

Testing the influence of paleoenvironmental conditions on the subsurface biosphere of Lake Fucino over the Last 350ka



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Introduction

- Lake sediments store information about the climatic and environmental conditions during deposition and allow a glimpse into the past to make conclusions about the geological and biological history of the lake.
- Sediments from Lake Fucino (Italy, Fig.1) were investigated using geochemical methods to analyze pigments, stable isotopes of organic matter and element composition. These data are used to explore environmental forcings on microbial communities that once lived in the water column (e.g. Cyanobacteria) and sediment.
- In a first step our study aims at matching "DNA reads" (Fig. 2), which are not entirely quantitative data, with information from quantitative geochemical data.
- The hypothesis is, that Cyanobacteria are more abundant in glacial periods, where the availability of reactive N-compounds is low. This study aims to show, if sedimentary indicators and/or pigment concentrations reflect the occurrence of Cyanobacteria-DNA and if a change in the trophic state is accompanied with DNA reads.

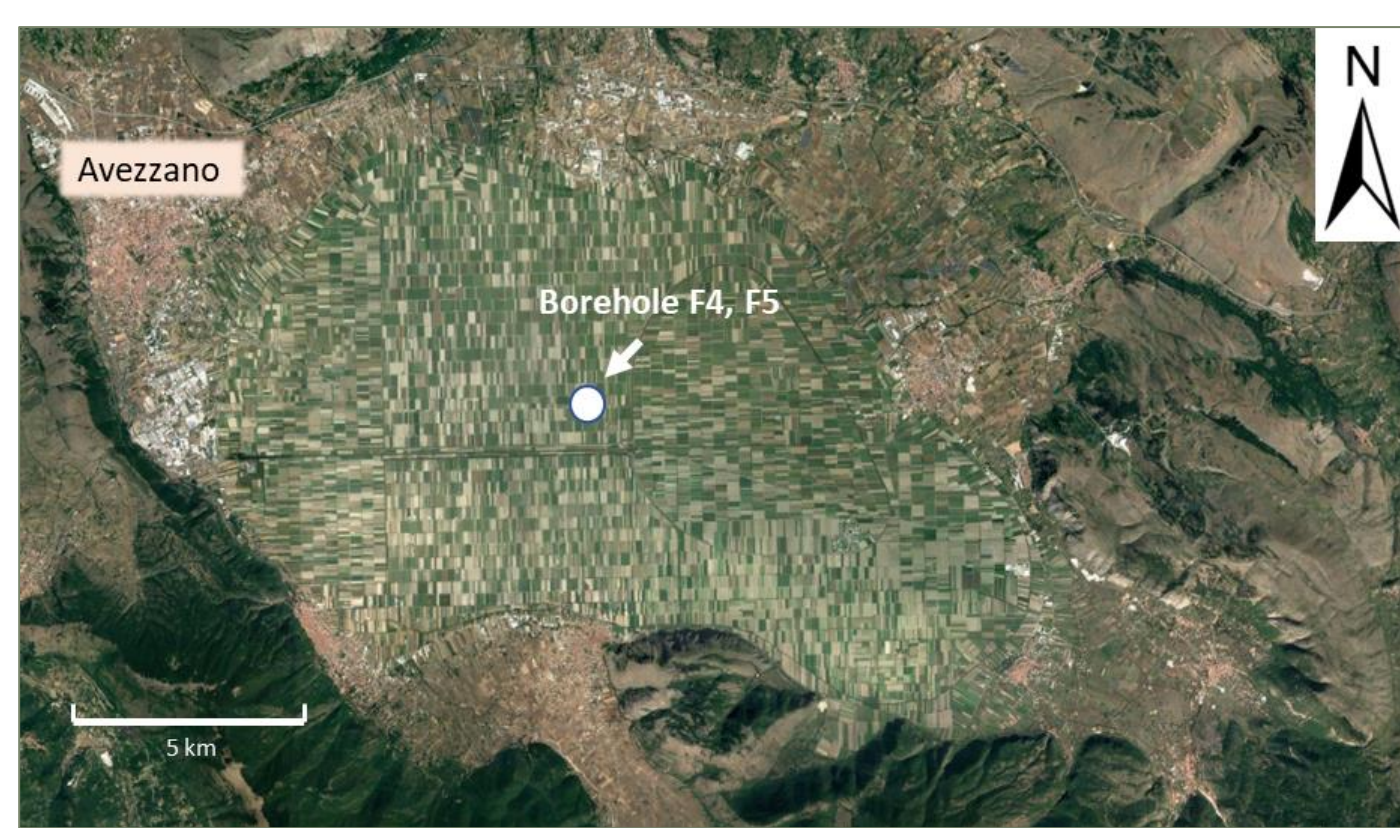


Fig.1: Area of Lake Fucino and location of Boreholes (F4, F5). The extent of the former lake is still visible, as the land is used for agriculture

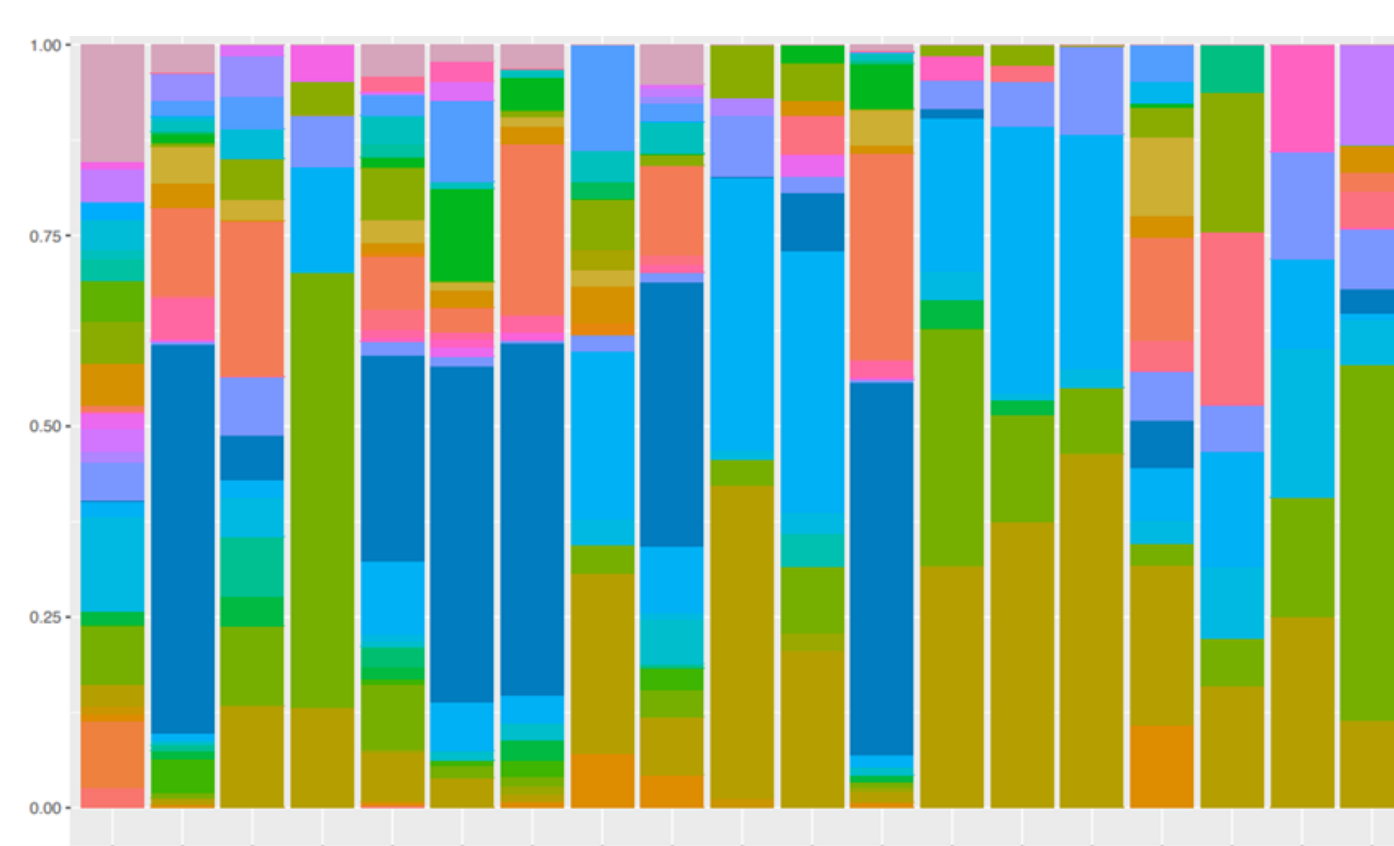
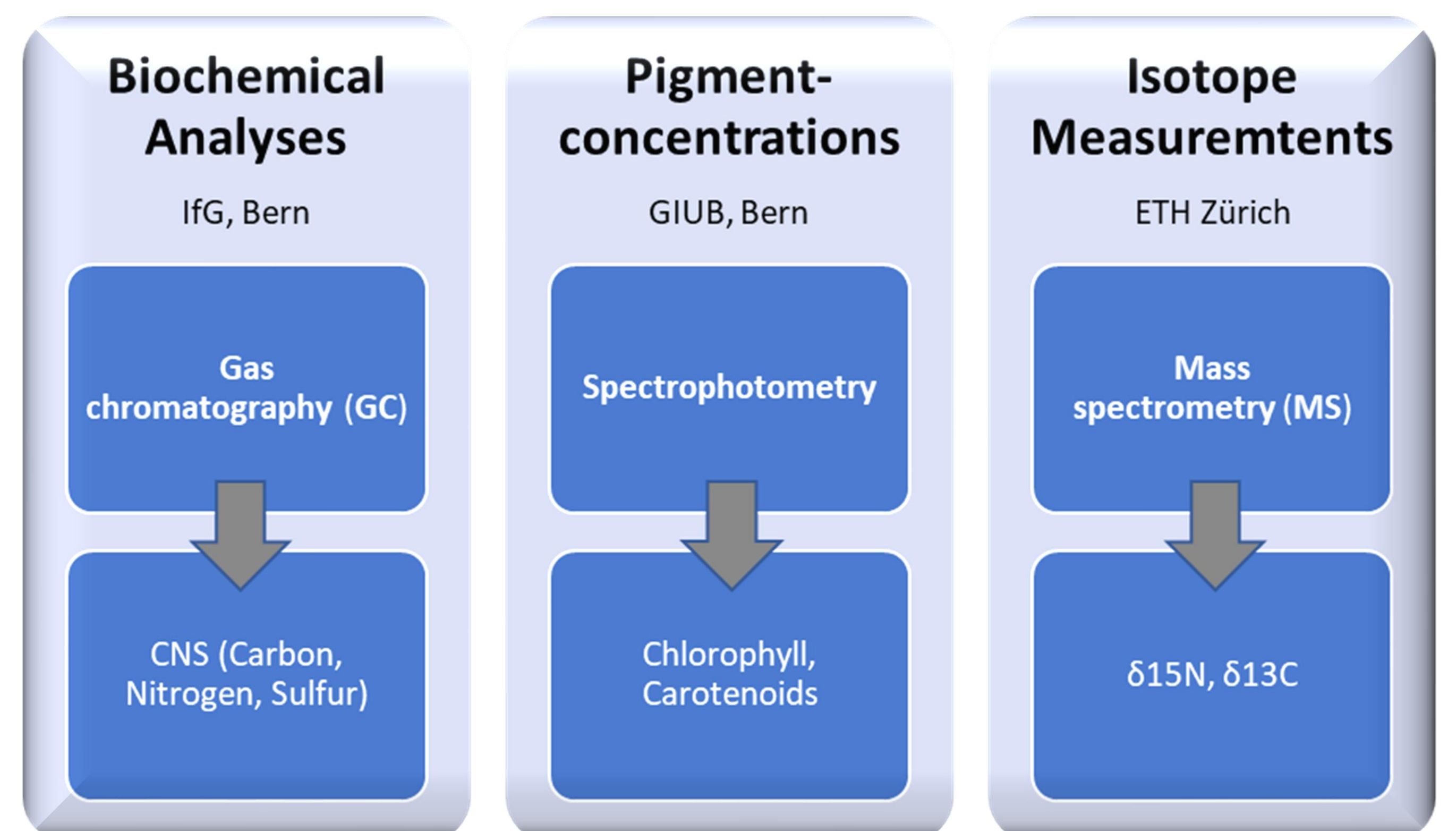


Fig 2: Illustration of "DNA reads" for selected samples. Different colours correspond to different taxa (e.g. pink=Cyanobacteria). Since organisms prefer certain conditions, they can be used for paleoenvironmental studies. Illustration: Camille Thomas

Study Site

- The Lago Fucino was an endorheic lake in the Central Apennines near Avezzano (Fig 2.), once the third largest in Italy (155km²) and was artificially drained in the 19th century.
- The lake deposits now offer a fertile base for agricultural use. Therefore, the area is not built up very much and the sediments have remained virtually untouched.
- Two cores were drilled in 2017. The sediment sequence covering a time period of more than 350'000 years.
- The region has experienced several volcanic eruptions in the past. 130 Tephra layers were identified in the sediment sequence and were used for dating.

Methods



Results

- 3 warm periods with a high primary production: high pigment concentration, high TIC, TOC and high TOC/TN (Fig.3)
- Pigment concentrations are generally higher in Interglacials
- For sediments older than 350'000 years almost no pigments were detectable
- Cyanobacteria-DNA in cold to intermediate climate intervals

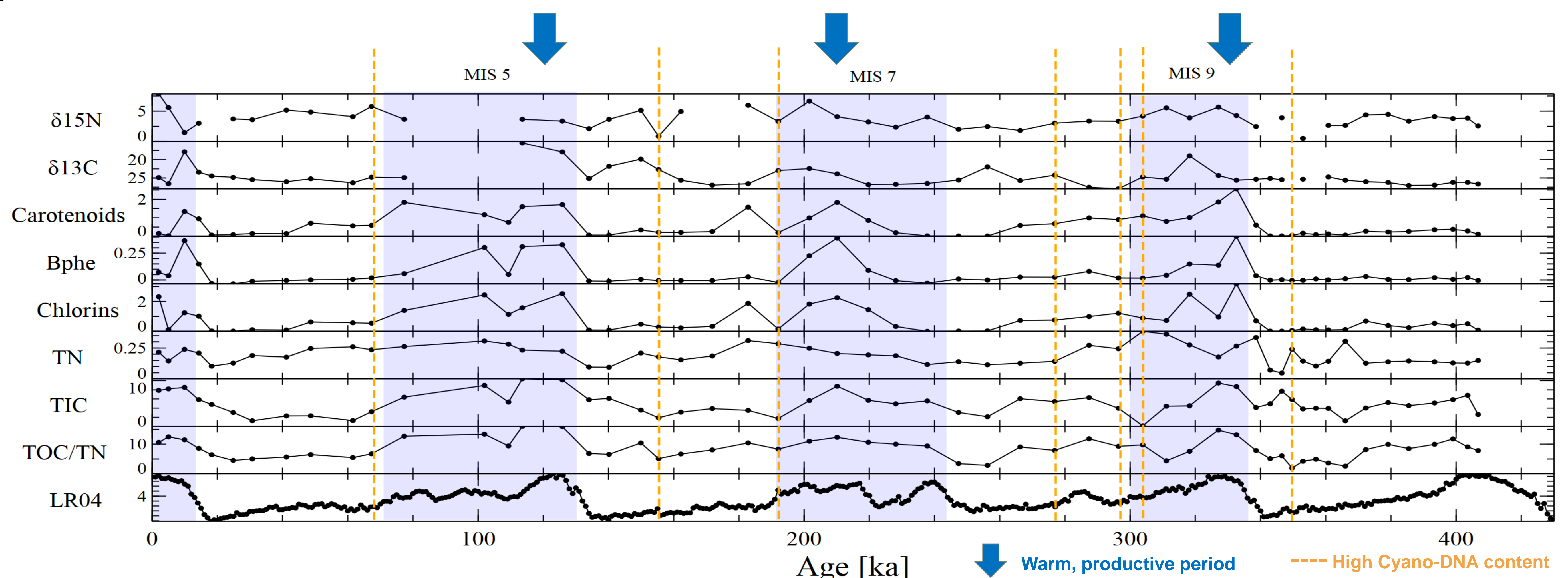


Fig.3: Plot of Isotopes, Pigments (Carotenoids, Bacteriopheopytin a (Bphe), Chlorins (Chlorophylls), Total Nitrogen (TC), Total Inorganic Carbon (TIC), TOC/TN and the LR04 Benthic Stack against Age.

Outlook

- Pigment concentration: For few selected samples a High Performance Liquid Chromatography (HPLC) was performed. HPLC measurements have a higher sensitivity. The next step is to evaluate this HPLC data and compare it with the existing data.
- Comparison of DNA data and environmental proxy data using multivariate statistics.