B789
EGU2013-9500

Microsedimentological investigations in lacustrine sediments from a maar lake: implications for palaeoenvironmental reconstructions

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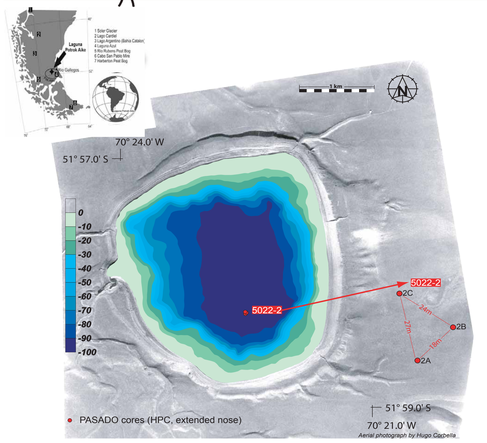


Location of Laguna Potrok Aike in southern Patagonia (blue circle on inset map of South America), Aerial photograph of the immediate catchment area of Laguna Potrok Aike (kindly provided by Hugo Corbella, Buenos Aires) and bathymetric map of the lake with indicated coring site 5022-2. Red dots indicate the positions of piston cores.(modified from ohlendorf et al., 2011)

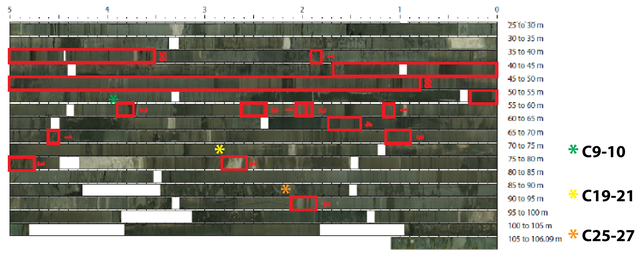
1- Introduction and objectives

Laguna Potrok Aike is a maar lake in Argentina, southeast of Patagonia, in the Santa Cruz province (51°59.0 'S ; 70°21.0' W).

- The climate is dominated by strong westerly winds (Endlicher, 1993)
- Polymictic conditions prevail (Endlicher, 1993)
- No ice cover during the winter (Endlicher, 1993).
- The lake has no outlet, which makes it very sensitive to changes in the precipitation/evaporation ratio (Haberzettl et al., 2005; Ohlendorf et al., 2011).

This work investigates how commonly used geochemical proxies such as Ca, Si, Ti, Fe, Mn, K, Ca/Si, Ca/Ti, Mn/Ti, Fe/Ti and K/Ti can be used in long lacustrine sedimentary sequences in the light of detailed microsedimentological facies analyses.

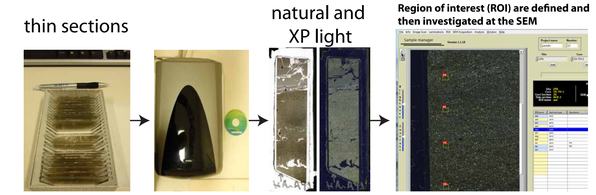
2- Materials: subsampling the PASADO sedimentary sequence



High-resolution analysis, combining:
- **µ-XRF,**
- **SEM-EDS and**
- **image analysis**,

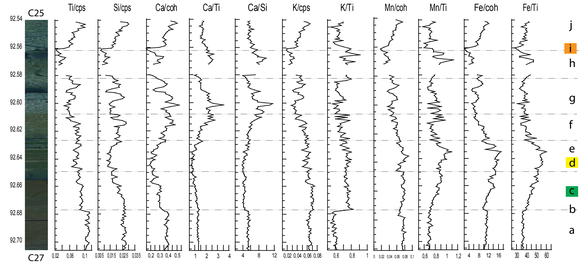
were conducted on 22 thin sections during the **Last Glacial**.
Red boxes, and numbers associated, represent all thin sections subsampled. Only eight thin sections are presented in this poster.

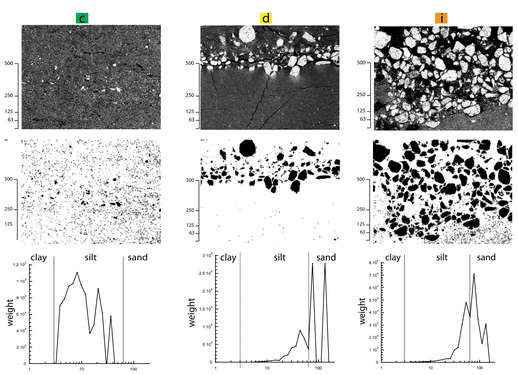
3- Methods : image analysis



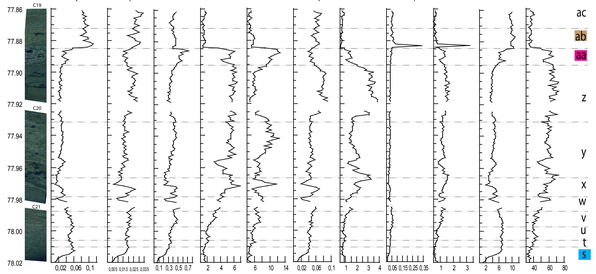
4- Results

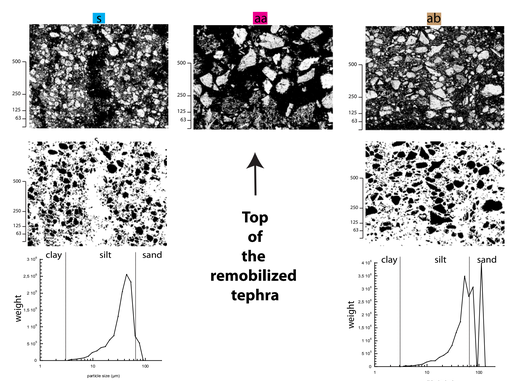
* C25-27 : very thin laminations during lake level change



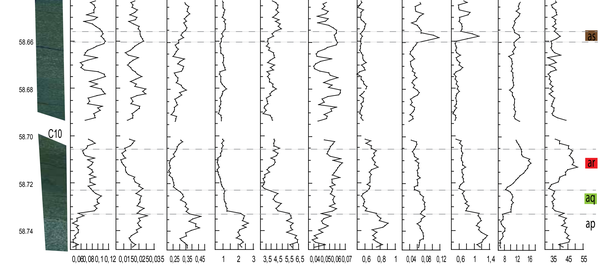


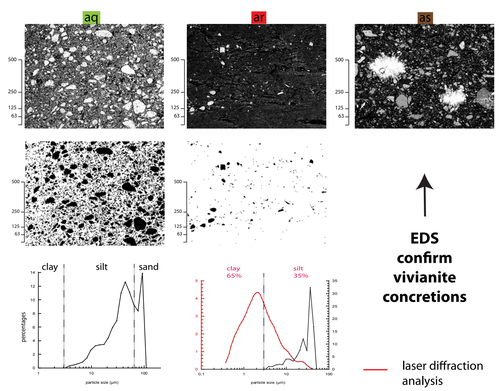
*C19-21 : Turbidite composed of micropumices





* C9-10 : rapid variations of microfacies and vivianite concretions





5- Interpretations

Fe and Mn: increase gradually in clays (c) and fine laminations (d)
K and K/Ti: rich in clays (c) and redeposited layers (i-j)
Ti: low in sands (g) and high in silts (a)
Ca and Si: increase in sands (g, j)

Fe and Ti: low in micropumices intervals (t-aa) (Jouve et al., 2012)
K: rich in clays (z)
Mn: peak on the top of turbidite (ab)
All ratios are particularly high during micropumices intervals because of Ti close to the detection limit. Thus, no one is useful for environmental or climatic reconstructions.

Ti: low in sands (ap)
K: rich in clays (ar) and coarse sediments (sandy silt sediments between ROIs ar and as)
Mn: peak in vivianite concretions (reddingite) while **Fe** does not increase significantly in vivianite (?) (ROI as)
Ca and Si: increase in sands (ap)

6- Conclusions

Microfacies interpretations
Successive microfacies from silt to very thin laminations (ROIs a-e) are interpreted as progressive elevation of the lake level created by less westerly winds and more easterly winds, bringing more precipitations from the Atlantic Ocean. Consequently, less mixing in the water column could have resulted in oxygen depletion in the deep basin, leading to enrichment of Fe and Mn at the oxic-anoxic boundary in the sediments (ROIs d, e).

Signification of elements and ratio of element peaks:

- **Ca, Ca/Ti and Ca/Si**:
  - o Coarse sediments during the Last Glacial, and
  - o Autochthonous calcite precipitation during the Holocene.
- **K and K/Ti**:
  - o Clay, or
  - o Redeposited layers
- **Fe and Fe/Ti**:
  - o Clay, or
  - o Silt, or
  - o Vivianite, or
  - o Low micropumices content, or
  - o Sand event
- **Simultaneous Fe, Mn, Mn/Ti and Fe/Ti :**
  - o Dislocation of volcanic rocks (non presented here), or
  - o oxic-anoxic boundary variations, or
  - o Redeposited layers.
- **Si and Ti :**
  - o Sand and silt respectively, but only if sediments are not rich in micropumices (Jouve et al., 2012).

Consequently, the behavior of elements, or ratio of elements, could not be used in a unique way for inferring environmental and climatic conditions. This work cautions against the use of many µ-XRF proxies for an entire long lacustrine sedimentary sequence, and warns about their use from a site to another.

References

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Collaborators
PASADO is an international and interdisciplinary scientific project with field work in Argentina coordinated at the University of Bremen by GEOPOLAR (Institute of Geography). It is based on a close cooperation of several research institutions distributed all over the world. PASADO is made possible by funding from ICDP and six national funding agencies.