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Constraints on crustal structure and composition within a continental suture zone from shear-wave wide-angle reflection data and lower crustal xenoliths: a case study from SW Ireland

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Shear wave seismic velocities (V_s) when used together with compressional wave velocities (V_p) are a powerful diagnostic of the chemical composition and mineralogy of the continental lithosphere. In this paper we present whole crustal models of V_s and V_p velocities from two wide-angle seismic profiles from southwest Ireland, which straddle the Eastern Avalonian Terrane within the Iapetus Suture Zone. These models are based on travel-time interpretations of primary and reflected P and S-wave seismic phases generated by explosive underwater sources. The quality of the shear wave data is exceptional when compared to similar data sets recorded elsewhere and allows the distribution of Poisson's ratio (σ) within the entire crust to be accurately determined. Poisson's ratio together with $V_p$and $V_s$is used to derive crustal chemistry and mineralogy at various depths down to the Moho (*ca* 32 km depth) using published laboratory velocity measurements from rocks of different metamorphic grades and chemistry. The results indicate that the Irish crust in this region of the Caledonian orogenic belt is unusually felsic in bulk composition with a σ value of 0.258, which is below the global average value of 0.265. Variations in σ within the upper c. 5 km of crust are greatest (0.20 – 0.28) and can be correlated with siliciclastic and carbonate sediments in Devonian and Carboniferous extensional sedimentary basins that were formed dur-

ing the early part of the Variscan orogenic cycle. The typically more uniform variation in the mid crust down to 15 km depth is consistent with a granite/granodiorite or metagreywacke composition of greenschist to amphibolite facies mineralogy. Within the lower crust the value of σ (0.257 - 0.265) is significantly less than the global mean value of 0.281 predicted from an average crustal petrology model. This suggests a bulk silica content (%SiO_2) of $\sim$64% for the lower crust, based on an empirical relationship between σ and %SiO_2, determined from compilations of laboratory data. These results are consistent with petrophysical, geochemical and petrological data from an unusually well preserved lower crustal xenolith suite from the Irish Midlands, hosted in early Carboniferous volcanic rocks. The xenoliths (mainly partially-melted granulite facies metapelites) evidently represent the bulk composition of the lower crust, which was largely derived by accretion of sedimentary material, derived from oceanic, island arc and continental margin sources, during oblique Caledonian collision.