Early Palaeoproterozoic secular magmatic evolution and crustal growth: insights from trace element analyses in accessory phases

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Trace element analyses in zircon, apatite and titanite from igneous rocks have become a powerful tool in understanding the evolutionary trends of the continental crust, not always demonstrated by whole-rock signature or unambiguously discriminated by isotopes. A pivotal magmatic evolution in the geological record is the transition from tonalite-throndhjemite-granodiorite (TTG) to sanukitoid magmas. This global evolution marks recycling of early altered mafic crust deep into the mantle associated with the generation of the continental crust. Eclogites are the restite of such TTG generation and increase the density of the shallowly subducting mafic plate, which likely caused the opening of mantle wedges. The interaction of similar TTG-like melts with an overlying metasomatised mantle wedge, generates high Ba-Sr magmas with elevated Mg#, Cr and Ni: the sanukitoid series. The Mineiro Belt, Brazil is composed of many plutonic bodies ranging in age from 2.47 to 2.1 Ga. Within these, high-Al garnet-bearing 2.35 Ga TTG are followed by 2.13 Ga sanukitoids and associated plutonic rocks (high Ba-Sr and hybrid magmas). The general increase of $\delta^{18}O$ and decrease of $\varepsilon Hf_{(t)}$ values in zircon grains from these plutons argues for a continuous process of supracrustal reworking into the mantle and subsequent extraction of magmas. The hallmarks of this evolution are represented by recycling of oceanic crust, sediment contamination in magmas and continental growth during the Palaeoproterozoic. Trace element analyses of accessory phases from these plutonic rocks by EPMA and LA-ICP-MS reflect the composition of the magmas from which they crystallised and can be used as proxies defining sources, mixing of magmas and recycling of the crust. Subtle but important changes in their trace element chemistry provide a fuller picture of petrogenesis and thus a much-needed window into tectonic processes, crustal growth and recycling in the early Palaeoproterozoic.

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