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Tephrostratigraphy and tephrochronology of a 410 ka sediment record from the Fucino Basin, central Italy, unites Mediterranean and North Atlantic archives

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The Fucino Basin is the largest and probably the only Central Apennine basin that hosts a continuous and thick lacustrine sediment succession documenting the sedimentary history since the Early Pleistocene and up to recent historical times. Its good range of distance downwind of the peri-Tyrrhenian volcanic centres (<150 km) makes the Fucino Basin the best candidate available in the central Mediterranean that allows the assemblage of a long and continuous tephrochronological record independently dated by the 40Ar/39Ar method and directly anchored to a comprehensive time series of proxies from the lacustrine sediments. In this framework, the Fucino lacustrine archive provides the opportunity to extend the network of long terrestrial Mediterranean records (e.g. Dead Sea, Lake Van, Lake Ohrid and Tenaghi Philippon) to the west, a currently vacant area. Transferring chronological and stratigraphic information on paleomagnetic excursions and long- and short-term climate variability to North Atlantic climate records sets the framework for a better understanding of the spatio-temporal variability, the magnitude, and the different expressions of Quaternary orbital and millennial-scale paleoclimatic changes.

In June 2015, a ∼82 m-long sediment succession (F1-F3) was recovered from the eastern-central area of the Fucino Basin. The lithology of the sediments is rather homogeneous and is dominated by fine-grained lacustrine sediments composed of grey calcareous marl with variable proportions of clay and organic matter. 21 tephra layers constrain the chronology of the core continuously back to 190 ka. The tephra layers originate from different Italian volcanoes, such as Campi Flegrei, Etna, Colli Albani, Ischia, Vico, Sabatini, the Neapolitan area and Latium region. They comprise key Mediterranean marker tephra layers, such as the Neapolitan Yellow Tuff, Y-7, C-22, X-5, and X-6. The tephrochronological information is the basis for the establishment of an age model for the F1-F3 core and to correlate geochemical and bio-geochemical data from F1-F3 to climate variability.

Based on these promising results, an international consortium of several scientists and institutions, including IGAG-CNR (Italy), IGG-CNR (Italy), INGV (Italy), LIAG (Germany), and the Universities of Pisa (Italy), Rome (Italy), Cologne (Germany), Geneva (Switzerland), and Nottingham (UK) provided funds for a new coring campaign and borehole logging. At the new site, the F4-F5 site, which is characterized by lower sedimentation rate, two ca. 86 m long cores were recovered in June 2017. Borehole logging was carried out in one of the two holes down to ca. 80 m.

First core analyses comprise multi-sensor core logging (MSCL, GEOTEK Co.), line scan imaging, and XRF scanning (ITRAX, COX Ltd). Based on these data and on optical information after core opening, the individual, overlapping 1.5 m long sediment sequences are correlated to a core composite. Subsampling of discrete sediment samples and tephra horizons for future paleomagnetic, geochemical, sedimentological, and tephrostratigraphical studies started in autumn 2017 and yielded more than 130 tephra or cryptotephra horizons back to ca. 415 ka. The high number of such horizons forms the backbone to build an independent radioisotopically-anchored chronology that can be transferred to other records from the Mediterranean realm.