# Coupled subduction of N and Xe as a tracer of mantle regassing

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The distribution of volatiles between the modern mantle and atmosphere is the result of the combined effects of retention of primordial components, outgassing of mantle reservoirs during melting, and recycling via subduction from surface reservoirs. Constraining the timing and magnitude of these processes has broad implications for the origin of terrestrial volatiles, mantle convection, plate tectonics, and early Earth climate.

Both N and Xe are recycled from the atmosphere into the mantle via subduction, with similar efficiencies of 84-92% and 80-90%, respectively [1,2]. Such similarity is surprising given the fundamentally different subduction mechanisms: N as $NH4^{+}$ bound in sediments and Xe weakly bound within many mineral structures.

Here we use a forward model based on previous work [2] to constrain the mantle outgassing and regassing history of N and Xe. Based on the remarkable similiarity in recycling efficiency, we assume that the same process controls regassing for both gases. The suite of parameters consistent with the evolution of mantle Xe/N ratios through time as well as the modern concentrations and isotopic ratios for stable isotopes $^{14}N$, $^{15}N$, $^{128}Xe$, and $^{130}Xe$ require that regassing begins no earlier than 2.5 Ga (Fig. 1).

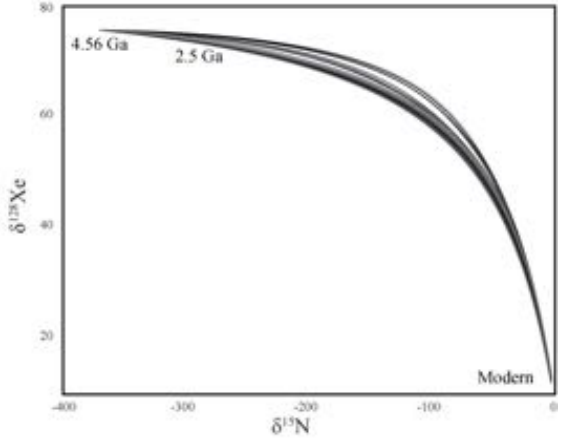


**Figure 1**: Predicted evolution of mantle isotopic ratios.

[1] Barry & Hilton (2016) *GPL* 2, 138-147. [2] Parai & Mukhopadhyay (2018) *Nature* 560, 223-227.