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Essential ingredients in the crustal differentiation recipe: from nanogranites to granites

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Granites are the ultimate product of crustal maturation, consequently understanding their origin is crucial to evaluate how the continental crust forms and differentiates. Among S-, I-, and A-type granites, the latter are the most debated in terms of source, in particular, metasedimentary origin is generally discarded. Here, by adopting an in-source perspective, rather than focusing on the final product (granite), the composition of melts produced by the hottest continental metasedimentary crust and their link to granites is investigated. Pristine melt inclusions (MI) from a residual metapelitic ultrahigh temperature (UHT) granulite from East Antarctica show a weakly peraluminous to weakly peralkaline affinity, ferroan character, high silica and alkali contents, high K/Na and Ga/Al, and low Ca, Ba, Sr, and H_2O concentrations. These features are akin to many felsic A-type granites from the literature. Coexistence of sapphirine + quartz coupled with phase equilibria calculations and Zr-in-rutile thermometry indicate that MI represent UHT melts formed at peak conditions (930–1000 °C) from a residual metapelitic source. Geochemical modelling indicates that MI can either be primary melts of the most felsic A-type granites or a suitable crustal melt component for a hybrid origin. This study reveals therefore the missing link between A-type granites and the hottest metasedimentary crust, providing a more complete picture of processes responsible for granite formation. These new results show that a larger variety of granites must be considered in models on the effects of UHT anatexis on crustal differentiation and suggest that voluminous amounts of A-type granites can be produced by large, residual UHT terranes.