



## **Karst depressions as geoarchaeological archives: revealing the past human-environmental interactions of Zominthos (Crete) through geophysical prospection, geomorphologic studies and mineralogical investigations**

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Focusing on the currently uninhabited plateau of Zominthos at 1200 m a.s.l. in Central Crete, which - according to huge archaeological remains - was densely populated during the Minoan era (Neopalatial period, ca. 1650 B.C.), the main objective of the project is to reconstruct the Bronze-Age landscape evolution with special regard to human-environmental interactions. Primary aims are to investigate the general structure of the subsurface karst relief (e.g. dolines, poljes), the amount of overlying loose sediments, their provenance and their geoarchive function, which has not been studied so far.

A multi-method approach with combined Earth Resistivity Tomography (ERT) and Seismic Refraction Tomography (SRT) perfectly qualifies for this issue, proving that Cretan karst depressions are filled with thick colluvial accumulations up to 20 m below surface. Subsequent to vibra coring of the sedimentary archives, mineralogical analyses and AMS 14C datings were conducted. Heavy mineral analyses (SEM-EDX, EPMA) show that the filled karst hollows include high concentrations of autochthonous materials. This suggests massive neotectonic activity, formerly existing but currently absent klippen of different petrography and aeolian input during the Holocene. The latter is supported by the detection of volcanogenic tephra in the cores, which absolutely correlates to the chemical composition of Santorini rhyodacites (Minoan eruption 3.6 ka). As such minerals have never been found at altitudes above 1000 m a.s.l. on Crete before, the spatial fallout of the ash needs to be revised with respect to a distribution further south of Santorini. Corresponding pyroxenes and glass shards were detected in a depth of up to 10 m below surface and thus prove the geomorphodynamic activity since the Bronze-Age, which lead to the radical change of the palaeolandscape induced by anthropogenic land use and soil erosion. The environmental transformation is confirmed by maximum radiocarbon ages of 4991-4770 BC cal at the base of anthropogenically constructed drainage channels next to the Minoan settlement complex of Zominthos, indicating massive colluviation and back-filling. The polygenetic nature of the sediments is revealed by XRD- and light mineral investigations that point to a considerable input of external materials (clay minerals, quartz grains with aeolian microtextures). ERT on-site studies demonstrate that the Minoan settlement was even more extensive than documented by surface artefacts. During the Late Holocene large parts were filled up with pedo-sediments, which nowadays cover an unknown building with subsurface wall remains and ancient trenches for water supply.

Contrary to the hitherto received opinion of generally being open systems with an unpredictable material flux, sediment filled karst depressions can yield promising records for the analysis of the Holocene landscape evolution. They provide valuable geoarchives for palaeoenvironmental reconstructions, particularly if investigated by a multi-method approach.