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Impact of lithosphere heterogeneity on geoneutrino flux prediction at LENA (Finland) and JinPing (China) detectors

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Determining the amount of radiogenic heat production in Earth's mantle is crucial for understanding chemical composition, mantle dynamics and thermal history of our planet. The recent breakthrough in new interdisciplinary geoneutrino method, based on detecting antineutrinos from $\beta-$ decays of radiogenic elements, provides us unique information about Earth's interior and it's heat generation processes. Nowadays two liquid-scintillator neutrino detectors, KamLAND and Borexino (e.g. Enomoto, 2005; Fiorentini et al., 2007) measure geoneutrino flux in different geological environments: subduction zone and orogenic belt. Correct interpretation of these data requires impact analysis of such variable parameters, as rock density, spatial distribution and abundance of radiogenic elements. Further an accurate modelling of crust structures near the detectors will allow to dispart crust and mantle contribution to total geoneutrino flux.

Recently many authors presented different models for geoneutrino events counting (e.g. Fiorentini et al., 2007; Huang et al., 2013; Šrámek et al., 2016), but less attention is given to heterogeneous structure of the continental crust and underlying lithospheric mantle in the area near the detectors.

In our research we calculated geoneutrino flux for the modelled geological structure of the lithosphere within Central Finland, where detector LENA was proposed to be placed (Wurm et al., 2015). We made different models combining real local continental crust underlaid by hypothetical mantle part: depleted mantle, primitive mantle, layered lithospheric mantle and homogeneous lithospheric mantle. We thoroughly modeled local continental crust, taking into consideration complicated structure of contact zone between Proterozoic belts and Archean craton. We concluded, that homogeneous and layered lithospheric mantle give the biggest contribution to total flux and the littlest number of geoneutrino comes from depleted mantle.

Currently, to estimate the influence of heterogeneous lithosphere on a total geoneutrino flux we are modelling geological situation for JinPing detector. It will be located in China, Sichuan Mountains (Šrámek et al., 2016), which are part of the highest orogenic complex in the world. Due to high lithosphere thickness in this area JinPing detector is expected to get the largest number of geoneutrino events. We are creating two models: simplified version with only three layers (upper, lower crust and lithospheric mantle) and version which is close to real geological situation. This will help to estimate the sensitivity of geoneutrino approach to uncertainties in geological structures and verify this method for internal heat production investigations.

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