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Quality of Some East-Slovakian Lake Sediments

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Abstract. Lake sediments were obtained down the axis of reservoirs "Bukovec" and "Domaša" namely from the inflow of feeding lapse till to the outlet. The thermogravimetric analyse (TG) and differencial thermal analyse (DTA) dependences at actual temperature, which slope was mainly linear, were observed. The mass loss in the some definite temperature ranges was regarded in the TG curves. The exothermic maxima and the endothermic minima in the DTA curves we could distinguish. The exothermic maxima were caused wholly by burning of organic parts of studied sediments.

Key words: lake sediments, mineralogy of sediments, thermogravimetry, differential thermal analysis

Introduction

The water reservoirs "Bukovec" and "Domaša" are the typical so-called flow lakes. The water sources, streams and small rivers input on the northern entry end. This flush soil substrates from hanging wall and then form lake sediments. The phase composition of these sediments is considerably monotonous and homogenous along the lake axis. Sediment is made of 70 % of fine-grained quartz, 7-20 % of mica like clay minerals, and considerably variable and inhomogeneous organic part (Hucko & Šumná, 2000). These are mainly non-polar extractable organic matters.

Water and hydroxyl ions in mineral components (Konta, 1952; Matherny, 2002) of flow lake sediments features considerably different forms of appearance (Fig. 1). In principle, this occur is divided into two groups. These are the chemical-bonded water and physical-bonded water, as well. The transition between these two forms is possible but highly complicated. On the other hand, osmosis and adsorption play an important role in this process. The strongest bond of the chemical-bonded water is mediated via the hydroxyl anions. This bond is released at high temperatures (650 – 850 ^{0}C) and crystal structure of water is destroyed during this process. At the considerably lower temperatures (150 – 450 ^{0}C) the crystal and hygroscopically (adsorbed) water, which is bonded in interplanar areas of crystal structures, is loosen. The hygroscopic, adhesive water, is loosen at the lowest temperatures (100 – 135 ^{0}C).

Decomposition temperature of carbonates is different; it starts nearly 850 ^{0}C and terminates nearly 1050 ^{0}C. Quartz is characterized by very compactness structure. Hence, quartz does not contain water neither hydroxyl ions. Merely, the shift between α and β quartz modifications manifest a weak endothermic maximum (Makenzie, 1957).

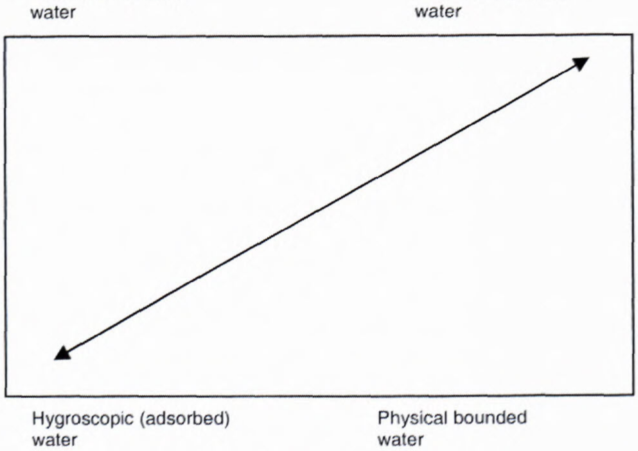

Fig. 1 The water bounding forms of the minerals

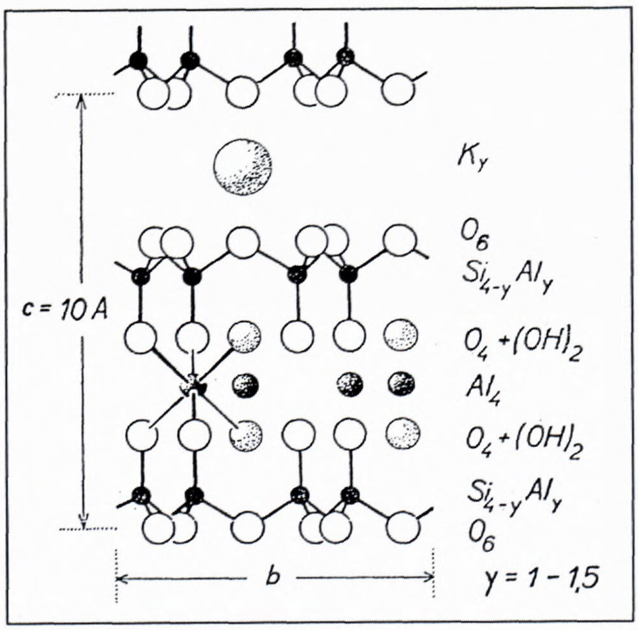

Fig. 2 The structure of the illite

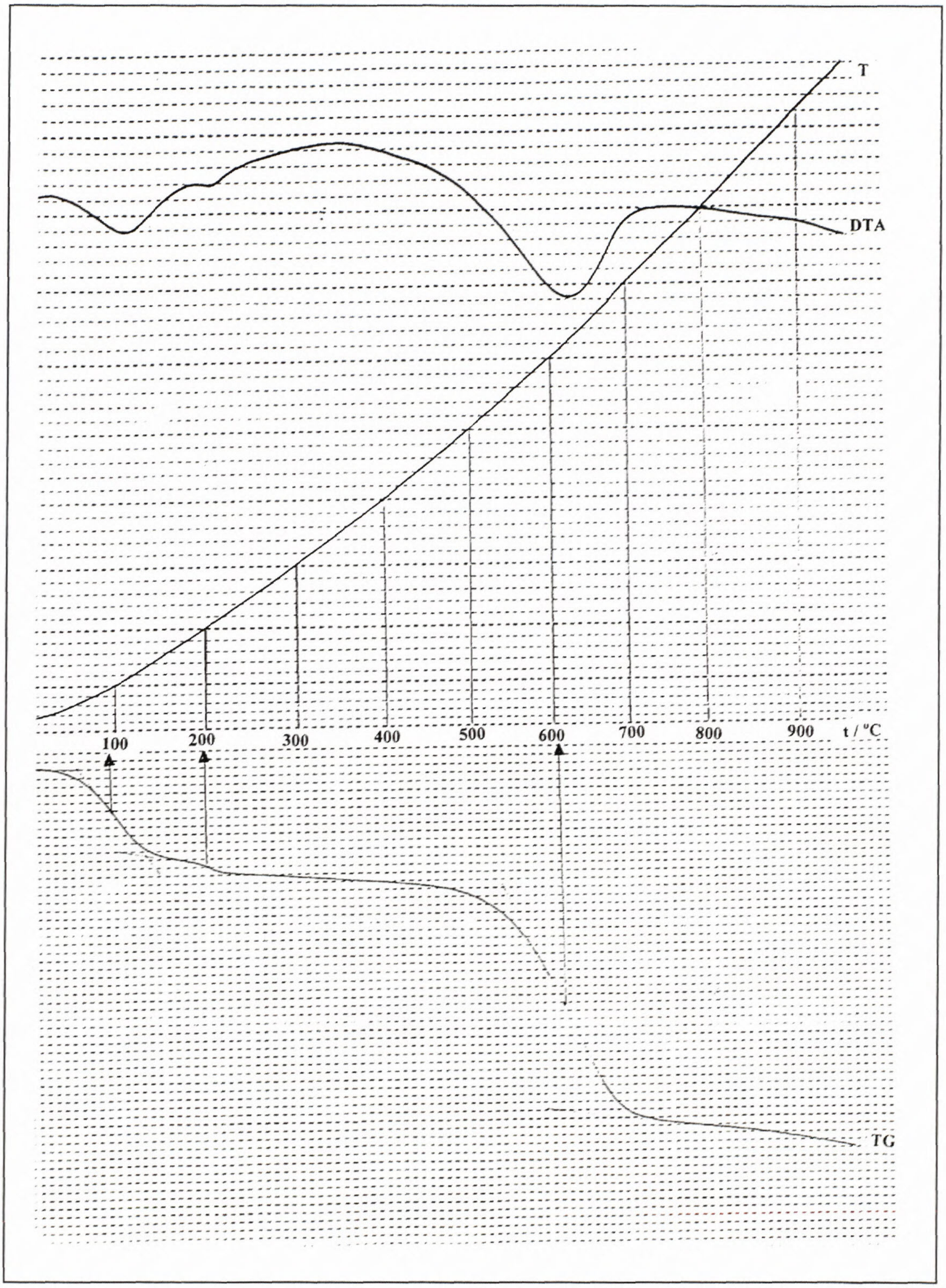

Fig. 3: The T, TG, and DTA curves of the isolated illite minerals.

Another frequent constituents of lake sediments are clay micas. These originate via weathering of acid and intermediate igneous rocks (Betechtin, 1955). These are humus constituents (Nary-Szabo, 1965) and are products of muscovite hydrolysis in association with montmorillonite and kaolinite. The clay micas are transported into water reservoars by rainfalls from the areas above the water structure. The epitome of the clay micas is mineral illite (Kodera et al., 1977). The illite structure illustrates Fig. 2. It is three-layer mineral type with non-expanded structure (so-called mixed structure). Potassium positions are substituted by water molecules and these molecules releases at low temperatures during thermo-chemical reactions. On the other hand, oxygen subrogating hydro-

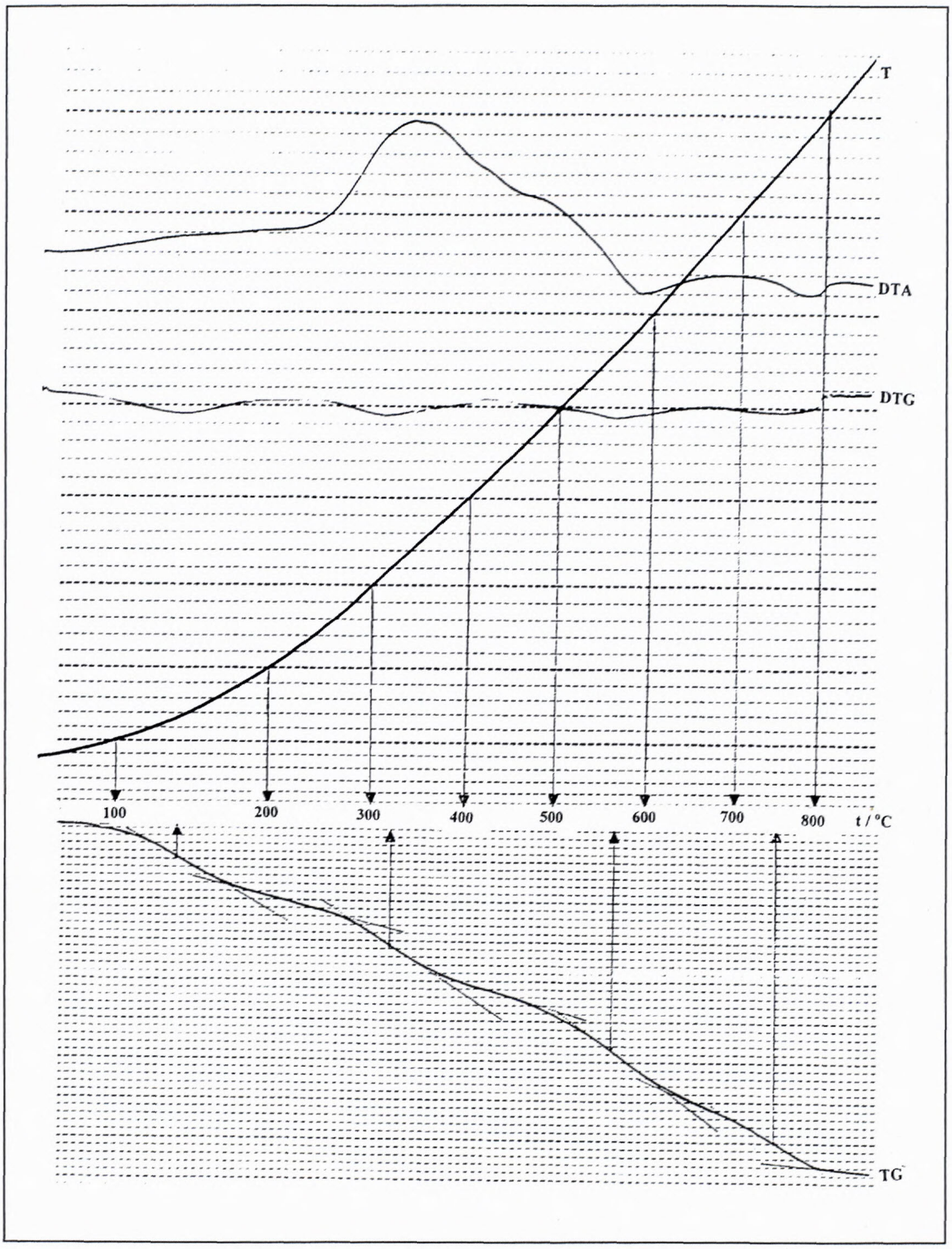

Fig. 4: The T, TG, and DTA curves of the real lake sediment

xyl ions releases over thermal frontier 420°C in the SiO_4 tetraeders (Konta, 1957; Slavík et al., 1956). These endothermic responses of lake sediments containing clay mica overlaps with exothermic responses of organic components. The temperature interval of this response is from 220 °C to 500 °C. Considering the loss of sample during the combustion process, these processes seem like a loss of mass in the thermo gravimetric curves. In the interest of water identification in the lake deposits minerals, the samples were subjected to thermo chemical analysis.

Experimental part

Samples were subjected to thermo-chemical analysis on Derivatographe MON instrument and data were recorded either by photography or by MON recorder. The measurement was performed in the temperature interval from 20 °C to 950 °C. Thermogravimetric, temperature increasement, and differential thermic analyze records were scored. To determine the presence of illite, TGA and DTA records were performed by means of settling method of pure illite (Fig. 3). It is evident from a record that dehydration of illite takes place in three stages. The first stage represents a leakage of physical bounded water with adsorption character from 45 ^{0}C to 140 ^{0}C. The residue of strongly bounded water leaks out at temperature between 150 ^{0}C and 220 ^{0}C. This water substitute particularly K^+ ions and occurs among SiO_4 tetraeder layers. The third stage of dehydration is associated with absolute destruction of illite structure (OH^- ions release) and occurs from 510 ^{0}C to 700 ^{0}C. The first inflection point is found at 95 ^{0}C, the second flex is at 605 ^{0}C.

Discussion

The samples come from the fresh water reservoir Bukovec and from south-northern direction of the ewage basin Domaša. As it can be seen above, TGA and DTA records of particular samples of lake sediments differ from the illite record. The lake sediment samples also showed an exothermic maximum of thermic destruction of organic portion of the lake sediments. Thus, the structure destruction is associated with a leak of products of thermic decomposition (Fig. 4). The thermic decomposition of organic share begins already near temperature 180 ^{0}C and stops at 525 ^{0}C. The inflection point of the process is found at 325 ^{0}C. The record quits by endothermic minimum of reduction of Fe-oxides at 745 ^{0}C.

The values of TG and DTA curves of lake sediments from the water basins Bukovec and Domaša are similar to each other. The significant clay constituent remains illite in sediments from Bukovec and Domaša. Sediments from Bukovec contain approximately constant amount of organic share in dry matter (circa 2 %). On the other hand, sediments from Domaša are characterized by significantly higher fluctuation of the organic share (circa 4 % - 6 %). This fact is quite comprehensive because of vaster Domaša's hanging wall and intense agricultural activities. This activity requires continual application of agrochemicals that are flushed by rainfall to Domaša basin. Some part of these chemicals is water insolubile and is adsorbed by surface-active components as clay; and so chemicals are anchored in lake sediments.

Conclusion

Finally, it can be stated that lake sediments from both Bukovec and Domaša basins contain a mass of flint that is dominant component, next clayey mica, and organic share. The content of carbonates is weak and atypical. Thermic analyze showed that illite is a typical clayey constituent of the lake sediments. The presence of the organic share was confirmed by exothermic maximum on the DTA curves. This exothermic process complicates emission atomic determination of the minor and trace elements of these sediments.

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