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Generation of TTG rocks in the Archean: insight from numerical simulations

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We study the creation of primordial continental crust (TTG rocks) for the first time employing fully self-consistent numerical models of thermochemical convection on a global scale. Starting from a pyrolytic bulk composition and an initially hot core, we first generate oceanic crust and depleted mantle. In our model, the basaltic material is both erupted at the surface and intruded at the base of the crust following a predefined partitioning. Second, we track the pressure-temperature conditions of the newly formed hydrated basalt and check if it matches the conditions necessary for the formation of primordial continental crust. We show that the "heat-pipe" model (assuming 100% eruption and no intrusion) proposed to be the main heat loss mechanism during the Archean epoch (Moore & Webb 2013) is not able to produce continental crust since it forms a cold and thick lithosphere. We systematically test various mechanical properties of the brittle domain (friction coefficients). Using our parameter study, we are also able to show that an intrusion fraction close to 70% (in agreement with [Crisp 1984]) combined with a friction coefficient of 0.2 products the expected amount of the three main petrological TTG compositions previously reported (Moyen 2011). This study represents a major step towards the production of self-consistent convection models able to generate the continental crust of the Earth.

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