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Solid Earth Discussions

Interactive comment on "Domains of Archean mantle lithosphere deciphered by seismic anisotropy – initial results from the LAPNET array in northern Fennoscandia" *by* J. Plomerová et al.

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General comments

Plomerova et al. present initial results of anisotropy measurements (P-wave and SKS) for northern Fennoscandian based on their well-known method of analysis of relative P-wave delay and 3D SKS-splitting. These initial results are very interesting and reveal a clear separation of distinct anisotropy domains in the northern Fennoscandia lithosphere.

These initial results seem robust enough and deserve publication before the full data set of the LAPNEt array is analysed.

Specific comments

1. The P-wave anomalies and SKS-splitting indicate different lithospheric domains which are attributed to be separated by geological boundaries or suture zones. However, no example of such geological boundaries are given in the Figures. If possible, it would be nice to see some of these geological boundaries, such as in Fig. 4, for example.

2. Page 665, Lines 20-25. The authors have argued that most of the anisotropy effects observed in Archean provinces come from frozen anisotropy in the lithosphere and cite Montagner, 1998; Pedersen et al., 2006; Assumpcao et al., 2011). However, Assumpcao et al.(2011) favor larger effects from present-day asthenospheric flow in South America. The data used by Assumpcao et al. were not analysed with detailed 3D techniques, such as done here by Plomerova et al. and so their conclusion may be disputed. However, given that the South American lithosphere (including the Amazon craton) is thinner than in Fennoscandian (see global lithospheric map of Conrad & Lithgow-Berteloni, 2006, based on Gung et al.,2003), and that the absolute velocity of S. America ($\sim$48 mm/y at HS3-NUVEL1A) is higher than Fennoscandian (16mm/y), there may be a real difference between anisotropy origin between northern Europe (mainly lithospheric) and South America (mainly asthenospheric flow).

Refs: Conrad, C. P., and C. Lithgow-Bertelloni (2006), Influence of continental roots and asthenosphere on plate-mantle coupling, Geophys. Res. Lett., 33, L05312, doi:10.1029/2005GL025621. Gung, Y., M. Panning, and B. Romanowicz (2003), Global anisotropy and the thickness of continents, Nature, 422, 707–711.

Minor technical corrections

1. Page 657, Lines 12-15: The paragraph implies that absolutely no progress has been made in imaging upper mantle velocity structure in Europe since Aki et al.(1977). That seems odd. The next sentence states that "significant" changes in LBA depth have been mapped. Perhaps the paragraph should be more explicit on which features have

been improved since Aki et al.(1977) and which have remained about the same.

2. Page 659, 1st paragraph. The technique of detecting P-wave anisotropy by searching for the “bipolar pattern” has been used extensively by the authors. However, in the summary description of this technique, perhaps an extra sentence or two should be added to explain how the relative residuals from anisotropy effects are separated from those due to lateral variations.

3. Page 660, Line 13: “the convergently dipping high-velocity directions...” This is not too clear for me. Please expand the sentence.

4. Page 663, Line 8. The sentence seems to imply that delay times (dt) are also in Table 1.

5. Table 1. Please add in the Table legend: phi= azimuth and theta= inclination from vertical downwards.

6. Fig. 3 legend: the boundaries are marked by THICK dashed lines. Thin dashed lines are country limits.

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