

An attempt at chronostratigraphic and maximum burial dating of bentonites within the Cretaceous/Paleogene sequence in the Outer Carpathians (Poland)

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In burial diagenetic settings, the mixed-layer illite-smectite (I/S) in non-contaminated bentonite is a product of progressive diagenesis. The grade of transformation from smectite to illite correlates with paleotemperature attained at maximum burial depth. In this context, the I/S is useful for dating of maximum burial. However, there are factors which can modify this simple relationship like, for instance, the local source of potassium and duration of burial.

Bentonitized tuffites occur at numerous sites within the sedimentary sequence in the Polish segment of the Outer Carpathians (Cieszkowski et al., 2006 and references therein). However, it follows from previous studies from this region, that only strata which underwent paleotemperatures >100 °C, may contain bentonites with diagenetic I/S convenient for K-Ar dating of maximum burial. Therefore, in present studies, sampling was restricted to regions where maximum paleotemperatures in claystones exceed 100 °C.

Bentonite samples were collected at 18 sites, mostly hitherto unreported ones. The sampled strata are from Cenomanian/Turonian up to Oligocene in age. Ten sites are located in the Magura nappe, 2 sites in the Dukla nappe and 6 sites in the Silesian nappe. The sampled bentonite layers are 1 cm to 1 m thick. At two sites, sampling was performed in hemipelagic sequences whereas at the remaining sites mudstone and claystone intercalations within turbidites were sampled.

Clay fraction (<0.2 micrometer) was analysed by X-ray diffraction (XRD) in all samples of bentonites and adjoining claystones. The degree of smectite to illite transformation was determined and maximum paleotemperatures were calculated using grade of the transformation in claystones. Based on the results of XRD analysis, most of bentonite

samples were excluded from further studies due to strong contamination by detrital illite. Therefore, K-Ar dating of I/S for maximum burial was carried out for three clay fractions (<0.02, 0.02–0.05 and 0.05–0.2) for only 8 samples of bentonites. The K-Ar dates for particular fractions for these particular samples show strong differentiation, except one Cretaceous sample from the Magura nappe. Only 3 bentonite samples do show maximum burial age younger than their stratigraphic age. These ages range from 22 to 48 Ma for the Eocene bentonite, 41–56 Ma for the Paleocene bentonite, and 43–44 Ma for the Cenomanian/Turonian bentonite, respectively. For determination of chronostratigraphic age of bentonites, U–Pb dating of zircons was performed using SHRIMP method for grains, separated from the oldest and youngest samples. The ages of analysed grains are significantly older than stratigraphic age of the host strata. The grains show mostly Paleozoic ages indicating contamination of bentonites. These results show that obtained maximum burial K-Ar ages of bentonites in both samples are too old. Summing up, bentonites within turbidite and hemipelagic sequences of the Outer Carpathians are: (i) mostly contaminated and, therefore, (ii) largely useless for K-Ar dating of I/S and U-Pb zircon dating.

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References

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