

MINERALOGY OF SEDIMENTS OF THE REGION OF THE MORASKO METEORITE RESERVE. A. Duczmal-Czernikiewicz¹ and A. Muszyński¹, ¹ Adam Mickiewicz University, Institute of Geology, ul. Maków Polnych 16, 61-606 Poznań, Poland, duczer@amu.edu.pl

In the area of Morasko there are several craters formed after the fall of a meteorite. Around the biggest craters there are discontinuous dikes, probably of the post-impact genesis, which are clearly indicated in the morphology of the area as they protrude above the surrounding deposits. The deposits forming the edge of the crater are Pleistocene glacial tills, under which at different depths there are fine-clastic deposits, whose age was determined at the Miocene-Pliocene; these are the so-called Poznań clays. Sometimes, these deposits in the study area are located on the surface, likely due to glaciectonic process. Both on tills and clays thin soils have developed; in the study area they are overgrown by Quercus-Fagetum forest. In places they include clay inserts, lenses and fine silt clasts of the substratum. Tills were the subject of mineralogical studies in the 1970s while the Poznań clays are tested mineralogically due to their raw materials and geotechnical importance.

About 5,000 years ago a meteorite hit the soft till-sandy deposits and left traces in the morphology. There is a question whether a meteorite caused a change in the mineral composition and if so - what extent these changes have had. Therefore the main objectives of mineralogical studies are the following: 1. to investigate minerals in the clay fraction in the sediments around the craters, 2. see whether there is variation in the mineral composition of the deposits in their vertical profiles, 3. see whether mineralogical studies indicate the impact phenomena, and 4. see whether it is possible to distinguish them from weathering processes.

The methodology involves the measurement of pH and macroscopic descriptions of deposits. Laboratory tests of the clay fraction prepared from the sediments, using the X-ray method at the Institute of Geology in Poznań, allowed determining the mineral composition of the tiniest fraction of the size of less than 2 microns. The used method is by [1], described by [2], according to which the samples were tested in three stages: in an air-dry state, treated with ethylene glycol and roasted at a temperature of 550 °C. In addition, polished thin sheets were subjected to microscopic observation of reflected light. Three profiles of sediments were examined of a thickness of 120, 160 and 220 cm situated close to the largest crater in which the samples were taken every 20 cm.

The tested deposits have low pH diversity, comprised in the range of 5.5-5.9. The colour of the sediment varies in the profiles from grey-black on the surface, to yellow-grey to greyish brown. The clayey deposits also show variable colouring from grey-black (from the presence of organic matter) by reddish yellow (from the presence of goethite) into the spotted red-greenish. The red colour is due to the presence of hematite. Lenses and clayey clasts in tills are greenish-grey, with no evidence of the presence of iron oxides and hydroxides. Deposits are inlaid with Fe and Mn hydroxides, and in some places contain carbonate concretions, which are the traces of soil processes. All the profiles have fragments of contemporary roots.

Microscopic analyses show a relatively small mineralogical variability of the clay fraction. In each of the studied profiles clay minerals found in tills included kaolinite, illite and smectite minerals, with a touch of mixed-layered phases like smectite/illite. The surface samples also contained admixture of minerals of the vermiculite structure (to a depth of 40 cm), or a mixed-layered type minerals like vermiculite/smectite or vermiculite/illite. The vermiculite minerals of the surface samples indicate partial collapse due to temperature increase to 550 degrees C. The smectite minerals show swelling feature, which results in movement of the basal reflections after glycol. Kaolinite and illite reflections do not displace after glycol, while after roasting illite reflections remain constant, while the kaolinite structure collapses, resulting in loss of kaolinite reflexes.

In Poznań clays the composition of clay minerals is homogeneous: dominated by smectite minerals, with varying participation of illite and kaolinite. In a few samples collected at the surface there are admixtures of mixed-layered of the illite/smectite type. None of the tested samples revealed evidence of vermiculite, but quartz occurs as an admixture in each tested sample. The composition of clay minerals in Poznań clays does not change in vertical profiles.

In addition, microscopic observations have shown microclasts that consist of both till and clay. Tills are composed of petty-clastic quartz skeleton, with a minor contribution of alkali feldspar, plagioclase, pyroxene and amphibole that are "embedded" in the finer clay matrix, with the yellow-brown colours. Another type of clasts found in microscale is homogeneous clasts of grass-green colour in microscopic image, which do not correspond to any of the optical characteristics of clay minerals identified with X-ray. It seems that they may be clay minerals affected by the impact, which are originally Poznań clay clasts in glacial tills. The colour may be due to changes in the structure, but it requires detailed microscopic analyses.

Tested deposits show a variation in the vertical profile in terms of colour and composition of clay minerals. The colour results from the presence of organic matter and the iron oxides or hydroxides. In the surface samples the presence of vermiculite was recorded, which does not appear in the sediments deeper than 40 cm. The deposits of different ages differ in mineral composition: tills have a different mineral composition (vermiculite, vermiculite-illite or vermiculite, smectite, illite, kaolinite) than Poznań clays (smectite, illite/smectite, kaolinite, illite with a touch of quartz). The impact could have resulted in clay clasts of grassy-green colour and so far unidentified mineral composition. Weathering processes lead to changes in the colour to reddish-yellow and reddish, and to development of minerals of the vermiculite minerals.

References: [1], Jackson M. L. (1959), Soil Chemical Analysis Wisconsin, 576. [2], Moore D.M. and Reynolds R.C. Jr (1989), X-ray Diffraction and the Identification and Analysis of Clay Minerals; Oxford University Press. 332.