Constraints on P-T conditions of TTG suite formation

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TTG formation conditions are not well constrained as their source lithologies are ambiguous. To produce TTG multi element patterns at melting degrees greater 20% a source enriched in LILE is necessary. Lower degree melting cannot account for their common occurrence in Archean cratons and the lack of large volumes of restites. Further requirements are the presence of a garnet signature and a low K_2O concentration.

One tool to resolve depth and temperature of TTG melt formation is combining liquidus studies with melting experiments on potential mafic source rock compositions to match abundance and composition of liquidus phases with restite mineralogies [1]. Striking uncertainty in this approach is not knowing the amount of water involved in melting as it has significant implications on solidus and liquidus paths, residual mineral proportions and their composition. An independent way to constrain formation conditions of TTG-magmas is to use Titanium solubility which is controlled by temperature, melt composition and pressure. This method reveals a minimum melt formation temperature, but if Ti is not buffered by a Ti-excess-phase during melting, maximum solubility is not reached, and estimated temperatures will be too low. Also, the method is susceptible to fractionation, with Ti phases removed from the melt again resulting in lower temperature estimates.

TTGs form a narrow trend between Ti and SiO_2, which suggests cotectic control. With the combination of forward and reverse melting experiments, as well as titanium solubility experiments, we have investigated the melt formation using samples from the Nuvvuagittuq belt [2,3]. The study also includes a newly calibrated Ti thermometer based on an extended experimental database.

[1] Wyllie et al. (1997), *Oxford monographs on geology and geophysics 35*, 256-266. [2] O'Neil (2012), *Precambrian Research 220*, 23-44. [3] Adam et al. (2012), *Geology 40(4)*, 363-366.