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PALEONTOLOGY SPRING FIELD SCHOOL
REPORT ON THE EXCAVATION OF CASTEL CELLESI
(BAGNOREGIO, VITERBO, CENTRAL ITALY)

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ABSTRACT: Fossil remains of *Palaeoloxodon antiquus* were found in 2013 at "Campo della Spina", near the small village of Castel Cellesi (Bagnoregio, Viterbo, Central Italy). A Paleontology Spring Field School was planned, under the patronage of AIQUA and the Italian Paleontological Society, to raise funds for the excavation. Sixteen students attended the lectures delivered by eight eminent teachers, most of which members of AIQUA. The excavation unearthed many bones of the highly disarticulated skeleton of Palaeoloxodon. Following an agreement reached with the Regional Board of the Ministry of Cultural Heritage and Environmental Conservation of Southern Etruria the specimens were left in situ. They will be housed in an eco-structure that will be built over them and that will represent a cutting-edge museum with no such equivalent in Italy.

Keywords: *Palaeoloxodon antiquus*, paleontological excavation, Spring Field School, Middle Pleistocene, Central Italy.

PREAMBLE

In July 2013, the discovery of fossil remains of a large-size, senile *Palaeoloxodon antiquus* at "Campo della Spina", a few kilometers southwest of the hamlet of Castel Cellesi (Bagnoregio, Viterbo, Central Italy, Fig. 1), was reported to the Department of Earth Sciences of the University of Florence (Fig. 2). An exploratory excavation was conducted at the end of August. On that occasion, a grid layout of 1 m^2 georeferenced squares, oriented NW-SE, was established over the area to be excavated. The squares were identified with letters and numbers, starting from A1, at NW, to D7 at SE. Three squares were explored, namely, A4, B5 and C6, where bones were exposed. A growing concentration of bones - a left humerus and numerous ribs - was found from A4 to C6 (Fig. 3). Part of the specimens were immersed, whereas others lied over, a greyish silty sedimentary body containing small volcanic breccias. A systematic excavation was therefore planned late in spring 2014.

To raise the funds for the excavation a Paleontology Spring Field School was also planned at Castel Cellesi. Sixteen students and eight teachers from many Italian Colleges participated in the Field School (Fig. 4).

By the first half of June, geoelectrical and georadar investigations were conducted to explore the resistivity of the fossil-bearing deposits, as well as to locate possible concentrations of bones. These surveys intended to reduce the excavation activities to a minimum, and save time and money. The geoelectrical exploration showed a lens of less resistive sediments dipping northwards. In contrast, the georadar survey gave chaotic and unreliable results.

THE EXCAVATION (Figure 5)

Excavations began on the 16th of June, 2014. The operations started from the squares B6, A5, C7 and D6 that were adjacent A4, B5 and C6 that had been explored in spring. This was decided following the bones that lied exposed from the walls of the three previously dug squares. The excavation was conducted using a methodology of "exfoliation" of the layers.

STRATIGRAPHY (Figure 6)

Within the excavated area, under the topmost 5-8 cm of trampled sediment, lie 50-60 cms of massive, ocher-coloured silty-clay (US2), consisting of reworked tuffaceous material with lithoclasts of different composition, but mostly of pumice, and with plant remains of various size, rhizoliths, small, white, thin-shelled gastropods. Bioturbations are also visible. This layer lies over a similar one (US3), some 90 cm thick, separated by a very hard lateritic duricrust, which forms an irregular horizon

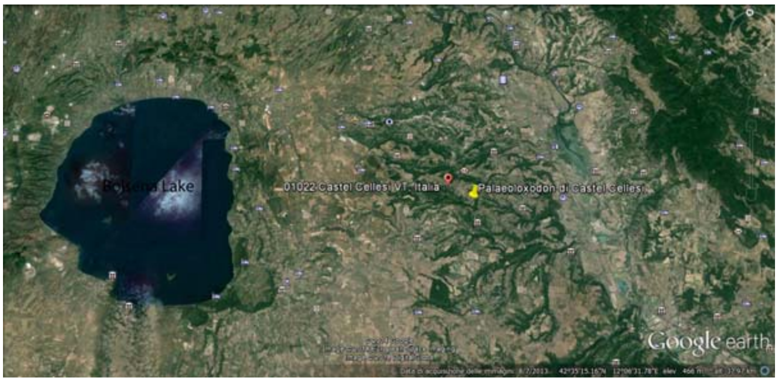

Fig. 1 - Location map of the Castel Cellesi excavation.

Fig. 2 - Lower molars of *Palaeoloxodon antiquus. The specimens were the first evidence of the presence of the fossiliferous site.*

sandwiched in between the two layers. The duricrust coats 16 to 90 cm-wide channels. US3 contains a large sedimentary lens, 30 to 50 cms thick, made of a gravel of poorly-rounded and poorly-sorted lithic elements floating in a greyish silty matrix (US4). The upper surface of the lens is irregular. It often intrudes upwards in US3 forming diapir-like pillars or flame-like structures. The lens is the fossil-bearing sedimentary body of the succession. The bones lie within and upon the grey gravelly-silty lens. All the layers are directed N-S and dip

Fig. 3 - Result of the exploratory excavation at the site.

Fig. 4 - Some of the participants of the Castel Cellesi's Paleontology Spring Field School during the excavations.

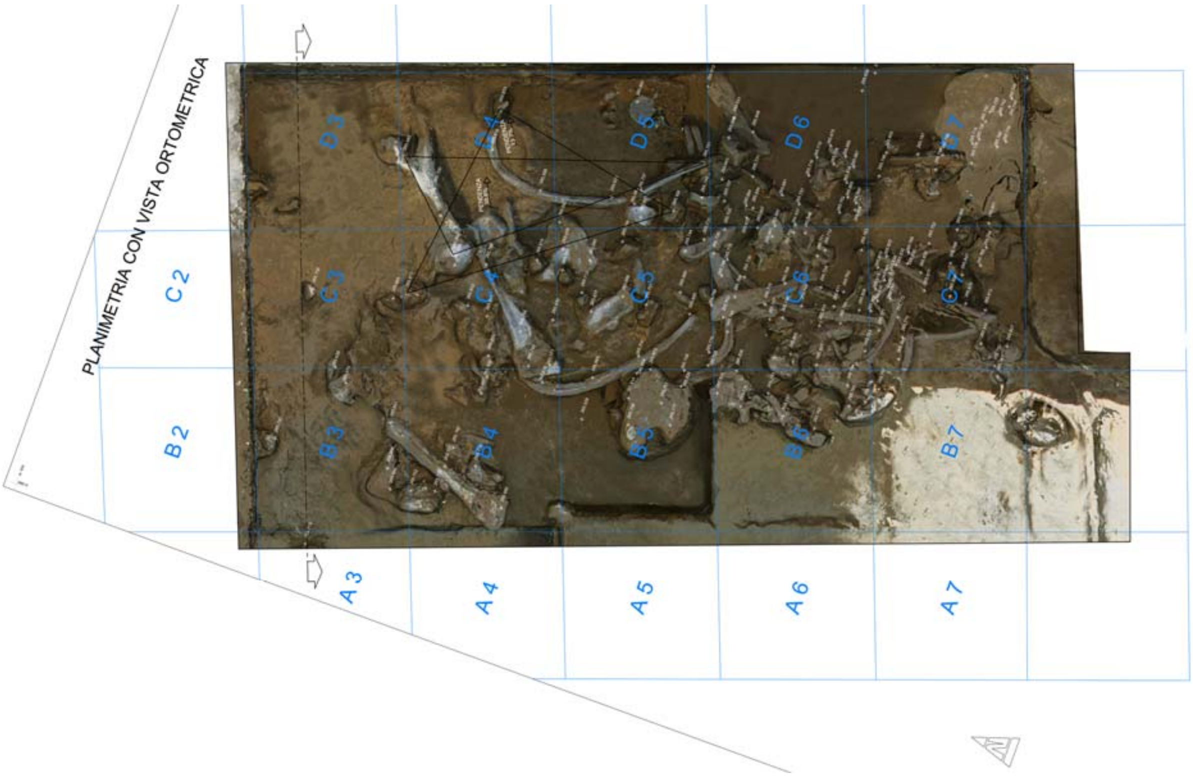

Fig. 5 - Plan view of the excavation.

10° N. The fossil-bearing lens dips markedly towards square D3.

More in general, the stratigraphic succession, consists of the following units, from the bottom upwards: 1) about 20 cm of rhythmic grey clay laminae, each approximately 1 cm thick, interbedded with fine-grained sands made of quartz and volcanic minerals (US7: the base of this unit is not exposed: Fig. 6 A, B); 2) 5 cm of light-yellow to whitish clayey marl with intercalations of lenticular grey clay and fine-grained sand made of quartz and volcanic minerals. This level contains plant remains rhizoliths and ripple-marks (US6: Fig. 6 A, B); 3) 30 cm of fine-grained sand and laminated clay, at times lenticular, with frequent plant remains (US 5: Fig. 6 A, B); 4) about 60 cm of light-grey, massive clayey silt, containing reworked tuffaceous material, various kinds of lithoclasts, numerous plant remains of different size, rhizoliths, small, thin-shelled, whitish gastropods and bioturbations (US3: Fig. 6 C-F); 5) lateritic duricrust (Fig. 6 C, D); 6) about 150 cm of solid, ocher-colored clayey silt, similar to the underlying ones of US3 (US2: Fig. 6 C -D, F, G-H). In the upper part, at the transition to the overlying US1, the unit is markedly reddened by soil processes (Fig. 6 F-H); 7) about 60 cm of whitish lacustrine diatomitic deposits. This level contains numerous plant remains, rhizoliths and shells of small freshwater mollusks. At the base there are several channels, some 100-120 cm wide (US1: Fig. 6 F-H).

The succession likely belongs in the tuffs of the "Paleo-Vulsini" Complex. It is therefore tentatively dated to around 600 ka. Nonetheless, this age attribution is still provisional and needs to be verified.

THE SPECIMENS

Given the limited time granted for the excavation and after an agreement reached with the Regional Board of the Ministry of Cultural Heritage and Environmental Conservation of Southern Etruria to leave the specimens *in situ* and not to recover them, the excavations were extended to the following squares: A3, B3, B4, B6, B7, C3, C4, C5, C7, D3, D4, D5, D6 and D7. The bones sum up to a total of 130. They belong almost entirely to *Paleoloxodon antiquus*, except a small fragmental rib likely of a cervid (*Cervus elaphus*?), found at the boundary between squares C5 and C6. The skeletal elements are all disarticulated, with the only exception of three thoracic vertebrae. The bones were nonetheless found accumulated in a relatively small area. Many bones seem having a bimodal orientation NW-SE and NE-SW, but this needs careful taphonomic verification (Fig. 5).

HYPOTHETICAL RECONSTRUCTION OF THE SITE'S FORMATION

The fossiliferous lens (US4), consisting of poorly rounded and poorly sorted gravel elements floating within a silty matrix has the characteristics of a fairly fluid debris-flow. These highly concentrated slurries of sediment and water are triggered by high relief, abundant

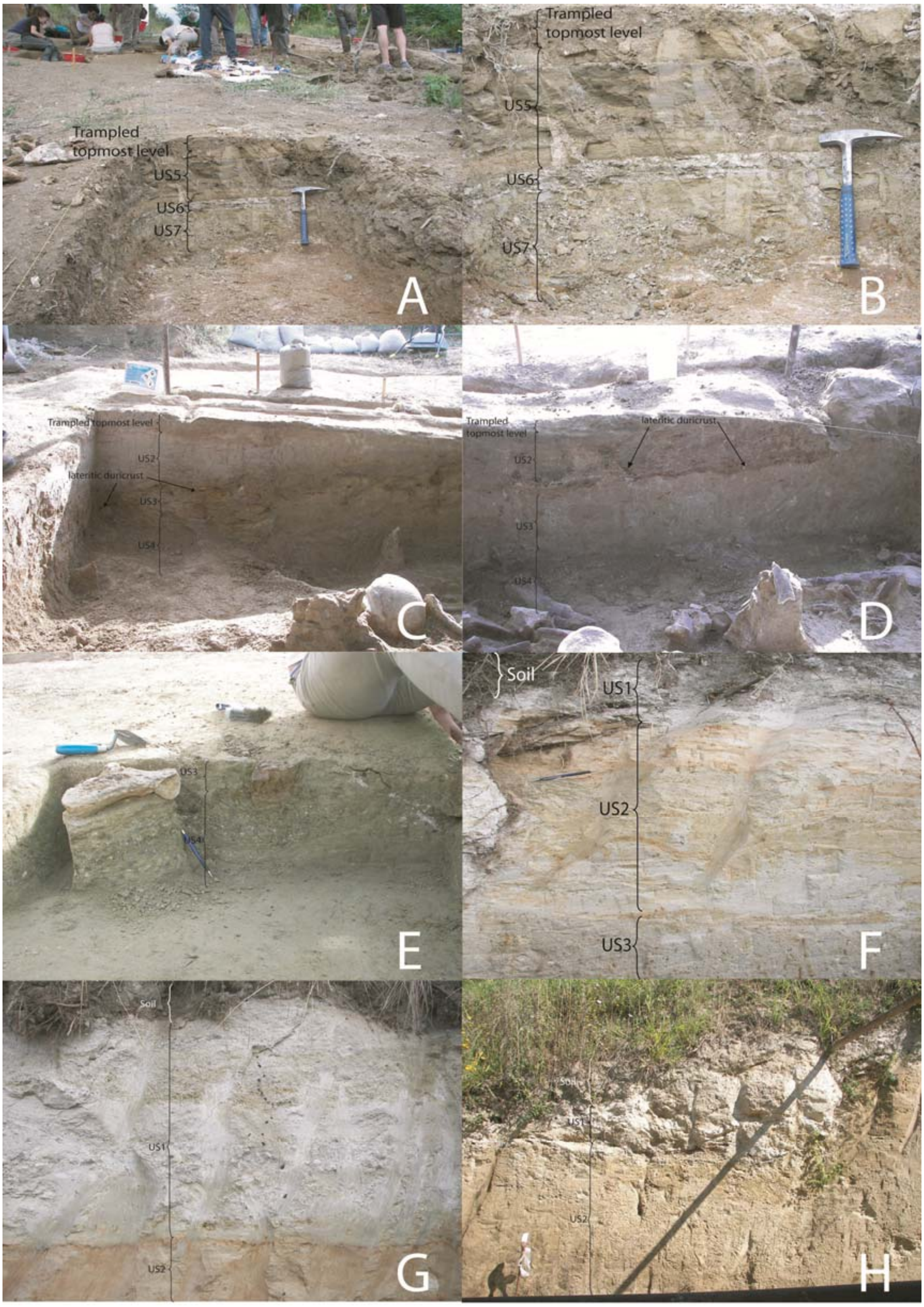

Fig. 6 - A-B. Basal part of the Castel Cellesi stratigraphic succession. C-E. Details of the stratigraphic units met at the excavation.

Fig. 7 - Draft of the project for the structure that shall house the Castel Cellesi paleontological site.

loose sediment trapped in steep catchments and a sharp peak in surface hydrological activity, during prolonged rain. The flame-like structures that deform the upper surface of the fossil-bearing sedimentary body, as well as the roughly bimodal arrangement of the bones, indicate that the debris-flow was probably quite fluid.

Based on the degree of wear of its teeth and on its particularly large size, the Castel Cellesi elephant was an old male. The characters of the stratigraphic succession indicate sedimentation in a shallow water basin, likely a swamp or a small lake. The sedimentary succession suggests that the water body alternatively deepened evolving into a lake or shallowed drying up and being replaced by a network of channels interspersed with vegetated plains. The elephant probably died along the banks of the water body, where US7-5 had already deposited, possibly bogged in the muddy sediments. Nonetheless, this cannot be verified until the animal's extremities are found. Alternatively, the elephant might have died from dehydration during a drought event. The degree of disarticulation of the skeleton, as well as the lack of evidence of weathering and carnivore ravaging on the bone surfaces indicate that the carcass probably decayed submerged in the water body. Once decomposition had reached an advanced phase, the debris flow (US4) ran into, entrained and buried, the already disarticulated elephant carcass, scattering the bones. The water body still maintained for a while and its normal pattern of sedimentation was restored (US3). Then it dried up, at least locally, and the area was subjected to soil formation and carved by a set of small channels. Alternating wet and dry conditions favored the formation of the lateritic duricrust. The area subsequently drowned again and the swamp/lacustrine sedimentation was again resumed (US2). After that it emerged once more, new soil was formed and then it definitively drowned evolving in a lake. During this final phase the area was enriched with silica of volcanic origin, which favored the blooming of diatom colonies (US1).

FUTURE PROSPECTS

The fate of the Castel Cellesi elephant is unique in Italy. Contrary to usual practice, the fossil skeleton will not be retrieved from its natural grave. The Regional Board of the Ministry of Cultural Heritage and Environmental Conservation of Southern Etruria made the decision to leave it where nature preserved it. The skeleton, together with the stratigraphic succession next to it, will be housed in an eco-structure, built in glass and wood, which will also include a mounted copy of a skeleton of *Palaeoloxodon antiquus*, a classroom for lessons in situ and a laboratory (Fig. 7). The building will be powered by photovoltaic panels and will use rainwater, which will be recicled using plant water purifiers. If the project will be realized in full respect the plan, the structure has no such equivalent in Italy. Being located in almost incontaminated surroundings, it would be a natural science laboratory for students from the schools of every order and degree, as well as for researchers of the widest range of natural history fields. It can even be used by archeologists, because the site is very close to Etruscan and Roman finds.

The project is indeed ambitious. But ambitions are made to achieve.

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