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The use of sedimentary ancient DNA from lakes in tracing human-environment interactions in the Western Alps

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Interdisciplinary approach



The use of aDNA from lake sediments

AIMS AND STRUCTURE

- understanding of **agricultural activities** and **practices**
- issues of scale
 - aDNA taphonomy
 - relationship with the identification of activities and practices in the Alps
- consider methodological and interpretive issues via examples from various periods

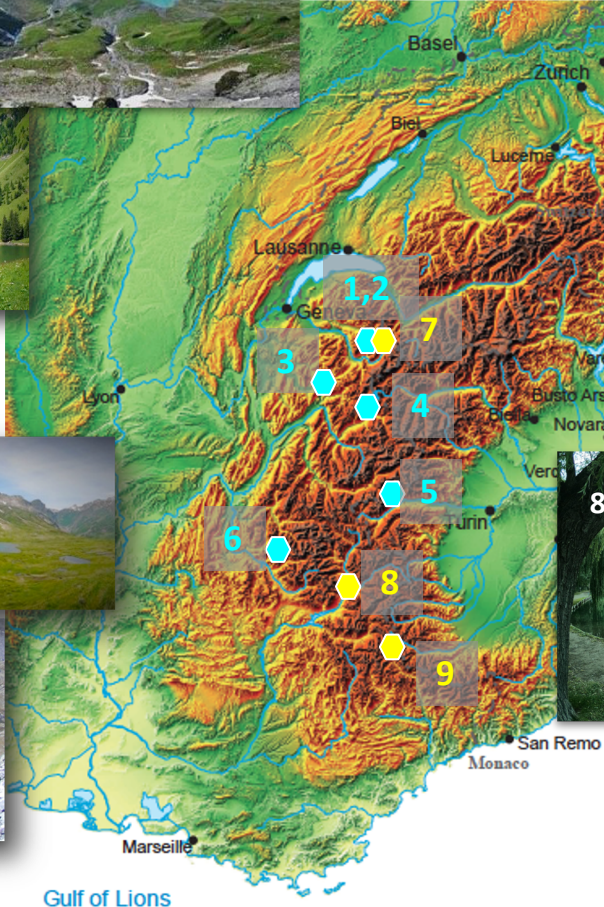
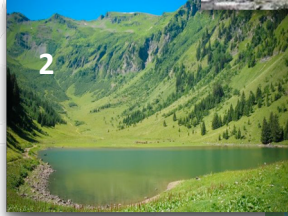


Study areas

→ main focus on pastoral activities

Previous studies

1. Lake Anterne, 2063 m
2. Lake Gers, 1537 m
3. Lake La Thuile, 875 m
4. Lake Verney, 2090 m
5. Lake Savine, 2443 m
6. Lake Muzelle, 2105 m (only 1600 yrs)



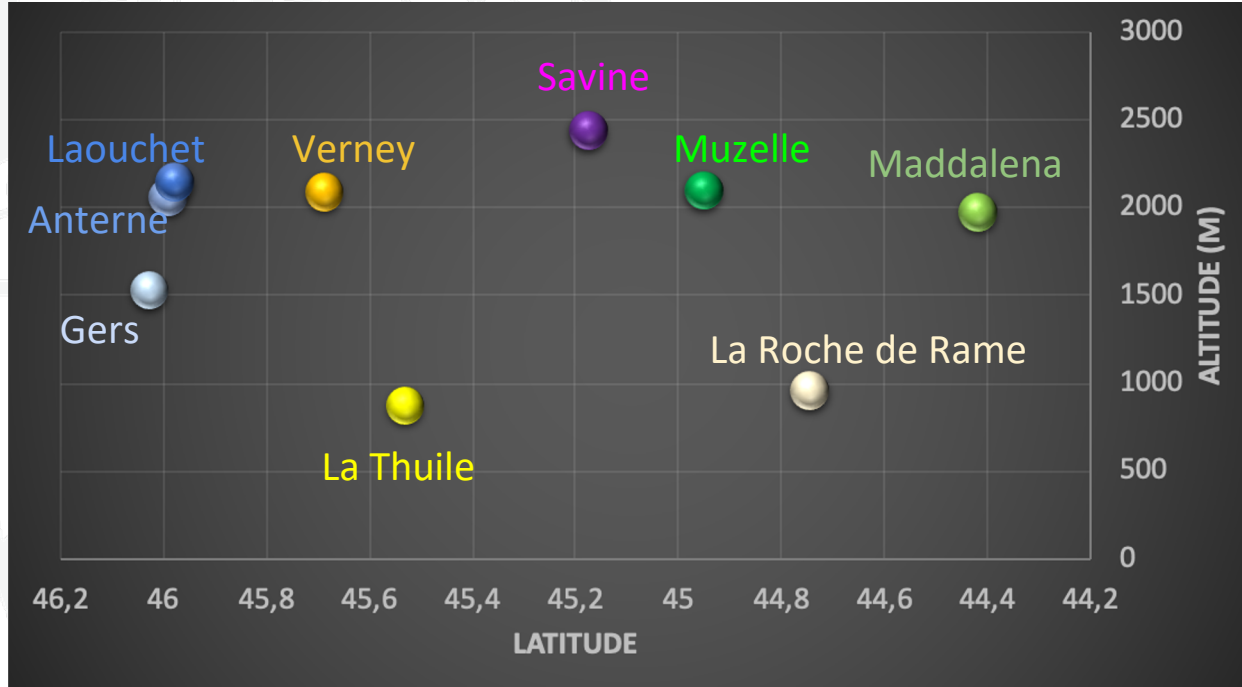
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New studies in Pathways

7. Lake Laouchet, 2150 m
8. Lake La Roche-de-Rame, 946m
9. Lake Maddalena, 1977 m



Altitudinal gradient



High altitude

→ Generally no faunal remains (but can be found in calcareous environments)

Low altitude

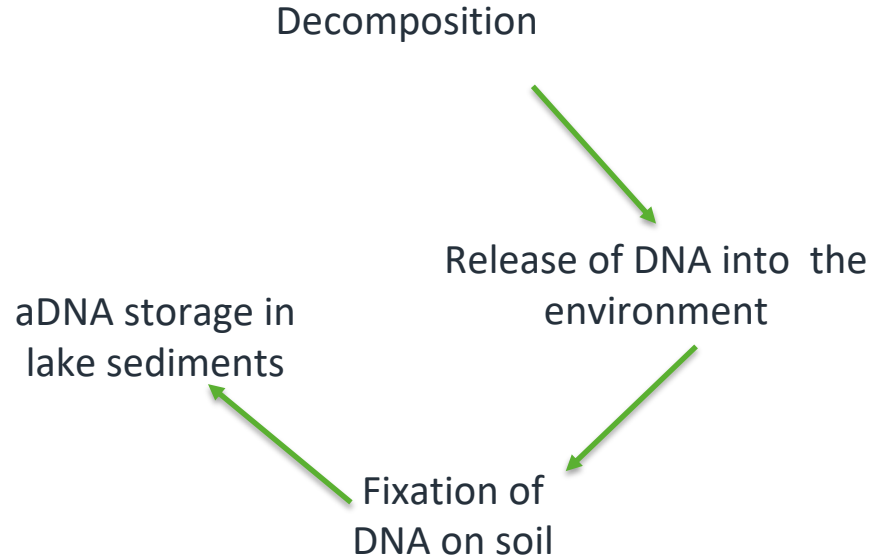
→ More systematic excavations and more favorable environment for faunal remain preservation

Environmental and lake sediment DNA

- Plant remains
- Faeces, urine
- Skin cells

- binds to soil
- washed into the lake
- sedimentation

- Extracellular DNA may represent the main DNA pool
- Provides most integrated view of aquatic, sedimentary and terrestrial biodiversity



Lake sediment core sampling



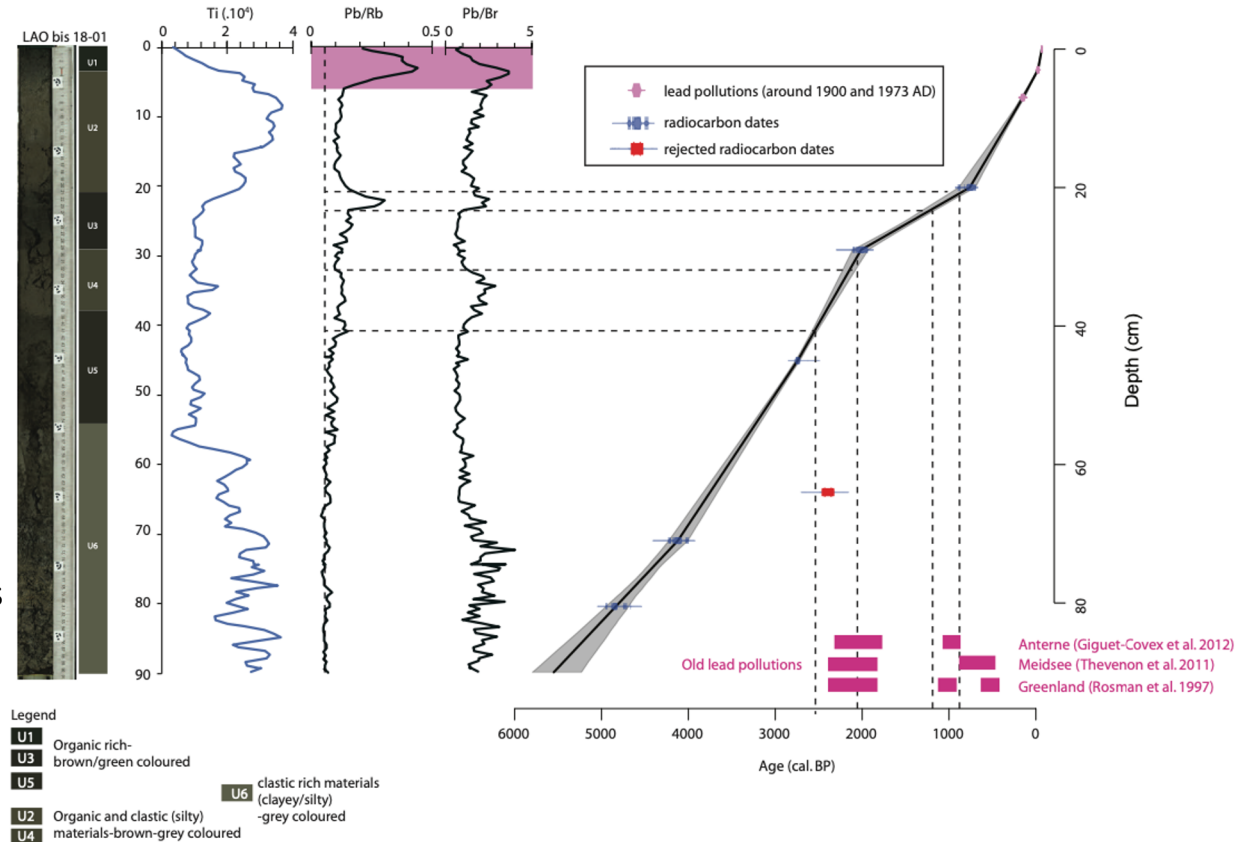
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Sedimentology/geochemistry, dating



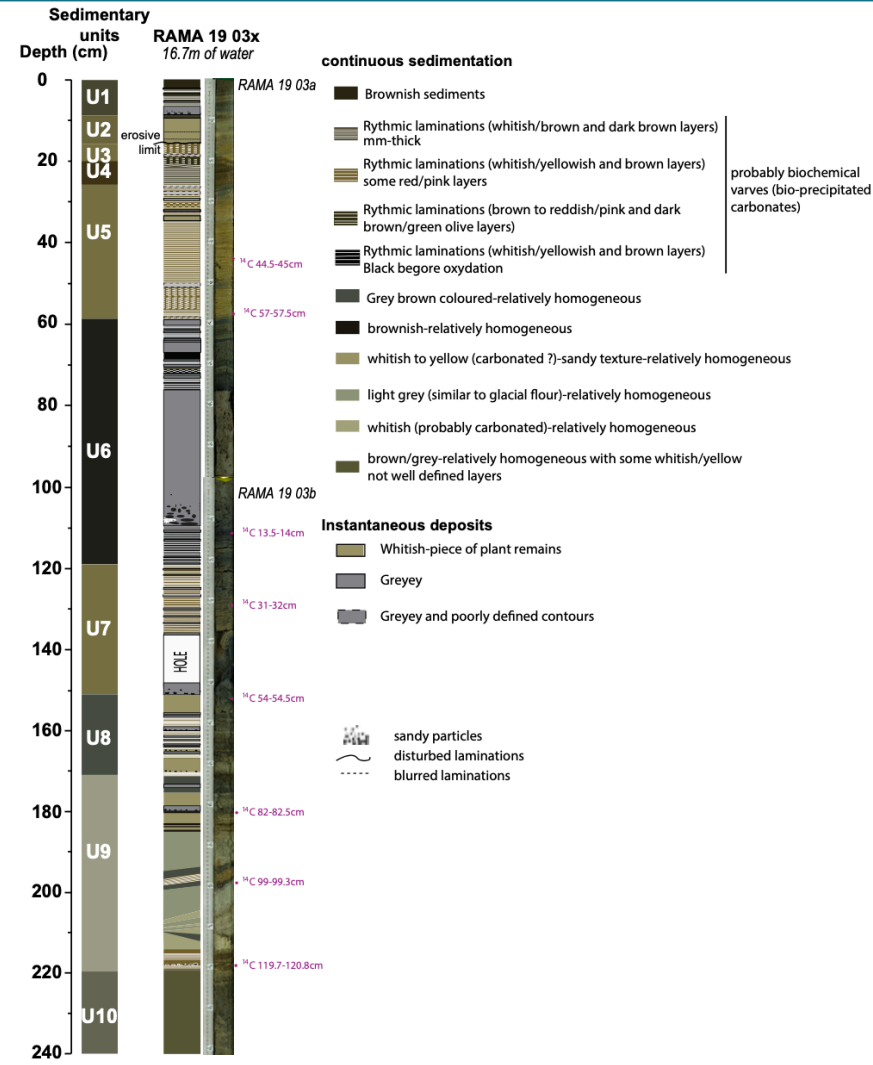
- “simple” sedimentation made of 6 units alternating between enrichment in organic matter and enrichment in detrital elements
- record of lead pollutions in agreement with other records in the region



Sedimentology & dating

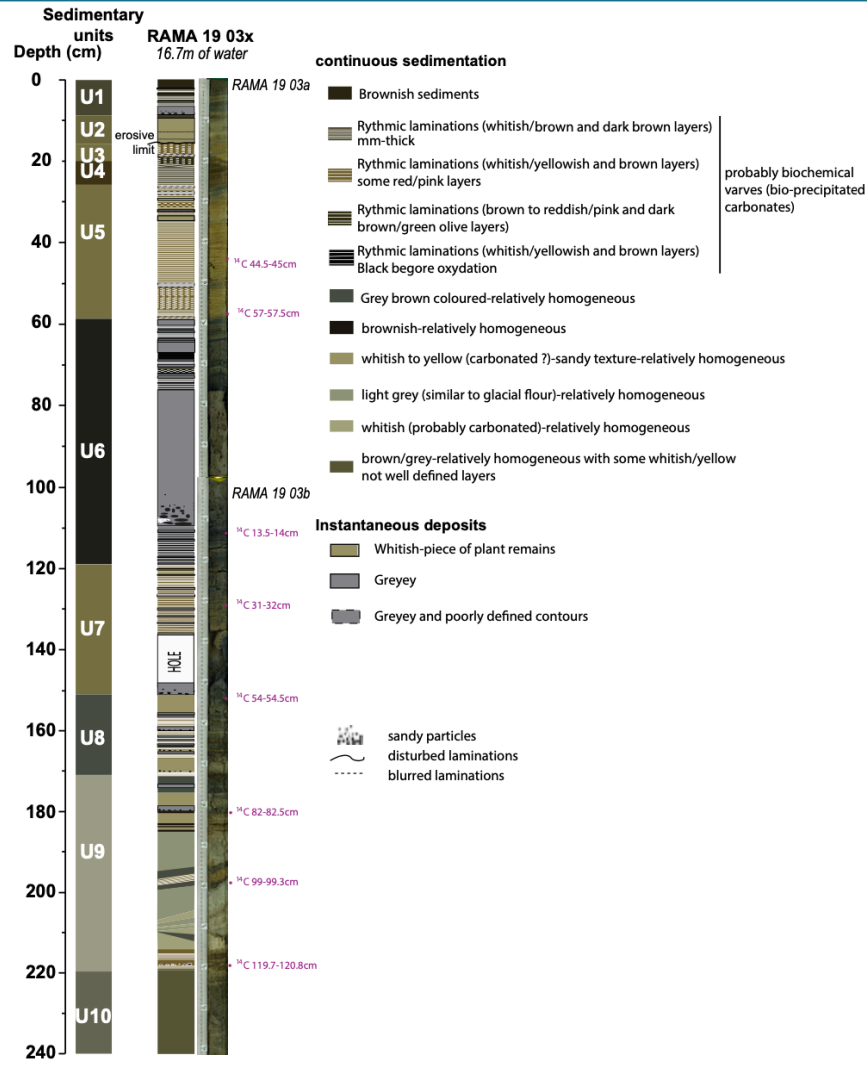
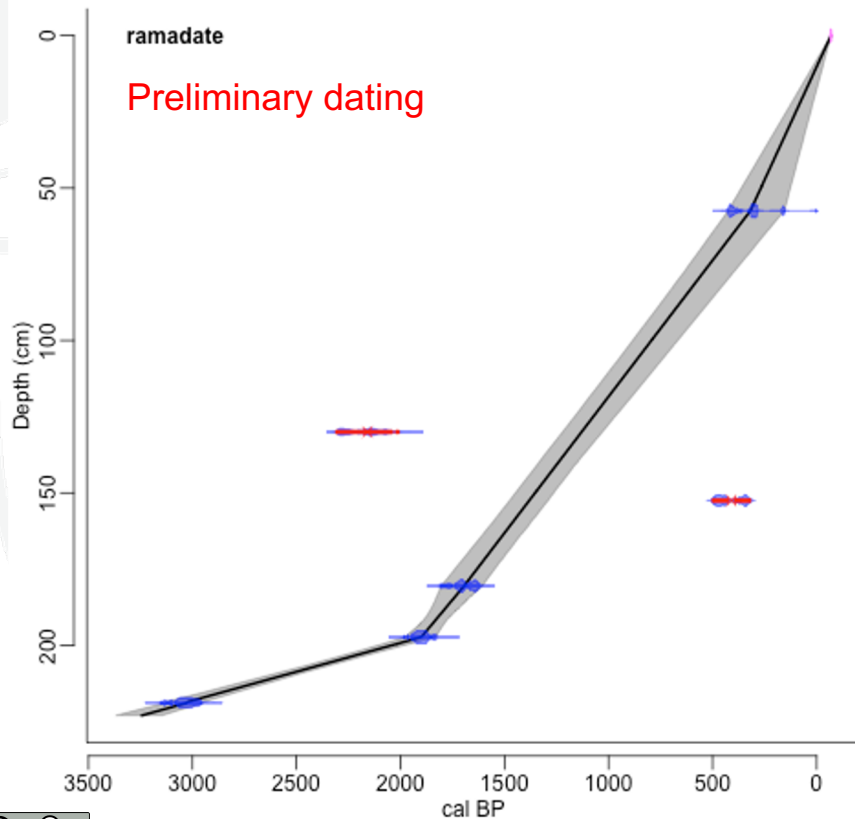


- “complex” sedimentation:
 - 10 units made of very different facies, including rhythmic laminations of different colours (probably biochemical varves: alternation of organic, carbonated and detrital clayey sediments)
 - instantaneous deposit



Sedimentology & dating

Lake La Roche-de-Rame, 946m



Sedimentology & dating

MAD 15 P2x
(5 m of water)

MAD 15 P3x
(6.2 m of water)

MAD 15 P1x
(5,6 m of water)

● “complex” sedimentation:

Preliminary
dating

1925 \pm 65

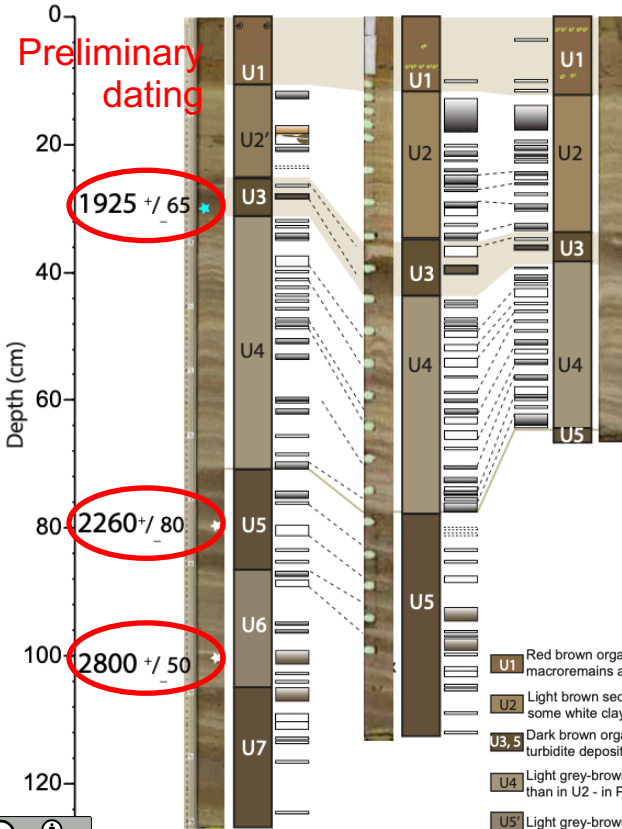
2260 \pm 80

2800 \pm 50

→ 6 units : some are enriched in organic matter and others in detrital elements

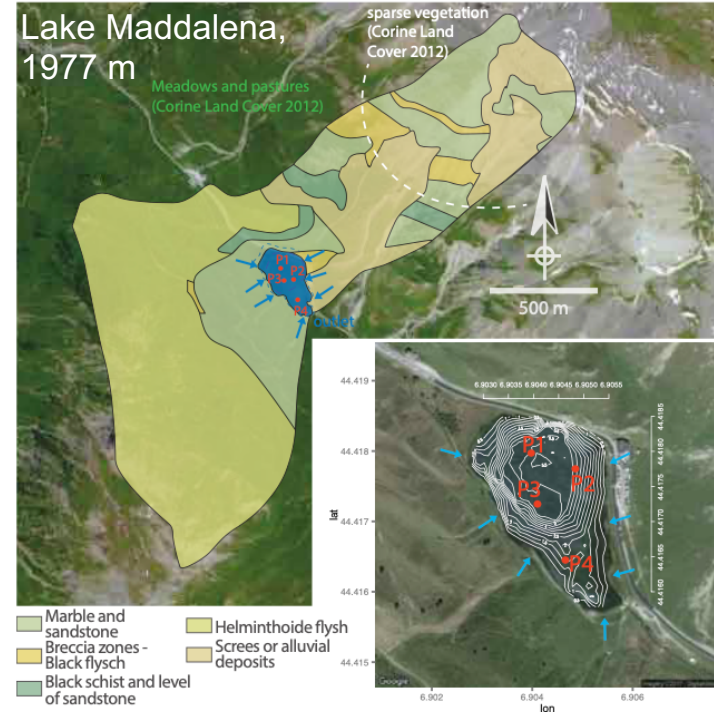
→ instantaneous deposits (mostly floods)

→ Good correlation of deposits between the cores in the deepest basin

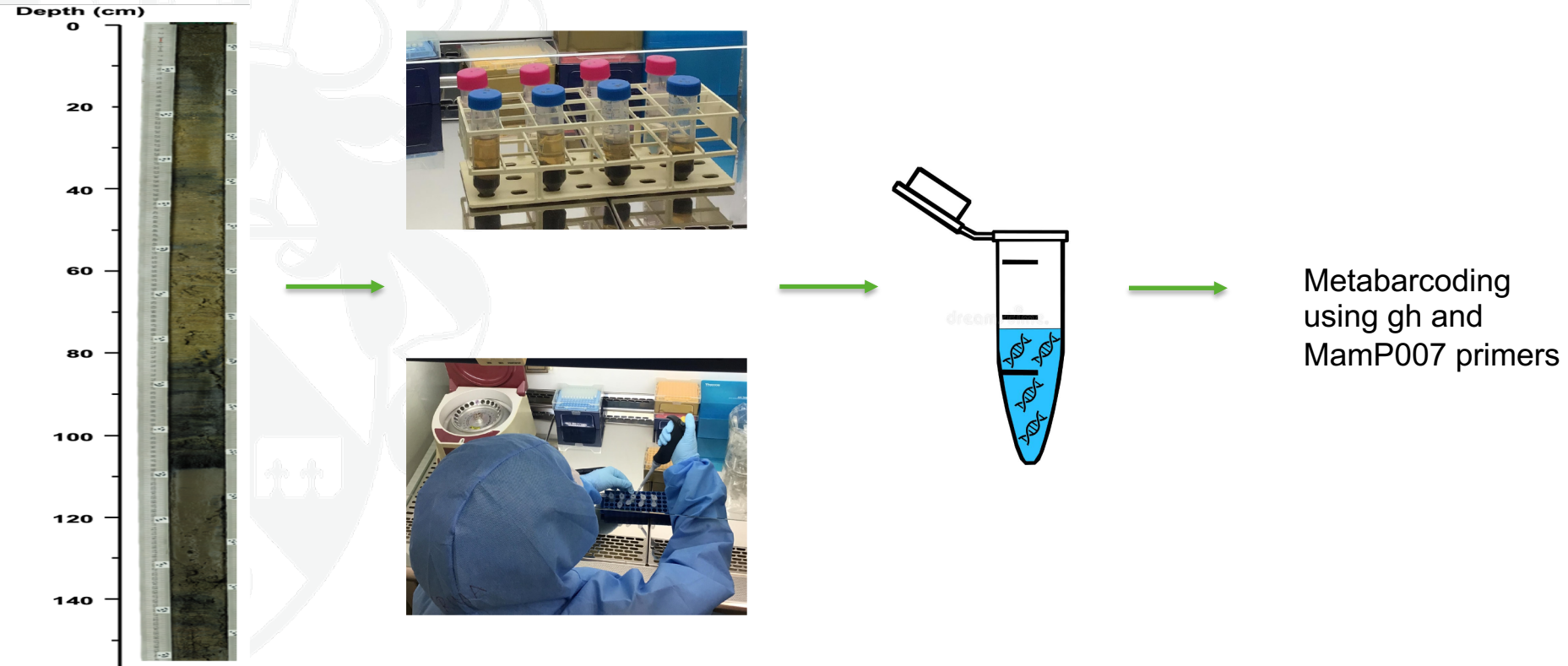


- U1** Red brown organic rich sediments containing some layers with plant macroremains and few white clayey layers
- U2** Light brown sediments containing turbidite deposits (mostly thin) and some white clayey layers
- U3,5** Dark brown organic rich sediments containing white clayey layers and maybe turbidite deposits (brown colored in U5- probably origin different than in U2)
- U4** Light grey-brown sediments containing white clayey layers and turbidite deposits (mostly thicker than in U2 - in P2, small plant macroremains are visible at the bottom in most of the deposits)
- U5** Light grey-brown sediments containing white clayey layers and turbidite deposits

Lake Maddalena,
1977 m



Workflow



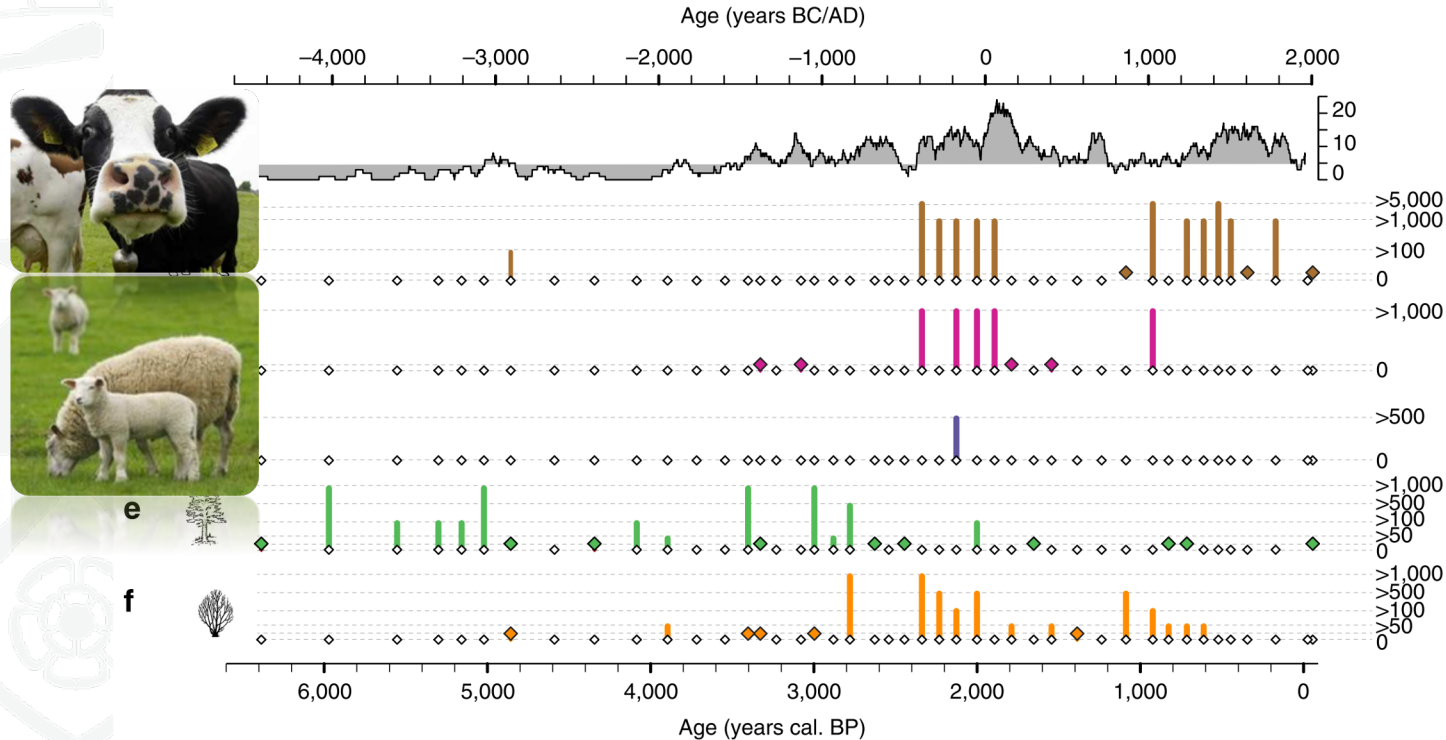
The aim

- Preparing PCR replicates for 6 lake sediment cores for plant and mammalian markers
 - Lakes Anterne, Maddalena, La Roche-de-Rame, Lauzanier, Laouchet and Lauvitel
- DNA extractions for all cores are done
- High-throughput amplicon sequencing
- Data analysis (in progress for plants)
- Integrate results



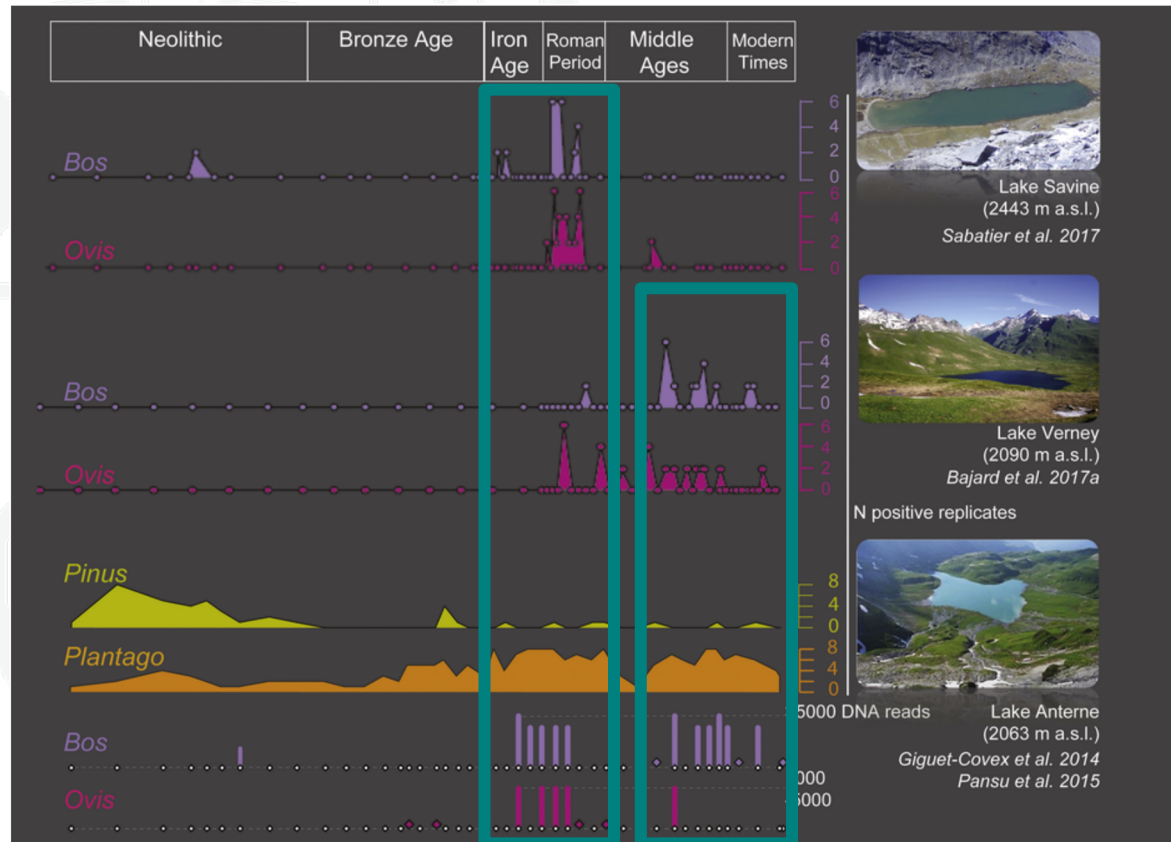
Expected results: examples from previous studies

First successful study on mammal DNA: Lake Anterne sediments (2063m asl)



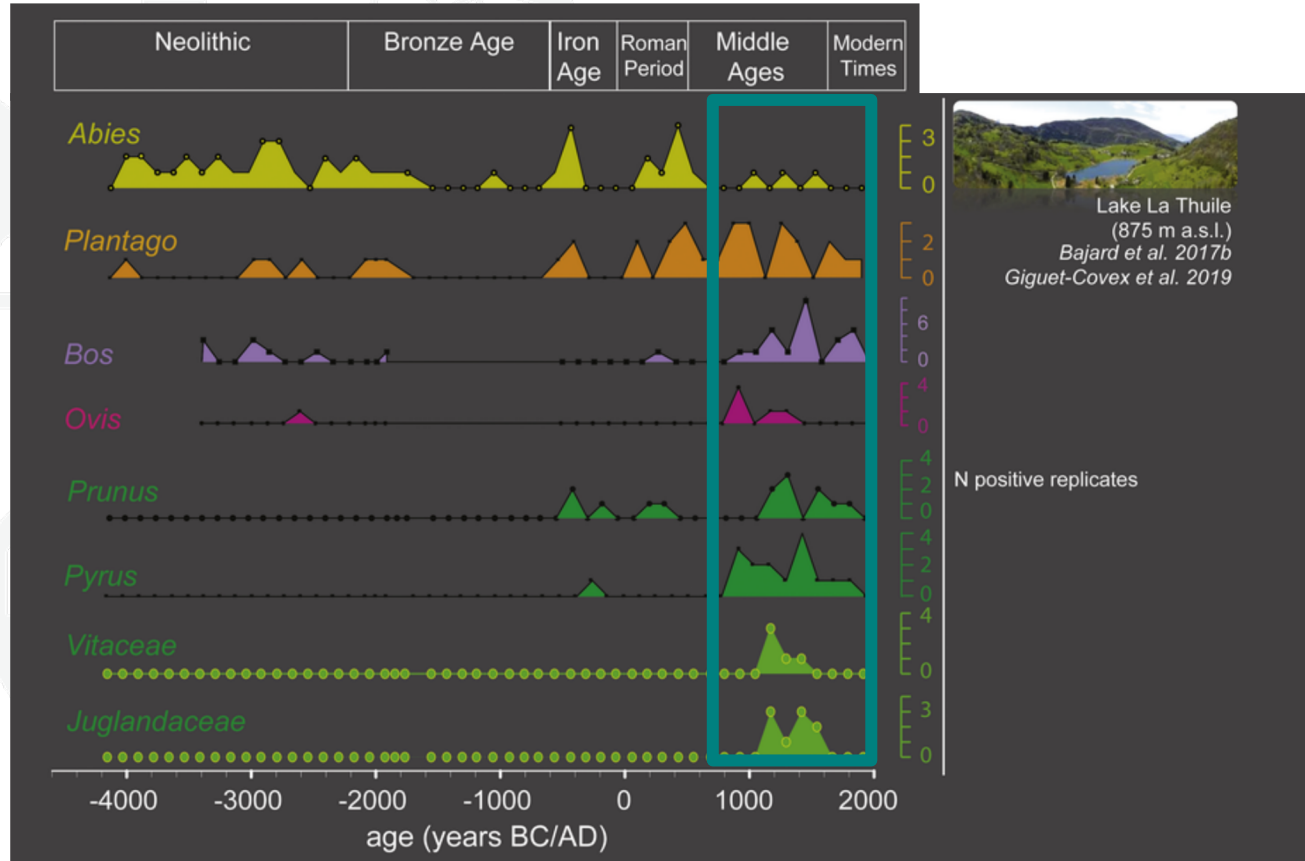
Giguët-Covex et al. (2014)

Expected results: examples from previous studies



- **Main phases of pastoral activities in altitude in the Northern French Alps:**
 - Iron Age/Roman
 - Middle Ages with a change in animal composition (first sheep and cow and then mostly cows)

Expected results: examples from previous studies



- Same medieval pattern at lower elevation (900 m)
- And important development of agriculture (fruit trees)

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Thank you for your attention!

