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Petrogenesis of a new type of subduction zone granitoid from the Samail ophiolite

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Granitoids with evolved chemical signatures, intrusive to both peridotite and mafic rocks, are well known in the Samail supra-subduction ophiolite of Oman and United Arab Emirates. In this study, major and trace element geochemical data from granitoid intrusions in the mafic ocean crust and mantle section of the ophiolite are used to investigate their origin and better constrain the relative contributions of sedimentary and mantle-derived sources to the range of melt compositions observed. The mantle-hosted granitoids are magnesian, calcic to calc-alkaline, and peraluminous, sharing similarities with cordierite- and muscovite-bearing peraluminous granitoids with enriched mid-ocean ridge basalt (MORB) like affinity. Most mantle-hosted granitoids are well-described by mixing between amphibolite and sedimentary melts, with undetectable to minor mantle contribution. The mantle-hosted granitoids mostly closely resemble peraluminous S-type granites (e.g., Himalaya, Variscan, Lachlan) but have relatively higher silica, and lower alumina and mafic components (Al_2O_3+FeO+MgO+TiO_2), Rb/Sr, Ba, Th/Nd, and Th/Yb contents. The mantle-hosted granitoids have an origin exclusively associated with the subducted slab and intruded peridotite below the MohorovicÌŒicÌ discontinuity, and no apparent interactions with the overriding oceanic plate/mantle wedge. In contrast, the crust-hosted granitoids are predominantly ferroan, calcic, and metaluminous, resembling trondhjemites and ridge 'tholeiitic' granitoids with MORB-like affinity formed by fractionation of mafic melt under fluid-present conditions from slab dehydration and partial melting of mafic rocks. We hypothesize that the crust-hosted granitoids have a similar origin to trondhjemites in other ophiolite settings (e.g., Troodos ophiolite) with a subduction-modified MORB source, while the mantle-hosted granitoids appear not to be represented in existing granite paradigms.