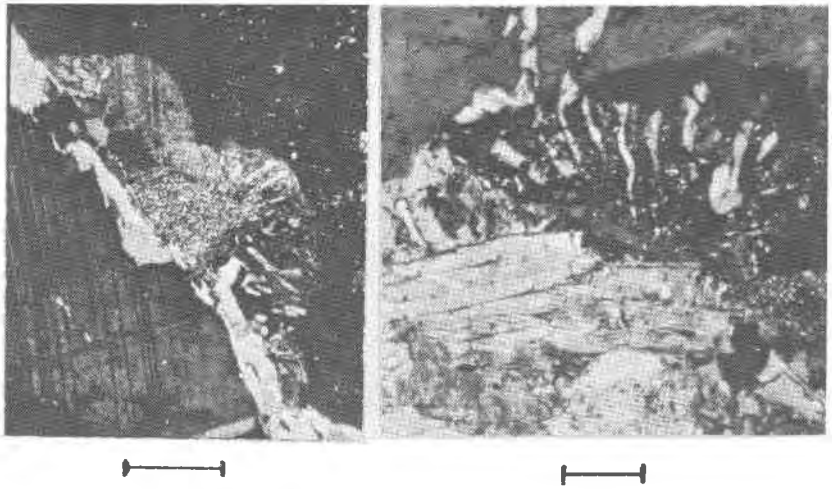
In a recent note, Phillips and Ransom (1968) state that in some gneisses from Broken Hill, New South Wales, there is a correlation between measured volume percentages of quartz in myrmekite and those predicted by Schwantke's (1909) exsolution hypothesis. It is, however, surprising that Phillips and Ransom do not discuss the errors involved in arriving at their results since the difficulties in measuring the volume of vermicular bodies of quartz in plagioclase are great. Even the coarse vermicules from Broken Hill have a diameter of only $\frac{1}{3}$–$\frac{2}{3}$ the thickness of a normal thin section and a simple measurement of two dimensional area will not represent three-dimensional volume. The best measurements would be obtained from myrmekites in which the quartz vermicules are seen in cross section, but this situation is rarely, if ever, attained over large areas and involves an additional error when the vermicules are differentially concentrated in radiating bundles.

The absence of quantitative data on quartz proportionality in myrmekite is due in part to these difficulties but also to the lack of consistent proportionality in many examples which makes measurement pointless. Statements noting this lack of consistency have been made previously (Shelley, 1966, 1967) but without citing any specific examples; the two following figures are now presented in their support. The examples are from the Constant Gneiss (Bowen, 1964), New Zealand, but similar features can be described from granitic rocks in Scotland, England or France. Figure 1 (a) illustrates a twinned and altered myrmekite showing plug-like forms towards alkali-feldspar. It is clear that a large area of the plagioclase, which is unzoned calcic-oligoclase, completely lacks quartz. Figure 1(b) illustrates an early growth of myrmekitic sodic-oligoclase that was altered and corroded leaving projecting vermicules (on the right); a later plagioclase growth of identical composition includes the old projecting vermicules but contains no new quartz.

Much of the literature purporting to show proportionality of quartz to plagioclase actually illustrates that inconsistencies occur. For example Garg (1967), in a discussion in support of Shelley's hypothesis of myrmekite formation (1964), pointed out that perthite is not always quartz-bearing, and although Hubbard (1967) replied that film perthite is exsolved at a later date than myrmekite, it is not made clear why this later perthite does not contain Schwantke's molecule. Further, Figure 1



(a) (b)

FIG. 1 (a). Explanation in text. Scale mark represents 0.2 mm. (b) altered and corroded myrmekite overgrown by non-myrmekitic plagioclase (black). Alkalifeldspar is grey and at the top of the figure. Scale mark represents 0.1 mm.

of Hubbard (1966) seems to require an initially irregular distribution of the molecule in the alkali-feldspar; the alkali-feldspar in the vicinity of the vein perthite would have contained the molecule whereas the remaining alkali-feldspar which exsolved its plagioclase as film perthite would not. Also, although Hubbard (1966, p. 772) claims that the ratio is fixed, he indicates that there are exceptions when he states (p. 771) that the proportion of quartz to plagioclase is low.

Lack of proportionality of quartz to plagioclase seriously weakens Schwantke's hypothesis. I would suggest that the amount of quartz in myrmekite is more truly related to speed of growth of the plagioclase, the amount of quartz available at the growth site and its state of readiness to recrystallize.

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THE PROPORTIONALITY OF QUARTZ IN MYRMEKITE: A REPLY

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We read Shelley's discussion with interest and welcome the opportunity to elaborate further on our rather concise note (Phillips and Ransom, 1968). There are undoubtedly many difficulties inherent in an attempt to measure quantitatively the amount of quartz in myrmekite and the errors involved require consideration.

Our method was based essentially on the measurement of an areal representation (*i.e.* a planar surface) of the quartz and plagioclase in myrmekite colonies. The random selection of gridded squares on random thin-section cuts should have provided a reasonable representation of the areal intergrowths considered, but such a method does not provide for *calculation* of a statistical error. The method that would allow for such a calculation—the point count method—is of doubtful use because possible repeat distances between the quartz and plagioclase are difficult to determine and the chance correlation between, say, a quartz repeat distance and a point count unit would introduce large errors. However, Thomson (1930) compared a method similar to ours with other lineal and areal techniques of microscopic analysis and showed that empirically derived deviations were small, being less than 2 percent.

As far as we are aware our method is not affected by the thickness of a thin section, since we were attempting to measure the relationship between the quartz and plagioclase on a surface without thickness, *e.g.*, the top of a thin-section. As long as random orientations are obtained (and this is unavoidable if a large number of intergrowths are measured) there can be no preference for "cross sections" or "longitudinal sections" of the quartz. Of course, the main problem is to establish if measurement is in fact being made at a surface. Our first step in attempting to ensure this condition was to reject intergrowths with diffuse grain boundaries, the assumption being that the intergrowth did not impinge on the surface on which we were making our measurements. In the final analysis then we were forced to make an observational choice and this, we acknowledge, may be the source