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Tracking the origin of Earth's volatile elements depletion with indium

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The abundances of volatile elements provide insight into fundamental processes of planetary accretion and differentiation. In chondrites, the abundances of volatile elements vary primarily as a function of the temperature at which 50% of their mass has calculated to condense during cooling of the solar nebula (T_C^{50}). In contrast, core formation also plays an important role in controlling the volatile element depletion in the bulk silicate Earth (BSE). Indium is a siderophile and volatile element. Its terrestrial abundance paradoxically lies above the abundance vs. T_C^{50} trend defined by lithophile volatile elements in the BSE [1]. Notably, the use of T_C^{50} presumes depletion took place under nebular conditions [2], and hence may not be an appropriate description of the volatility of indium under more oxidizing- and higher pressure conditions during chondrule formation and post-nebular processes.

To constrain the volatility of In from silicate melts under conditions close to chondrule and planetary formation, we performed evaporation experiments on an In-doped basaltic melt under variable oxygen fugacities (fO_2) and temperatures (T). Elemental volatility is quantified by deriving the enthalpy and entropy during evaporation at the given conditions (T, fO_2 and duration)[3].

Our results show that the volatility of indium strongly increases with decreasing fO_2, as observed for other moderately volatile elements [3,4] and is relatively less volatile than Zn for fO_2 typical of planetary mantles. In spite of this new volatility scale, In is no more depleted than Zn in the BSE notwithstanding its more siderophile nature. Therefore, the chondritic Zn/In ratio in the BSE is either *i)* a coincidence or *ii)* consistent with a 'hockey stick' volatile depletion pattern [5]. The lower volatility of In relative to Zn supports the idea that its over-abundance in the BSE may be inherited from its source materials, which have a CI-like ratio for volatile elements whose $T_C^{50} < 750K$ [6].

[1] Witt-Eickschen et al. (2009) GCA 73, 1755-1778
[2] Lodders. (2003) Astrophys.J. 591, 1220-1247
[3] Sossi et al. (2019) GCA 260, 204-231
[4] Norris and Wood. (2017) Nature 549, 507
[5] Braukmüller et al. (2019) Nat. Geosci. 12, 564-568
[6] Hellmann et al. (2020) EPSL 549, 116508