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S-Se-Te sequestration into Earth's core suggests a volatile-poor late veneer composition

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Volatile elements play important roles in life development and planetary evolution. Therefore tracking their origin on planets is key for understanding habitability. Nevertheless, how and when they were delivered to Earth is still unclear. Were they accreted during core formation[1] or after (a.k.a. late veneer hypothesis)[2]? Was it throughout the accretion process or only within the later stages[3]?
In order to answer these questions, we consider a set of elements : sulfur, selenium and tellurium (S, Se, Te). They are similarly depleted on the bulk silicate Earth (BSE) with respect to other elements of similar volatility (e.g. Zn)[1]. Planetary processes such as core segregation from an early Earth's magma ocean may explain their depletion from the BSE since they are both, siderophile (iron-loving) and volatile elements. Although previous studies indicate they should have been delivered to Earth after core formation, these experiments are well below the expected metal-silicate equilibration conditions for early Earth[4], rendering the topic open to debate yet. Consequently, we present new experimental results obtained at direct conditions expected for core-mantle equilibration[5]. Significantly, they show striking differences from those obtained at lower pressures and temperatures. With these results, we can argue that volatile elements should not be considered in the context of a late veneer, changing the view on the nature of Earth's accretion material.

[1] Wood, B. J., et al. (2006). Nature, 441(7095), 825-833. **[2] Albarede, F. (2009)**. Nature, 461(7268), 1227-1233. **[3] Suer, T. A., et al. (2017)**. Earth and Planetary Science Letters, 469, 84-97. **[4] Rose-Weston, L., et al. (2009)**. Geochimica et Cosmochimica Acta, 73(15), 4598-4615. **[5] Wade, J., & Wood, B. J. (2005)**. Earth and Planetary Science Letters, 236(1-2), 78-95.

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