Lithology, mineralogy, geochemistry and chronostratigraphy of heavy-mineral bearing dune sands in the Podravina, northeastern Croatia

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The Đurđevac Sands constitute a wide area of extraordinary small-scale dune relief in the Podravina (northeastern Croatia), along the central part of the southern Drava river valley. They are thought to have been formed by reworking of fluvial material due to strong northern winds. Their significance is evident from the geometry of the dunes (shape, orientation, thickness), and the presence of intra- and post-formational alteration (pedogenesis). In addition, the elevated heavy mineral content puts the sands in the position of potential ore deposit.

The objective of this study is to explore this aeolian archive in an attempt to extract relevant palaeo-environmental information and to compare it with similar landscapes across Europe. The lithology (grain-size) and intra-formational alteration (palaeosoils) as well as geochemical signatures are investigated from outcrops in an abandoned sand pit to define phases of sand movement and landscape stability. Radiocarbon dating of charcoal, optically stimulated luminescence (OSL) dating of quartz, and historical archives are used to develop a geochronological framework. The heavy and light mineral fractions of the sands are used to determine their composition, provenance and detailed sedimentological context at the time of deposition. A digital elevation model of the region is used to gain insight into the geometry of the dunes, while geo-electric soundings and mechanical coring are applied to investigate the vertical and lateral variations in sand lithology and thickness, as well as intraformational soils.

At first sight, the dune landscape seems to have a chaotic nature, showing an irregular alignment of smaller parabolic, linear and domal shaped dunes. Although, larger structures may also be classified as complex long-walled transgressive dunes or compound en-echelon parabolic dunes. The thickness of the dune sand can clearly be traced on geo-electrical profiles, where the dry dune sand appears to generate a different signal than the underlying water-saturated fluvial material. Furthermore, the results show that phases of sand movement occurred before and after the Bølling-Allerød (B-A) interstadial, as well as during the early Holocene and up to the 19th century. Phases of stability are witnessed by the presence of slightly altered parent material (presence of organic carbon, slightly finer grain size, and decalcified) and are dated to the B-A interstadial, and
several episodes in the Holocene. The heavy mineral content is dominated by garnet, while muscovite is strikingly more present in the Holocene sediments. This may be due to either a change in source material (new Holocene Drava river sediment) and/or changing aeolian dynamics. Overall, these new findings obtained from the Đurđevac Sands area correlate rather well with other regions in the Pannonian Basin as well as the North European Plain, especially in terms of the timing of events.