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Thermobarometry of metamorphic xenoliths from the Scottish Midland Valley: samples from the lower and middle crust?

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Thermobarometry calculations have been carried out on felsic xenoliths from the Scottish Midland Valley, which represents a volcanic arc-and fore-arc system, developed in the Iapetus ocean during the Caledonian Orogeny. These xenoliths have been carried to the surface by Carboniferous volcanism, though they are believed to represent the present-day lower crust.

Three types of felsic xenolith were identified based on their mineralogy: a garnet-sillimanite-bearing "type 1" xenolith [Grt +Qtz +Pl +Kfs +Sil +Bt +Rt +Zc $\pm$Ap] yields a temperature of c. 630 $^{\circ}$C and a pressure of c. 6 kbar (c. 16 km crustal depth, middle crust); garnet-bearing "type 2" xenoliths [Grt +Qtz +Pl $\pm$Kfs $\pm$Bt +Rt +Zc $\pm$Ap] yield a range of values from 730-840 $^{\circ}$C and 7-11 kbar (20-35 km crustal depth, lower crust). The mineral assemblage of the garnet-free "type 3" xenoliths [Pl +Qtz $\pm$Kfs $\pm$Bt $\pm$Rt +Zc] is unsuitable for thermobarometry.

From the LISPB seismic profile, the upper crust of the Midland Valley is underlain by middle ($V_p > 6.4$ km/s, 8-14 km) and lower crustal ($V_p > 7$ km/s; 14-35 km) layers, which broadly correspond to the type 1 and 2 xenolith populations respectively. Seismic velocities were calculated from mineral modes to test the assumption that the xenoliths were entrained from the depths indicated by the calculated pressures. Though mineral modes are compromised by alteration, small sample size and lack of correspondence with actual mineral compositions, the calculations led to reasonably

good, preliminary result: The type 1 and 2 samples both fall within the same V_p range (V_p = 6.31-6.63 km/s), which, within error, correspond to the middle crustal layer, suggesting that the xenoliths represent material from at least middle crustal depths.