Reinforcement of age models in recent alpine lake sediments using geomagnetic field secular records.

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Résumé

A still challenging point for palaeoenvironmental or palaeoclimatic studies is the chronology carried out using of sedimentary archives is the chronology of different events retrieved. For the last century, short-lived radionuclides (210Pb, 137Cs) allow a reliable dating. Beyond this period, age-depth models are mainly based on 14C dates of terrestrial plant fragments or carbonated material. Such remains may be very scarce or even absent in particular environments such as high altitude / latitude lakes.
This study aims to explore the possibilities and limitations of the use of geomagnetic field paleosecular variations to for dateing recent lake sediments. The direction of the measured natural remanent magnetization (NRM) measured in sediment cores will be compared to a reference curve to provide additional chronological markers, including other to the classic

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chronological and sedimentary constraints in order 14C ages. Age – depth models calculated with and without the paleomagnetic chronological markers will be compared to assess their value to provide estimations for age – depth modelling. A paleomagnetic study of 7 high altitude lakes whose elevation is between 880 m and 2517 m asl has been realized. UWITEC gravity corer or piston core were used to retrieve sediment cores. All the magnetic measurements were performed in CEREGE laboratory. In some cases, cubic samples were collected in order to ensure good preservation of sedimentary features using the Anisotropy of Magnetic Susceptibility (AMS). U-channel samples were subjected to stepwise alternating field (AF) demagnetization Anhysteretic Remanent Magnetization (ARM) and Isothermal Remanent Magnetization (IRM) were imparted.

For the 4.5 m long sequence of Lake La Thuile lake, S-ratio varies from 0.84 to 0.97 with an average of 0.91 $\pm$ 0.02. Low field susceptibility (kLF), ARM40/ARM and kARM/kLF show important change at around 1.0 m depth. kLF is anticorrelated to the two other parameters implying suggesting that they are mainly linked with grain size changes and not to mineralogical parameters. Also the ratio kARM/kLF demonstrates that the magnetic grain size is ranging from 5 mm to 0.1 mm. The mean destructive field (MDF) of the ARM is varying from 18 to 35 mT with average value of 28.9 $\pm$ 4.4 mT, while the average value of the NRM MDF is 35.9 $\pm$ 6.3 mT. Comparison between the ARM and NRM MDFs gives provides good correlation coefficient ($r = 0.67$ and $r = 0.78$ for the part below 1.0 m). The NRM is carried by the same particles than the ARM. This suggests that magnetite grains of low coercivity magnetization are the dominant carrier of remanence.

For the other lakes, the environmental magnetic parameters (ie: ARM/SIRM; ARM40/ARM; MDF) are stable through each core indicating that no major changes in the magnetic content occurred during sedimentation. The strongest variations in magnetic parameters are associated to grain size change variability usually correlated to sedimentary detrital inputs. The NRM was carefully analysed and artefacts due to coring were evidenced and therefore deleted from the dataset. Usually only a single, highly stable, magnetic component was observed. The different lacustrines lake records show well defined peaks of declination (D-1 to D-5) that are compared to neighbouring other records and to the reference curve. The obtained age-depth models are consistent with short short-lived radionuclides, 14C dating and correlations to historical events. This approach allowsed also reducing age uncertainties related to 14C dating of more than 30%. In some cases (Doménon Llake Doménon) with very low sedimentation rate, a delay in remanence acquisition (lock in depth effect) can be evidenced and estimated not more than 10-15 cm. This study demonstrates that the use of paleosecular variations record can be an efficient tool in different sedimentary environments as a tool for dating recent millennium-long lake sediments records or consolidating their age- – depth models can be efficient in different sedimentary environments.