New constraints on the pre-Alpine evolution of the Austroalpine basement: A LA-ICP-MS U/Pb zircon study on the Schladming nappe

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Introduction

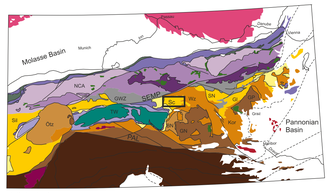


Fig.1 - Geological overview of the Eastern Alps (modified map after Schuster et al., 2015, and Schmid et al., 2004). The Schladming nappe is indicated by the black rectangle.

The southern margin of the Variscan orogen, and with it the pre-Variscian and Variscian continental crust, was incorporated into the Alpine orogenic belt and is therefore obscured through Alpine tectonics. The Schladming nappe (Fig.1), as one of those incorporated pieces, is a part of the Austroalpine basement nappe system. More specific it belongs to the Silvretta Seckau nappe complex which represents the lowermost unit of the Upper Austroalpine nappe system (according to Schmid et al., 2004).

As it is built up of pre-Alpine crystalline basement and overlain by Permomesozoic metasediments, critical information for the pre-Alpine evolution can be gained from these rocks. Preceding work was done by Mandl et al. (2018) in the Seckauer nappe, which can be compared to the Schladming nappe and shows similar results.

In this study the information was conducted so far through U/Pb dating by LA-MC-ICPMS of seven metagranitoid samples from the crystalline basement of the Schladming nappe, as well as from geochemistry. In order to obtain information of the post-Variscan evolution and sedimentation processes, the Permomesozoic cover was also sampled and - so far - three samples were analysed through U/Pb dating of detrital zircons.

As this is an ongoing research, more information can and will be gained from this key area in the near future.

Geochemistry

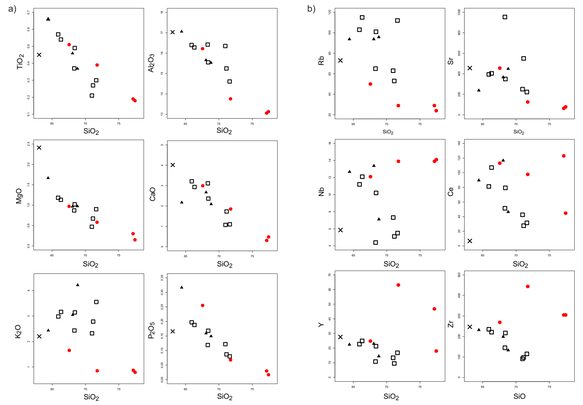


Fig.2 - Bivariate discrimination diagrams of the metagranitoid samples of the Schladminger Tauern. a) main elements b)trace elements. red circles - older age group; black triangles - younger age group; black rectangles & black cross - no age data yet;

The metagranitoids of the Schladming nappe belong to the calc-alkaline magma series and can be classified as peraluminous. Based on their U/Pb zircon age they can be divided into two groups: (1) an Upper Devonian granitoid complex (black triangles in Figs. 2,3,4) and (2) a Furongian/Miaolingian granitoid complex (red symbols in Figs. 2,3,4).

The bivariate discrimination diagrams with major (Fig.2a) and trace elements (Fig.2b) against SiO2 display typical fractionation trends for granitoids where TiO2, Al2O3, MgO, CaO, P2O5 decrease with increasing SiO2. Potassium does not display a clear trend. Trace element trends are negatively correlated with SiO2 for Sr, Nb, Ce, Y and Zr. The trend in Rb is ambigous. Interestingly, HFS elements are typically higher concentrated in the older granite suite (red symbols) while LIL elements are typically low compared to younger granitoid suite (black triangles, Fig.2b).

The chondrite normalized REE pattern (Fig. 4a) exhibits a clear negative Eu-anomaly in all samples of the older age group. In contrast, the younger granitoids display only a slight negative Eu-anomaly. One sample has unusual low LREE.

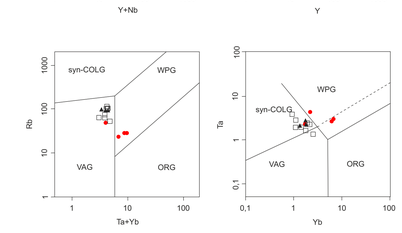


Fig.3 - The metagranitoid samples of the Schladminger Tauern in the Granite tectonic discrimination plot after Pearce et al., 1984. red circles - older age group; black triangles - younger age group; black rectangles - no age data yet

The MORB normalized plot (Pearce, 1983, Fig.4b) shows a higher enrichment in LIL elements for the younger granitoids, while the older group has higher HFS contents and a strong depletion in P. Both suites have negative trends in Ti and Nb, typical for subduction related magmatic rocks.

The granite tectonic discrimination diagrams after Pearce et al., 1984 (Fig.3) confirms a Volcanic Arc Granite (VAG) setting for the younger age group. The older age group plots predominantly in the Within Plate Granite (WPG) field.

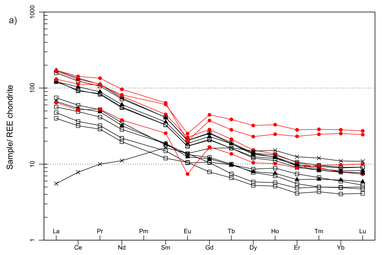
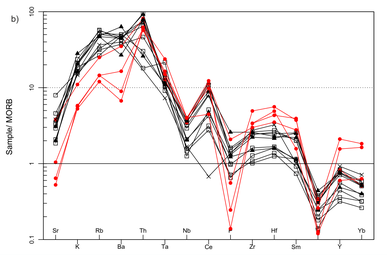


Fig.4 - a)Spider plot of sample against REE chondrite of the Metagranitoid samples after Nakamura, 1974; b) Spider plot of sample against MORB of the same samples after Pearce, 1983 red circles - older age group; black triangles - younger age group; black rectangles and black cross - no age data yet



U/Pb ages Metagranitoids - Preliminary Results

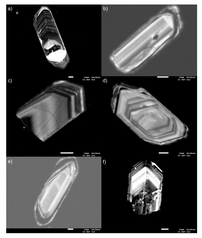


Fig.5 - CL-pictures of some representatitve zircons of the metagranitoids. a) to c) represent the younger cluster; d) to f) the older cluster

Zircons of the metagranitoid samples from the Schladminger nappe were dated by LA-MC-ICPMS at the NAWI Graz Central Lab for Water, Minerals and Rocks (University of Graz and Graz University of Technology). The obtained results gave two different age groups, a (1) metagranitoid suite with an Upper Devonian age and (2) a second suite with a Furongian/Miaolingian age.

The older event is so far confirmed through four samples (Fig.6c-f) displaying concordia ages between 488.6 Ma ± 6.7 Ma to 498.9 Ma ± 4.5 Ma (Table 1). The zircons mostly show fine oscillatory zoning (Fig.5a-c) and slightly yellowish coloring. Some grains display typical characteristics of metamictization which were not used for age dating.

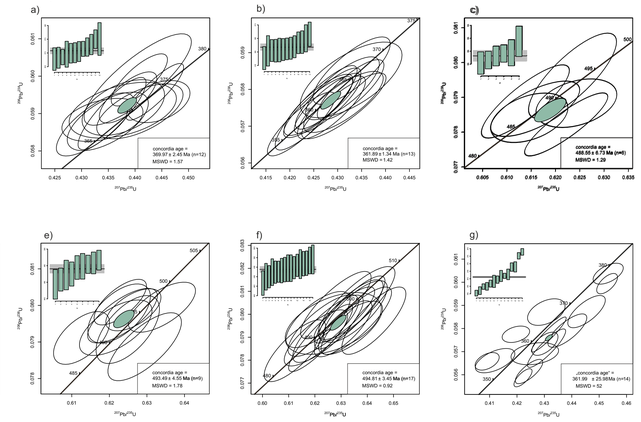
The second, younger event, which was measured in two samples so far (Fig.6a-b), is given by concordia ages of 361.9 Ma ± 2.5 Ma and 369.9 ± 1.3 Ma. The zircons exhibit clear coloring, and less dense oscillatory zoning (Fig.5d-f). A few grains have well developed cracks and inclusions. These were also excluded from measurement.

	Concordia ages
older event:	488.55 ± 6.73 Ma
	498.85 ± 4.50 Ma
	493.49 ± 4.55 Ma
	494.81 ± 3.45 Ma

	Concordia ages
younger event:	369.97 ± 2.45 Ma
	361.89 ± 1.34 Ma
	361.99 ± 25.98 Ma

Table 1. - grouping of the Concordia ages of Fig. 6 into two events

Fig.6 - Cluster concordia plots of the metagranitoids of the Schladminger Tauern, with additional weighted means. a) and b) are depicting the younger event, while c) to f) represent the older ages within the samples. g) not well defined concordia cluster, which can be associated to overprinting metamorphism



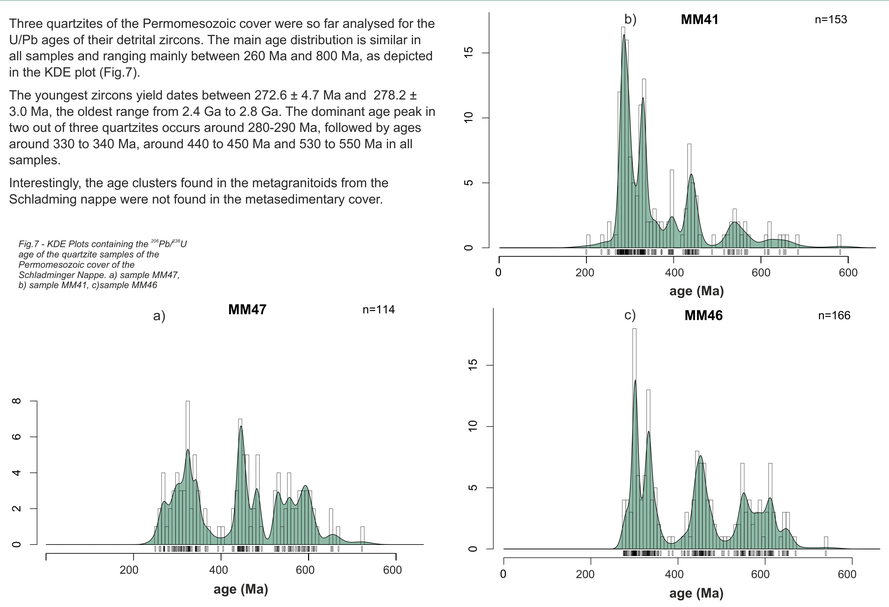
Detrital U/Pb ages - Preliminary Results

Three quartzites of the Permomesozoic cover were so far analysed for the U/Pb ages of their detrital zircons. The main age distribution is similar in all samples and ranging mainly between 260 Ma and 800 Ma, as depicted in the KDE plot (Fig.7).

The youngest zircons yield dates between 272.6 ± 4.7 Ma and 278.2 ± 3.0 Ma, the oldest range from 2.4 Ga to 2.8 Ga. The dominant age peak in two out of three quartzites occurs around 280-290 Ma, followed by ages around 330 to 340 Ma, around 440 to 450 Ma and 530 to 550 Ma in all samples.

Interestingly, the age clusters found in the metagranitoids from the Schladming nappe were not found in the metasedimentary cover.

Fig.7 - KDE Plots containing the $^{206}Pb/^{238}U$ age of the quartzite samples of the Permomesozoic cover of the Schladminger Nappe. a) sample MM47, b) sample MM41, c)sample MM46



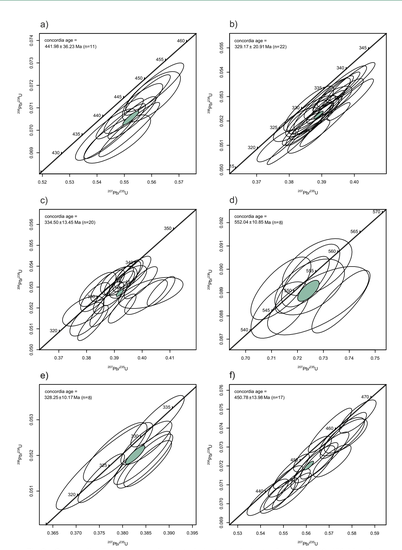


Fig.8 - Concordia diagrammes of selected clusters. a) cluster for peak 440-450 Ma of sample MM41. b) cluster for peak 330-340 Ma of sample MM41. c) cluster for peak 330 to 340 Ma of sample MM46. d) cluster for peak 530 to 550 Ma of sample MM46. e) cluster for peak 330 to 340 of sample MM47. f) cluster for peak 440 to 550 Ma of sample MM47.

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