Illite/smectite diagenesis in the Carpathian Foredeep; preliminary results and comparison with the East Slovak and Vienna basins

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The conversion of smectite to illite has been studied in the Miocene shales of the eastern part of the Carpathian Foredeep in Poland. The basin, whose Neogene evolution was affected by the final stages of subduction of the North European platform under the Carpathians, is characterised by relatively cool thermal conditions.

The transformation of smectite to illite through mixed-layer intermediates is the most important mineral indicator of diagenetic evolution of sedimentary basins.

The investigated samples of shales were taken from the three boreholes:

Jodłówka–4: the Miocene sediments are buried under the 1345m thick Carpathian overthrust;

Buszkowiczki–4: the well is located at the front line of the Carpathian overthrust;

Załazie-2: the well is situated about 15 km north of the front line of the Carpathian overthrust.

Illitization of smectite has been studied in <0.2 μm fractions of shales by X-ray diffraction techniques of Jan Środoń.

In the three boreholes, diagenetic evolution of mixed-layer illite/smectite has been observed as a general trend of decreasing % smectite in mixed-layer minerals with depth. However, in Jodłówka–4 this process advances at slower rates (measured in Δ% smectite/100 km below the onset of illitization) than in the other two boreholes. These differences are interpreted as related to the variations in thermal conductivity in different parts of the basin which, in turn, are due to variations in lithology (thermal conductivity is higher in psammitic than pelitic rocks). The Miocene of Jodłówka-4 is covered by the Carpathian rocks which have lower clay content than the Carpathian Foredeep sediments, therefore geothermal gradient and the degree, of diagenesis in this region are lower than in more northern parts of the basin.

The illitization of smectite in the Miocene of Carpathian Foredeep has been compared with the data from the East Slovak and Vienna Basins which are intramountain depressions of the Alpine-Carpathian orogenic belt. The trends of diagenesis reflect general variations in thermal conditions between the basins. The degree of diagenesis in the Carpathian Foredeep and Vienna Basin is comparable as the basins are characterised by similar, relatively low geothermal gradient. The conversion of smectite to illite in the East Slovak Basin progresses much faster because the basin has very high heat flow.