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# INCOMING RESEARCH PROJECT: ABRUPT CLIMATE CHANGES – EVIDENCE FROM QUATERNARY SEDIMENTARY SEQUENCES IN CROATIA (ACCENT)

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“Abrupt climate changes–Evidence from Quaternary sedimentary sequences in Croatia” is a four-year investigation project that is funded by the Croatian Science Foundation and started on April 1<sup>st</sup> 2021. We propose a fundamental and multidisciplinary approach to produce meaningful data on past abrupt climate changes (CC). Interpretation of these data can help create the basis both for comparison of paleo- and modern climate changes and for predicting their dynamics in the future.

The specific geological, pedological geomorphological and climatic diversity of Croatia enables to study in high-resolution study the parallel development of abrupt CC during the Late Pleistocene and Holocene at four locations only 300 km apart.

A stepwise fieldwork approach will be applied. Initial fieldwork is required to investigate four different geological successions and harmonize terminology and research approaches in different scientific fields and among various experts. Further, dedicated and focused fieldwork will be exercised including outcrop and core sampling. Several analytic methods will be applied to characterise soils and sediments, together with their paleoenvironmental significance and age: micromorphology and stable isotope analysis, granulometry, radiocarbon and optically stimulated luminescence dating. Gathered data will be subjected to geostatistical analysis. For selected sites, digital elevation model analysis and geoelectrical soundings will be performed.



Figure 1: (a) Bioturbated cumulic horizon Z-10 overlaying palaeosoils in loess; (b) Buried paleosoil in a dune sequence; (c) Fluvio-glacial sedimentation overlaying *terra rossa* and infilling desiccation cracks; (d) Disturbed laminated lake sediments with soft sediment deformations on the contact between clay and lacustrine chalk.

The **loess–palaeosol sequences** of NE Croatia show great potential in reconstructing the Upper Pleistocene climate and environmental changes. The cumulic horizons are mentioned in descriptions of the sections and geochronologically framed by IRSL-dating as weakly developed incipient soils representing the sedimentological record of short-term warming that preceded the long-term cooling and sedimentation of loess (Fig. 1a). The lower parts of the horizons are bioturbated, indicating intensive life in cumulic horizons (soils), while the silty texture and pale color indicate short exposure to pedogenic processes. 14 horizons represent paleoclimate archives of 14 CC episodes. Preliminary studies on **dune sands** (Đurđevac Sands) were conducted in the Podravina area. Within the dunes sets, two paleosoils, type arenosol, were discovered. Preserved bioturbations confirm their in situ formation (Fig. 1b). Radiocarbon analysis of charcoal from the paleosoils showed that they developed before the very beginning of the Holocene, and, consequently, the oldest dune sediments were already formed before the end of the Pleistocene. Glacial features and forms in karst indicate different ages of glaciations on the Velebit Mountain. Presumably **fluvioglacial features** can be observed (Fig. 1c) 1 m above the sea level. Their properties and age of formation will be the subject of detailed analysis. Finally, the Vrgoračko Polje is a karst field situated at the southern edge of the Dalmatian Zagora. During the Quaternary, the polje was flooded for variable periods and a **lacustrine environment** was established. The multidisciplinary study of drilling cores, outcrops and geoelectric measurements recognized five main sedimentary facies: laminated sediment, redeposited sediment, coarse-grained carbonate debris, littoral clay and lacustrine chalk. A stratigraphic break between littoral clay and lacustrine chalk could be time-equivalent to the disturbed laminated sediments deposited in deeper water (Fig. 1d). According to radiocarbon dating, deposition of the lacustrine chalk started at the beginning of the Holocene and lasts until today. The described depositional environments and sediment facies found in the Vrgoračko Polje are considered to represent a typical Quaternary lacustrine sedimentary pattern for other Dinaric poljes.

So far, preliminary investigations and a short literature survey suggest that the four proposed Croatian sites represent meaningful archives in the context of Late Pleistocene and Holocene CC. The main objectives of the project are: 1) Understanding of the spatial extent and differences in appearance of paleoclimatic events in the Pannonian and Dinaric areas; 2) Determine teleconnections in SE Europe and compare it with abrupt CC in the European Sand Belt, and 3) Correlate it with climate archives from the Adriatic Sea.

Reaching the set objectives and goals will help researchers to identify and map critical ecological conditions during the Quaternary, where major geomorphological, hydrogeological and pedological changes had occurred and where current ecotones can be expected to exist in the future in different climatic regions. Ultimately, the outcomes can be applied by land-use planners and stakeholders to check whether the present land-use will be sustainable any longer under changing conditions and, if not, to suggest alternative management of land-use changes, especially concerning geohazards like landslides, slumps, debris flows, floods and drifting dunes.