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DATING (PB-PB-TIMS) AND TRACE ELEMENT SIGNATURES (LA-ICPMS) OF SINGLE ZIRCONS FROM METABASITES IN THE AUSTROALPINE BASEMENT TO THE SOUTH OF THE TAUERN WINDOW

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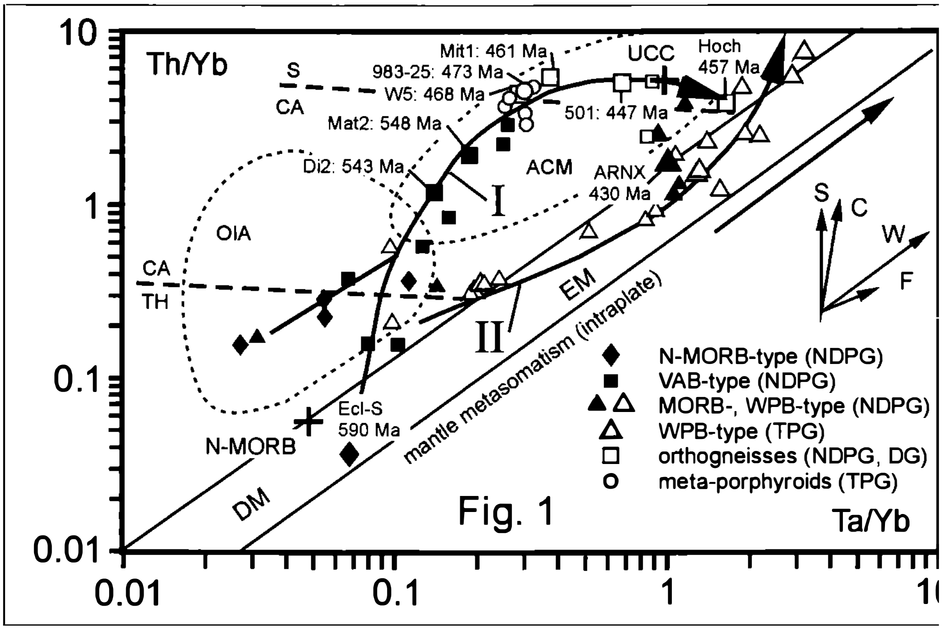
The Variscan and partly Alpine metamorphic Austroalpine basement to the south of the central Tauern Window is subdivided into four lithological units: (1) the Northern-Defereggen-Petzeck Group (NDPG) with the metabasic Rotenkogel, Torkogel, Michelbach and Prijakt Subgroups; (2) the Durreck (Cima Dura) Muscoviteschist Group; (3) the Defereggen Group (DG), all of pre-Upper-Ordovician age, and (4) the Palaeozoic Thurntaler Phyllite Group (TPG). In units 1-3, N-MORB-type eclogitic amphibolites, VAB-type hornblende-plagioclase-gneisses, MORB- and WPB-type amphibolites occur with CAG- and CCG-type orthogneisses. Tholeiitic and alkaline WPB-type metabasites are associated with acid meta-porphyroids in the Thurntaler Phyllite Group.

Whole-rock Ta/Yb-Th/Yb and oxygen, Sr, Nd isotope data define two principal magmatic evolution lines (Fig. 1). An older evolution (I) involved magmatic suites with elevated whole-rock Th/Yb typical of subduction-related magmatism. Protolith ages of defined members in these suites were dated by TIMS with the Pb-Pb single zircon evaporation method [1]. N-MORB-type eclogitic amphibolites of the Prijakt Subgroup in the Schobergruppe with magmatic LIL and LREE enrichment and $(Th/Ta)_N$ of 1.38–2.5 which can be interpreted as a sign of backarc magmatism display a protolith age of 590 ± 4 Ma. Hornblende-plagioclase-gneisses of the Rotenkogel and Prijakt Subgroups have basic to intermediate compositions. They display Ti/-Zr, Ti/V and Cr/Y ratios typical of calk-alkaline volcanic arc magmatites. Their protolith ages range between 550 ± 5.9 and 533 ± 3.8 Ma. Orthogneisses with compositions ranging from metaluminous dioritic to peraluminous granitic are closely associated with the arc magmatic suite, but occur as well widespread in the Defereggen Group. Protoliths of orthogneisses with compositions matching the continental arc granites discriminant field appear as slightly older (471 to 461 Ma) as those of orthogneisses ranging in the continental collision field (457 to 448 Ma). Geochemical signatures and REE patterns of these orthogneisses and the meta-porphyroids in the Thurntaler Phyllite Group are very similar. The meta-porphyroid protolith ages are 473 ± 6.7 and 469 ± 6.2 Ma. However, when corresponding single zircon ages are compared, the porphyroid volcanism appears slightly older as the granitoid plutonism. Both acid rock groups bear many inherited zircons with ages up to 1930 Ma. A younger evolution (II) in both pre- and post-Ordovician units is characterized by an intraplate mantle metasomatism or mantle-enrichment trend (Fig. 1).

The corresponding amphibolites in the Northern-Defereggen-Petzeck and in the Thurni Phyllite Groups have Zr-Ti-Y contents ranging from MORB tholeiites to within-plate all basalts. A highly differentiated sample from the alkalibasalt-like suite in the Torkogel Subgı yielded a 430 ± 1.6 Ma Pb-Pb zircon age.



Occurrence of zircon in magmatites poses the question whether this mineral crystallized ir magma which can be defined by its actual host rock, or has been assimilated during ma formation, fractionation and ascent. Trace and rare earth elements in zircon populations f these rocks have been extracted in-situ by a 266 nm Merchantek LUV laser and analysed quadrupole AGILENT 7500i ICP-MS. The zircon U, Th, Ti, Ce vs Y allow to distinguish con sitional fields and trends. Zircons of N-MORB-type metabasite give a mantle-trend endmen at low Y, Ce, U, but high Ti, whereas zircons with elevated Y, Ce and U from highly diffe tiated WPB-type amphibolite define an opposite crustal trend. When Yb/Gd and Yb (normal to the primitive mantle) are chosen as proxies for an interplay between magma composition zircon crystal chemistry, the mantle-trend zircons show low degree of HREE enrichment very variable HREE fractionation, whereas the crustal-trend zircons have considerable Hl enrichment at low and constant fractionation. The well-defined and limited compositional fi of N-MORB-, VAB- and WPB-type metabasite zircon populations are matched by their ho geneous Neoproterozoic, Cambrian and Early Silurian crystallization ages. Zircons with elev common Pb and apparently disturbed Pb systematics display deviations from ideal REE patı It is concluded that each Austroalpine metabasite zircon population crystallized from a spe magma which is represented by the geochemical characteristics of the actual host rock. compositional fields of acid metamagmatite zircon populations show large variations but exc the extreme mantle-trend compositions. This is explained by a considerable share of inheı and/or assimilated zircons.

These principal magmatic evolution lines are related to a progressively mature Austroalpine active margin which lasted from Neoproterozoic through Cambrian to Early Silurian times along the north-Gondwanan periphery. The subduction-driven magmatism culminated in the formation of an Early-Cambrian magmatic arc. Ordovician acid volcanism and plutonism appear as a mature stage of this evolution. Early-Silurian alkalibasaltic magmatism then signalizes a subsequent and partly simultaneously starting passive margin evolution, which was probably related to the opening of the Palaeo-Tethys. Subduction could still have been the cause of mantle-source enrichment recorded in the corresponding alkaline WPB-type magmatites.

References

[1] SCHULZ, B. & BOMBACH, K. (2003): Single zircon Pb-Pb geochronology of the Early-Palaeozoic magmatic evolution in the Austroalpine basement to the south of the Tauern Window. - Jahrbuch der Geologischen Bundesanstalt, 143/2, 303-321.