# Li and B isotopic fingerprint of Archean subduction

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Onset, prevalence and style of subduction on the early Earth are highly debated. Mineral chemistry, zircon U–Pb dating, Rb–Sr internal mineral dating and oxygen isotope, whole-rock Sm–Nd and Li–B isotope analyses were conducted on Archean peridotite xenoliths and the host ~2.52 Ga Zhulagou diorites (Yinshan Block, North China Craton) to evaluate the nature of metasomatism above an ancient subduction zone. Peridotite xenoliths have low whole-rock Mg# (80–81) and low Mg# (81–84) in olivine, indicating they are cumulates that formed near the crust-mantle boundary. They experienced multi-stage metasomatism. SIMS U–Pb dating of zircon from peridotites yielded an upper intercept age at ~2.53 Ga, and a lower intercept age at ~1.8 Ga. Considering amphibole hosts most Zr in the Zhulagou peridotite xenoliths, the ~2.53 Ga age is interpreted as the timing of metasomatism that related to the formation of amphibole. Rb–Sr mineral isochrons date phlogopite formation at ~1760 Ma, consistent with the lower intercept age of zircon. Pargasitic amphibole from the Zhulagou peridotites has fractionated REE and pronounced depletions of Nb, Ta, Zr and Ti. Combined with slightly depleted mantle WR $\varepsilon_{Nd}$ (~+1.3), high zircon $\delta^{18}O$ (+5.6 to +7.0‰), and heavy $\delta^{7}Li$ (~+14‰) and light $\delta^{11}B$ (~−11‰) in amphibole, we suggest that amphibole-forming melts were released from Archean subducted altered oceanic crust and its overlying sediments. The Zhulagou peridotite xenoliths have the highest $\delta^{7}Li$ values (~+12‰) recorded in Archean peridotites. Heavy Li is most likely related to melts derived from the subducted oceanic crust that was altered by seawater, rather than resulting from diffusion-driven Li isotopic fractionation with the host diorite, or late-stage serpentinization and phlogopite-related metasomatism. Recycling of ancient subducted materials in the studied samples demonstrates that plate tectonics operated in the late Archean.

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