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Paleosecular variations recorded by Holocene-Pleistocene sediments from Lake El Trébol (Patagonia, Argentina)

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Abstract

Paleomagnetic studies carried out on six cores from the bottom sediments from lake El Trébol, South Argentina are described.

Measurements of directions declination and inclination (*D* and *I*) and intensity of natural remanent magnetisation (NRM), magnetic susceptibility at low and high frequency (specific, *X* and volumetric, *k*), isothermal remanent magnetisation (IRM), saturation isothermal remanent magnetisation (SIRM), back field and anhysteric remanent magnetisation (ARM) were carried out. Stability of the NRM was investigated by alternating-field demagnetisation.

Rock magnetic studies suggest that the main carriers of magnetisation are ferrimagnetic minerals, predominantly pseudo single domain magnetite.

Records of NRM and *k* show a good correlation with the sedimentological description, and also with those of shorter cores previously studied.

The tephra layers were identified from the lithologic profiles and also from the magnetic susceptibility logs. Due to their different chronological meaning and their rather bad behaviour as magnetic recorder, these layers were removed from the sequence and the gaps that were produced along the profiles by the removal were closed, obtaining a *shortened depth*.

Radiocarbon age estimates from these cores and from earlier studies allow us to construct a paleosecular variation (PSV) record for the past 24,000 years. These results show good correlation with the previous one.

The spectrum obtained from spectral analysis shows major peaks at periodicities of about 1150, 1500, 2490, 3630, 5240 and 11,810 years. Both clockwise and counterclockwise precession of the geomagnetic vector is evident from analysis of the Bauer plots, with a preponderance of clockwise movement.

Keywords: Paleosecular variation; Holocene-Pleistocene; South America; Lake El Trébol; Spectral analysis

1. Introduction

Lake sediments have the potential of providing continuous and high-quality records of the past geomagnetic field. Paleomagnetic records obtained from lake sediments often cover time spans of several thousand years.

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For this reason, they are useful for studies of paleosecular variation (PSV) over periods of about 10^3 years.

In this paper, we present a PSV record from Lake El Trébol (south–west Argentina). These results are compared with other records from this area previously reported (Creer et al., 1983; Sinito and Nuñez, 1997; Gogorza et al., 1999, 2000a,b, 2002).

2. Site description

Lake El Trébol, a closed basin (41°04′S 71°29′W), is an oligotrophic, small lake (surface area: 0.4 km^2, maximum depth = 11 m), located at 758 a.s.l. on the east side of the Andean Patagónica Cordillera, in a wooded area with moderate human influence (Fig. 1). At present, no perennial stream discharges into the lake and the hydrological budget is dominated by groundwater influx and losses by evaporation (Bianchi et al., 1999). The area is dominated by humid winds from the west with annual precipitation between 1500 and 1800 mm/year; the average annual temperature is about 8.7 °C. The vegetation of the area is within the Subantartic forest. Nowadays, lake El Trébol lies in the transition forest (700–1000 m a.s.l.) with *Nothofagus dombeyi* and *Austrocedrus chilesis* as dominant tree species (Bianchi et al., 1999). This region presents one of the most marked humidity gradients of the world, clearly reflected by vegetation: from west to east, the moist forest is replaced by the Patagonian steppe in less than 50 km (Bianchi et al., 1999).

Advances and retreats of glaciers during the Pleistocene glaciation shaped the surrounding landscape. As a result, numerous glacial melt-water spillways, lakes (e.g. Lake El Trébol and Lake Escondido) and glacio-fluvial deposits were formed (Flint and Fidalgo, 1964, 1969; Rabassa and Clapperton, 1990; Bianchi et al., 1999).

3. Field work and sampling

Four long cores (labelled lt98-1, lt98-2, lt98-4 and lt98-5, respectively) about 11 m long and two short cores (labelled lt98-3 and lt98-6) about 3 m long, were collected in water depths of about 10 m using a push corer installed on a raft with a central hole. The corer has an internal piston, which rises as sediment is drilled. The core sections are 2 m long with a diameter of 60 mm collected in PVC tubes. The cores were cut into 1 m-segments and split into halves using a nylon thread. They were then sealed in polythene and stored at 4 °C.

One half of each core was described, and then subsampled using cubic plastic boxes of 8 cm^3 at regular intervals of 2.5 cm, sealed and weighed for paleomagnetic studies. In total, 1478 subsamples were taken. Rock magnetic studies and ^{14}C and δ^{13}C analysis were carried out on samples from core lt98-4.

4. Sedimentology

Lake El Trébol sedimentary stratigraphy shows strong similarities to others obtained by the authors from surrounding lakes (Gogorza et al., 1999, 2000a, 2002). The

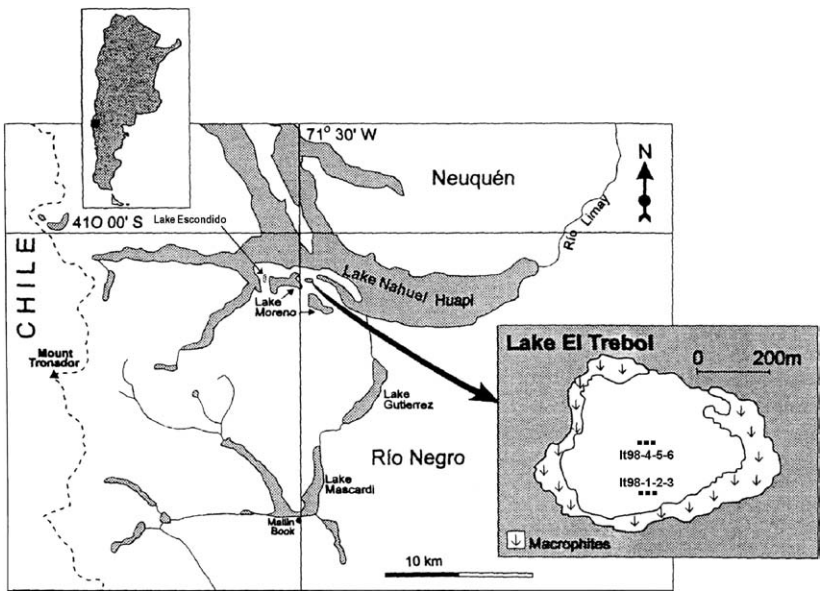

Fig. 1. Geographical location of lake El Trébol showing coring sites (This figure is based on the Fig. 1 by Bianchi et al., 1999).