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Partial melting of the mid-lower continental crust of the Alborán domain -western Mediterranean- during the Neogene

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The volcanics of the Neogene Volcanic Province of SE Spain attest for the partial melting of the continental lithosphere in the Alborán domain (western Mediterranean) during the Neogene. Petrologic and geochemical studies indicate that melts have been derived both from the mantle and the continental crust. Geophysical, structural, metamorphic, and geochronologic data indicate that melting took place during and, especially, after thinning of the lithosphere and upraising of the astenospheric mantle, and that melting of the crust occurred during isobaring heating. We have studied in detail the major element chemistry of melts generated within the middle-lower crust during this event by SEM and EMP analysis of silicate glass present in crustal xenoliths within the El Hoyazo dacites, either as glass inclusions in a suite of mineral phases or as matrix glass. Furthermore, Sr and Nd isotope analyses have been performed on silicate glass, mineral separates, whole-rock xenolith, and the host dacite. Previous petrologic studies indicate that the glass represents former silicate melt produced during partial melting of the xenoliths at c. 800-850^{o}C and 5-7 kbar, and quenched upon rapid ascent and extrusion. EMP analyses conducted in five different xenoliths indicate that the glass is granitic s.s., mostly homogenous, high in SiO_2 ($\approx$ 71-75 wt %) and K_2O ($\approx$ 4.0-5.5 wt %), low in FeO_t ($\approx$ 1.0-1.7 wt %), MgO ($\approx$ 0.0-0.2 wt %), CaO ($\approx$ 0.1-1.0 wt %) and H_2O ($\approx$ 0-5 wt %, calculated by difference), with moderate to high ASI values ($\approx$ 1.10-1.35). The glass in each textural position, however, presents a particular chemical signature independently of the host xenolith. Glass included in ilmenite is characterized by the highest FeO_t and TiO_2 concentrations. Glass in ilmenite and cordierite is nominally anhydrous, whereas glass in plagioclase and in the matrix presents the highest H_2O concentrations and ASI values. Glass within garnet has intermediate H_2O contents. Glass in garnet and cordierite has virtually no MgO. In general, glass is more evolved in the order: Ilm $<$ matrix $<$ Grt $<$ Pl. Preliminary analysis suggests that these differences may reflect the evolution of melt composition during the prograde partial melting of the xenoliths, though post-entrapment modification of the liquid/glass might have played also a role. Regarding the isotopic analyses, initial $^{87}Sr/^{86}Sr$ of glass in the matrix (0.7298) is lower than that of whole-rock xenolith (0.7309), indicating that some minerals did not completely re-equilibrated their Sr isotope composition during the high-T event that melted the crust. Preliminary data provide evidence for the occurrence of unradiogenic ($^{87}Sr/^{86}Sr \approx 0.713$) accessory phases (e.g. apatite) enclosed in garnet and biotite that escaped Sr isotope re-equilibration, thus providing the source of unradiogenic Sr during melting. These data represent the first report on the precise composition of crustal anatectic melts from the study of natural samples, and can help modelling the late magmatic evolution of continental collisional zones. They are helpful as well to constrain the geodynamic evolution of the Betic Cordilleras.