Subduction initiation in the west Proto-Tethys Ocean record by the ophiolitic Speik Complex of the Eastern Alps

Qingbin Guan[1], Yongjiang Liu[1], Franz Neubauer[2], Johann Genser[2], Sihua Yuan[3], Qianwen Huang[1], Ruihong Chang[2]

[1] Frontiers Science Center for Deep Ocean Multispheres and Earth System, Key Lab of Submarine Geosciences and Prospecting Techniques, MOE and College of Marine Geosciences, Ocean University of China, Qingdao 266100, China; e-mails: guanqingbin@ouc.edu.cn; liuyongjiang@ouc.edu.cn
[2] Department of Environment and Biodiversity, Paris-Lodron-University of Salzburg, Austria; e-mails: franz.neubauer@plus.ac.at; e-mails: ruihong.chang@stud.sbg.ac.at; Johann.Gense@plus.ac.at
[3] College of Earth Science, Institute of Disaster Prevention, Sanhe 065201, Hebei, China; e-mail: yuansihua@126.com

Supra-subduction zone (SSZ) ophiolites form in forearc settings, *e.g*., the Izu–Bonin–Mariana (IBM) in-situ forearc and show conversions from normal mid-ocean ridge basalt (N-MORB) to boninitic affinities, which are widely interpreted as rules for the evolving chemical geodynamics of subduction initiation magmatism (Ishizuka *et al.*, 2018). Here, we report newly documented forearc rocks, generated during subduction initiation of the Speik Complex in the Eastern Alps, which is part of the Middle Austroalpine basement unit. Lithologically, the Speik Complex consists of variably serpentinized ultramafic rocks, plagioclase amphibolites, garnet-amphibolites, locally exposed eclogites, granitic gneisses and some metasedimentary rocks (Neubauer *et al*., 2022). New zircon U-Pb dating results show that the garnet-amphibolites, plagiogranitic gneisses and plagioclase amphibolites were formed during latest Cambrian (496 ± 5 Ma–489 ± 6 Ma), latest Cambrian (491 ± 2 Ma) and Early Ordovician (476 ± 3 Ma–472 ± 4 Ma), respectively. The amphibolites have geochemical characteristics similar to those of IBM forearc basalts, with nearly flat REE patterns and positive $\varepsilon_{Hf}(t)$ values (2.5–14.9), and show enrichment in Rb, Ba, and Sr and slight depletion in Nb, Ta, and Zr, suggesting an origin by decompression melting of a depleted mantle source. The granitic gneisses have low K_2O contents (0.56–0.59 wt%), low K_2O/Na_2O ratios (0.14–0.15), $(La/Yb)_N$ ratios (1.54–1.60) and $(Gd/Yb)_N$ ratios (0.93–0.98), flat REE distribution patterns and positive $\varepsilon_{Hf}(t)$ values (4.7–8.0), indicating that their protoliths are typical oceanic plagiogranites. The plagioclase amphibolites are similar to those of typical boninites with low rare earth element and high field-strength element contents, and show depletion of Nb, Ta, Zr and Hf. These geochemical features and the depleted $\varepsilon_{Hf}(t)$ values (6.1–8.7) suggest that the protoliths of plagioclase amphibolites were generated later during residual, highly depleted mantle fluxing by the subducting plate. Because the subduction of the Proto-Tethys Ocean, the Wechsel arc was detached from the northern margin of the Gondwana and a backarc basin was formed during the late Ediacaran. The backarc basin continued to expand thus forming the Speik Ocean. An intra-oceanic subduction initiated in the Speik Ocean and formed the ophiolitic Speik Complex during the late Cambrian–Early Ordovician.

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