

Origin and timescale of volatile element depletion in Solar System material

FREDERIC MOYNIER¹ AND JAMES M. D. DAY²

¹Institut de Physique du Globe de Paris and Université Paris Diderot, 1 rue Jussieu, Paris, 75005, France
moynier@ipgp.fr

²Scripps Institution of Oceanography, La Jolla, CA 92093-0244, USA jmdday@ucsd.edu

Volatile elements play a fundamental role in the evolution and differentiation of planets. However, our understanding of how volatile budgets were set in planets, and how and to what extent planetary bodies became volatile-depleted during the earliest stages of Solar System formation remain poorly understood. It has been proposed that the depletion is due to incomplete condensation (volatile elements were not there in the first place, in which case the timing would have to be very fast, <1Myr), or that the different bodies lost volatile elements by evaporation (post-accretion volatilization). Volatilization is known to fractionate isotopes, thus comparing the isotope compositions of volatile element between samples is a very powerful tool for understanding the origin of volatile element abundance variations. For example, recent work has shown that lunar basalts are enriched in the heavier isotopes of Zn (~1 ‰ for ⁶⁶Zn/⁶⁴Zn) compared to chondrites, terrestrial and martian basalts. We will discuss these Zn isotopic data, as well as other stable isotopic systems (e.g., Si) in relation with the giant impact origin theory of the Moon as well as the lunar magma ocean and expand to other parent bodies (e.g., angrite parent body).

The timescale of depletion in volatile elements of Solar System material is estimated by using radiogenic systems for which the parent and daughter elements have different volatility. Here we will focus on the Rb-Sr and Mn-Cr isotopic systems and discuss the timescales and the implications for the origin of volatile element depletion (solar nebula stage vs. planetary stage).