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Self-consistent generation of continental crust in global mantle convection models

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Numerical modeling commonly shows that mantle convection and continents have strong feedbacks on each other (Philips and Coltice, JGR 2010; Heron and Lowman, JGR 2014), but the continents are always inserted a priori while basaltic (oceanic) crust is generated self-consistently in such models (Rolf et al., EPSL 2012). We aim to implement self-consistent generation of continental crust in global models of mantle convection using StagYY (Tackley, PEPI 2008).

The silica-rich continental crust appears to have been formed by fractional melting and crystallization in episodes of relatively rapid growth from late Archean to late Proterozoic eras (3-1 Ga) (Hawkesworth & Kemp, Nature 2006). It takes several stages of differentiation to generate continental crust. First, the basaltic magma is extracted from the pyrolitic mantle. Second, it goes through eclogitic transformation and then partially melts to form Na-rich Tonalite-Trondhjemite-Granodiorite (TTG) which rise to form proto-continents (Rudnick, Nature 1995; Herzberg & Rudnick, Lithos 2012).

TTGs dominate the grey gneiss complexes which make up most of the continental crust. Based on the melting conditions proposed by Moyen (Lithos, 2011), we parameterize TTG formation and henceforth, the continental crust. Continental crust can also be destroyed by subduction or delamination. We will investigate continental growth and destruction history in the models spanning the age of the Earth.