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GEOMORPHOLOGY AND THE EVOLUTION OF THE KARST POLJE BOKANJAČKO BLATO BASED ON HIGH RESOLUTION SEDIMENT CORE AND GPR DATA

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Abstract

Karst polje Bokanjačko blato (Ravni Kotari, Croatia) is filled with Quaternary sediments of various sedimentary, mineralogical and geochemical features. Ground penetrating radar (GPR) was conducted to mapp 3D variability in the thickness of lake and red sedimentary deposits in polje. A survey grid consisting of 6 individual GPR profiles in total length of over 7 km was designed to cover the extension of the Bokanjačko blato depression. Depression was covered with GX 80MHz shielded antenna, and additional several profiles were surveyed with GX450 MHz antenna. Sediment sequence studied in detail in southeastern part of the polje consists of 10 m Holocene lake carbonate sediments, 3 m of loess-like deposits and 10 m thick red clay deposits that overlie limestone bedrock (Ilijanić et al., 2018). The upper part of the core (0-4.1 m) consists of lake sandy carbonate sediments, dominantly composed of authigenic calcite, which gradually contain more clay content and siliciclastic material, indicating significant detrital input. Smectite occur in these samples, while the upper sediments of the core contain very little clay minerals, presented by vermiculite, illite and kaolinite. Red clay deposits are dominantly composed of kaolinite, followed by vermiculite and illite. Geochemical and mineralogical record imply the formation of shallow lake from 10.5 m, but with significant catchment erosional processes and sediment runoff, evident by higher content of siliciclastic elements and magnetic susceptibility. Dominantly carbonate lake sediments appear from 4.1 m up-core. Magnetic susceptibility reveals two extremely distinct sedimentary units, red clays (23-12.5 m) with extremely high values indicating the presence of magnetite, and from 12.5 m up-core low values of magnetic susceptibility, being the lowest from 4.1 m up-core. In addition, high frequency dependent magnetic susceptibility in red clays indicates the presence of superparamagnetic (SP; <0.03 μm) magnetite (pedogenic magnetite), which appear to be smaller than 0.022 μm in comparison to the synthetic magnetites. In contrast, loess-like deposits contain coarser magnetites (2.5-6.5 μm). Hematite is recorded in bulk mineralogical analysis in red clays (23-11.5 m), while rock-magnetic data suggests the presence of magnetically hard minerals (hematite/goethite) in loess-like sediments (12.5-8.6 m) and in red clays as superparamagnetic hematite. Dominance of SP magnetite and SP hematite in red clays, as well as clay mineral kaolinite and ultra-stable minerals such as zircon, tourmaline and rutile, suggests advanced weathering of these soils, warm climate and an old age. These results imply the depositional and erosional processes of the different sedimentary sequences in Bokanjačko blato sediment succession, very variable in thickness, revealed by radar stratigraphy. We suggest that it is related to the bedrock karstification and development of karst paleorelief through long period of time of its formation. The documented depths of up to 20 m of sediments allow the presumption that georadar surveying could resolve sedimentological relationship in Bokanjačko Blato depression, indicating the great potential of use ground subsurface surveys in karst poljes filled with clayey and silty sediments.