Silicon isotope fractionation between the upper and lower mantle of the Earth

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As the second most abundant element in rocky planets, Si exhibits limited isotopic variations among different chondrite groups [1]. The δ^{30}Si of Bulk Silicate Earth (BSE), estimated based on basalts and peridotites, is higher than chondritic value. The heavier Si of BSE is proposed to be balanced by lighter Si in the Earth's core. In detail, a range of $\delta^{30}Si_{BSE}$-$\delta^{30}Si_{Chondrite}$, from 0.04 to 0.20‰, has been reported [e.g., 1-3]. Kempl *et al* [4] reported Si isotopic fractionation coefficient between metal and silicate under high P-T conditions, and they concluded that "the core contains between 11 and 29 wt% Si" depending on the value of $\delta^{30}Si_{BSE}$-$\delta^{30}Si_{Chondrite}$. Such high Si content in the core conflicts with seismic observations.

We calculated equilibrium fractionation factors of Si isotopes at high P-T conditions using density functional theory for mantle silicate minerals. Our calculations reveal significant Si isotope fractionation among mantle minerals with different Si coordination numbers (CN), especially between Mg-perovskite (CN=6) and olivine polymorphs (CN=4). Using our *ab initio* calculation and the magma ocean crystallization model of [5], the lower mantle, dominated by perovskite, is estimated to have lower δ^{30}Si (by ~0.1‰) than the upper mantle, dominated by olivine polymorphs. If such primordial Si isotope heterogeneity between the upper and lower mantle is not completely destroyed through the Earth's history, δ^{30}Si of BSE could be lighter than that inferred based on peridotites and basalts which are derived from the shallow upper mantle. Consequently, it does not require an unrealistically high Si content in the core.

[1] Savage and Moynier (2013) EPSL. [2] Chakrabarti and Jacobsen (2010) GCA. [3] Georg *et al* (2007) Nature. [4] Kempl *et al* (2013) LPSC. [5] Walter, M.J. and R.G. Trønnes, EPSL, 2004.

The mercury in the low latitude Holocene peat profile associated with monsoon variation

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Mercury is key trace metal in earth surface system. The gasous elemental Hg takes over 90% and has a long resident time in atmosphere. Mercury in ice core has been researched for a long time. The total element Hg changes from interglacier and glacier period, although there exits the argument on the driving process. The thermal lability of mercury in peat bog could be considered as an important paleoclimate proxy. The 1.3m peat core at the Caohai Lake was collect. By the AMS dating age the core covered 3.8 ka up to 9.4 ka. The total mercury concentration with the different temperature heating pretreatment associated with the organic carbon analysis including the stable carbon isotope analysis. The results show the mercury concentration is consistent with the organic carbon variation. The clear fluctuation at 8.2 ka and 4.3 ka could be detected. The mercury concentration variation is consistent with the solar radiation change from Dongge Cave which is closed to this peat core site. Compared to the mercury in the ice core, by this result, the mercury in peat at low latitude takes the different variation pattern from the high latitude region, which implies that the deposition pattern with the climate change varies with the latitude.

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