

## Archean tectonics and the generation of continental TTG crust in global mantle convection models

P.J. TACKLEY<sup>1\*</sup>, C. JAIN<sup>1</sup>, D. LOURENCO<sup>2</sup>, A.B. ROZEL<sup>1</sup>  
AND T.V. GERYA<sup>1</sup>

<sup>1</sup>Department of Earth Sciences, ETH Zurich, 8092, Switzerland (\*correspondance: ptackley@ethz.ch)

<sup>2</sup>Department of Earth and Planetary Sciences, University of California, Davis, USA

The tectonic mode in the Archean, and when and how continents formed, are two key unresolved questions. Here we investigate these issues using global simulations of Earth evolution from post magma ocean to the present day, including self-consistently calculated production of basaltic oceanic crust and TTG continental crust.

We use the code StagYY [1] in a 2D spherical annulus geometry. The mantle starts with a uniform pyrolytic composition and has an initially hot core. Basaltic crust is formed by partial melting of pyrolytic material, while TTG is formed by partial melting of basalt in certain (P,T) windows [2] in the presence of water. Produced magma is erupted at the surface and intruded into the crust with a ratio that is specified a priori.

After an early overturn of post-magma-ocean-formed crust, we find that the tectonic mode was likely neither modern-day plate tectonics nor a rigid lid, but rather, one characterized by abundant mostly intrusive magmatism resulting in a hot, weak, deformable lithosphere – a “Plutonic Squishy lid” (PSL) [3]. In this mode, a thick basaltic crust is recycled at its base by eclogite drips plus episodic delamination of depleted lithosphere [4].

Abundant TTG crust is produced, with a production rate far exceeding typical continental crustal growth curves [5,6]. At the same time it can also be destroyed by entrainment in downwellings.

These models thus indicate that (i) subduction was not necessary for the production of early continental crust, (ii) intrusive magmatism was dominant during the Archean (as opposed to “heat pipe” extrusive magmatism), and (iii) Archean tectonics was characterised by a weak, hot deformable lithosphere undergoing extensive delamination as well as significant horizontal motion.

[1] Tackley (2008) *PEPI* **171**, 7-18. [2] Moyen (2011) *Lithos* **123**, 21-36. [3] Lourenço *et al.* (2018) *GCubed*, submitted. [4] Sizova *et al.* (2015). *Precamb. Res.* **271**, 198-224. [5] Rozel *et al.* (2017) *Nature* **545**, 332-335. [6] Jain (2018), *PhD Thesis*, ETH Zurich.