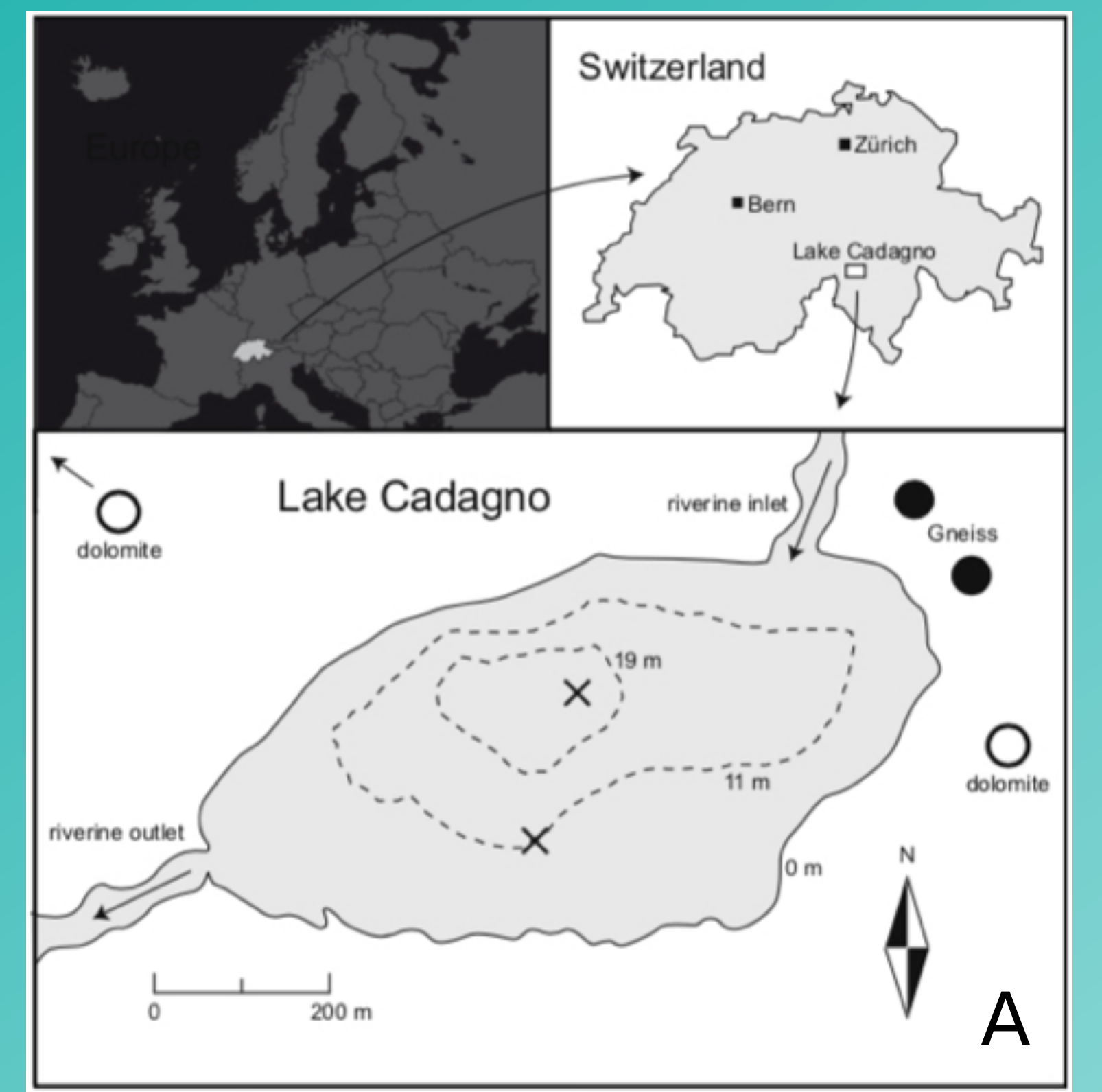
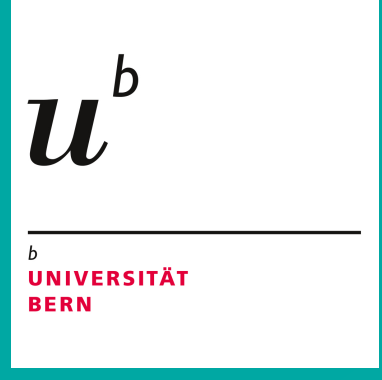


Behaviour of molybdenum and sulfur isotope systems in a swiss euxinic lake

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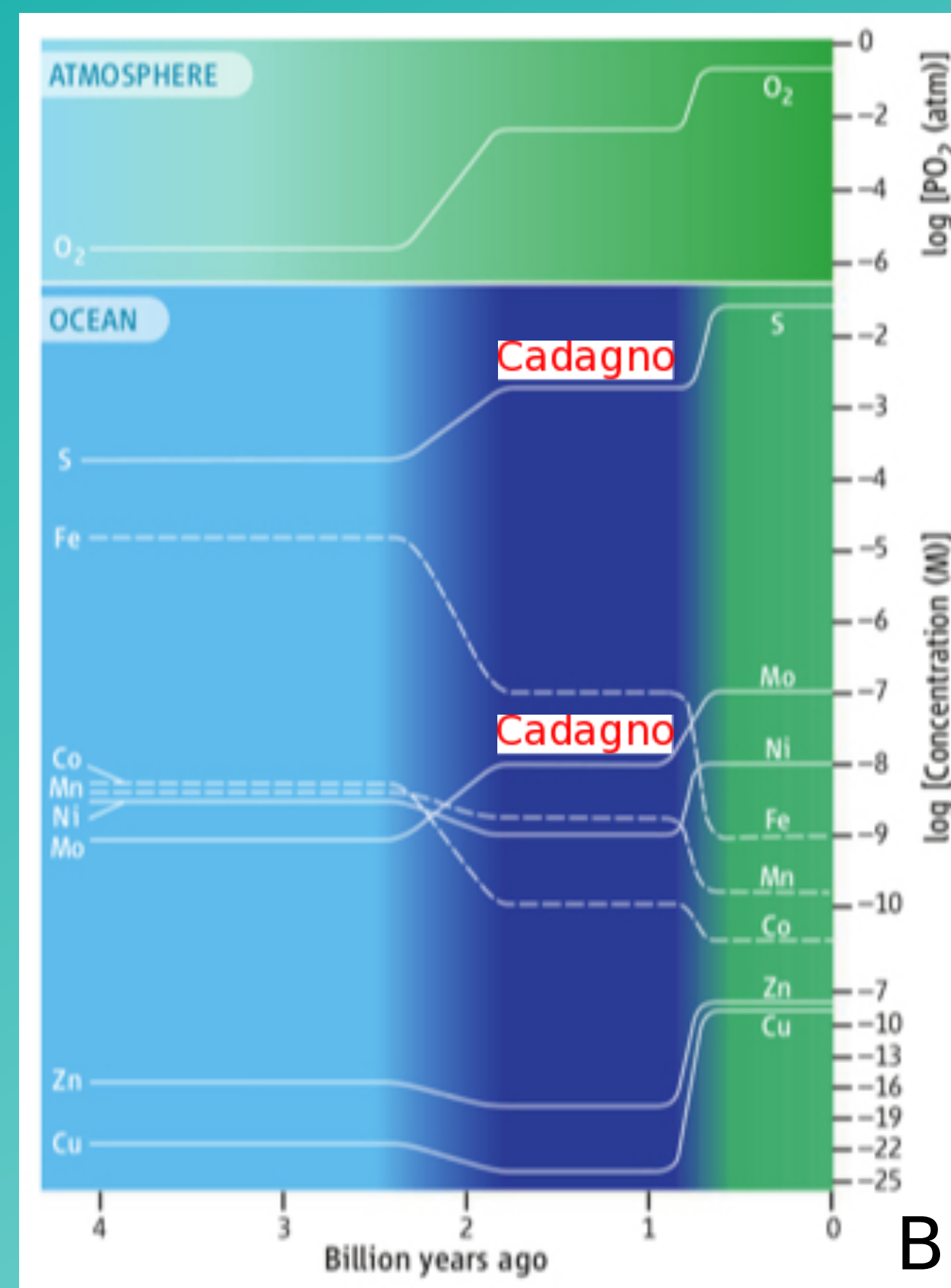
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Dahl et al. (2010)

Introduction

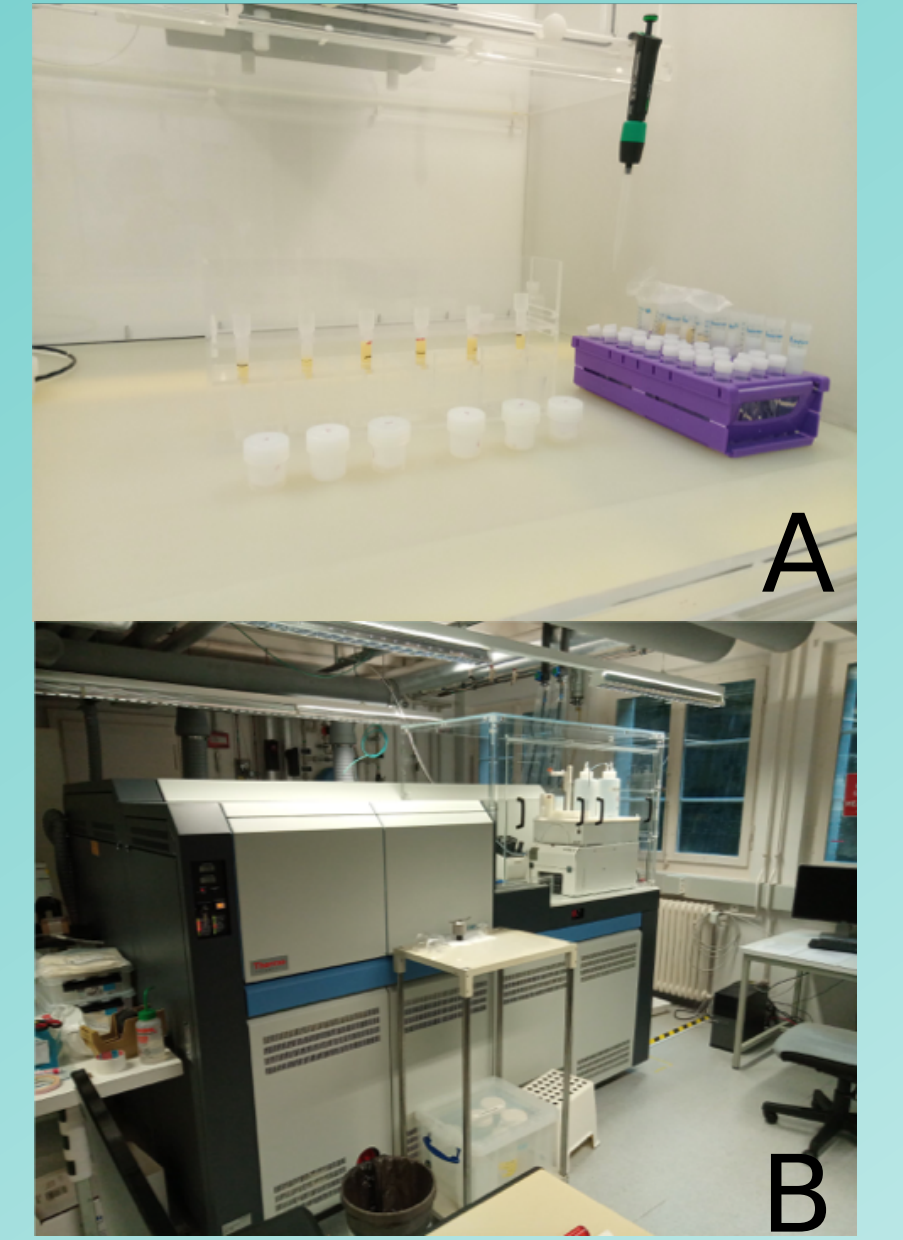
The Val Piora located in the the Ticinese Alps hosts the Lake Cadagno (A), which is located at a height of 1921 m.a.s.l. This euxinic lake of glacial origin formed ~10k years ago at the end of last glaciation. The Lake Cadagno is a low-sulfate euxinic Proterozoic early ocean analog (B) as show the Anbar et al. (2008) figure. Early-Earth sulfur and molybdenum cycling are used to reconstruct oxidative weathering from isotopic composition of marine sediments deposited under anoxic/euxinic conditions. It is therefore suitable to study the behavior of molybdenum and sulfur isotope systems in unprecedented detail.



Modified from Anbar et al. (2008)

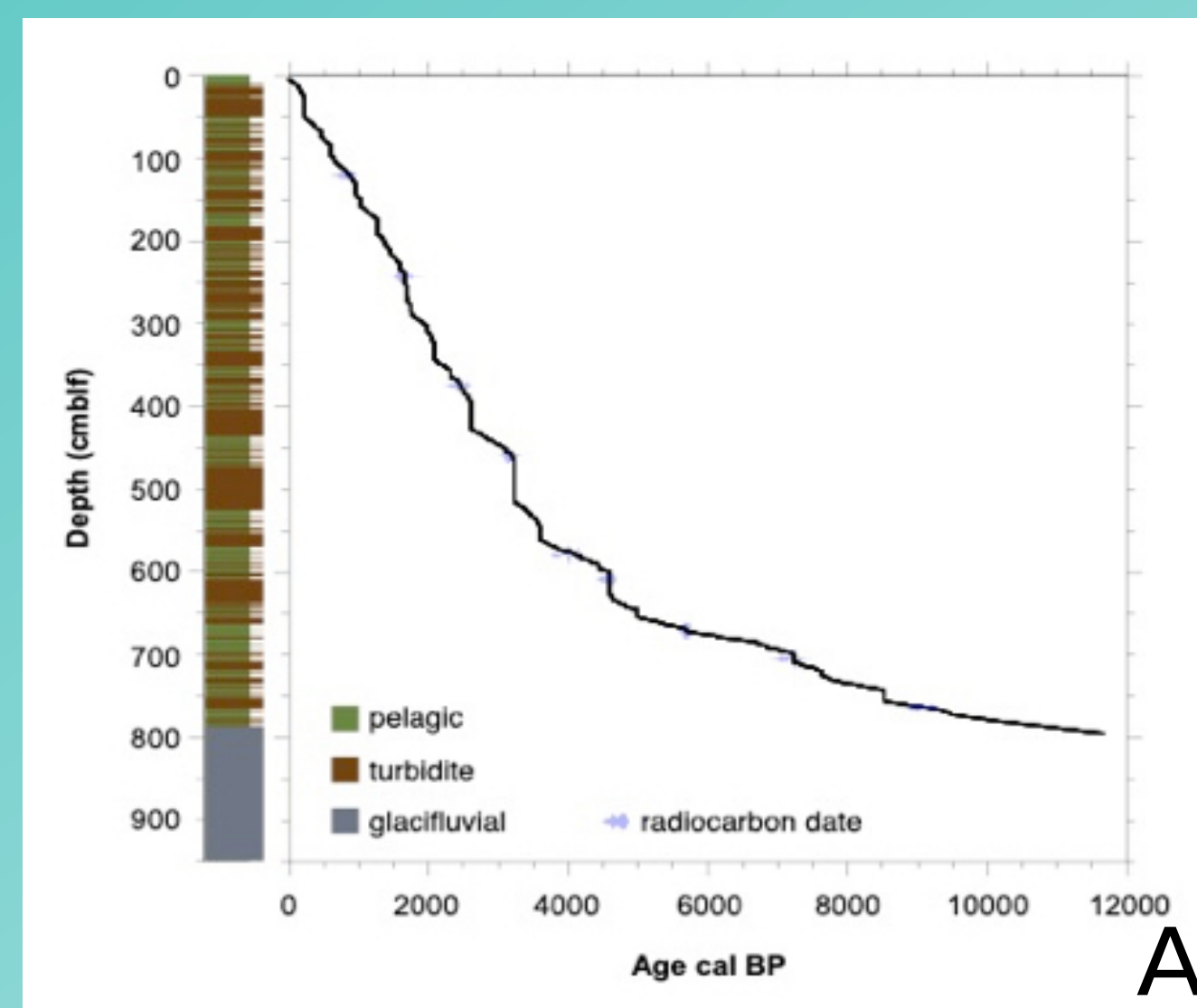
Methods

20 samples from pelagic sediments taken between ~1 - 8m depth. Acid digestion and column chemistry to isolate molybdenum (A). MC-ICP-MS analysis (B) to measure the isotopic composition of molybdenum. Sulfur measurements were done at ETHZ. XRF-analysis .

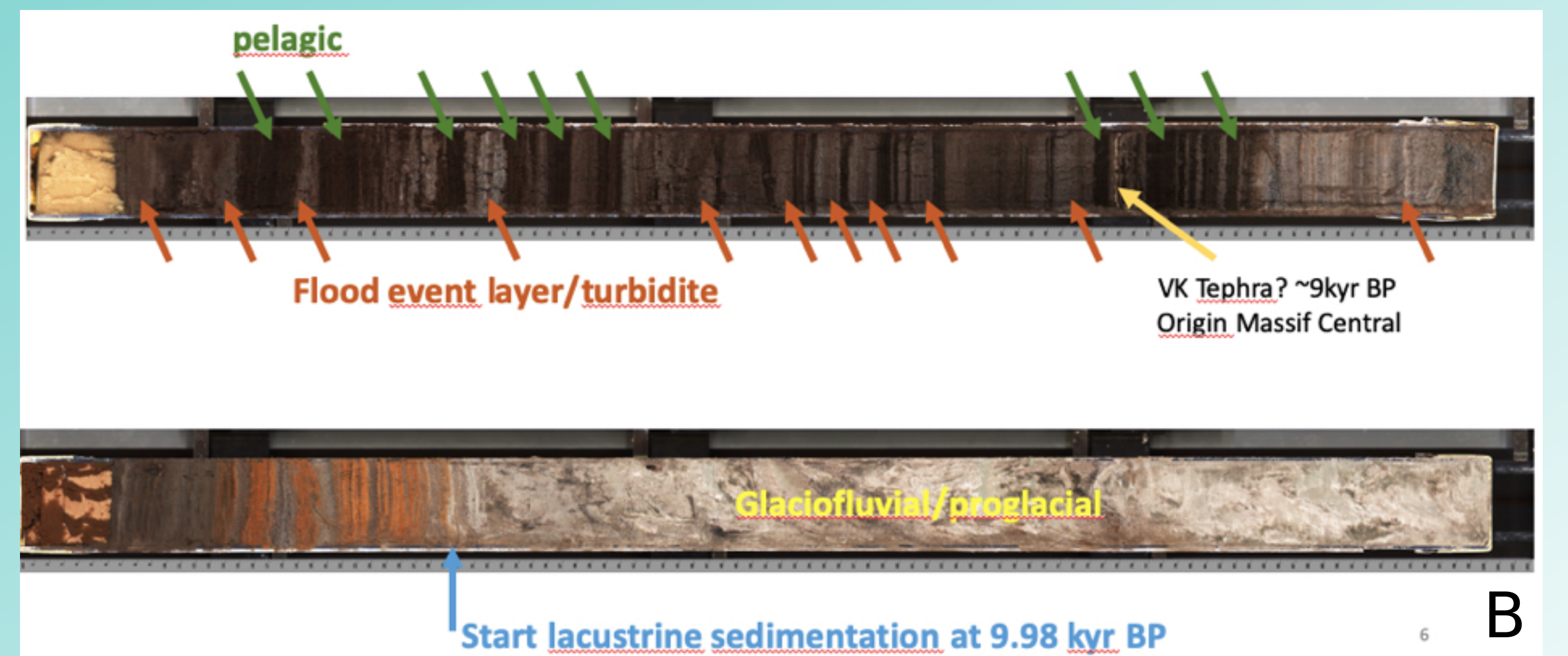


Geological Materials

Lake Cadagno is a meromictic lake surrounded by felsic gneiss, dolomite and gypsum bedrock. In this study a 10m sediment core shows glaciofluvial sediments with the start of lacustrine sedimentation 9.98 kyr BP (A and B). The lacustrine sediments are a succession of flood events deposits (turbidites) and pelagic background sedimentation (B).



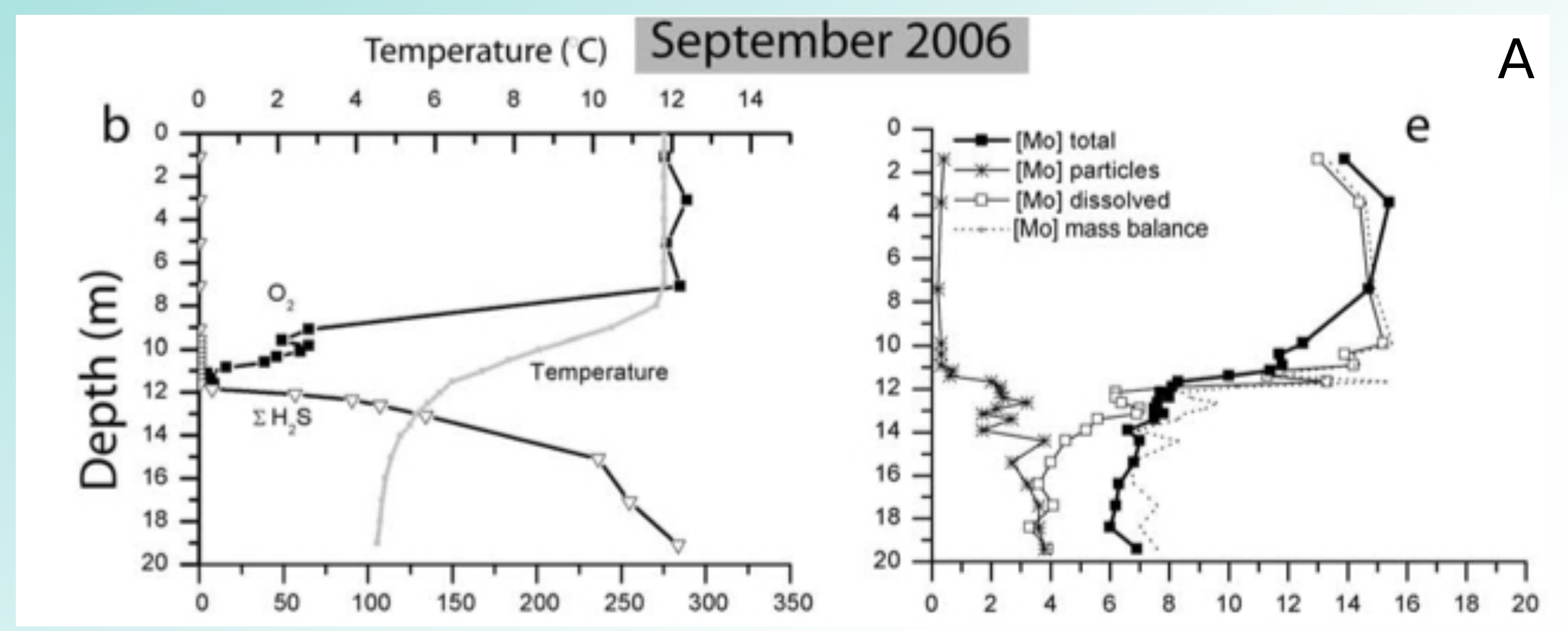
A



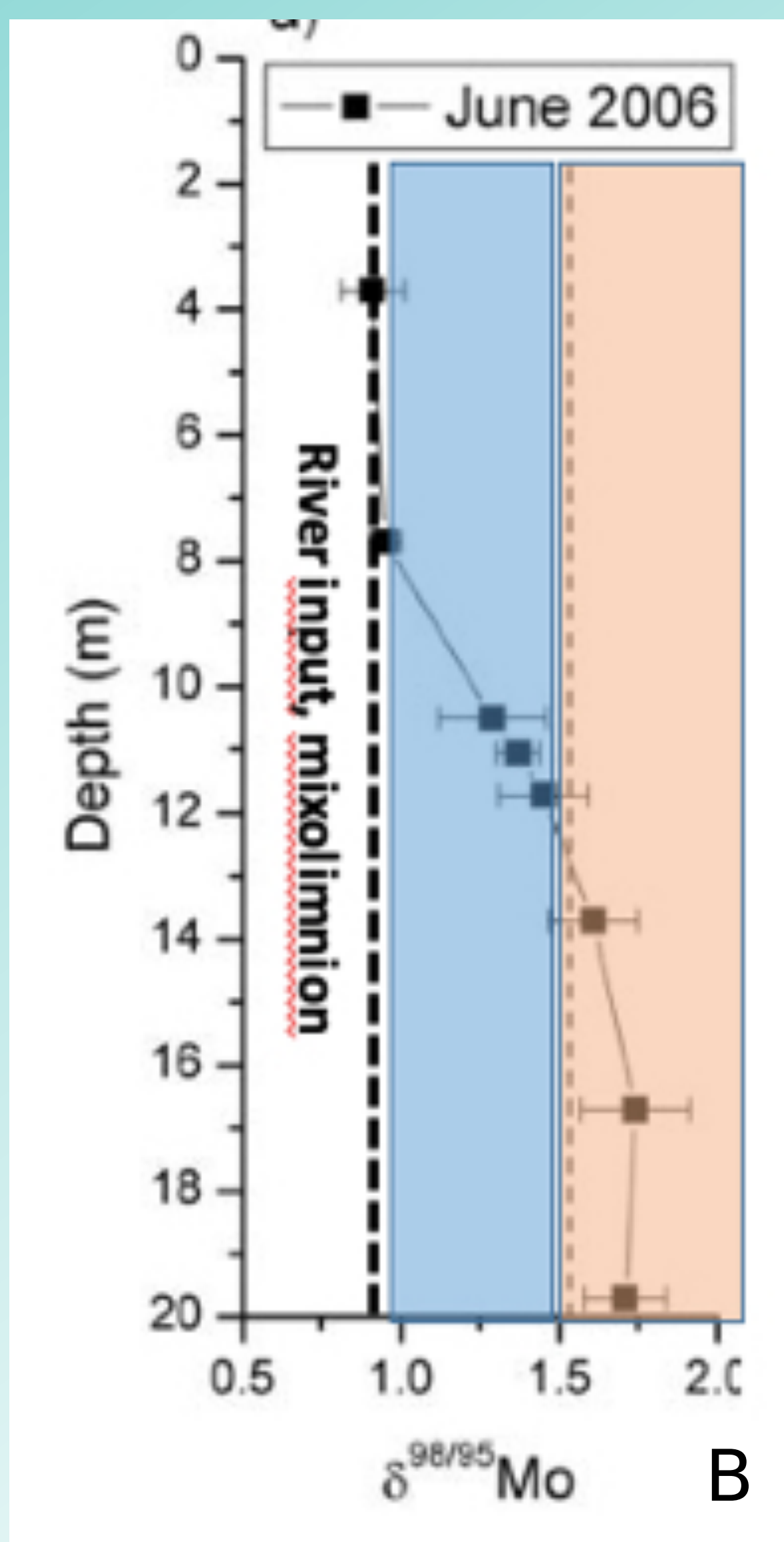
B

Results

Figure (A) shows that dissolved O₂ disappears from the water column at the chemocline (11m depth) while H₂S appears. While Mo is partially removed from water column below the chemocline, there is a progressive increase of H₂S with depth. At the chemocline and below, dissolved Mo concentration decreases due to the conversion of MoO₄²⁻ to particle reactive thiomolybdates. Figure (B) shows the water column Mo isotopic composition expressed as $\delta^{98/95}\text{Mo}$. Lake surface waters have Mo isotopic composition close to that of the main river input source with $\delta^{98/95}\text{Mo}$ of $0.86 \pm 0.20\text{‰}$ (black dashed line). At the chemocline (blue area) and further in the euxinic part (orange area) Mo concentration decreases and the dissolved Mo isotopic composition $\delta^{98/95}\text{Mo}$ becomes progressively heavier (Dahl et al. 2010). Figure (C) shows that most of the sediment bound Mo has $\delta^{98/95}\text{Mo}$ close to that of the riverine/chemocline (blue area) input. But an increase towards higher $\delta^{98/95}\text{Mo}$ occurs between 6-8 m depth.

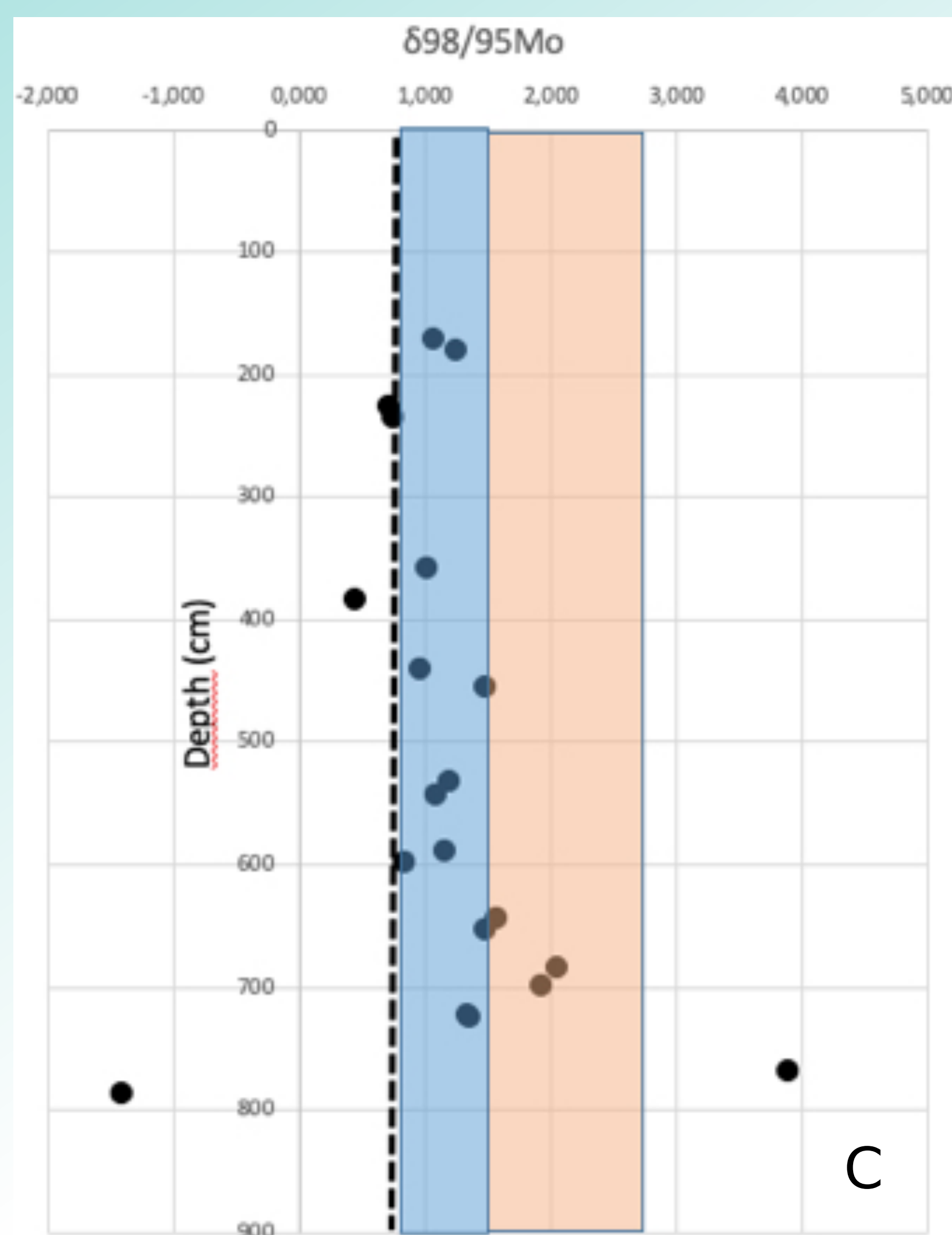


A



B

Modified from Dahl et al. (2010)



C

Discussion

At chemocline, the increase of $\delta^{98/95}\text{Mo}$ and decrease of Mo in the water column suggests a loss of light molybdenum to the sediments. It is due to the conversion of molybdate to particle reactive thiomolybdate as indicated by light $\delta^{98/95}\text{Mo}$ values of the first 6m of the core. The shift towards heavier Mo isotopic composition in sediments below 6m might either be caused by a dominant input of isotopically heavier dissolved Mo from nearby dolomite outcrops with $\delta^{98/95}\text{Mo} = 1.56 \pm 0.10\text{‰}$ or by a change in redox regime of the lake. This question will be addressed by combining Mo isotopic information with S isotopic data.

Outlook

Lab work is in progress. The interesting results between 6 - 8m need a higher-resolution resampling which is currently in progress. Samples from the water-sediment interface are also currently undergoing analysis. Results are coming during the spring of 2021. Thanks to these future new results the connection between molybdenum and sulfur will be further explored.