Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23361

Rapid response to abrupt change in subduction carbon flux revealed by intraplate volcanisms in Northeast Asia

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Well-tuned cycles of carbon regulate the Earth's habitable climate through geological time. Subduction zones are the main pathway for the interaction of carbon between Earth's interior and the exosphere. An amount of subducted carbon, especially hosted in carbonated oceanic crust, may have survived beyond the sub-arc regime. Although carbon is insoluble in mantle silicate minerals, surviving subducted carbon neither sink into the lower mantle nor return to near-surface reservoirs immediately, and may retain in the upper mantle for several millions to billions of years. However, the duration between carbon input and remove in the upper mantle remains enigmatic.

Northeast Asia documents the deep carbon cycling above the mantle transition zone since the late Mesozoic. Here, we report Zn isotopic data for intraplate basalts with ages of 99–2 Ma in Northeast Asia. Zn isotopes honestly reflect different amounts of recycled carbonates/carbon in the deep mantle, which may be caused by the instability of deep carbon input from subduction slab. From this, 0.8–1.2 wt% C is estimated to have added by recycled carbonates, and shows an abrupt decline in the amount of recycled carbon at 92 Ma and 42 Ma, respectively. Furthermore, we reconstruct subducted carbon fluxes from all reservoirs implicated in the Western Pacific subduction plate over the past 120 million years. The calculated results revealed that the subducted carbon fluxes ranged from 2.6 to 17.2 Mt C yr^{-1}, with significant decrease at 112 Ma and 55 Ma. The temporal link between the reconstructed carbon flux and estimated recycled carbon in the mantle indicates that the former may exert a strong control over the latter. Moreover, the short time delay of 13–20 Ma between them provides evidence for rapid response to abrupt change in subduction carbon flux revealed by intraplate volcanisms in Northeast Asia.

This work was financially supported by the National Key R&D Program of China (Grant No. 2022YFF0801002) and the National Natural Science Foundation of China (Grant 42372065).