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A comparison of modern and fossil ostracods from Frasassi Cave system (northeastern Apennines, Italy) to infer past environmental conditions

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Cave water and sediments from an extensive sulfidic, chemioautotrophic subterranean ecosystem in the hypogenic karst complex of Frasassi (northeastern Apennines of Italy) was analysed for modern and fossil ostracode assemblages. 22 extant and 16 extinct ostracode species make of this continental sulphidic ecosystem one of the richest worldwide. Both modern and fossil assemblages show the expected pattern of species diversity after the simulation procedure for taxonomic distinctness, which indicates no major extinction events since the Pleistocene. Extant species display patchy distribution according to habitat heterogeneity within the sulphidic environment.

Fossil assemblages from a 3 m thick fluvial deposit trapped near the entrance of the Caverna del Carbone (CDC) at about 30 m above present river level, and a fine sand deposit resting at about the same elevation in Sala Duecento (SDS) within the Grotta Grande del Vento preliminarily dated with OSL at 111±17 ka are being investigated. The former deposit has yet to be dated but it represents probably a normal stratigraphic succession spanning a few tens of kyr, which was deposited when the cave entrance was at the reach of fluvial flooding, potentially recording the transition from the last interglacial Riss-Würm to the glacial Würm. Sediment samples from the SDS site yielded an ostracode assemblage represented by 12 species with a d18O signature of -5‰ and a well-diversified palinoflora assemblage indicating a transitional condition between steppe and temperate forest. The top sediment from the CDC site is characterized by a less diversified ostracode assemblage represented by 8 species, d18O of -3‰ and a poorly diversified palinoflora dominated by herbaceous plants and lesser pines, indicating a colder environment in the early stage of the last glacial. Additional information on the geometric morphometry approach of B-splines method applied to extant and fossil specimens of the hypogean Mixtacandona ostracode was used to identify microevolutionary patterns and environmentally cued variation. Analyses indicate the presence of one morphotype of a new species A of the group Mixtacandona riongessa, and three distinctive morphotypes of a species B of the group M. laisi-chappuisi occurring in stratigraphically distinct fluvial-cave sediments. Apparent difference in the disparity level between these species could be associated with their survival in different environmental conditions. Species A is found nowadays living exclusively in sulphidic cave waters, and was present in the system since at least the end of the last interglacial.

The extraordinary high taxonomic and morphological diversity of ostracods reflects in situ evolutionary processes that have occurred under the cumulative effect of high environmental energy availability of subterranean sulphidic ecosystems, heterogeneous environmental conditions, and spatial and temporal isolation.