Opening of the West Paleo-Tethys Ocean: New insights from Early Devonian meta-mafic rocks in the southern Saualpe crystalline basement, Eastern Alps

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Timing of the opening of the West Paleo-Tethys Ocean in Eastern Alps remains controversial. The debate over the timing has revolved mainly around three possible periods, namely Silurian, Early Devonian and Middle–Late Devonian. To constrain this event, we present new zircon U-Pb ages, Hf isotopic compositions, and whole-rock major- and trace-element data for the meta-mafic rocks in the southern Saualpe crystalline basement, Eastern Alps. Zircon U-Pb dating results from three samples yielded crystallization ages of 418 ± 6 Ma, 417 ± 3 Ma and 415 ± 3 Ma, indicating that they formed during the Early Devonian. Geochemically, these meta-mafic rocks have relatively low SiO₂ and MgO contents and high TiO₂ contents. They are enriched in light rare earth elements (LREE), particularly in Nb and Ta, and show relatively flat heavy rare-earth elements (HREE) patterns, indicating that they have affinities with the alkaline oceanic island basalts (OIB). The geochemical characteristics, together with the positive εHf(t) values of 0.7–11.1, imply that the OIB-like meta-mafic rocks originated from partial melting of a lherzolite source including spinel and garnet. And the primary magma showed complex sources involving the asthenospheric, lithospheric mantle and subducted slab components and subsequently modified by crustal contamination, revealing that the magma formed in a slab window environment associated with mid-ocean ridge subduction. The contemporaneous OIB-like alkaline amphibolites were also found in the central Austroalpine basement and Northwestern Turkey. We suggest that the Late Silurian–Early Devonian OIB-like magmatism is related to a back-arc extension setting in the northern margin of Gondwana leading to the detachment of the European Hunic terranes and hence placing an age on the opening of the West Paleo-Tethys Ocean.