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The Mantle's Radioactive Power - Understanding the Geoneutrino Signal

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Although many assume we know the Earth's abundance and distribution of radioactive heat producing elements (i.e., U, Th, and K), estimates for mantle's heat production varying by an order of magnitude and recent physics findings challenge our dominant paradigm. Geologist predict the Earth's budget of radiogenic power at 20±10 TW (terrawatts, 10^{12} watts), whereas the physics experiments predict $11.2^{+7.9}_{-5.1}$ TW (KamLAND, Japan) and $38.2^{+13.6}_{-12.7}$ TW (Borexino, Italy).

We welcome this opportunity to highlight the fundamentally important resource offered by the physics community and highlight the shortcomings associated with the characterization of the geology of the Earth. We review the findings from the continent-based, physics experiments, the prediction from geology, and assess the degree of misfit between the physics measurements and the predicted models of the continental lithosphere and the underlying mantle. Because our knowledge of the continents is so weak, models for the mantle and the bulk silicate Earth continue to be uncertain by a factor of ∼30 and ∼4, respectively. Detection of a geoneutrino signal in the ocean, far from the influence of continental, offers the potential to resolve this tension and offer an powerful tools to interrogate the composition of the continental crust.

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