

Holocene lake-level changes in the Siljan Lake District – Towards validation of von Post's drainage scenario

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1 Introduction

In 1934, the Swedish geologist Lennart von Post proposed that ancient Lake Siljan was drained catastrophically by moving the old outflow through the Åkerö channel to the north to form the present outlet of River Österdalälven (Fig. 1A). This drainage event led to a lake-level drop of about 6 m and Heden, a basin 2 km to the south that was part of the ancient lake, got isolated (Fig. 1B). The present study is an evaluation of von Post's scenario.

Figure 1. Cross profiles over Åkerö (A) and Heden (B).

2 Methods

The employed methods and techniques were:

- sediment description
- radiocarbon dating & pollen analysis
 - determine the age of organic inclusions
 - indirect dating control
 - age-depth model
- magnetic susceptibility
 - core correlation
 - chemical and biological composition of the sediments
- XRF scanning & multivariate statistics of elemental data
 - relative variations in the elemental concentrations
 - correlation between elements and variation analysis
- C and N analysis
 - palaeo-productivity and origin of organic matter
- Digital elevation model
 - Inspection of changes in elevation
 - drawing of cross profiles

3 Results

Figure 2. Lake Siljan (SE outlet) evolution stages after 10 cal kyr BP. A. Ancient Lake Siljan covered a greater area than today and drained through the Åkerö channel until 8.8 cal kyr BP. B. After the catastrophic drainage event, the Åkerö channel was abandoned and the Heden basin became isolated.

Figure 3. Core 8 (550-650 cm) from Åkerö (A) and core 9 (640-740 cm) from the Heden. From left to right, log of lithology, and radiocarbon samples. The optical and radiographic (RD) image, density, magnetic susceptibility (MS), relative concentrations of typical elements for lake surveying, C and N contents and C/N ratios (Heden), and Ca/Ti and Mn/Fe ratios. The boxes indicate zones with unusual signal.

4 Discussion - The drainage scenario

The area of the present outlet for River Österdalälven was at a lower-elevation depression between 168.5 and 175 m a.s.l. (Fig. 1). At approximately 8.8 cal kyr BP, during a stochastic water level rise of the ancient Lake Siljan, the depression at Leksand was flooded (Fig. 2A). The water level rise must have been in the order of c. 6 m and initiated erosion processes that led to the formation of a new, lower-situated outlet for the Siljan basin. A lake level lowering signaled the end of ancient lake Siljan and the abandonment of the Åkerö channel (Fig. 2B). The almost complete absence of shorelines from 164 to 168 m a.s.l. exhibit the abruptness of the lowering. In Åkerö, the first signs of increased water flow is seen in the coarsening of the fluvial sand (Fig. 3A) at c. 8.65 cal kyr BP and lacustrine deposits develop at c. 8.5 cal kyr BP. However, the great dynamism in the environment of an outlet channel suggests a more volatile sedimentary record. The reduction in the minerogenic content after 8.65 cal kyr BP at Heden (Fig. 3B), indicate that by assigning the drainage this age or a younger, the date will be lagging behind. The start of the increase in the minerogenic detrital matter and the decrease in organic matter content indicate the lake lowering and the continuation of erosion processes on the landscape. The evidence of the sedimentary record of a calm environment like the basin in Heden indicates that the drainage event must have happened around 8.8 cal kyr BP.

5 Conclusions

- The catastrophic drainage is placed at 8.8 cal kyr BP. The abrupt peak in the minerogenic detrital matter at 679 cm of the Heden record marks the fall in water levels. Therefore, the opening of the new channel at Leksand took place approximately 1-2 cal kyr earlier than the original scenario proposed by von Post (1934).
- The connection of the Heden basin to the Siljan basin is reflected by the silty lenses in the algae rich gytja.
- The coarsening of sand at Åkerö around 8.65 cal kyr BP reflect the erosion of the drainage event, however, the sedimentary record of a channel that responded to the event is more volatile and should not be trusted chronologically.

6 References

von Post, L., 1934: Bonäslinjen. En lednivå bland Siljansbäckens senkvartära strandlinjer. *GFF* 55, 19-59.