PALAEOENVIRONMENT OF THE LOWER PERMIAN LACUSTRINE KALNÁ HORIZON, NORTH–EASTERN BOHEMIAN MASSIF: SEDIMENTOLOGY AND STABLE ISOTOPE SIGNATURES

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During the Lower Permian the central part of the Krkonoše-piedmont Basin was occupied by a low-relief arid alluvial-lacustrine sedimentary system which resulted in a more than 60 m thick succession of red-brown mudstones with rare intercalations of siltstones and fine-grained sandstones of the Upper Prosečné Formation. This succession represents alluvial plain facies which alternate with temporary lake facies. Periods without sedimentation are recorded by abundant palaeosol horizons. Frequent facies transitions are related to water table fluctuations which were probably driven by climatic changes.

The Kalná Horizon is formed predominantly by grey fine laminated fossiliferous mudstones with subordinate carbonates of a total thickness of 10–15 m. These rocks can be found over an area of 160 km^2 in the central part of the basin, but their original extent was probably much larger. Fine laminated organic-matter rich (up to 2 % TOC) fossiliferous mudstones of the Kalná Horizon represent offshore facies of a permanent lake. Carbonate beds overlying the offshore mudstones indicate the end of lacustrine period, desiccation of the lake and a transition to nearshore mudflat. The lower limestone bed is formed by laminated organic-rich clayey micritic limestone which contains thin early diagenetic lenses of pure microspar calcite. Fossiliferous offshore limestone is overlaid by nearshore dolomitic limestone with evidence of subaerial exposure.

Samples for carbon and oxygen stable isotope analyses were separated into 4 groups: 1) primary clayey micritic calcite of the offshore limestones, 2) early diagenetic pure microspar calcite of the offshore limestones, 3) calcite phase from microsparitic matrix of the nearshore dolomitic limestones and 4) dolomitic phase from microsparitic matrix of the nearshore dolomitic limestones. Primary calcites of the offshore limestones show $\delta^{18}O$ values between -1.9 ‰ and 1.5 ‰. These values are relatively high in comparison to most freshwater carbonates. This may be caused by meteoric water with a high $^{18}O/^{16}O$ ratio in equatorial zone (the assumed latitude for the Bohemian Massif during Lower Permian). The $\delta^{13}C$ values of primary calcite of the offshore limestones are within the range from -1.4 to 1.5 ‰. We assume that the main source of carbon was DIC in lake epilimnion, which was probably in equilibrium with atmospheric CO_2. Due to a lack of correlation between $\delta^{18}O$ and $\delta^{13}C$, and the narrow range of these values with no larger fluctuations in vertical logs, we interpret the offshore limestone as a product of precipitation from a hydrologically closed reservoir. The calcite from nearshore dolomitic limestone shows $\delta^{18}O$ values from -5.1 to 3.2 ‰ and $\delta^{13}C$ from -5 to 0.7 ‰. In vertical logs, where the transition from offshore to nearshore carbonates and subaerial exposure at the top is sedimentologicaly documented, significant increase in $\delta^{18}O$ values was found. High $\delta^{18}O$ calcite in nearshore limestones is interpreted as having precipitated from an isotopically heavy reservoir, where evaporation outweighed precipitation. Hydrological closing of the lacustrine system is also documented by fluctuation in $\delta^{18}O$ values of the nearshore carbonates. The $\delta^{13}C$ values significantly decrease during the transition from offshore to nearshore carbonates which may be due to a decrease in bioproductivity in the closed lake with higher salinity and/or due to oxic degradation of organic matter from the lake bottom after lake level lowering and termination of lake stratification.