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Geochemistry and Genesis of Recent Sedimentation In a Coastal Lake Sarbsko

(Northern Poland)

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Geochemical methods are widely employed in studies of modern and ancient lake sediments. However, early diagenesis and incomplete understanding of complex chemical processes involved in lacustrine sedimentation in modern geosystems hinder interpretations of geochemical data in past records. This is particularly important in coastal lakes displaying substantial spatial – temporal variability of environmental conditions.

Consequently, establishing the interrelations between chemical composition of water and sediments in the basin is indispensable to delimit the range, in which geochemical indices can be applied in a given lake.

Preliminary studies on chemistry of waters and deposits of a coastal Lake Sarbsko (Poland) have revealed that:

1. Waters of Lake Sarbsko show minor albeit readable spatial variation of chemical composition:
    - Salinity of the lake slightly lowers with the distance from the inlet, which is mirrored by decreasing concentrations of Cl^-, SO_4^{2-}, K^+, Na^+ and Mg^{2+} as well as enrichment in HCO_3^- and Ca^{2+}
    - Pore waters differ significantly from bottom and surface waters. The for-

mer are distinctly enriched in most of dissolved species except sulfates. Depletion in SO_4^{2-} and increased concentrations of HCO_3^- in interstitial solution result mainly from the process of microbial oxidation of sedimentary organic matter, which is expressed by the equation:

$(CH_2O)_{106}(NH_3)_{16}H_3PO_4 + 53SO_4^{2-} + 14H^+ \rightarrow 106HCO_3^- + 16NH_4^+ + HPO_4^{2-} + 53H_2S$ (Furrer, Wehrli, 1996).

On the other hand, below the sediment – water interface pH is lower than in overlying waters which leads to the conclusion that reduction of sulfates is not the only process applied by microbes to decompose organic matter within the sediments of Lake Sarbsko. This reaction might go on simultaneously with oxic respiration or methanogenesis which release H^+ ions to the interstitial waters and thus substantially decrease pH. H_2S oxidation and precipitation of FeS, if take place in the sediments, are of secondary importance.

1. Weakly pronounced chemical gradients in water argue for very well mixing of Lake Sarbsko.
2. In the deposits of Lake Sarbsko three lithofacies have been distinguished: fine quartz sands, olive non-carbonate gyttja and black gyttja enriched in FeS and $CaCO_3$
3. Sediments of Lake Sarbsko display increased contents of terrigenous silica indicating enhanced environmental dynamics and/or significant contribution of marine, aeolian and fluvial input to the lake.
4. Spatial geochemical diversity of recent deposits of Lake Sarbsko is far greater than chemical variability of lake waters. This discrepancy results from spatial variability of energy levels in the lake and partly from the postdepositional alteration of sediments.
5. Carbonates were encountered in FeS-enriched black gyttjas in three isolated sections of the lake. $CaCO_3$ concentration in the sediments is up to 17%. The only carbonate mineral is calcite, however, minor amounts of Mn-bearing carbonates are present as well. It is anticipated that carbonate sedimentation in the lake is mostly due to microbial oxidation of organic matter at the expense of sulfates as well as Fe and Mn oxides reduction under anoxic conditions. Hence, carbonates in Lake Sarbsko sediments are of early-diagenetic origin.

The data and conclusions presented herein should be considered as preliminary-ones. They will be elaborated within the frame of ongoing research project “Hydrochemical and hydrodynamical constraints on spatial variability of chemical composition of Lake Sarbsko sediments” supported by the Ministry of Science and Higher Education (grant no. N N306 3543 33).

References

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