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Updated reference model for lithospheric heat production and geoneutrino flux

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We report a critical assessment of the abundance and distribution of the heat producing elements in the lithospheric and provide insights into its heat production, physical properties, and geoneutrino flux. The energy yield from these elements are then inputs for calculating the energy budget of the mantle and bulk Earth. We couple and compare these insights with mature and higher resolution methods for modeling lithospheric heat production.

Our updated 3D model for heat and geoneutrino production of the global lithosphere ascribes U, Th, and K concentrations to 1° x 1° x 9 layers as specified by the geophysical model LITHO1.0. The physical state of this lithosphere is constrained by data from seismic and gravity models. Density and seismic wave velocity uncertainties are derived from a comparison of LITHO1.0 with a high-resolution surface wave tomography model of the United States. Uncertainties in layer thickness are determined from a comparison of crustal thickness models, using seismic and gravity measurements. The chemical state of each layer is determined using literature data and, for the middle and lower crust, from seismological-compositional relationships. Geochemical uncertainties are determined from natural variation in datasets. Input uncertainties are propagated through Monte Carlo methods, providing uncertainty on every parameter calculated from the model.

The heat production in each layer voxel (1° x 1° x layer thickness) is calculated and summed for bulk crustal and lithospheric heat production. Surface and Moho heat flux results from our model are compared with global models of heat flux. The geoneutrino flux is calculated for current and proposed detectors and compared with previous estimates. Uncertainty correlations and the sensitivity of various modeling parameters, particularly regarding the calculation of abundances in the middle and lower crust, are assessed.