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Quantifying Geochemical Anomalies in the Mantle Using Geoneutrinos

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Earth crust, enriched in heat producing elements such as U and Th, has been recycling into the mantle. Particular models envisage the material to sink deep to the core mantle boundary and form seismically observed Large Low Shear Velocity Provinces. Other models propose erosion and transport of continental crustal material by subduction, which could lead to the assembling of upper crustal materials that are gravitationally stabilized relatively shallow at the base of the Transition Zone, at some 600 to 700 km depth. If the recycled material remains enriched by U and Th, it would form a geochemical mantle anomaly, which can be imaged using geoneutrinos. We investigate such a possibility in favorable location is the East Asia, where currently operating KamLAND experiment will be in the near future accompanied by JUNO and Jinping detectors. We also investigate the option of using movable Ocean Bottom Detector to explore vast areas of the mantle beneath the oceans. We show that we can successfully detect geochemical mantle anomalies using geoneutrinos, if the amount of the subducted material is large enough and it keeps its high enrichment of U and Th. We discuss the imaging limits based on the size and degree of enrichment of these mantle anomalies. Such a method is complementary to the other geophysical techniques and it specifically reveals the compositional distinctions in the mantle.

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