Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15507

Serpentine dehydration and continental crust formation

JÖRG HERMANN[1], RENEE TAMBLYN[1], CARLOS GANADE[2], PROF. DANIELA RUBATTO[1] AND THOMAS PETTKE[1]

[1]University of Bern

[2]Geological Survey of Brazil

Presenting Author: joerg.hermann@geo.unibe.ch

New continental crust is formed above subduction zones, where the dehydration of the subducted slab produces fluids that trigger wet melting in the hot part of the mantle wedge. Serpentinites play a key role in this crust-forming process. Antigorite stability at the top of the slab is confined to the fore-arc and antigorite dehydration in deeper levels of the subducted lithosphere is required for fluid production at sub-arc conditions. In contrast, chlorite dehydration occurs at temperatures 100-150°C higher than antigorite breakdown. Therefore, chlorite-rich rocks at the slab-mantle interface potentially play an important role as a fluid source. The aqueous fluid released from the serpentinties interacts with oceanic crust and sediments within the slab. The efficiency of the extraction and transfer of key incompatible elements from the subducted crust is highly dependent on the top-slab temperature and the nature of the fluid phase. For instance, hydrous melts carry much higher loads of major and trace elements per unit H_2O than supercritical fluids or aqueous fluids.

In general, the amount of new continental crust that forms in arcs scales with the amount of H_2O released from the subducted slab at sub-arc depth. Therefore, the amount and distribution of serpentinite in the slab likely influences the productivity of magma addition to the arc. Serpentinites are particularly abundant in ocean-continent transitions, and thus a flare-up of continental crust production can occur at the time of transition from subduction to continental collision.

Did serpentinites also play a key role in the formation of the tonalite-trondhjemite-granite (TTG) continental crust in the Archean, when subduction was likely shallower and hotter? The most commonly preserved Archean ultramafic rocks are komatiites, which are extensively hydrated and contain antigorite, chlorite and tremolite. During burial of such rocks, most of the water is released by the breakdown of chlorite and tremolite at temperatures between 680 and 800 °C. This released water can induce extensive partial melting of associated basalts to eventually form TTG batholiths.