Formation of continental lithosphere by oceanic paleosubductions constrained by 3D seismic anisotropy

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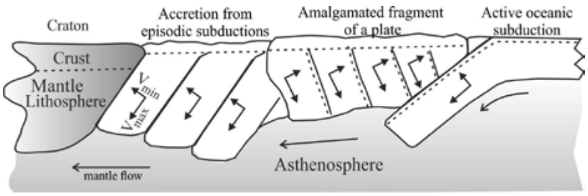
We examined seismic anisotropy of Archean, Proterozoic and Phanerozoic provinces of Europe and modelled fabric of the mantle lithosphere by inverting anisotropic parameters evaluated from traveltime deviations of teleseismic P-waves and shear-wave splitting [1]. Changes in orientation of the large-scale anisotropy, caused by systematic preferred orientation of olivine, identify boundaries of domains of mantle lithosphere with different fabrics. Individual domains show consistent large-scale orientation of anisotropy approximated by hexagonal symmetry with symmetry axes oriented generally in 3D (inclined foliation and/or lineation).



Systematically dipping mantle fabrics and other seismological findings support a model of continental lithosphere built from systems of paleosubductions of ancient oceanic lithosphere [2], or from stacking of the plates [3]. Seismic anisotropy in the oceanic mantle lithosphere, explained mainly by the olivine A- or D-type fabrics [4], was discovered more than a half century ago [5]. Field observations and laboratory experiments indicate the oceanic olivine fabric might be preserved in the subducting lithosphere to a depth of at least 200-300 km. We thus interpret the dipping anisotropic fabrics in domains of the European mantle lithosphere as systems of “frozen” paleosubductions [6]. Petrological models also suggest that the continental mantle lithosphere formed at a hot ocean ridge [7] and a first continental crust originated from melting of hydrated oceanic crust in subduction zones [8].

[1] Plomerova & Babuska (2010) *Lithos* **120**, 131-143. [2] Babuska & Plomerova (1989) *AGU Monograph* **50**, 2009-2017. [3] Helmstaedt & Schulze (1989) *Geol. Soc. Aust. Spec.Publ.* **14**, 358-368. [4] Karato *et al.* (2008*) Annu. Rev. Earth Planet. Sci.* **36**, 59–95. [5] Hess (1964) *Nature* **203**, 629-631. [6] Babuska & Plomerova (2006) *Phys. Earth Planet. Int.* **158**, 264-280. [7] Rollinson (2010) *Geology* **38**, 1083-1086. [8] Nagel et al. (2012) *Geology* **38**, 375-378.