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Paleomagnetism and rock magnetism of the Lago Lungo sediments (Rieti basin, Italy)

Leonardo Sagnotti (1), Fabio Florindo (1), Scott Mensing (2), Paula Noble (3), Gianluca Piovesan (4), and Irene Tunno (4)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy (leonardo.sagnotti@ingv.it), (2) Department of Geography, University of Nevada, Reno, Nevada, USA, (3) Department of Geological Sciences and Engineering, University of Nevada, Reno, Nevada, USA, (4) DAFNE, University of Tuscia, Viterbo, Italy

We present the results of a high-resolution rock magnetic and paleomagnetic study of the sedimentary sequence of Lago Lungo, in the Rieti basin of the central Apennines (Italy). The Rieti Plain is an intramontane basin with an area about 90 km2, located about 80 km north of Rome, filled by alluvial sediments and bordered by mountains composed of carbonate and siliciclastic deposits. The basin has been nearly continuously utilized for agriculture for >2,300 years and it is characterized by the diffuse occurrence of springs along the plain border. It presently includes a few shallow lakes which represent the remnants of a larger ancient lake (known as “Lacus Velinus”), that was partially drained by the Romans in 272 BCE through the drainage system of the "Cascata delle Marmore". The basin is characterized by very high sedimentation rates during historical times, with preservation of a lacustrine sequence suitable for reconstruction of past environmental change at decadal resolution.

In this study, we analyzed the rock magnetic and paleomagnetic properties measured at 1-cm spacing on u-channel samples collected from four distinct and partly overlapping cores retrieved from Lago Lungo, in a water depth of 4.4 m. The composite section that we analyzed spans a total sedimentary thickness of about 15 m. The cores were also analyzed for their pollen and diatom content, as well as for geochemical proxies, with the aim of reconstructing a detailed record of forest and land use changes, flood occurrence and erosion history in the Rieti basin catchment.
The trends in the rock magnetic and paleomagnetic parameters can be correlated at high resolution between the overlapping sections of the different cores. The variation in the concentration of magnetic minerals in the Lago Lungo sequence - as indicated by the trends in the magnetic susceptibility (k), natural remanent magnetization (NRM) and anhysteretic remanent magnetization (ARM) values - shows some distinct sharp features which are correlated to historical changes in land use and to hydraulic works affecting the overall drainage of the basin. The NRM and the ARM were stepwise demagnetized in peak alternating field (AF) up to 100 mT. The NRM demagnetization diagrams allow the unambiguous identification of a Characteristic Remanent Magnetization (ChRM) throughout all the sequence. The trends in the ChRM declination and inclination are characterized by wide oscillations at high-frequency around the expected values for a geocentric axial dipolar field at the site. These wide oscillations are however unexpected considering the observations and the models of paleosecular variation (PSV) of the geomagnetic field over the last millennia. In any case, these variations are consistent between the analyzed cores and the reconstructed ChRM directional trends are replicated in the overlapping sections of the distinct cores. Only if broadly smoothed these trends can be correlated to the available PSV reference curves and models. The reconstructed relative paleointensity (RPI) trend, estimated by normalizing the intensity of the NRM by the k and ARM values, can be more easily correlated to the reference RPI curves and models. A RPI-based age model suggests that the analyzed sequence spans the last 2.7 ka, with an average sedimentation rate of 5.6 mm/yr, which is consistent with published estimates from former studies.