

On the sediment chemistry of an oxbow lake in the Szigetköz (Danube, 1835 river km)

By

M. DINKA*

Abstract. This publication reports the result of sediment investigations in an oxbow lake having been separated from the Danube for a long time. The water and organic matter content and the N, S, total, inorganic and organic P concentrations of sediment layers down to 30 centimeters and their differences are described.

The side arm systems in the Szigetköz region are situated on the right side of the Hungarian Upper Danube section. They are of special natural value with a lot of semi-natural characteristics in spite of the more than a hundred year old river regulation activity in the region. The fluctuating water discharge of the Danube supported spatially and temporarily variable water bodies. After a one-sided decision on the originally joint Hungarian—Czechoslovakian project of the Bős/Gabčíkovo—Nagyymaros River Barrage System, Slovakia diverted the Danube from its main arm (October, 1992). It lowered the water table seriously damaging the side arm systems together with other impacts of the construction. The Hungarian Republic took urgent measures to carry out all possible mitigating operations against present and future damages to lessen their effects at least to a certain extent. In connection with that activity an extensive environmental assessment was done. It included our sediment chemistry analyses.

Material and methods

The investigation of the sediment in the side arm systems had produced extremely unreliable data during the previous water discharge dynamics of the area due to basic methodological and evaluation difficulties. On one hand different drag forces because of different current velocity values at different water discharge made bed load transportation and river bed evolution unpredictable, on the other hand the origin and the retention time of the accumulated sediment of any given section could not accurately be proved.

**Dr. Mária Dinka*, MTA Ökológiai és Botanikai Kutatóintézete, Magyar Dunakutató Állomás (Institute of Ecology and Botany of the Hungarian Academy of Sciences, Hungarian Danube Research Station), 2163 Vácrátót, Hungary.

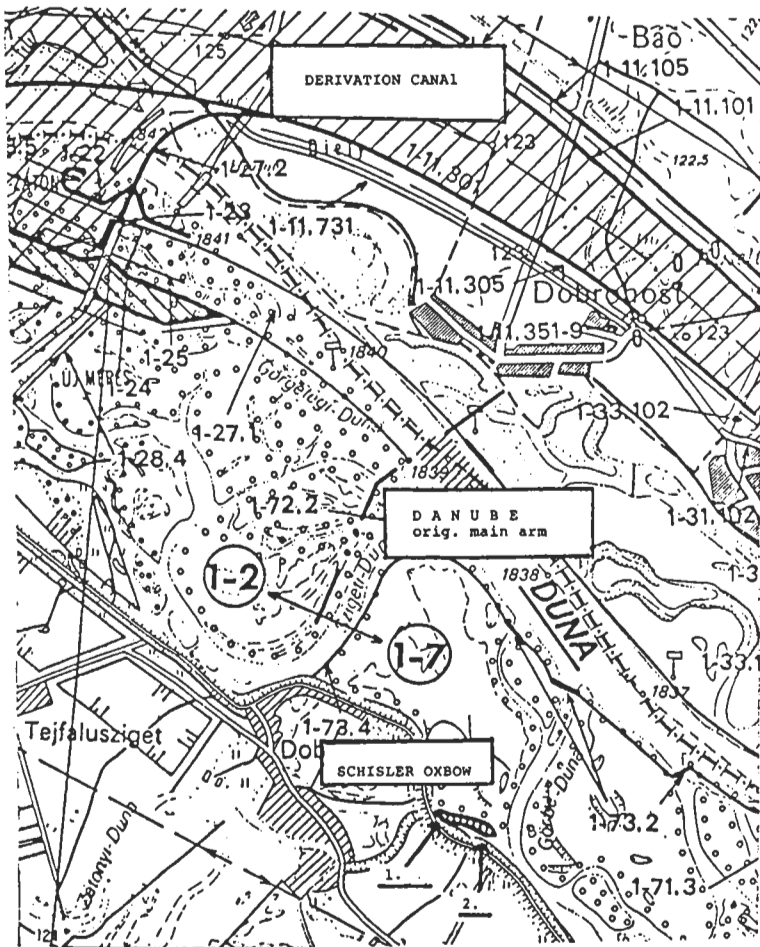


Fig. 1. Map of the sampling sites

Because of the above outlined situation a separated, floodplain oxbow lake was selected for our sediment chemistry studies, which was relatively independent even from the nearest large side arm and had a surface inflow only when the water level was above 500 cm in the main arm of the Danube at Dunaremete. In other periods only subsurface inflows depending on the water level of the Danube supplied this water body, besides rain water.

As a result the allochthonous elements of the sediment could originate only from the surface inflow (or the air) and what was important there was no transport of the sedimented material. Besides, the dissolved chemical characteristics of the subsurface inflows could unhinderedly pass into the oxbow lake.

On the basis of the above discussed characteristics Schisler oxbow lake in the Cikola side arm system of the Szigetköz region was selected for our studies. Sediment samples were collected in September, 1994. Three samples were taken from

two localities along the longitudinal axis using a plexi core of 5 cm in diameter (Figure 1). After they were cut into one cm layers, the first, third, fifth, tenth, twentieth and thirtieth layers were analysed. The water content of the sediment was determined by drying at 105°C, the organic matter content (LOI) by a two hour ignition at 550°C, the C, N and S concentrations by a CNS Fisson equipment and the P content (total, inorganic and organic P) by molibdenblue reaction with the method of ASPILA et al. (1976). The concentrations were calculated on the basis of the dry mass. The mathematical evaluation was done according to SVÁB (1981).

Results

Figure 2. shows the average water content of the sediment layers at the two sampling sites. It varied between 62 and 72% in the upper five cm layer. There was no important difference between the two localities, the western (1. sampling site) and the eastern (2. sampling site) part of the oxbow lake. In the function of depth the water content of the sediment decreased to a greater extent at the second sampling site, the eastern part of the oxbow lake (46% at 30 cm) than at the first sampling site.

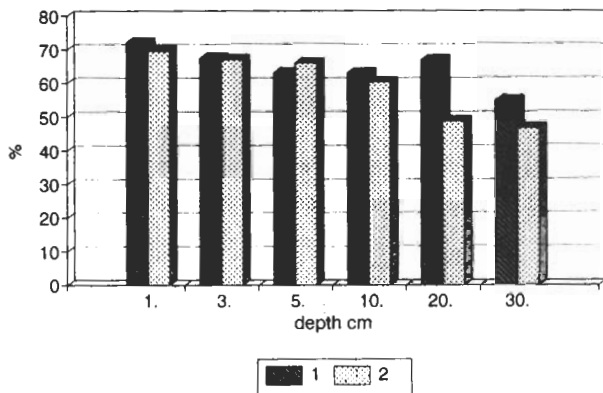


Fig. 2. Water content of the sediment

Figure 3. shows the average organic matter content of the sediment layers at the two sampling sites. On the basis the ignition loss (LOI) it varied between 7.9 and 9.7% in the upper five cm layer. This parameter was between 6.5 and 7.7% if it was determined by a CNS-analyzer, which is a natural difference between the results, as the previous method always gives higher values than second one. The organic matter content of the sediment decreased in the function of depth.

Figure 4. demonstrates the average N and S concentrations of the sediment layers at the two sampling sites. The N concentration of the upper five centimeter layer of the sediment was between 2.1 and 3.1 mg/g. The N concentration of the tenth and twentieth cm of the sediment was significantly higher at the first than at the second sampling site. The N concentration decreased in the function of depth in the thirtieth centimeter it was 50% lower than in the surface one 1 cm layer.

There were considerable differences in the S concentration of the two sampling sites. With the exception of the thirtieth cm layer, 1.2—2 times higher S concentra-

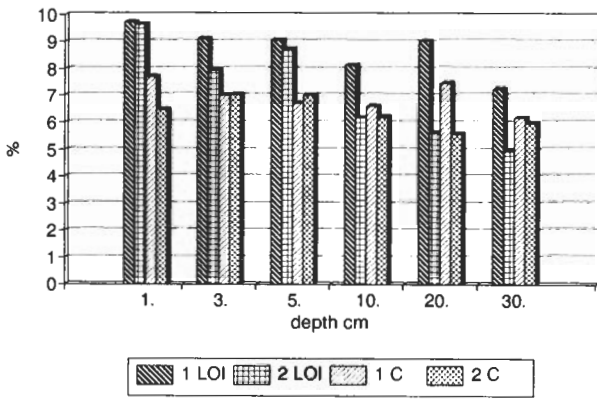


Fig. 3. Organic matter of the sediment

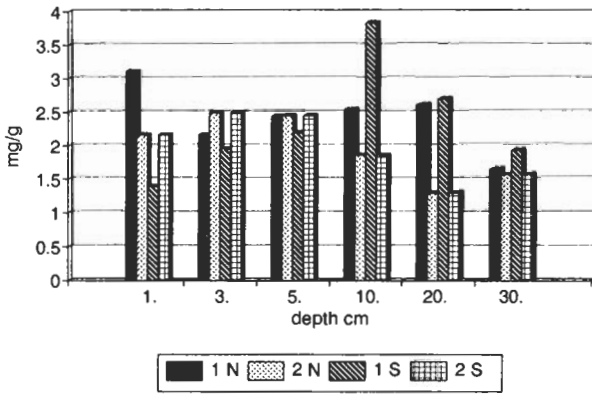


Fig. 4. N and S content of the sediment

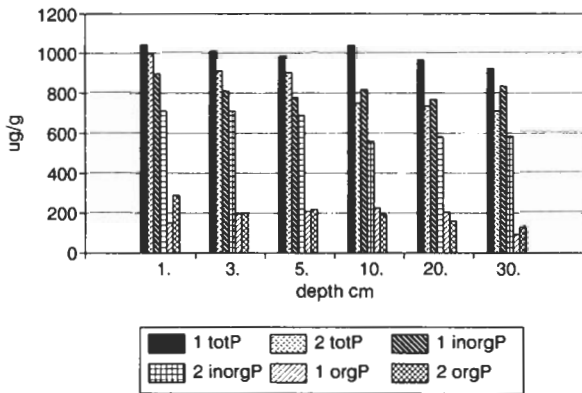


Fig. 5. P content of the sediment

tions were recorded at the second sampling site (eastern part of the oxbow lake, near to the main arm) than in the appropriate layers of the first sampling site.

Figure 5. shows the average total, inorganic and organic P concentrations of the sediment layers at the two sampling sites. The total, inorganic and organic P concentrations in the upper five centimeters of the sediment varied between 906 and 1045, 689 and 897, and 148 and 287 $\mu\text{g/g}$, respectively, they decreased in the function of depth but these values were higher in all layers at the first sampling site than in the second, in the case of the ten and twenty cm values significantly.

In 1991, three years before the above detailed studies, the heavy metal concentration in the sediment of the same sampling sites was analysed also in the function of depth (DINKA, 1994). All these studies unambiguously revealed vertical and to a certain extent horizontal differences in the investigated sediment chemistry parameters. Sediment accumulation and formation are especially important processes to follow because of the hydrobiological changes in the region outlined at the beginning of this paper. Therefore, a considerable extension of the sediment chemistry studies should be organized.

REFERENCES

1. ASPILA, K. I. & HAIG AGEMAIN-CHAU, A. S. Y. (1976): A semiautomated method for the determination of inorganic, organic and total phosphorus in sediments. — *Analyst*, 10: 187—197.
2. DINKA, M. (1994): Vorstudie über die Schwermetallbelastung des Sediments in einem Altwasser der kleinen Schüttinsel. — *Arbeitstagung der Internat. Arbeitsgem. Donauforschung, Wiss. Kurzf. Zuoz, Schweiz*: 331—335.
3. GYÓRI, D., CSEH, E. & PALKOVICS, M. (1976): Talajvizsgálatok. Egyetemi jegyzet. — Keszthely: 1—118.
4. SVÁB, J. (1981): Biometria i módszerek a kutatásban. — Budapest: 1—557.