



Prevailing stratospheric easterly wind direction in the Paratethys during the Lower Badenian: Ar-Ar- and Nd-isotopic evidence from rhyolitic ash layers in the Upper Freshwater Molasse, S-Germany

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Paleo-wind patterns are essential puzzle-stones in reconstructing paleoclimatic conditions. It was previously suggested (Ref. 1) that bentonite-related, plinian-type rhyolitic tuffs embedded in ca. 15 Ma old sediments of the Upper Freshwater Molasse (UFM) in southern Germany derived from the Pannonian Basin, E-Hungary. Such a scenario implies westward transport of the volcanic ashes by up to more than 1.000 km and will imply easterly winds at stratospheric highs (~20 km).

To investigate this important issue, we have sampled several up to six meter thick rhyolite tuffs of the UFM, to test if they can be related to Central Paratethyan rhyolites or not, both with respect to age and isotopic composition. We applied replicate Ar-Ar analyses to Ries impact glasses and four rhyolitic tuff samples. The data indicate that the different and spatially isolated occurrences of the so-called main bentonite are not the product of a single magmatic puls but were delivered over a period of more than 1.5 million years, both before and after the Ries event (14.89 ± 0.10 Ma). In detail, ages range from about 16.10 ± 0.30 Ma (Zahling tuff) through 15.45 ± 0.10 Ma (Krumbad bentonite) to 14.69 ± 0.19 Ma Hachelstuhl bentonite) and 14.54 ± 0.14 Ma (Hegau bentonite). Several rhyolite occurrences ranging in age between 15 and 17 Ma have recently been reported from Carpathian-Pannonian region (Ref. 2) and

underline this area as a potential source of the UFM tuffs. We have further analysed tuff samples from eight different UFM localities with respect to their Nd isotopes and Sm/Nd ratios. The results are highly consistent and identical within error, ranging between $^{143}\text{Nd}/^{144}\text{Nd} = 0.512419$ and 0.512432 (initial values). This indicates that, despite of their different ages, all samples are genetically related and may possibly be derived from a single volcano (field), which must have been active and isotopically uniform for at least 1.5 million years. 15 Ma old Carpathian-Pannonian rhyolites from at least three different locations from the Bükk foreland and the Dej tuff complex have a Nd isotopic composition that is identical to that of our samples. Thus, both the age and isotopic constraints strongly suggest a Carpathian-Pannonian origin of the UFM rhyolitic tuffs.

Today, easterly stratospheric winds in the European mid-latitudes occur only during the summer season. The frequent occurrence of rhyolitic tuffs in S-Germany which originated in the Central Paratethys could therefore suggest that during the Miocene Climate Optimum (Lower Badenian) this type of stratospheric circulation was temporally more dominant.

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(1) Boehme, M., *Geology* 32 (5): 393-396, 2004. (2) Seghedi I. et al., *Lithos* 72: 117-146, 2004.