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THE METAMORPHIC EVOLUTION OF THE ORTLER CRYSTALLINE

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In the Martell valley (western Südtirol) the Martell granite intrudes into medium-grade micaschists and paragneisses of the Ortler crystalline basement.

The intrusion is situated at the lithological and tectonical contact of three different units: a) the Laaser series, characterized by intensely deformed, mylonitic amphibolites, micaschists, paragneisses and almost pure marbles; b) the Martell Micaschists, which are a more or less homogeneous stack of Grt-Sta-Bt-bearing micaschists; c) The Zebru Schuppenzone: this unit consists mainly of quartzphyllites with small intercalations of greenschists, quartzites and impure marbles. The Martell Granit forms an inhomogenous intrusive body consisting of prevalent coarse grained leucogranitic, pegmatitic and minor fine-grained aplitic rock types, and an extensive surrounding dyke swarm. This study was performed to get information on the age of the Martell granite and its relationship to the different surrounding country rock units.

Sample RS32/01 represents a fine-grained Martell granite with a mineral assemblage of Pl + Kfp+ Qtz + Ms + Grt ± Trm ± Bt. It was collected in the central region of the intrusive body at the road near to St. Johannhütte in the central Martell valley. The whole rock (WR) and two garnet fractions (Grt1, Grt2) where analyzed by the Sm-Nd method. The two garnet separates show quiet similar Sm contents (1.50 ppm and 1.76 ppm), but different Nd contents (0.38 ppm and 0.15 ppm). For this reason they show different $^{147}Sm/^{144}Nd$ ratios of 2.5 and 6.69 respectively. Most probable the garnet separate with the lower spread Grt1 is contaminated by a Nd-rich, Sm-poor phase. The isochron age calculated with all three data points is 279 ± 24 Ma. Calculations of the individual garnet separates with the whole rock yield 291 ± 3 Ma and 277 ± 3 Ma respectively. The Ar-Ar age determination of the magmatic muscovite from the same sample yielded a plateau type spectra and a value of 250 ± 2 Ma.

From the road along the Zufritt Lake a coarse-grained pegmatite dyke (RS33/01) outcropping at the rim of the Martell granite with a mineral assemblage of Pl + Kfp+ Qtz + Ms + Grt + Trm was sampled. The rock is characterized by a primary magmatic foliation and a slight overprint of mylonitic greenschist-facies deformation. The garnets have low Sm (1.05 ppm) and Nd (0.16 ppm) contents and a $^{147}Sm/^{144}Nd$ ratio of 4.08. The Sm-Nd garnet-whole rock age is 274 ± 3 Ma. For the same sample a Ar-Ar plateau type age of 230 ± 3 Ma has been measured on a coarse-grained muscovite.

A fine-grained quartzphyllite (RS35/01) from the Zebru Schuppenzone was collected to the west of the Zufritt Lake, about 10 m to the west of the Zebru line that separates the Zebru Schuppenzone from the Martell Micaschists. It is characterised by a mineral assemblage of Ms + Chl + Qtz + Pl ± Grt. Garnet is scarce and up to 1cm in diameter, whereas biotite or chloritoid has never been found in this unit. The rock shows a S-C deformation or crenulation cleavage respectively, which indicates NNW-directed ductile deformation. The muscovites from this sample yielded a plateau type age spectra of 87 ± 2 Ma.

Three samples from the Martell Micaschists were investigated. The first one, a typical staurolite-garnet micaschist (RS34/01) was collected near the sample described above, less than 10 m to the east of the Zebru fault, not far from the top but outside the small contact aureola of the granite. The rock shows a planar schistosity and extended planar layers of quartz lenses and bands. Staurolite crystals up to 2 cm in length crosscut the schistosity. Muscovite from this sample yielded a total gas age of 170 ± 4 Ma with individual age steps of 154 to 186 Ma. The biotite Rb-Sr age from the same sample is 86 ± 1 Ma.

From the Peder valley ca. 3 km W of the sampling point described above a staurolite-garnet micaschist (RS36/01) was used for dating. It is rich in up to several centimeters large and perfectly crystallized postdeformative staurolite porphyroblasts, which occur in a fine-grained, graphitic white mica matrix. Further up to several millimeters large garnet and biotite porphyroblasts are present. The Ar-Ar muscovite age spectra from this sample is saddle shaped and yielded a total gas age of 196 ± 3 Ma. The individual steps are in the range of 176 to 208 Ma. The Rb-Sr age of the biotite porphyroblasts is 138 ± 2 Ma.

Another staurolite-garnet micaschist from the Laaser Spitz (RS37/01) ca 6 km N of the Zufritt lake is also rich in staurolite. However, the individual crystalls are only up to 1 cm in size and form black, elongated batches without sharp crystall edges. Muscovite from this sample yielded also a saddle shape spectra with a total gas age of 195 Ma and individual steps of 177 to 209 Ma.

Based on a Rb-Sr-WR-isochron BOCKEMÜHL [1] postulated a Lower Permian age (271 Ma) for the Martell granite. The new data prove this age and argue for a intrusion at about 275 Ma. The Ar-Ar ages of the muscovites are 250 and 230 Ma in age. However, these age values have to been taken with care, because micas from pegmatitic rocks often contain excess argon. In addition, an eo-Alpine overprint of the rocks has to be considered, which, as implied by the deformation structures of the granite, increases from the center to the border of the intrusion leading to an increasing rejuvenation of the ages.

The medium-grade staurolite-garnet micaschists of the Martell Micaschists yielded pre-Alpine Ar-Ar muscovite ages in the range of 170 to 196 Ma and a Rb-Sr biotite age of 138 Ma (sample RS36/01). These ages might be interpreted as Permo-Triassic cooling ages or Variscan ages partly reset during the eo-Alpine tectonometamorphic event. One argument for the first possibility is that ages of c. 200 Ma are typical for areas, which contain Permian pegmatites [2]. Several arguments though argue for the second possibility: The Variscan amphibolite facies mineral assemblage garnet + staurolite + biotite + plagioclase + quartz is partially replaced and/or overgrown by the eoalpine greenschist facies assemblage of garnet + plagioclase + biotite + musco-

vite ± chloritoid + paragonite ± margarite. In addition the eo-Alpine deformation features such as folds and mylonites are of medium to high greenschist facies with generally decreasing temperatures from NE to SW.

The sample RS34/01, collected from the uppermost part (at the SW-end) of the Martell Micaschist unit near the Zebru fault, indicates some rejuvenation, and shows a typical eo-Alpine Rb-Sr age of 86 Ma. As the blocking temperature for the Rb-Sr system in biotite (c. 300°C) is much lower than that for the Ar-Ar system in muscovite (c. 40°C) it implies eo-Alpine temperatures between 300 and 400°C for this area at the contact with the Zebru Schuppenzone.

The quartzphyllite of the Zebru Schuppenzone sampled a few meters above the Zebru fault shows an eo-Alpine muscovite age of 87 Ma. Since the staurolite micaschists immediatly underlaying the Zebru fault show Ar-Ar muscovite age of 170 Ma and a typical eo-Alpine Rb-Sr age of 86 Ma, it seems clear that the Zebru fault is eo-Alpine in age. In addition the quarzphyllites of the Zebru Schuppenzone have to be considered as a separate tectonic unit with a slightly higher eo-Alpine overprint than the underlying rocks. This is in strong contrast to previous investigations by [3], [4] and [5] reported also in [6], which argued that the quartzphyllites were the strongly retrogressed pendants of the underlying micaschists.

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