INTRODUCTION

The roof of the expelled coal seams of the Sokolov Basin in the Czech Republic, i.e. the Cypris Formation, consists of an up to 180-m thick complex of Miocene lacustrine claystones (Křížek et al., 1998; Röjk, 2004). The poster provides new information on the composition of inorganic components of the studied rocks. This information is employed to determine the sources for the sediments and to reconstruct the history of sedimentary environments of the Miocene lake. Special attention is given to the origin of tuffification and multiple repetition of organic matter-rich and poor intervals in the studied unit.

GEOLGY

The herein studied samples were collected from a core derived from the Sokolovská uhelná JSC, Sokolov, Czech Republic. Chemical composition was determined using the portable INNO-X Alpha and INNO-X Omega XRF analysers. The results of the high-density sampling were checked against whole-rock ICP-MS data.

METHODS

The K2O and Rb/Zr ratios (Fig. 4) gradually increase from the bottom to the top of the studied section thus documenting an increase in the contents of clay minerals. The upward increase in the Ca/Zr and Sr/Zr ratios (Fig. 5) is attributed to the rising contents of the carbonate component in sediments.

CHEMICAL EVOLUTION OF LAKE SEDIMENTS

The amount of total organic carbon (TOC) and carbonate carbon (TIC) generally increases from the bottom to the top of the Cypris Formation. However, claystones of the Cypris Formation show highly variable contents of TOC and TIC even at the scale of centimetres to tens of centimetres (Fig. 7). The distribution of major elements was studied along two sections of the Cypris claystones (Fig. 8). The results show that K and Rb contents as well as Sr and Al contents are essentially the same in TOC-rich and TOC-poor intervals. On the other hand, Ca and Sr contents as well as contents of TIC are significantly higher in organic matter-poor intervals. It is therefore believed that the intercalation and multiple repetition of TOC-rich and TOC-poor intervals during the sedimentation was controlled not by the rate of terrigenous input in the basin but rather by long-term climatic variations.

SEDIMENTARY CYCLES

The results of the high-density geochemical logging employed portable XRF equipment in combination with classical chemical methods represent the excellent tool to decipher the sources of clastic material and palaeoenvironmental changes in Late Miocene clastic sediments. A progressive increase in K, Rb, Ca, Sr and Al contents toward the top of the studied section can be interpreted as indicating a gradual transition from the hydrologic open, relatively deep freshwater lake environment to hydrologically closed, shallow, warm, alkaline and saline lake environment. This interpretation corresponds with the upward increasing contents of anhydrite, smectite, analcite and K-cinoformite in the clay sequence. The alkaline and saline environment of the upper part of the Cypris Formation can be paralleled with Cenozoic playa- or lake-like environments with the alkaline and saline environment of the contemporary Bearpaw Lake in southeastern California.

CONCLUSIONS

The results of this study show that the high-density geochemical logging employing portable XRF equipment in combination with classical chemical methods represent the excellent tool to decipher the sources of clastic material and palaeoenvironmental changes in Late Miocene clastic sediments. A progressive increase in K, Rb, Ca, Sr and Al contents toward the top of the studied section can be interpreted as indicating a gradual transition from the hydrologic open, relatively deep freshwater lake environment to hydrologically closed, shallow, warm, alkaline and saline lake environment. This interpretation corresponds with the upward increasing contents of anhydrite, smectite, analcite and K-cinoformite in the clay sequence. The alkaline and saline environment of the upper part of the Cypris Formation can be paralleled with Cenozoic playa- or lake-like environments with the alkaline and saline environment of the contemporary Bearpaw Lake in southeastern California.

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REFERENCES


Fig. 1. A geological sketch map and cross-section of the Sokolov Basin showing the extent of the Cypris Formation. After Dopite et al., 1985. Sediments of the Cypris Formation accumulated in a lake which eventually formed from fluviolacustrine plains formed within an Oligocene to Miocene pull-apart basin of the Rhine type.

Fig. 2. A. Contents of Ti determined by XRF (blue points) and control analyses of Ti (ICP-MS), total digest. red points). B. Ti/Zr ratio in clays of the Cypris Formation. Bohumír 333-09.

Fig. 3. Ti vs. Zr contents in tuffs and tuffites, in weathered crystalline rocks and gneisses, and in claystones of the Cypris Formation. The diagram shows that the Ti/Zr ratio of lacustrine sediments is mostly determined by the Ti/Zr ratio in volcanic material which represents the major source of terrigenous input into the study area.

Fig. 4. The K2O and Rb/Zr ratios (Fig. 4) gradually increase from the bottom to the top of the studied section thus documenting an increase in the contents of clay minerals. The upward increase in the Ca/Zr and Sr/Zr ratios (Fig. 5) is attributed to the rising contents of the carbonate component in sediments.

Fig. 5. The Ca/Zr and Sr/Zr ratios indicate an increase in the carbonate contents in the clay minerals. Positive spikes indicate positions of silitic peliocarbonates.

Fig. 6. The Al/Si ratio in the studied sediments indicates a gradual increase in Si contents from the base to the upper part of the Cypris Fm. (A), and the Na/K ratio a gradual increase in Na contents in the upper part of the Cypris Formation (B).

Fig. 7. A repetition of TOC-rich and TOC-poor intervals in the upper part of the Cypris Formation: A: Authigenic growth of a mixture of laminites and carbonate with particles of residues in the TOC-rich interval of the Cypris Formation claystones. C: Intercalation of alginite laminae (light yellow) with clay minerals-rich laminae (dark yellow) in TOC-rich claystone. Figures 7B and 7C by courtesy of Ivana Sykorova, Academy of Sciences of the Czech Republic.

Fig. 8. Detailed geochemical profiles across TOC-rich and TOC-poor intervals in two stratigraphic sections of the Cypris Fm. These results show that the concentrations of Ti, Al, K and X in both types of intervals are constant. However, concentrations of Ca, Sr (not shown in TOC very considerably, this indicates that the intercalation of TOC-rich and TOC-poor intervals is mostly due to climatically-driven variations in the oxidized (TIC) and reduced (TOC) form of organic matter.