Long-term development in lake Øyeren studied by paleolimnological method

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Introduction

This master thesis is based on a paleolimnological study of the freshwater lake Øyeren in SE-Norway. The lake is located in the lower part of the river Glomma, having a substantial drainage area that covers a major part of Eastern Norway. In the northern part of the lake, river Glomma and two smaller rivers have built up the largest inland delta of Northern Europe (Fig. 1). A shallow delta platform (< 5 m) is followed by a deeper part in the south (maximum 75 m). Lake Øyeren is currently at good ecological status, but has been affected by agriculture, industry and urban emissions (Berge et al., 2002). Lake Øyeren is an important natural reserve with rich vegetation and high bird and fish biodiversity.

Objectives

The aim of the study is to reconstruct the long-term development in:

- lake primary production based on pigment analysis stored in lake sediments
- inorganic pollution from local and long range sources based on element analysis (macro- and trace elements) in the sediment
- sediment transport as caused by flooding and water level regulations

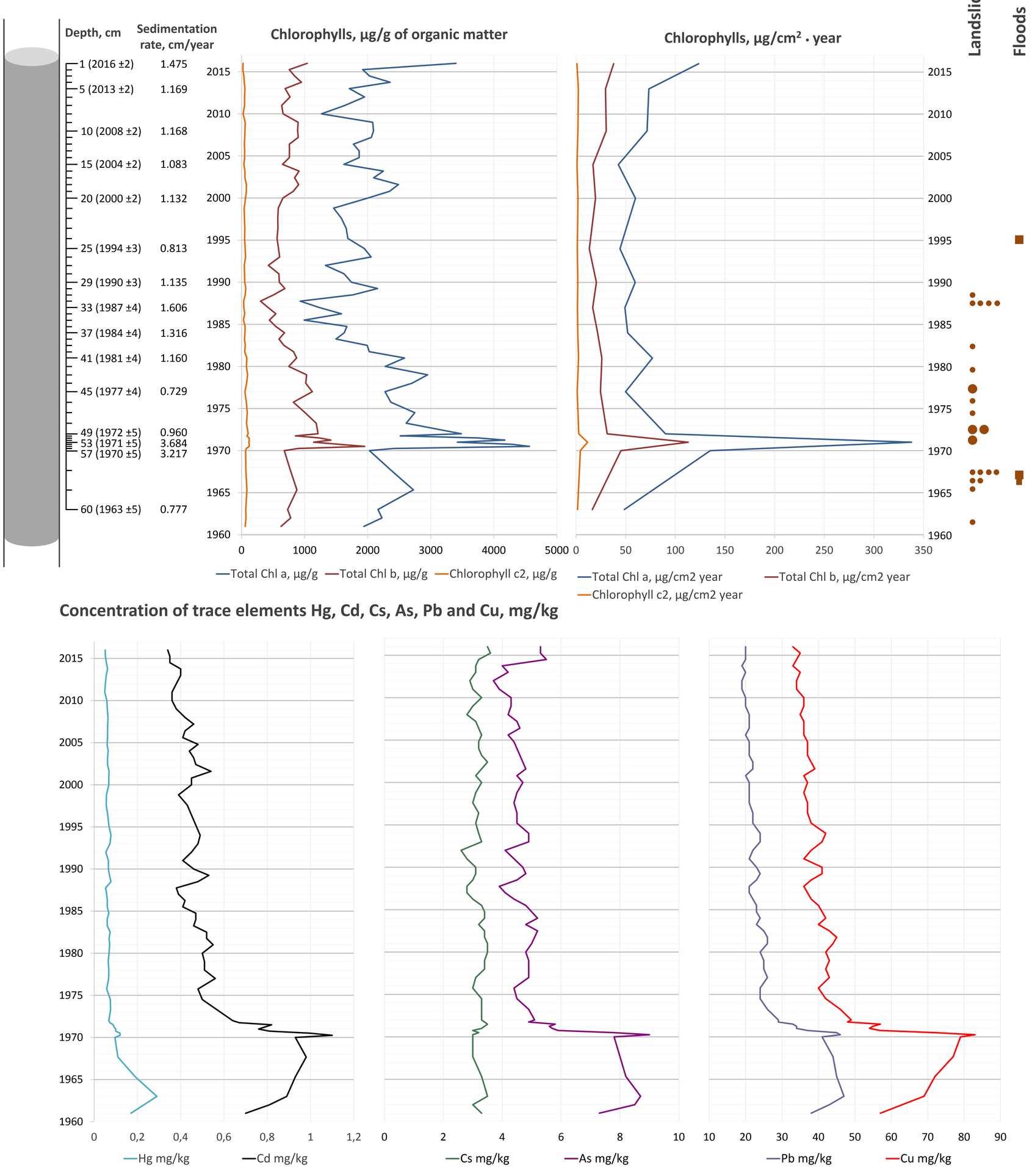
Methodology

Three sediment cores 60 cm long were sampled from 65 m depth in a deep basin part of Øyeren in August 2016. The sediment cores were collected from a boat with a gravity corer – 75 cm long acrylic tube, 6.0 cm inner diameter and 1 mm wall thickness. The sampled sediment cores were immediately transported to the laboratory, where they were sectioned in 1 cm slices. The sectioned subsamples were freeze dried prior to the further analysis.

The **pigment** compositions were extracted with ethanol (96%) at 4 °C in the dark. The spectral scans of supernatant were measured in a range from 400 to 700 nm by a spectrophotometer. The individual concentrations of pigments were derived from spectral scans with the modified Gause-peak spectra (GPS) method (Thrane et al., 2015).

The subsamples were analysed for ^{210}Pb, ^{226}Ra, ^{137}Cs and ^{241}Am by direct gamma assay for **dating** in the Elements Environmental Change Research Centre at University College London.

Concentrations of **elements** Cu, As, Cd, Cs, Hg, Pb, C and N were measured by inductive coupled plasma-mass spectrometry (ICP-MS), while concentrations of Al, Ca, Fe, K, Mn, Na, P and S were measured by inductive coupled plasma-mass optical emission spectrometry (ICP-OES).



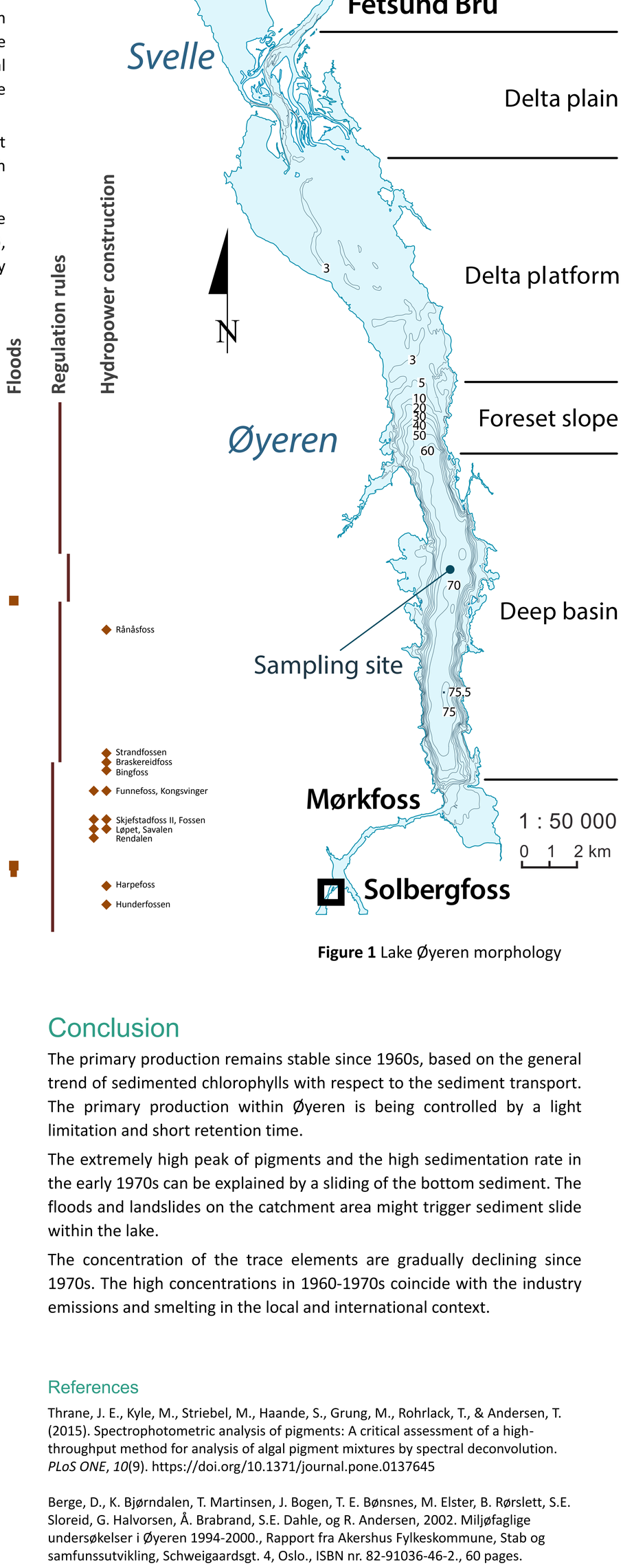


Figure 1 Lake Øyeren morphology

Concentration of trace elements Hg, Cd, Cs, As, Pb and Cu, mg/kg

Conclusion

The primary production remains stable since 1960s, based on the general trend of sedimented chlorophylls with respect to the sediment transport. The primary production within Øyeren is being controlled by a light limitation and short retention time.

The extremely high peak of pigments and the high sedimentation rate in the early 1970s can be explained by a sliding of the bottom sediment. The floods and landslides on the catchment area might trigger sediment slide within the lake.

The concentration of the trace elements are gradually declining since 1970s. The high concentrations in 1960-1970s coincide with the industry emissions and smelting in the local and international context.

References

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