Geol. Paläont. Mitt. Innsbruck, ISSN 0378–6870, Band 25, S. 1–242, 2001

THE WINNEBACH MIGMATITE (ÖTZ-STUBAI CRYSTALLINE UNIT) – EVIDENCE FOR A PAN-AFRICAN METAMORPHISM IN AN OVERTHRUST NAPPE SEQUENCE IN THE EASTERN ALPS (AUSTRIA)

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The Winnebach migmatite is part of the Ötz-Stubai crystalline unit, a metamorphic nappe unit which forms the basement of the Mesozoic cover (middle Eastern Alpine unit) of the Eastern Alps. This unit can be divided into two series, the Ötztal Peri-Gondwana complex (ÖPC) which represent supra-crustal metamorphic rocks and the Ötztal ophiolite complex (ÖOC)which has formed in an oceanic crustal regime. In the northern part of the Ötz-Stubai crystalline unit and in tectonic contact to the ÖOC, in addition, a nappe can be separated (Ötztal Gondwana complex, ÖGC) which is characterized by local phenomena of anatexis. This complex borders to the ÖOC by a major shear zone (Sulztal shear zone, Söllner et al. this volume) which is exposed near Längenfeld (northern Ötztal valley) and can be traced back over several kilometers to the southeast.

The Winnebach migmatite denote the largest anatectic area (7 to 3.5 km) among others within the ÖGC, e.g. the outcrop near the Regensburger Hütte (Stubai valley, Ranalt village). Despite the widespread distribution of supra-crustal rocks in the ÖPC, which built up the overall southern part of the Ötz-Stubai crystalline unit beyond it, anatectic rocks are lacking.

The Winnebach migmatite is formed by homogeneous diatexites with numerous xenolites ("Schollenmigmatite"), which passes gradually into an inhomogeneous migmatite (xenolites dominate molten parts) and finally into a foliated biotite-plagioclase-gneiss and biotite-quartz-schist. The central part reveals only a very weak deformation thus, prior to age determinations the migmatite forming process was ascribed to the last fundamental thermal event in this area.

Age determinations on zircons of the homogeneous migmatite (Söllner & Hansen 1987) provide a very complex pattern in the Concordia diagram. This can be attributed to the multi-stage crystallisation history of the zircons. Cathodoluminescence (CL) investigations denote three to four different zircon growth phases. Bulk zircon analyses therefore, can always record mixing ages only, without the possibility to detect the real crystallization age of the numerous growth phases.

The only way, to avoid such mixing ages was to use SHRIMP analyses (Sensitive High Resolution Ion Micro Probe). This method allows to focus the analysing beam to a single zircon growth zone an thus, to record real crystallization ages.

In general, the investigated zircons display a detrital core which is positioned asymmetrically and bordered to the rim by rupture or abrasion surfaces. Normally, oscillatory zoning points at the igneous origin of the detrital cores. Ages inferred from these cores vary from Archean to Late Proterozoic. The oldest core age is dated at 2.6 ± 0.02 Ga. Several data concentrate between 1.96 and 2.3 Ga. The most surprising result in core ages denotes a high quantity of Grenville ages (3 of 12 analyses, mean 1 ± 0.04 Ga). This, in addition, implicates a nearby position of the sedimentation area to northern Gondwana **and** a continent which suffered Grenville thermal overprint. Nearly half of the core ages characterize a Panafrican igneous zircon crystallization, separated in different phases. These growth stages coincide well with phases, known from Panafrican orogenic events in northern Gondwana (summarized in SÖLLNER et al. 1997). Ages can be assorted to Pharusian I (818 ± 36 Ma), Pharusian II (677 ± 17 Ma) and Pan-African I with focal points at 639 ± 22 Ma and 610 ± 14 Ma. The large errors, conditional on limited SHRIMP count rates on Late Proterozoic zircons prevent a more exact separation of the igneous phases during Panafrican thermal event.

The detrital cores are all surrounded by a rim which results in the euhedral outer shape of the zircons. The quantity of the rim varies from small to volumetrically dominant. The presence of rims in all zircons clearly demonstrates the in situ growth. This zircon growth can be related to the anatectic event. The inhomogeneous growth conditions may be attributed to a dispersion of the fluid phase during anatexis. This phenomenon may also account for variations in luminescence as sector zoning or irregularly, cloudy to spotted, dark and light domains. In some cases, the anatectic zircon phase is overgrown itself by a very thin rim (up to 5μm) which may be attributed to a final metamorphic thermal overprint in Caledonian [or Variscan?] times.

Age determinations carried out on the anatectic rim display a mean value of 607 ± 13 Ma. Therefore, the anatexis in the Winnebach area has to be attributed to a Panafrican thermal event. Conventional zircon analyses of the migmatite, in any case supply mixing ages. The smaller the crystals are and the more they are metamict, caused by an anomal high U content (up to 1700 ppm U), the more dominates the influence of the Caledonian thermal heating effect in the zircons (SÖLLNER & HANSEN 1987, KLÖTZLI 1999). The Caledonian metamorphic influence on zircons is profound as well, in the surrounding precursor rocks (biotite-plagioclase-gneisses) and in granite-gneiss veins cross-cutting the migmatite (remolten migmatite).

In consequence, the unit named Ötztal Gondwana complex (ÖGC) has to be regarded as a nappe, originated from Gondwana itself or a terrane split from there and subsequently thrust over the sequence of Peri-Gondwana metasediments (ÖPC) and metabasites (ÖOC) in Variscan times (SÖLLNER et al. this volume). The thrust plane is exposed in the Sulztal shear zone. The southwestern to western front of the nappe is well documented in the outcrop of mylonitic biotite-augengneisses.

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