CORRESPONDENCE

Petrographic evidence bearing on plate tectonics of the Upper Ordovician Welsh Basin

SIR – Over the past few years there has been a resurgence of interest in greywacke sandstone petrography but now within a plate tectonics context. Following the lead of Dickinson (1970) a comprehensive set of criteria is now developed and is being applied to ancient and modern sands, for example Dickinson, Helmold & Stein (1979), Moore (1979) and Ingersoll & Suzcek (1979). The following data may hence be of interest to workers in the British Caledonides where plate tectonic models are increasingly applied, for example Phillips, Stillman & Murphy (1976).

The Ashgill greywackes of the Central Wales inliers previously described by the writer (James, 1971) provided an extensive data base from which modern petrographic diagrams for framework composition have been made. Although methods of analysis were not identical to those now current (i.e. counting only medium sand grains), consideration of 106 size-frequency analyses made by the grid-by-number method and hence compatible with sieve analysis (Kellerhals, Shaw & Arora, 1975) has allowed the selection of 46 relatively well-sorted samples in which the framework grains have an average grainsize of medium sand grade. Hence a general quantitative comparison with the work cited above appears well founded. The four triangular plots for the Plynlimon Group as a whole are presented in Figure 1. Separate plotting of samples from the constituent Formations of the Group revealed no appreciable differences between them.

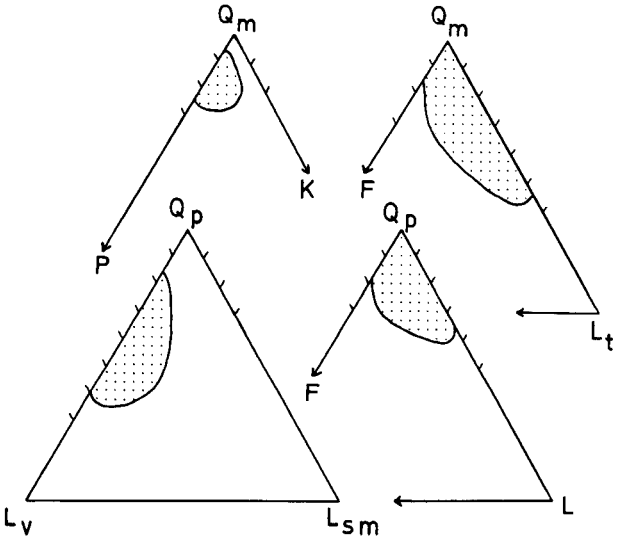

Figure 1. Triangular plots showing fields of various grain parameters. Q, total quartz; Q_m, monocrystalline quartz; Q_p, polycrystalline quartz including chert; F, total feldspar; P, plagioclase; K, potassium feldspar; L_v, volcanic-hypabyssal lithics; L_{sm}, sedimentary (s) and metamorphic (m) lithics:
$Q = Q_m + Q_p$, $L = L_v + L_{sm}$, $L_t = L + Q_p$, $F = P + K$.
Bar divisions are of 10%.

The QFL and Q_mFL_t plots indicate the importance of recycled sediment and of cratonic influence (Dickinson *et al.* 1979) combined with volcanic arc influence (Moore, 1979). The $Q_pL_vL_{sm}$ plot and detailed subdivision of the L pole (L_s = 28%, L_v = 69% and L_m = 3%) indicates affinity to mixed magmatic arc/rifted continental margin conditions such as may exist in back-arc basins (Ingersoll & Suzcek, 1979).

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A similar conclusion can be made when applying the petrographic criteria of Potter (1978). The P/F ratio scatters about 0.7, lower than for a typical volcanic source terrane and reminiscent of suture belts with granitic influence (Ingersoll & Suzcek, 1979, p. 1223). Not apparent from the triangular plots is the degree of polycrystallinity and undulatory extinction of the quartz. According to recent criteria (Basu *et al.* 1975, p. 879; Young, 1976) the Ashgill greywackes have a large contribution of quartz from low-rank metamorphic terranes if the quartz diaognosis is not complicated by post-Ordovician tectonic strain effects.

The broad conclusion of a 'back-arc' basin environment of derivation for these greywackes seems entirely reasonable (cf. Mitchell & Reading, 1971). The high ratio (approx 9:1) of acid or acid/intermediate volcanic and hypabyssal material as opposed to basic or intermediate/basic volcanic material may indicate the arc to have been compressional (Dewey, 1980) in the upper Ordovician. Subsequent greywackes in Central Wales with a more southerly than easterly derivation operating by the late Llandovery may be even more quartzose than the Ashgill (Okada, 1966), indicating a diminution of arc influence.

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