Isotope constraints on the growth of continental crust and its composition

JUN KORENAGA[1]

[1]Department of Geology and Geophysics, Yale University (jun.korenaga@yale.edu)

As elucidated in a recent review [1], the growth models of continental crust may be classified into three categories: crust-based, mantle-based, and others. Crust-based models are estimates on the formation age distribution of extant continental crust, whereas mantle-based models are on net crustal growth. The latest net growth model based on the Nd isotope systems [2] indicates rapid crustal growth and efficient crustal recycling in the early Earth, akin to the classic Armstrong model [3]. Moreover, such combination of crustal growth and recycling successfully explains the formation age distribution of extant continental crust [4]. What is critically important here is to not only distinguish between the following four different curves, net crustal growth, crust generation rate, crust recycling rate, and formation age distribution, but also understand that they are intimately linked. In this talk, I will also revisit one of the growth models in the third category, the model of Pujol et al. [5], which is based on argon degassing. Surprisingly, the effect of continental growth on noble gas degassing has not been properly accounted for in the literature, because the distinction of the above four curves has long been overlooked. Furthermore, to understand the relation between argon degassing and crustal growth, we need to include two more curves, i.e., crustal reworking rate and surface age distribution. As argon is degassed from the formation of continental crust and its evolution as well as from mid-ocean ridge magmatism and hotspot magmatism, it is also indispensable to take into account the likely thermal history of the mantle and the core. Whereas argon degassing is thus not a simple function of crustal evolution, it nonetheless provides a unique perspective for the growth of continental crust and its composition, because the secular evolution of atmospheric argon turns out to be very sensitive to the K contents of continental crust in the early Earth.

[1] Korenaga (2018) *PTRSA* **376**, 20170408. [2] Rosas & Korenaga (2018) *EPSL* **494**, 42-49. [3] Armstrong (1981) *PTRSLA* **301**, 443-472. [4] Korenaga (2018) *EPSL* **482**, 388-395. [5] Pujol et al. (2013) *Nature* **498**, 87-90.