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The dehydration of slabs in the Early Earth regime and its implications for continental crust composition

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The andesitic nature of the bulk continental crust, as well as its characteristic trace element ratios, have a close resemblance to the differentiated crust of volcanic arcs, thus leading to models for formation of continental crust in subduction zone settings. If the modern processes leading to continental crust formation at convergent margins are well constrained, the extrapolation to early Earth conditions is hazardous, because the composition of Earth's early crust can be achieved through several processes. However, a large part of the Archean continental crust is made of a composite rock assemblage dominated by granitoids belonging to the TTG series (tonalite-trondhejmeite-granodiorite) that show a subduction signature. We modelled Early Earth subduction dynamics by focusing our attention on the fate of water, since it is a component that is essential to the formation of TTG series. The amount and composition of water bearing fluids in a subduction zone is controlled by slab devolatilization process, and influence both the melting regime and the melt composition. To this end, we present thermomechanical numerical models that incorporate internally consistent thermodynamic data in order to simulate slab dehydration. Our goal is to track the course of subducted water in an Archean style subduction regime to better comprehend its modus operandi. We find that in an Early Earth regime slab devolatilization occurs over a larger depth interval while starting and finishing at shallower pressure compared to present-day situation. Importantly, the slab phases nature and proportion in equilibrium with the released fluid are significantly different from nowadays situations. Overall, an early earth subduction zone regime leads to the formation of a much wider arc that is fed with melts forming through significantly different melting conditions and slab fluid chemical input.