Transformation of dioctahedral vermiculite during early diagenesis of marine sediments

Description for the general public

Dioctahedral vermiculite is phyllosilicate which, because of its interesting properties, is a subject of proposed research. The mineral often occurs in the soils of temperate climates, that is why it is assumed to be also a common soil mineral in the Vistula River catchment, being the research area. The main goal of the proposed research is to study the evolution of dioctahedral vermiculite in the time between it is eroded and transported in finely-grained material by the Vistula River and deposited in the Baltic Sea basin. According to the results of previous research during early diagenesis, divermiculite undergo transformation into other clay minerals: illite, NH_4-illite-like phase (in organic-rich marine sediments) due to selective sorption of K^+ and NH_4^+ from the sea-water and the cation fixation within its structure. However, this reaction is limited to open systems, in which the sediments had an unlimited contact with waters of an opened sea, and it cannot explain the lack of divermiculite in sediments deposited by fast sedimentation in closed system. In the second case divermiculite is believed to transform into chlorite due to seletvite sorption of Mg^{2+}. Considering the fact that divermiculite occurs in soils and not in sedimentary rocks of marine origin, the proposed research has a chance to explain how and when actually the mineral is getting transformed.

The goal is expected to be achieved by analyses of clay fraction separated from finely-grained material which is being transported by the Vistula River, oxbow lakes deposits (containing material which has been transported by the Vistula in the past) and from sediments of the Vistula delta from the Gdańsk Bay. Detailed mineralogical (using X-ray diffraction) and chemical characterization (using e.g. ICP-OES) of the separated clay minerals will be applied. In addition, long term (i.e. at least 1 year) laboratory experiments consisting of treatment of divermiculite-rich samples with artificial (one containing NH_4^+ and one without NH_4^+) and natural sea-waters in closed systems will be performed.

Verification of the proposed research hypothesis is especially of great importance for present and future studies dealing with clay mineralogy of sedimentary basins- the studies crucial for e.g. hydrocarbon prospection. The proposed research is also very important for understanding of the K, N and Mg cycle in the Baltic Sea having potential implication for conservation of this unique basin.