Subject offered for a contract starting in September 2013

SUBJECT TITLE: Structure and anisotropy of the continental lithosphere

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Presentation of the subject: (1 or 2 pages)

In a series of previous studies, based on a combination of long period seismic waveforms and SKS splitting measurements, we have documented the presence of several domains, or "layers", of anisotropy, in the lithosphere/asthenosphere system of the north American craton (Marone and Romanowicz, 2007; Yuan and Romanowicz, 2010; Yuan et al., 2011).

In particular, the fast axis direction of anisotropy changes around 200-250km depth from a northerly direction to a direction parallel to present day motion, providing a way to define/detect the lithosphere-asthenosphere boundary (LAB), which is not precisely defined from isotropic velocity tomography and in general is not detectable under cratons from receiver function studies. On the other hand, the lithosphere itself can be divided into two layers, separated by an undulating discontinuity which may coincide with the negative jump detected in receiver function studies (i.e. mid-lithospheric boundary, MLD). The upper layer may correspond to the oldest, chemically distinct (depleted) part of the lithosphere, formed by collision of old archean blocks, while the lower layer may have accumulated subsequently, as a result of primarily thermal processes ("thermal blanket") that may or not be related to modern day subduction (see cartoon in Figure 1).

From clustering analysis of a recent tomographic model (Lekic and Romanowicz, 2011), it appears that the main cratons of the world share similar average shear velocity depth profiles (e.g. Figure 2). The goal of the thesis project would be to explore other cratons in the world, to determine the similarities and differences in their lithosphere/asthenosphere structure and help advance our understanding of the formation and evolution of continental cratons.

The project would involve continental scale seismic waveform tomography combined with constraints from SKS splitting and receiver function analysis.

References

Yuan, H. and B. Romanowicz (2010) Lithospheric Layering in the North American Continent, *Nature*. 466, 1063-1069.

Lekic, V. and B. Romanowicz (2011a) Tectonic regionalization without a priori information: a cluster analysis of upper mantle tomography, Earth Planet. Sci. Lett., 308, 151-160.

Lekic, V. and B. Romanowicz (2011b) Inferring mantle structure by full waveform tomography using the Spectral Element Method, *Geophys. J. Int.*, 185, 799-831, *doi: 10.1111/j.1365-246X.2011.04969.x.*

Marone, F. and B. Romanowicz (2007) On the depth distribution of azimuthal anisotropy in the continental upper mantle, *Nature*, 447, 198-201.

Yuan, H. and B. Romanowicz (2010) Lithospheric Layering in the North American Continent, *Nature*. 466, 1063-1069.

Yuan, H. B. Romanowicz, K. Fischer and D. Abt (2011) 3-D shear wave radially and azimuthally anisotropic velocity model of the north American upper mantle, *Geophys. J. Int.*, 184, 1237-1260, doi:10.1111/j.1365-246X.2010.04901.x

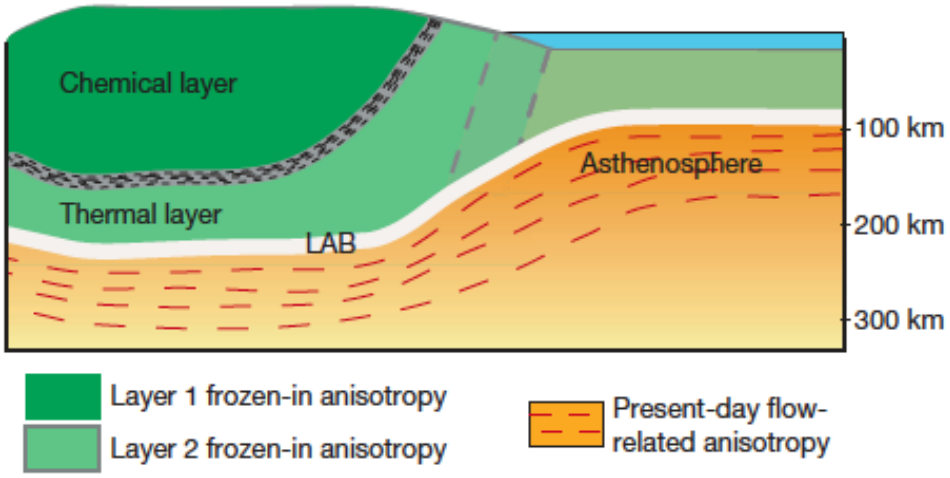

Figure 1: sketch illustrating the concept of stratified lithosphere, as inferred from the study of anisotropy in the north American craton. From Yuan and Romanowicz (2010)

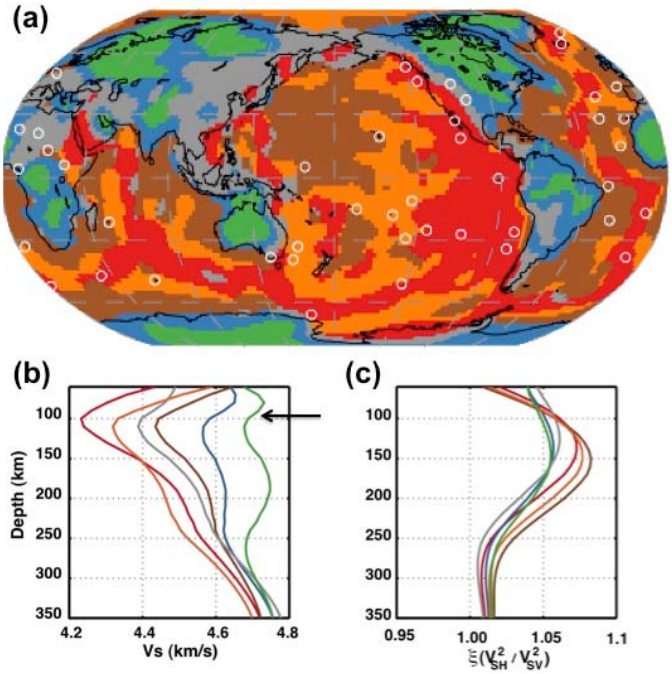

Figure 2: result of clustering analysis of global upper mantle shear velocity model SEMum (Lekic and Romanowicz, 2011b), specifying 6 regions. Cratons appear as green regions. (a): geographical distribution of the 6 families of Vs profiles; (b) corresponding average Vs profiles for each region; (c) corresponding average profiles of radial anisotropy, described by the parameter ξ. For more details see Lekic and Romanowicz (2011a).