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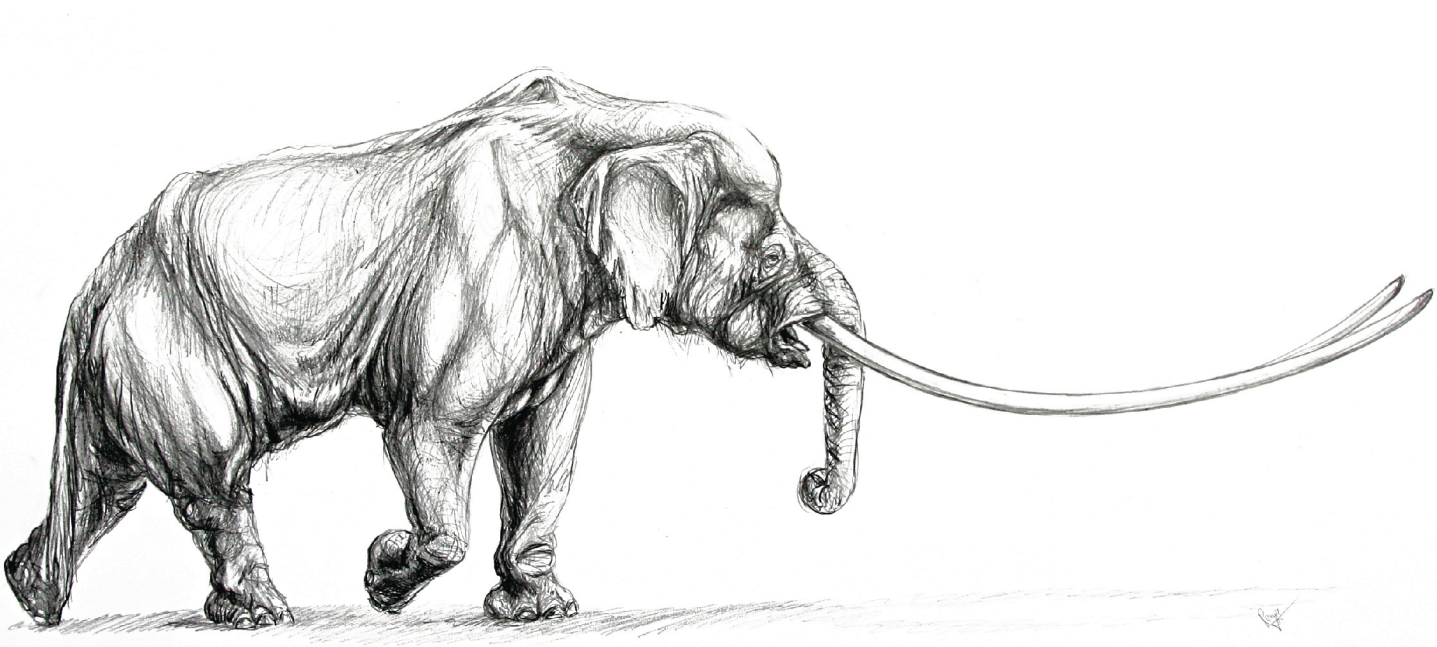

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ABSTRACT BOOK

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Remains of mammoths, horses and deer from the Late Middle Pleistocene loess deposits at Nosak (Drmno coal pit), Kostolac Basin, NE Serbia

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In 2009, an almost complete steppe mammoth (*Mammuthus trogontherii*) skeleton was discovered in Kostolac Basin (Lister et al., 2012). In 2012, several hundred metres to the north and few dozen metres above the previous find, mammoth bones and tusks were seen sticking out of a section made by a large backhoe excavating the overburden at the Drmno coal mine.

Drmno is an open-pit coal mine in the Kostolac Basin in operation since 1870. Containing Late Miocene to Quaternary sediments, the basin sits between three large rivers, the Danube on the north, the Velika Morava on the east, and the Mlava on the west. The Quaternary units comprise Pleistocene alluvial sediments and a later Pleistocene loess sequence with intercallated paleosols, topped by Holocene sediment. In 2009, the first Kostolac mammoth skeleton was found in alluvial deposits, but the

Fig. 1. **A**, Excavations in course, 21th August 2012, view from southwest. **B**, Skull, tusks and postcranial bones of a steppe mammoth in the Trench KI 97.
Photos: Nemanja Mrđić.

2012 finds from the Kostolac Basin occurred in the later Pleistocene loess sequence.

The coal exploitation required the removal of the Quaternary overburden above the Miocene coal. Large backhoes removed the sediment by making cuts approximately 6-7 m deep revealing furrowed, subvertical profiles. The archaeological field survey discovered the mammoth bones and teeth in one profile, at 19 m below the land surface. Palaeontological excavations started in July, 2012 in trenches approximately 10 m wide positioned in a line approximately 150 m long (Fig. 1A).

Skeletal remains from large mammals were scattered over an area up to 10 m wide and 130 m long. Individual bones and teeth were encased within thick carbonate concretions. From their composition, morphology, and manner of formation, these carbonate concretions resemble the characteristic "loess dolls" that form in loess. The brittle, fully mineralized, white bones are difficult to separate from the carbonate coatings.

For many bones and teeth covered with this thick carbonate cover, it was impossible to identify the skeletal element and taxon before their conservation and preparation, which still remains to be completed. Exceptions were some large bones and teeth that were identified according to their size and shape. In Trench KI 97, spirally curved tusks suggested the presence of a mammoth (Fig. 1B). The identification of a steppe mammoth, *Mammuthus trogontherii*, was based on the enamel thickness and lamellar frequency of the molars in the lower mandible, M2-1, found in Trench 99. The enamel is 3 mm thick, and the lamellar frequency 6,6. These values are approximate, since they were calculated on molar fragments less than 10 cm long. Although coated in carbonate, horse remains (*Equus* sp.) were identified by the morphology of a femur recognized by a third trochanter, and by a few bones from the hind limb, including the phalanges. The presence of a cervid was confirmed by a tooth fragment protruding from a carbonate concretion and by a few long, curved antler-shaped carbonate concretions.

Preliminary analyses indicate remains from at least three mammoths, one horse, and one cervid. A fragmented skull, complete left and right tusks, at least five vertebrae, several ribs, a scapula, radius, ulna, femur, tibia, and several short bones from the extremities originated from an adult mammoth (Fig. 1B). The remains from another mammoth include a fragmented skull, a mandible, and one tusk. Between these two mammoths' remains, mixed bones from mammoths and other large mammals occurred. The third mammoth is evidenced by a fragmented skull and a tusk. The equid remains included two vertebrae, a femur, tibia, metatarsus, and third phalanx. The cervid remains included antlers and teeth.

Most likely hyaenas scattered some bones and teeth. In Trench 97, a mammoth vertebra, a scapula, and an ulna display characteristic damage most likely of biogenic origin. Breakage on the bones is irregular and serrated, while the spongiose tissue has been furrowed. Given the bones' massive size, obviously a large predator must have produced such damage. Only hyenas have jaw strengths powerful enough to leave such marks.

The bones and teeth accumulated at a single level within the loess sitting just above the upper of two paleosols. Given the sedimentological and faunal analyses, the paleosols most likely were formed during MIS 7, while the loess likely was deposited in MIS 6 (Marković et al., 2013). Accordingly, the age for the Nosak mammoths falls near the last appearance of steppe mammoths within Europe (Lister et al., 2005). Therefore, precise dating of the Nosak finds by is critical. Samples for ESR dating were taken from a mammoth molar from Mandible M2-K1 found in Trench 99. Two sediment samples were collected from the loess. Eight enamel subsamples from the molar fragment have been dated by standard ESR enamel and isochron protocols, using time-averaged cosmic and sedimentary dose rates. While the molar postdates 180 ka, preliminary isochron analyses indicate that it has experienced multiple U uptake events.

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