

Neusiedlersee/Fertő tó (Austria/Hungary): lake level variations reconstructed by geomorphology, archaeology and historical maps

Erich Draganits¹, Andras, J. Zámolyi², Barbara Hodits², Susanne Gier²,
Bernhard Grasmann², Christoph Janda³, Bernhard Schiel⁴ & Andreas Rohatsch¹

1 Institute for Engineering Geology, Vienna University of Technology, Austria
(Erich.Draganits@tuwien.ac.at)

2 Department of Geodynamics and Sedimentology, University of Vienna, Austria

3 Geological Survey, Vienna, Austria

4 Gruppe Wasser, Vienna, Austria

Situated southeast of Vienna, at the eastern boundary of Austria, the Neusiedlersee (German) or Fertő tó (Hungarian) and the associated wetlands of the Waasen/Hanság form a unique landscape and environment in central Europe, becoming the Neusiedlersee-Seewinkel/Hanság National Park in 1993 and UNESCO World Heritage in 2001. The lake is in the center of conflicts of interests of (a) tourism (interested in high and constant lake levels), (b) agriculture (interested in low lake levels, thus increasing the area of land for cultivation, *but* also in high lake levels because of its micro climate for the cultivation of wine and the sales potential of tourism for agricultural products), (c) national park authorities (interested in preserving natural conditions of the lake and last but not least (d) the local population which uses the lake for recreation and for which the lake is part of the regional identity.

The present hydrographic conditions of Europe's second largest steppe lake are: (a) the lake is very shallow (<1.8 m depth), (b) even small variations of the lake level have an impact on large areas, (c) the Wulka river is the only major fluvial input, (d) the lake thus is mainly depending on precipitation on, or nearby the lake, (e) the input of ground water is considered to be low, although details of the ground water budget are still under discussion, (f) the water balance is delicate, because of the high surface to volume ratio and the general climate boundary conditions. Continuous measurements of the lake water level started in 1932; in this period, the minimum lake level (measured in altitude above the Austrian zero-level in Trieste, Adriatic Sea) was 114.50 m (July 1949), the maximum 116.08 m (May 1941) and the mean value was 115.30 m (source: <http://byc.at>).

However, the present boundary conditions of the Neusiedlersee are very different from the natural situation; modifications of the hydrological system have a long history, reaching back at least several centuries. There are several possibilities for the reconstruction of former lake extensions and hydrological conditions. Beginning with – to our knowledge – the first historical map showing the Neusiedlersee (ca. 1490 Henricus Martellus Germanicus) there are many maps (and more or less exact copies of maps) showing the lake at various

scales and variable accuracy. The first maps of the lake with nearly modern standards have been produced in 1784, when the first Austrian Land survey has been carried out in this area at a scale of 1:28,800. Generally, the historic maps show that at least occasionally (a) the area of the lake was much larger, (b) during periods with high water level the lake formed a continuous water surface with the Hanság area, (c) the rivers Ikva and Répce flowed into this large lake and (d) most of the maps show an outflow at the eastern part of the lake (Rábca river), (e) the lake was completely dry occasionally. During Danube floods at Győr, even Rába water flooded the Fertő tó/Hanság area.

The general distribution of archaeological sites indicates that areas with altitudes below some 119–120 m asl have been avoided in the past. However, there are also very few archaeological sites even within the present lake, witnessing the large amplitude of lake level changes.

Geological maps show that the Neusiedlersee is surrounded by muddy sediments that have been recognized as “lake clays” by the mapping geologists. These lake clays can be found up to about 119–120 m above sea level (asl), indicating that former lake levels, at least occasionally, have been up to ca. 4 m higher compared to the average value of modern measurement during the last 70 years! Similar lake sediments and additionally peats have been mapped in the Hanság area and to the East of Lébény. Elongate ridges (so called “Seedamm”) broadly parallel to the eastern lake shore have been recognized early. They consist of sand and pebbly sand, commonly enriched in heavy minerals; they are interpreted beach ridges, mainly formed by wind and ice. Three different generations of these beach ridges have been recognized in the literature, indicating different lake levels up to about 119–120 m asl.

In summary, the reconstruction of the Neusiedlersee/Fertő tó by geomorphology, lithostratigraphic sections, archaeology and historical maps shows that the modern lake is very different compared to its natural hydrological conditions before the mid-16th century. At present, the Neusiedlersee is cut-off from most of its former fluvial inflows, drained during periods of high lake level by a large channel and in the last 50 years the uppermost groundwater table in the Hanság area has been lowered up to 2 m by extensive irrigation for agriculture and abundant drainage ditches. Under these circumstances even small climatic changes with lower precipitation and/or higher evaporation may have strong impact on the water budget. Studies comparing present lake level variations and the impact of climate with past lake level changes have to carefully consider the impact of man made modifications.