

## THE GROTTA DEI FIORI (SARDINIA) STRATIGRAPHIC SUCCESSION: A MULTIDISCIPLINARY APPROACH

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ABSTRACT: Melis R.T. *et al.*, *The Grotta dei Fiori (Sardinia) stratigraphic succession; a multidisciplinary approach*. (IT ISSN 0394-3356, 2011)

Grotta dei Fiori Cave is one of the many limestone caves in South Western Sardinia containing well-stratified fossiliferous deposits intercalated with flowstones. A multidisciplinary methodological approach (paleontological, sedimentological, stable isotope analyses) and U/Th datation, has been used to define the palaeoenvironmental context and chronology of fossiliferous deposits in the cave.

RIASSUNTO: Melis R.T. *et al.*, *La successione stratigrafica di Grotta dei Fiori (Sardegna): approccio multidisciplinare*. (IT ISSN 0394-3356, 2011)

*Grotta dei fiori è una delle numerose grotte nella Sardegna Sud occidentale caratterizzata da sedimenti ricchi in resti fossili intercalati con flowstones. La correlazione e l'interpretazione dei risultati di uno studio multidisciplinare (paleontologico, sedimentologico, analisi isotopica) e datazioni U/Th, sono stati utilizzati per definire il contesto paleoambientale e precisare l'intervallo cronologico dei depositi fossiliferi presenti nella grotta.*

Key words: Pleistocene, Biochronology, Sardinia.

Parole chiave: Pleistocene,, Biocronologia, Sardegna

Grotta dei Fiori Cave (Carbonia, Sardinia) is one of the many caves in South western Sardinia that contains fossiliferous deposits with large and small mammals intercalated with flowstones. The cave is localized nearby the Carbonia town and developed in a Cambrian limestone ("Gruppo di Gonnese") slightly metamorphosed by Ercinic tectonic (Fig.1). The hypogean karstification started at Lower Cambrian and continued at different times until the Quaternary. The cave evolution was made through various spelaogenetic cycles



Fig. 1, Location of Grotta dei Fiori.  
*Ubicazione di Grotta dei Fiori.*

characterised by a succession of sedimentation, erosion and collapsing phases. Probably sedimentation started in the Permo-Trias, as supported by data on karst evolution in the Iglesias area (CIVITA *et al.* 1986). The oldest (?) deposits likely correspond to fine sediments filling some fissures in the ceiling of main cavities. The Plio-Pleistocene deposits, mainly fine and coarse sediments, are the most abundant and are characterised by rich small mammal remains (MELIS *et al.* 2002b).

A multidisciplinary study has been carried out with the aim of reconstructing the cave evolution and finding a more accurate attribution of fossiliferous deposits cropping out in the karstic cave, through the correlation and interpretation of the results of different disciplinary approaches (palaeontology, geochemistry, sedimentology, soil micromorphology and U/Th datation). Three fossiliferous sequences have been identified outside, on the first and on the third cavity of "Grotta dei Fiori" cave (Fig.2).

The sequence U, localized outside the cave in a man-made cut of the second entrance, is characterized, in the bottom, by clayed deposits with mudcracks filled by calcite. Follows a flowstone, about 30 cm thin, covered by cemented chaotic coarse deposits composed by large fragments of the previous flowstone, limestone

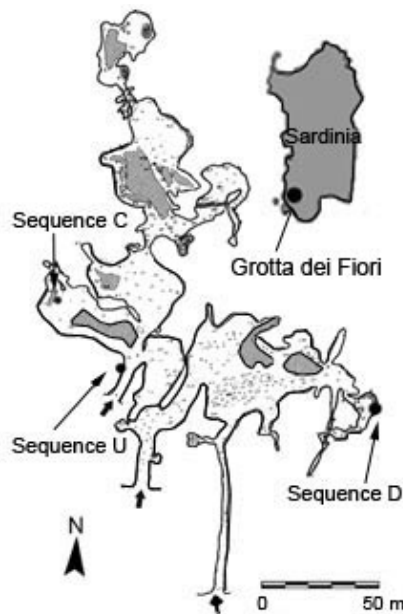


Fig. 2, Localization and plan of Grotta dei Fiori cave, from: *Elenco Catastale delle grotte del Comune di Carbonia, Gruppo Ricerche Speleologiche "E. A. Martel" Carbonia (1977)*.

*Ubicazione e pianta della Grotta dei Fiori, da: Elenco Catastale delle grotte del Comune di Carbonia, Gruppo Ricerche Speleologiche "E. A. Martel" Carbonia (1977).*

clasts and red fine matrix with abundant fossil remains confined to small areas. The upper sequence ends with a thick flowstone.

The sequence C, is formed by sub-horizontal levels ending with a flowstone of 25 cm. This sequence, about 5 m thick, is subdivided into two units: lower unit (*Unit A*), characterised by fine red clay sediments with pedorelicts interpreted as deposits which were washed into the back of the cave by gentle water flow of eroded soils developed outside. The transition from the lower to the upper unit B is marked by a level characterised by 3 thin flowstones alternated by levels of red clay sediments. This level is characterised by fine sediments interbedded with coarse clastic deposits. The coarse clastic deposits are poorly sorted and contain bone fragments. The amount of pedorelicts within the fine sediments matrix, suggests erosion of soils originated outside the cave, which fell into the cave. In the Unit B, the poorly to well-developed internal layering, the angular to subangular shape of clasts, the large amount of pedorelicts in the fine matrix with coarse sediments, indicates that soils from outside the cave were catastrophically and suddenly washed down the slope and deposited into the cave.

The sequence D, about 8 m thick, is formed by clayed and coarse sediments. The lower unit (*Unit A*) is characterised by fine sediments, whereas the

upper one (*Unit B*) mostly by coarse deposits. The lower *Unit A*, interbedded between two thin flowstones, consists of alternating clayed and sandy levels with poor fossil remains. The Upper *Unit B* is composed by predominantly coarse sediments and abundant fossil remains. The upper sequence ends with a flowstone about 10 cm thick. Fossiliferous levels occur in all the above described stratigraphic sequences. Small mammals (*Microtus (Tyrrhenicola)*, *Ragamys*, "*Nesiotites*" and *Prolagagus*) are always present, but so far only voles from the sequence C have been preliminarily analysed. The Upper level sequence C, includes several fossiliferous levels from which a rich sample of small mammals have been retrieved. Scanty remains of a quite large *Cynotherium* aff. *C. sardous* and some no endemic birds (*Ciconia nigra*, *Gypaetus barbatus*, *Aquila* sp., *Columba livia*, *Pyrrhocorax pyrrhocorax*, *Pyrrhocorax graculus*, *Corvus corone*, *Corvus corax*, *Emberiza cirius/schoeniclus*) have been found in the uppermost fossiliferous level (MELIS *et al.* 2002; PAVIA & BEDETTI 2003, BOLDRINI *et al.* 2010).

Data provided by sedimentology, soil micromorphology and geochemistry indicate that the fossiliferous sequences of "Grotta dei Fiori" was deposited under climatic conditions characterized by an alternation of wet and dry periods (BOLDRINI *et al.* 2010). Taking into account results of palaeontological analysis, the hypothesis that the "Grotta dei Fiori" succession would be not older than the marine isotope stage (MIS) 11 cannot be ruled out. U/Th dating of flowstones, directly associated with this deposits, roughly support this hypothesis, indicating that depositional events in the Grotta dei Fiori cave, occurred during the Middle Pleistocene from MIS 11 to MIS 9?

## REFERENCES

- BOLDRINI R., PALOMBO M.R., IACUMIN P. & MELIS R. (2010) - *The Middle Pleistocene fossiliferous sequence of Grotta dei Fiori (Sardinia, Italy): multidisciplinary analysis*. *Boll. Soc. Paleontologica It.*, **49** (2), 123-134.
- CIVITA M., COCOZZA T., FORTI P., PERNA G. & TURI B. (1986) - *Identification of groundwater flow parameters of karstic aquifer in the mining district of Iglesias (Sardinia-Italy)*. CEE "RESOURCES report EUR 10572 EN, 1-56.
- MELIS R.T., PALOMBO M.R., BEDETTI C., FENZA P., PAVIA M., MUREDDU M. & VILLANI M. (2002). *Evoluzione speleogenetica e paleoambientale della grotta dei Fiori SA/CA 218 (Carbonia-Sardegna sud-occidentale)*. *Anthéo Bollettino Gruppo SpeleoArcheo Giovanni Spano di Cagliari*, **6**, 71-88.
- PAVIA M. & BEDETTI C. (2003) - *The late Pleistocene fossil avian remains from Grotta dei Fiori, Carbonia (SW Sardinia, Italy)*. *Boll. Soc. Paleontologica It.*, **42**, 163-169.