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The troublesome petrogenesis of Archean TTG magmas: current understanding and future directions

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The Archean (4.0–2.5 Ga) Earth's continental crust is volumetrically dominated by metamorphosed granitoids of tonalite-trondhjemite-granodiorite (TTG) composition. Despite decades of study, there remain several key questions concerning the genesis of TTG gneisses [1]; most importantly, debate revolves around (i) whether these TTG gneisses formed via plate tectonic-like processes or non-uniformitarianistic mechanisms, and (ii) whether they represent primary melts derived from mafic precursors or whether they have chemically evolved during migration from their source, for example via fractional crystallization or hybridization of multiple melt fractions. Here, I briefly review the current understanding of both major questions noted above, and discuss two recent studies that shed light on the issues. First, I show how the novel geochemical tracer Ba can be used to track the changing geodynamic environment in which TTG magmas formed through time, allowing the timing of subduction initiation to be determined on a craton-by-craton basis [2]. Second, I discuss how the geochemistry of discrete TTG melt fractions may evolve during ascent through the crust due to magma mixing, leading to obfuscation of primary signatures [3]. Promising avenues of research that may advance our understanding of these issues are also presented.

[1] Palin & Santosh (2021), *Gondwana Research* 100, 3-24.

[2] Huang, Mitchell, Palin, Spencer & Guo (2022), *Nature Communications* 13, 6553.

[3] Hernández-Montenegro, Palin, Zuluaga & Hernández-Uribe (2021) *Scientific Reports* 11, 1-9.