# Phase equilibria and trace element modelling of sanukitoid melts

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Sanukitoids are Mg-rich, Late Archaean granitoids, which are interpreted to have formed by the interaction of crustal and mantle melts possibly in a subduction zone setting. Geochemically and chronologically they seem to represent the transition between the tonalite-trondhjemite-granodiorite series rocks predominant in the Archaean and the modern-style, subduction-related magmatic suites. Studying their formation conditions can therefore provide important insights into the geodynamic processes shaping the cratonic crust in the Late Archaean.

We present a combination of phase equilibria and trace element modelling to study the melting conditions and protolith sources, which best reproduce the characteristic major and trace element concentrations of sanukitoid melts (high Mg#, V, Cr and Ni but enriched in LILE). After comparing our model to results from experiments for validation, we explore the formation conditions and melt sources for sanukitoids of two localities: the Amazonian craton and the Superior Province. Mixtures of 70% crustal melt (TTG) and 30% relatively undepleted peridotite are most favourable to reproduce major and trace element characteristics of granodioritic sanukitoids (62-67 wt.% $SiO_2$). The P-T conditions of melting vary significantly with the composition of the crust-mantle mixture but range within 1100-1250 °C and 2.0-3.2 GPa generating relatively high melt fractions between 50-65%. Less differentiated sanukitoid melts (49-53 wt.% $SiO_2$) can result from either 50/50 or 70/30 crust-mantle mixtures, depending strongly on the composition of the TTG source. The addition of small proportions of carbonatite can account for the elevated concentrations of Ba, Sr, P, Eu and LREE in most sanukitoids of the Superior Province.

In contrast to mere trace element models where the degree of melting and the P-T conditions are poorly constrained, the combination with phase equilibria calculations allows for a better-defined model that is consistent with formation conditions in the subcratonic lithospheric mantle or possibly a mantle wedge.