QUANTIFYING THE DEVOLATILIZATION THAT LEADS TO ROCKY PLANETS. H. S. Wang[1], C. H. Lineweaver[1], T. R. Ireland[1], [1]Planetary Science Institute, Research School of Astronomy and Astrophysics and Research School of Earth Sciences, The Australian National University, Canberra, ACT 2611, Australia, haiyang.wang@anu.edu.au, charley.lineweaver@anu.edu.au, trevor.ireland@anu.edu.au

To estimate the chemical composition of a rocky planet in orbit around a star, we need observations of the elemental abundances of the star, and we need a good model of the devolatilization of the pre-stellar nebula that produced the rocky planet. Our main goal is to establish a fiducial model of the chemical relationship between a rocky planet and its host star.

To first order, the Earth is a devolatilized piece of the Sun. It is likey that rocky exoplanets are devolatilized pieces of their host stars. To develop this idea and to quantify the devolitilization that leads to rocky planets, the elemental abundances of bulk Earth and proto-Sun are essential. Here we present concordance estimates (*with uncertainties*) of the elemental abundances of bulk Earth derived from a variety of Earth obser-vaions and models. We report new estimates of protosolar abundances by combining current best estimates of solar photospheric abundances and CI chondritic abundances.

Using these two sets of elemental abundances, we quantify the Earth-to-Sun abundance ratios as a function of 50% condensation temperatures of elements [1], as shown in Figure 1. The yellow pattern is the normalized protosolar abundances, and the blue slope is the devolatilization of solar nebula that produced the Earth. The variables associated with the devolatilization pattern have important cosmochemical implications. The slope suggests that Earth accreted matter from the solar nebula over a wide range of temperatures and continued its fractionation and loss of primordial material over its accretionary history. The temperature at which the slope intersects the yellow horizontal region probably represents the highest temperature in the solar nebula experienced by material in the feeding zone of the Earth.

We will discuss the strong depletion of life-critical volatile elements (H, C, N, and O) and other depletion mechanisms pertaining to noble gases. The devolatilization that dominantly acted on Earth's material worked on meteoritic parent bodies as well but produced less devolatilization.

References: [1] Lodders K. (2003) *ApJ*, 691: 1220-1247. [2] Palme H. and O'Neill H. (2003) *Treatise on Geochemistry*, 1st Ed., Vol.2, 1-38. [3] Palme H. and O'Neill H. (2014) *Treatise on Geochemistry*, 2nd Ed., Vol.3, 1-39. [4] Kargel L. and Lewis J. (1993) *Icarus*, Vol.105(1), 1-25. [5] McDonough W. (2003) *Treatise on Geochemistry*, 1st Ed. Vol.2, 547-568. [6] McDonough W. (2014) *Treatise on Geochemistry*, 2nd Ed. Vol.3, 559-577.

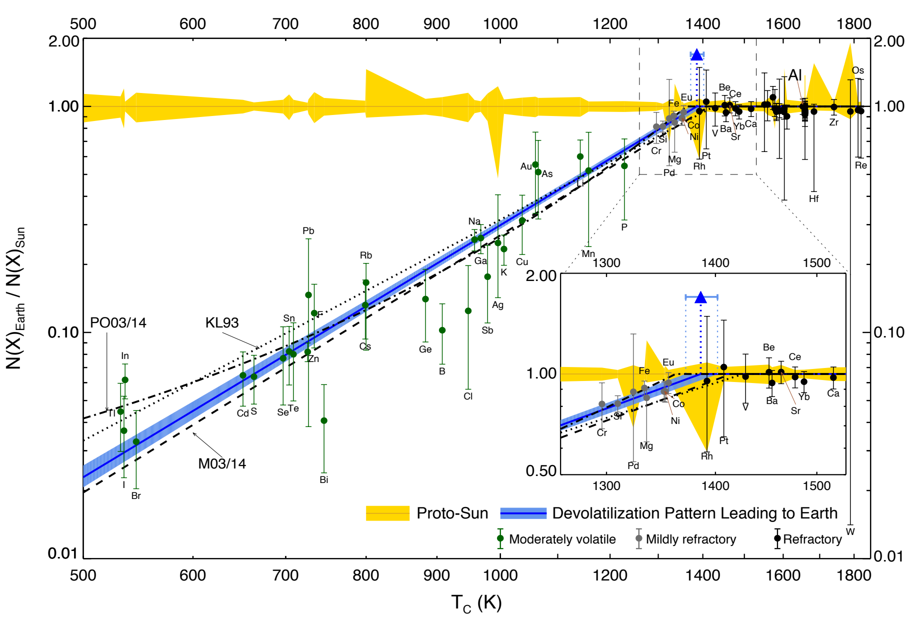

Figure 1. Quantifying the devolatilization that leads to rocky planets like the Earth. The x axis is the 50% condensation temperature [1]. The y axis is the Earth-to-Sun abundance ratios. The inset box in the lower right is a blow up of the region within the dashed lines. The blue triangle in the box is the critical devolatilization temperature that marks the boundary between depleted and non-depleted elements of the Earth relative to the Sun. Previous volatility trends from [2]-[6] are plotted here for comparison.