EGU21-6328
https://doi.org/10.5194/egusphere-egu21-6328
EGU General Assembly 2021

Estimating compositions of the deep continental crust

Laura Sammon[1], William McDonough[1,2], and Walter Mooney[3]
[1]Department of Geology, University of Maryland, College Park, USA
[2]Research Center for Neutrino Science, and Dept. of Earth Sciences, Tohoku University, Sendai, Japan
[3]United States Geological Survey, Menlo Park, USA

The deep continental crust's chemical makeup is central to the debate of crustal formation, evolution, strength, and bulk composition. The impenetrable depths and pressures of the deep (roughly > 10 km) crust force geoscientists to rely on indirect sampling methods, studying medium- to high-grade metamorphic terrains and xenoliths to ascertain the composition of the middle and lower continental crust. Analyzing the deep crust in situ requires geophysical data, such as seismic velocities: Vp, Vs, and the Vp/Vs ratio. Each method provides a different perspective on deep crustal composition, but alone, neither is definitive.

To address the nonuniqueness in crust composition modeling, we use thermodynamic modeling software (i.e. Perple_X) to relate observed seismic velocities to bulk compositions and mineralogies. We present a multidisciplinary model for the composition of Earth's deep crust, using geochemical and geophysical data. Through a Monte Carlo modeling approach, we determine the best-fit geochemical model for bulk middle and lower crustal compositions. For 12 different tectonic regimes, we quantify uncertainties in crustal composition, temperature, and seismic velocity while recognizing our own scientific biases. We present a global model of deep crustal composition conclude that regional scale geological variations benefit from a higher resolution model. Overall, our model forecasts 77% of the deepest continental crust has 45 to 55 wt.% SiO_2; 15% 55 to 65 wt.% SiO_2; 8% may have > 65 wt.% SiO_2. Of perhaps equal or greater importance, however, we present a scalable, modular program that can be altered to incorporate additional petrological and geophysical constraints, allowing geoscientists to more easily compare different scenarios for the deep crust.