Making Earth's continental crust from serpentinite and basalt

A.Y. BORISOVA[1,2]*, N.R. ZAGRTDENOV[1], M.J. TOPLIS [3], W.A BOHRSON [4], A. NEDELEC [1], O.G. SAFONOV [2,5], G.S. POKROVSKI [1], G. CEULENEER[1], O.E. MELNIK [2], A.Y. BYCHKOV[2], A.A. GURENKO [6], S. SHCHEKA [7], A. TEREHIN [5], V. M. POLUKEEV [5], D.A. VARLAMOV [5], S. GOUY [1] AND P. DE PARSEVAL [1]

[1] GET, Univ. de Toulouse, Toulouse, France (*correspondence: anastassia.borisova@get.omp.eu, nail.zagrtdenov@get.omp.eu)
[2] Geological Department, MSU, Moscow, Russia
[3] IRAP, Univ. de Toulouse, Toulouse, France
[4] CWU, Ellensburg, WA, USA
[5] IEM, Chernogolovka, Moscow region, Russia
[6] CRPG, Vandœuvre-lès-Nancy, France
[7] BGI, Univ. of Bayreuth, Bayreuth, Germany

How the Earth's continental crust was formed in the Hadean eon is a subject of considerable debates [1-4]. For example, shallow hydrous peridotites [2,5], in particular the Hadean Earth's serpentinites [6], are potentially important ingredients in the creation of the continental ptoto-crust, but the mechanisms of this formation remain elusive.

In this work, experiments to explore serpentinite-basalt interaction under conditions of the Hadean Earth were conducted. Kinetic runs lasting 0.5 to 48 hours at 0.2 to 1.0 GPa and 1250 to 1300°C reveal dehydration of serpentinite and release of a Si-Al-Na-K-rich aqueous fluid. For the first time, generation of heterogeneous hydrous silicic melts (56 to 67 wt% SiO_2) in response to the fluid-assisted fertilisation and the subsequent partial melting of the dehydrated serpentinite has been discovered. The melts produced at 0.2 GPa have compositions similar to those of the bulk continental crust [2,3]. These new findings imply that the Earth's sialic proto-crust may be generated via fluid-assisted melting of serpentinized peridotite at shallow depths (≤7 km) that do not require plate subduction during the Hadean eon. Shallow serpentinite dehydration and melting may be the principal physico-chemical processes affecting the earliest lithosphere.

[1] Harrison (2009) *Annu. Rev. Earth Planet. Sci.* **37**, 479-505. [2] Rudnick (1995) *Nature*, **378**, 571-578. [3] McDonough & Sun (1995) *Chem. Geol.*, **120**, 223-253. [4] Hawkesworth & Kemp (2006) *Nature* **443**, 811-817. [5] Hirschmann et al. (1998) *GCA* **62**, 883 – 902. [6] Albarede & Blichert-Toft (2007) *C.R. Geoscience* **339**, 917 – 927.