The crystalline basement of the Seewinkel (Burgenland/Austria): Petrological and geochronological data enable a first tectonic correlation

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INTRODUCTION

During this study cores of six OMV drill-holes reaching the pre-Neogene basement in the Seewinkel area (Burgenland) are investigated. The aim of the study is to get more information on the distribution of the tectonic units in the subsurface of the northwestern corner of the Pannonian basin. This area is of special interest, because it covers the transition of the Austroalpine to the West Carpathian units. At present the correlation of the Austroalpine and Western Carpathian units is under discussion and it is not clear whether these units are laterally neighbouring or whether one of them is tectonically overlying (Fig. 1, Fig. 2).

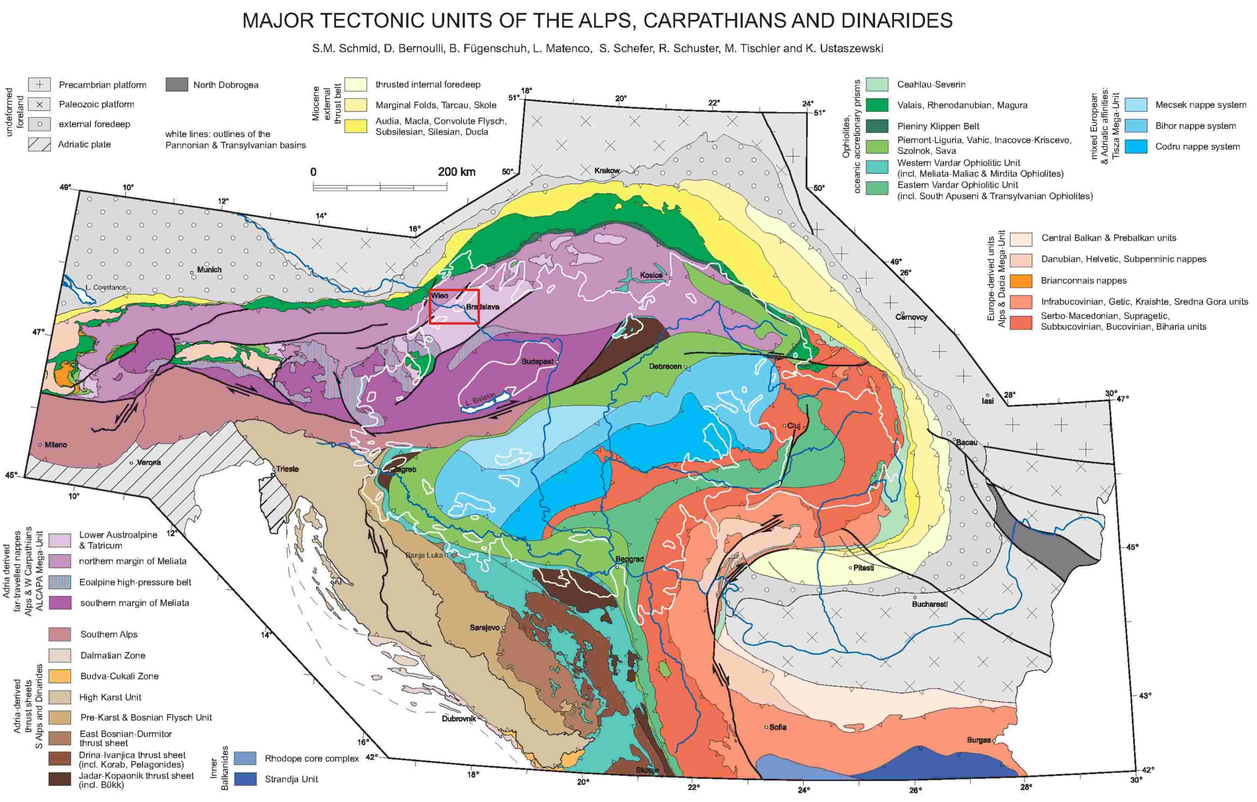

Fig. 1: Tectonic map of the Alps, Carpathians and Dinarides according to SCHMID et al. (2008). The red square shows the area of Fig. 2.

SAMPLE LOCALITY AND LITHOLOGY

The locations of the drill-holes are shown in the map in Fig. 2 (WESSELY et al., 1993) . The cores cover the uppermost 5 to 55 m of the basement below the Carpathian transgressional series between 1200 to 2115 m below the surface. In the area of Halbturn the basement consists of weekly deformed meta-granodiorite to granodiorite gneisses (**Ha 1**, Fig. 3A, 3D) and garnet-rich paragneisses (**Ha 2**, Fig. 3E). Northwest of Pamhagen fine-grained, garnet-bearing paragneisses of epidote-amphibolite facies metamorphic grade occur (**Ap 1**, Fig. 3F; **Pam** 2, Fig. 3G). To the east of Pamhagen (**Pam 1**, **Ta 1**) quartz-rich meta-conglomerates (Fig. 3B), meta-arcoses, quartzites and quartzphyllites were drilled.

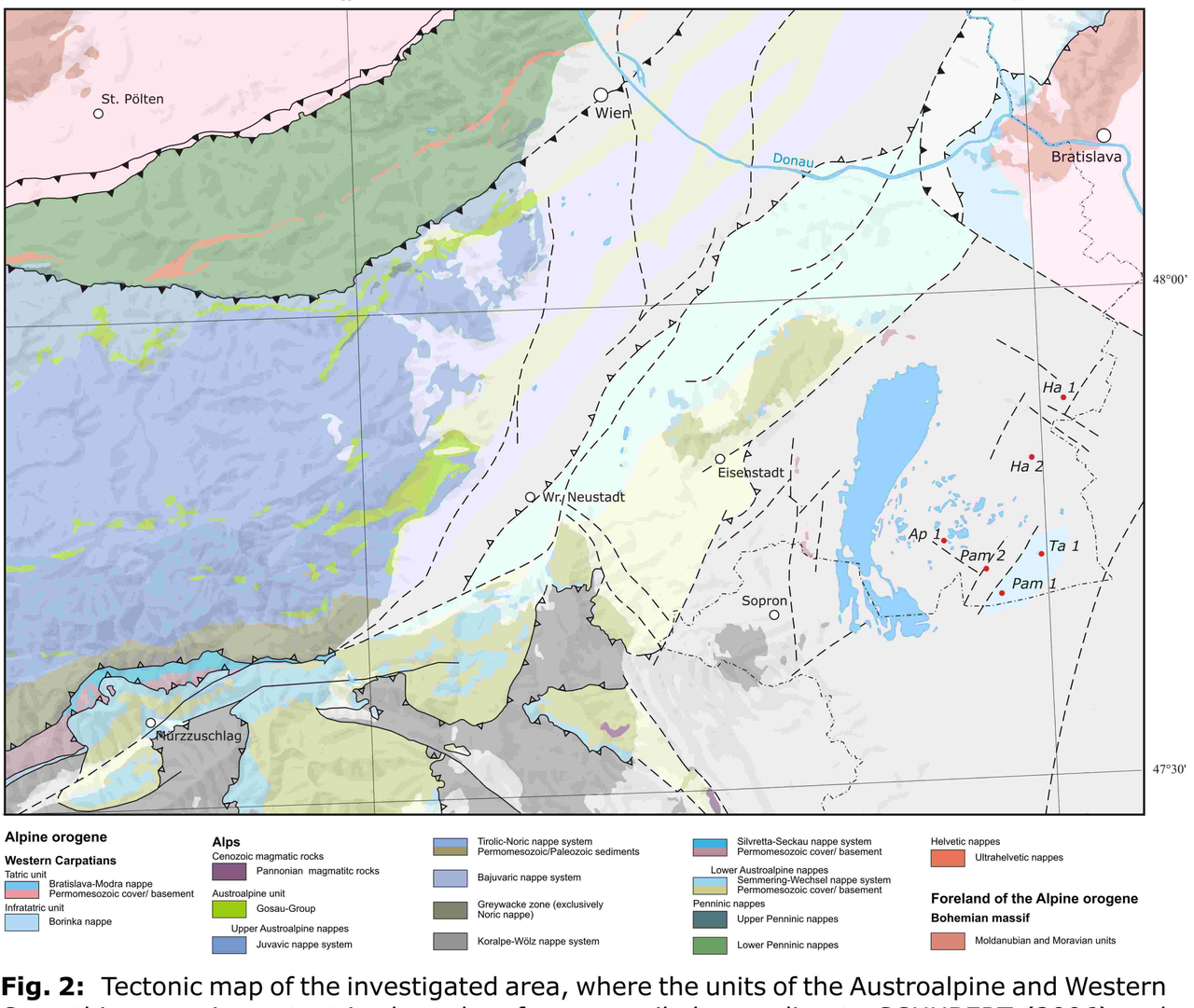

Fig. 2: Tectonic map of the investigated area, where the units of the Austroalpine and Western Carpathians are in contact in the subsurface, compiled according to SCHUBERT (2006) and WESSELY et al. (1993). Based on the regional metamorphic zoning and the correlation of the individual units we suggest that the Tatric unit is the tectonically uppermost element which was thrusted onto the margin of the Austroalpine nappe stack. Further the localities of the investigated drill-holes are given (WESSELY et al., 1993).

PETROLOGY

In the basement around Halbturn the granodiorite gneisses of core **Ha 1** exhibit zones of week deformation with augen texture (Fig. 3D). Dynamic recrystallisation of plagioclase and green biotite, as well as newly formed epidote/clinozoisite and chlorite indicate a deformation temperature of around 500°C.The garnet of the paragneisses from core **Ha 2** reach up to 1 cm in diameter (Fig. 3E). The occurrence together with biotite-muscovite-plagioclase-quartz documents a peak metamorphism in epidote-amphibolite-facies. Similar to **Ha 1** plagioclase shows dynamic recrystallisation under comparable conditions.
Fine-grained garnet-bearing paragneisses northwest of Pamhagen (**Ap 1**, **Pam 2**) contain the assemblage garnet-biotite-muscovite-plagioclase-quartz. In the core **Pam 2** additionally amphibole and clinozoisite are present (Fig. 3G). These minerals give evidence to peak metamorphism in epidote-amphibolite-facies and intense dynamic recrystallisation is recorded in the core **Ap 1** (Fig. 3F).
The metasediments east of Pamhagen are bright coloured and contain no biotite and even no chlorite (**Pam 1**, **Ta 1**). Preserved clasts of K-feldspar and plagioclase as well as recrystallised feldspars characterise the prograde greenschist-facies metamorphism in a quartzitic meta-arcose (Fig. 3G). Especially the uppermost parts of the cores exhibit an intense tectonic brecciation (Fig. 3C). The tectonic character of the breccias is evidenced by monomict clasts and initial quartz recrystallisation along shear planes (Fig. 3H). On top of the tectonic breccia a sedimentary breccia with red carbonaceous matrix occurs (Fig. 3I).

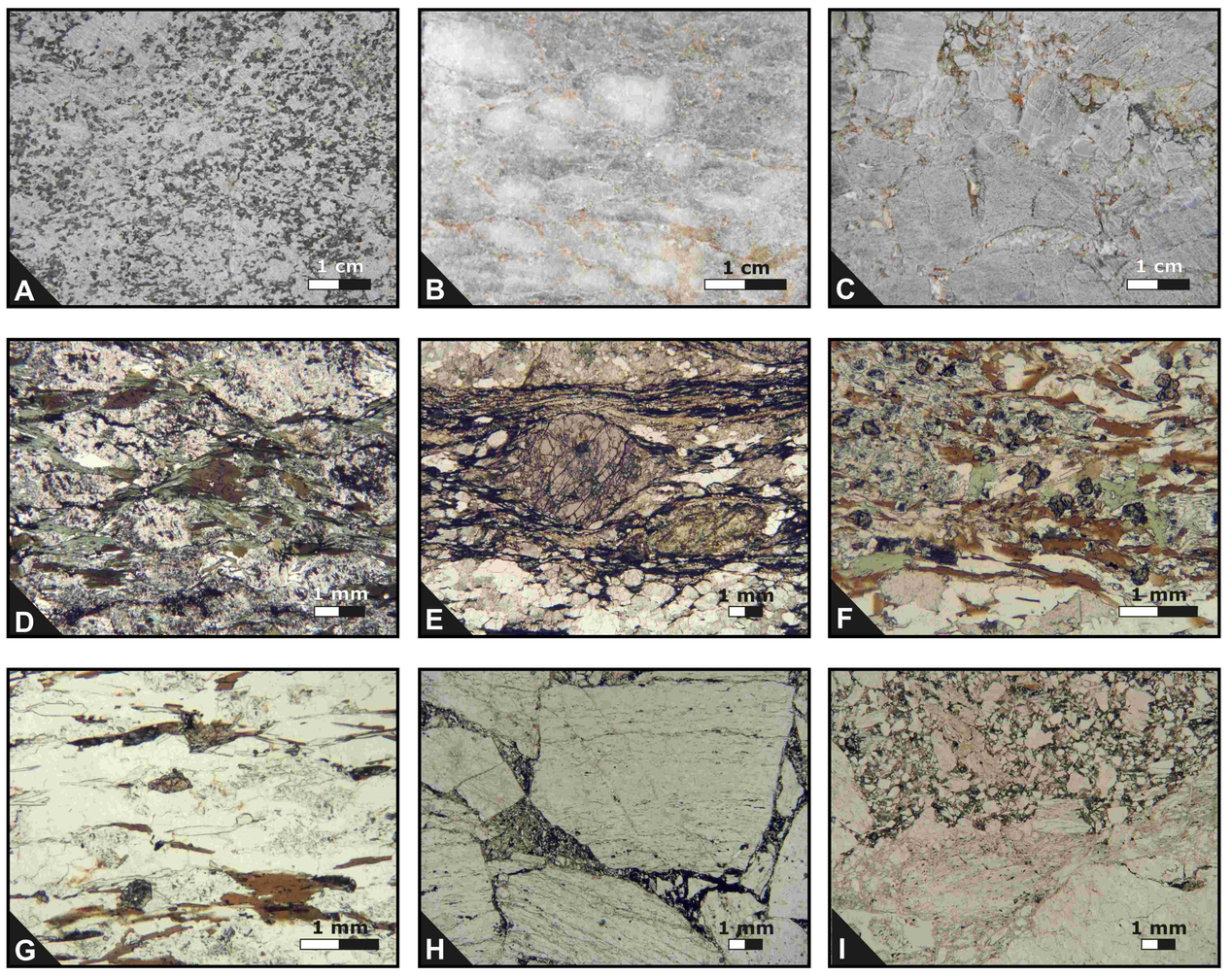

Fig. 3: Drill-samples - A) Core **Ha 1**, Meta-granodiorite with altered plagioclase and green biotite. B) Core **Pam 1**, Meta-conglomerate with quartz pebbles. C) Core **Pam 1**, Tectonic breccia in quartzitic meta-arcose.
Thin-sections - D) Core **Ha 1**, Granodiorite gneiss with augen texture. Dynamic recrystallisation of plagioclase indicates a deformation temperature of around 500°C. E) Core **Ha 2**, Garnet-rich paragneiss with coarse-grained garnet, plagioclase, green biotite and muscovite indicates at least epidote-amphibolite facies metamorphism. F) Core **Ap 1**, Fine-grained garnet paragneiss with dynamic recrystallisation. G) Core **Pam 2**, Garnet-amphibole paragneiss with fine-grained garnet, amphibole and clinozoisite accounts for a peak metamorphism in the epidote-amphibolite facies. H) Core **Pam 1**, Tectonic breccia in quartzitic meta-arcose. Within the clasts greenschist-facies metamorphism is preserved. The tectonic character of the breccia is evidenced by monomict clasts and initially quartz recrystallisation along shear planes. I) Core **Pam 1**, A tectonic breccia out of quartzitic meta-arcose (light quartz matrix) is overlain by a sedimentary breccia (dark carbonaceous matrix). This sedimentary breccia contains typical clasts of muscovite and additionally tourmaline which is missing in the meta-arcose.

GEOCHRONOLOGY

A Rb-Sr biotite age determination on greenish biotite from granodiorite gneiss of core **Ha 1** yielded a Late Cretaceous cooling age of 86±1 Ma (Fig. 4A). The gneiss shows a low 87Sr/86Sr ratio (0.704943) typical for an I-type magmatic rock. The calculated age for biotite from core **Ha 2** is 28.7±0.3 Ma (Fig. 4B). However, this value has to be taken with caution because of the low spread in the 87Sr/86Sr ratio (26.6) and the high Sr content of biotite (34.6 ppm). For biotite from a paragneiss of core **Ap 1** a Late Cretaceous cooling age of 75.4±0.8 Ma was determined (Fig. 4C).

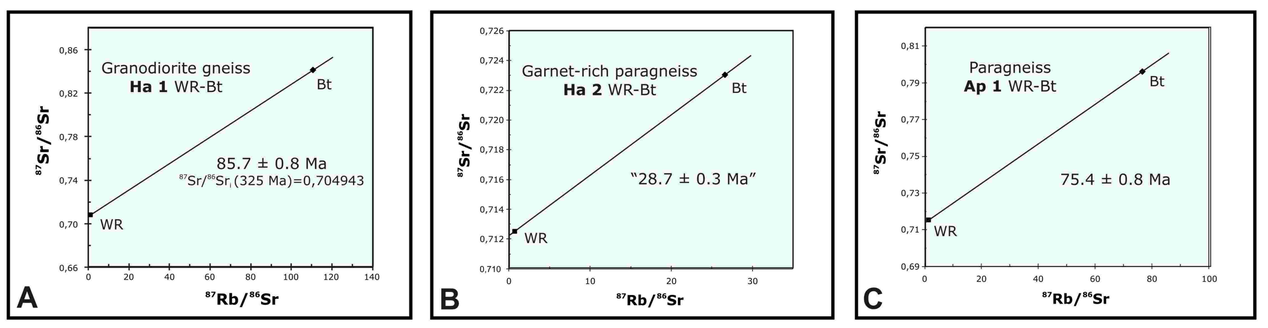

Fig. 4: Rb-Sr biotite ages of drill-samples from the Seewinkel area.

DISCUSSION AND CONCLUSION

Summarising the data large parts pre-Neogene basement of the Seewinkel consists of epidote-amphibolite facies metamorphic rocks with an upper greenschist facies metamorphic overprint. The age of the epidote-amphibolite facies imprint is not known until now, but most probably it occurred during a pre-Alpine (probably Variscan) event. Due to the Late Cretaceous cooling ages of biotite the retrograde overprint is related to the eo-Alpine event. With respect to the Oligocene Rb-Sr biotite age it might be possible that some parts of the basement cooled down in the Cenozoic. The prograde greenschist metamorphic rocks east of Halbturn are located on the eastern side of a fault scarp shown in the map by WESSELY et al. (1993). Based on petrographic characteristics they may represent (Late Carboniferous?) Permian to Lower Triassic siliziclastic sediments similar to those in the Schladminger and Seckauer Tauern ("Rannach Series").

The consistent polymetamorphic history of the investigated rock series allows a correlation with basement units outcropping in surrounding areas. The basement of the Seewinkel cannot resemble the Tatric unit of the Little Carpathians because the latter is characterised by pre-Alpine cooling ages, indicating less than 300 °C during the Alpine event. The Lower Austroalpine unit in the Leithagebirge shows an intense Alpine phyllonitisation, which causes the more or less complete transformation of biotite to chlorite in most of the lithologies. Further there are no lithological similarities. The crystalline rocks of the Ruster Höhenzug and in the area of Jois show variable lithology with frequent biotite. Ar-Ar muscovite and Rb-Sr biotite ages are partly or fully reset during the eo-Alpine event (FRANK et al. 1996). However, no Permo-Triassic sedimentary cover is known from this basement.

In our interpretation the basement of the Seewinkel can be correlated with units of the Silvretta-Seckau nappe system of the Schladminger and Seckauer Tauern, which are overlain by Permian to Lower Triassic clastic sediments with a greenschist facies metamorphic imprint during the eo-Alpine event.

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