



$^{40}\text{Ar}/^{39}\text{Ar}$ dating of Miocene tuffs from the Styrian part of the Pannonian Basin, Austria: first attempts to refine the Paratethys stratigraphy

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Knowledge on absolute age data is crucial to establish stratigraphic correlations and for the knowledge on the duration of geological processes, particularly for the Paratethyan realm.

With this presentation we want to proof the usability and reliability of $^{40}\text{Ar}/^{39}\text{Ar}$ step-wise heating technique using a defocused infra-red laser. As an example few volcanic minerals separated from Miocene tuffs at three sampling sites within the Styrian basin have been selected in order to constrain the absolute age of volcanism and coeval sedimentation.

The $^{40}\text{Ar}/^{39}\text{Ar}$ method of dating seems to be the most suitable tool for dating young volcanic and volcanoclastic rocks, because: (1) it is not necessary to correlate isotopic analyses of the volcanic minerals with analyses from whole-rock samples, as is necessary, for instance, in Rb-Sr dating; (2) because of the high abundance of potassium, errors obtained from Ar-isotopic analyses are much lower, compared to other methods, e.g. errors reported for zircon fission track dating generally range between 5 – 10% of the age, whereas in ideal cases errors of less than 1% of the age can be obtained from $^{40}\text{Ar}/^{39}\text{Ar}$ analyses; (3) compared to the conventional K-Ar method of dating, the advantage of $^{40}\text{Ar}/^{39}\text{Ar}$ analyses is some kind of control on the intra-grain Ar-isotopic

distribution, i.e. alterations of the volcanic minerals, as well as loss or incorporation of extraneous ^{40}Ar -components can be detected by the Ar-release spectra in combination with inverse isochron plots.

Retznei: A first description of volcanic rocks within the sedimentary succession exposed in the quarry of Retznei can be found in Hauser (1951), who describes an “andesite” in the hangingwall-part of this quarry. Today it is accepted to be rather a volcanoclastic than a volcanic rock, which has been deposited in a kind of patches above the consolidated and eroded (?) Leitha Limestone of Badenian age. From this layer a biotite concentrate has been prepared. Although slightly weathered, it was possible to separate one fresh biotite (125-250 μm) and one fresh, coarse-grained (0.5-1.0 mm) sanidine concentrate. Ar-release plots of a biotite bulk-grain concentrate (30 grains) and a concentrate of three sanidine crystals, both display fairly flat release-patterns with minor fluctuation in the low-energy gas-release steps. From the statistical point of view the biotite concentrate yielded a high-precision age of 14.206 ± 0.066 Ma, the three sanidine crystals yielded 14.39 ± 0.12 Ma. The geochronologic ages obtained match the biostratigraphic record (Upper Lagenide Zone) as described by Friebe (1990).

Pöls: Volcanoclastic rocks are intercalated within the Floriani Fm., for which Kopetzky (1957) suggested a Lower Badenian (16.4 – ca. 15 Ma; according to Rögl 1996) age based on biostratigraphic observations on molluscs and foraminifers. K-Ar whole-rock ages of 16.6 ± 0.6 Ma and 15.1 ± 0.5 Ma have been reported from this site by Balogh et al. (1994) and are well in agreement with the biostratigraphic ages. We analysed a concentrate of two clear sanidine crystals (0.5-1.0 mm), which yielded a perfect Ar-plateau recording an age of 15.75 ± 0.17 Ma. Our age obtained from two sanidine crystals confirm the previously published results (Balogh et al. 1994).

Well Hörnsdorf: A deep-drilling project reached the pre-Tertiary basement at a final depth of 265 m (for a lithostratigraphic description see Gruber et al., 2003). In the hangingwall the basement is overlain by the Eibiswalder Fm. for which a Karpatian age is assumed. Within fine-grained strata a ca. 30 cm thick layer of coal is intercalated, which is correlated to the “Eibiswalder coal seam” by Gruber et al. (2003). Few meters in the hangingwall, several sand dominated horizons and two layers of crystal tuff are intercalated. From both tuff horizons one biotite (> 1 mm) concentrate each has been separated. Ar-analysis of one biotite single-grain from the stratigraphic older sample yielded a slightly disturbed Ar-release pattern recording a plateau-age of 15.22 ± 0.17 Ma. Ar-analysis of a biotite single-grain from the hangingwall sample again displays a slightly disturbed Ar-release spectrum, however, from a statistical point of view a high-precision plateau-age of 15.078 ± 0.087 Ma is defined. Based on mammal fauna, Mottl (1970) a Karpatian age (ca. 17.2 – 16.4 Ma; according to Rögl 1996) has

been postulated for the coal from Eibiswald. Our new age data, which have been obtained from two tuff-samples just a few meters in the hangingwall of this coal horizon, however argue for a younger, i.e. Badenian (16.4 – 13.0 Ma; according to Rögl 1996) age for the Eibiswald coal. However, according to Rögl's (1996) stratigraphic correlation, the Mammal zone MN6-5 covers an absolute age span from ca. 17.0 – 13.0 Ma, which corresponds to nearly the whole Karpatian **AND** Badenian stage. Therefore we interpret our data not to contradict earlier biostratigraphic observations, but to better constrain the absolute age of volcanic activity and coeval sedimentation.

References:

BALOGH, K., EBNER, F. & RAVASZ, C. (1994): K/Ar-Alter tertiärer Vulkanite der südöstlichen Steiermark und des südlichen Burgenlandes.- Jubiläumsschrift 20 Jahre Geologische Zusammenarbeit Österreich - Ungarn **Teil 2**: 55-72.

FRIEBE, J.G. (1990): Lithostratigraphische Neugliederung und Sedimentologie der Ablagerungen des Badenium (Miozän) um die Mittelsteirische Schwelle (Steirisches Becken, Österreich).- Jb. Geol. B.-A. **133** (2): 223-257.

GRUBER, W., HERMANN, S., SACHSENHOFER, R.F. & STINGL, K. (2003): Kohlefazies und Sedimentologie der Eibiswalder Bucht (Miozän, Steirisches Becken).- Mitt. Österr. Geol. Ges. **93**: 15-29.

HAUSER, A. (1951): Ein Vorkommen von Biotitandesit in Retznei bei Ehrenhausen.- Tscherm. Mineral. Petrogr. Mitt. **2** / **Folge 3**: 157-165.

KOPETZKY, G. (1957): Das Miozän zwischen Kainach und Laßnitz in Südweststeiermark.- Mitt. Mus. Bergbau, Geol. Techn. Landesmus. Joanneum **18**: 1-112.

MOTTL, M. (1970): Die jungtertiären Säugetierfaunen der Steiermark, Südostösterreich.- Mitt. Mus. Bergbau Geol. Techn. Landesmus. Joanneum **31**: 1-92.

RÖGL, F. (1996): Stratigraphic correlation of the Paratethys Oligocene and Miocene.- Mitt. Ges. Geol. Bergbaustud. Österr. **41**: 65-73.