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New geochronologic constraints on the timing and geodynamic setting of Ordovician plutonism in the Ötztal nappe of the Eastern Alps

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The supercontinent Gondwana, assembled during late Neoproterozoic, was delineated by peripheral accretionary orogens and associated magmatic belts. The timing and geodynamic setting of the peri-Gondwana magmatism remain debated, especially in case of the Avalonian–Cadomian belt that straddled Gondwana´s northern margin. A great deal of this magmatism can be attributed to the Cadomian orogeny, however, the magmatic activity continued into the Ordovician. It has been well established that the Ordovician magmatism was widespread as abundant volcano-plutonic complexes are now found in almost all Cadomian terranes in the Variscan and Alpine orogens. Two different models have been proposed to explain the Ordovician magmatism in Western and Central Europe. One model, mainly based on observations in the Alps, invokes subduction and slab-rollback underneath north Gondwana (the Cenerian orogeny). The other model, based on work in the Bohemian Massif, assumes a hyperextended passive margin and rifting generated by a mantle plume or far-field slab pull. Whereas a large body of data exists for the latter, the Ordovician magmatism in the Alps remains worth of further investigation. In this study, we present new U–Pb zircon ages from the Ötztal nappe, composed of a metasedimentary complex which encloses bodies of metagranitoid rocks. The U–Pb detrital zircon age spectra obtained from paragneisses suggest deposition during the latest Ediacaran to Cambrian and were sourced from basement characterized by minor Archean and Paleoproterozoic, more abundant Tonian–Stenian, and dominant Ediacaran (Cadomian) ages, presumably the Arabian–Nubian shield. The metagranitoids, ranging in composition from tonalite through granodiorite to granite, were previously categorized into 5 groups and their intrusion ages (U–Pb on zircon) could now be constrained as follows: Group 1 (M-, I-, and A-type granitoids associated with metabasites) at ca. 500 Ma, Group 2 (Winnebach S-type granodiorite/tonalite) at ca. 640 Ma, Group 3 (Sulztal S-type granite suite) at ca. 470 Ma, Group 4 (Alpeiner I-type granitoids) at ca. 470 Ma, and Group 5 (Bassler S-type granite suite) at ca. 470 Ma. In addition, a mafic eclogite yielded zircon ages at ca. 480–450 Ma and a Variscan overprint at ca. 340 Ma. Although the timing of Ordovician magmatism is apparently similar in the Bohemian Massif and the Alps, we highlight the possibility of different geodynamic causes: in particular, we envisage a curved geometry of the north Gondwana margin, where rifting in its western segment (Bohemian Massif) was broadly coeval with subduction along its eastern segment which included also the present-day Ötztal nappe.