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Hydrous partial melting of natural oceanic plateau basalt under varying P-T pathways: Experimental constraints on formation of TTG-like magmas.

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Earth's oldest preserved continental crust is composed of 4 billion year old tonalites, trondhjemites and granodiorites (TTGs). It is widely accepted that TTG formed through partial melting of hydrated metamorphosed basalt. However, there is still no consensus on the tectonic mechanism that formed these rocks, and a variety of intraplate (e.g. partial melting the base of thick oceanic lithosphere, crustal overturns, sagduction etc.) and plate tectonic-like (e.g. underthrusting of one thick oceanic plate under another) models have been proposed.

Thermodynamic models provide insight into the potential source regions of TTG. However, the phase relations, and therefore partial melting conditions these models predict, require ground truths from high-pressure, high-temperature experiments. We present new partial melting experiments on a natural Icelandic basalt. Iceland has often been suggested as a modern-day analogue to the Archaean, due to the thick basaltic crust (15-35km), high geothermal gradients, and the relative abundance of plutonic silicic rocks (~10%) for an oceanic island. The Icelandic composition selected is a natural tholeiitic basalt, found in close association with silicic plutonic rocks in SE Iceland. To test intraplate vs subduction pathways of partial melting we present experiments at 0.5-1.8GPa, which extend to the maximum pressures (1-1.4GPa) possible in an intraplate setting, and beyond that (1.4-1.8GPa), requiring an alternate process such as subduction or dripduction. We discuss the major and trace element composition of the partial melt fraction and resultant residual mineralogies in relation to key features observed in natural TTGs and silicic Icelandic plutons.