

RENDICONTI *Online* della Società Geologica Italiana  
Volume 21 - Settembre 2012



COMITATO ORGANIZZATORE

Salvatore CRITELLI (Università della Calabria)  
Paolo CAPPADONA (ONG e Autorità di Bacino Regione Calabria)  
Gino Mirocle CRISCI (Università della Calabria)  
Rosanna DE ROSA (Università della Calabria)  
Carlo DOGLIONI (Presidente Società Geologica Italiana)  
Rocco DOMINICI (Università della Calabria)  
Elisabetta ERBA (vice-presidente Società Geologica Italiana)  
Francesco GAGLIARDI (Università della Calabria)  
Fausto GUZZETTI (Direttore CNR-IRPI)  
Francesco MUTO (Università della Calabria)  
Francesco PERRI (Università della Calabria)  
Fabio Massimo PETTI (Società Geologica Italiana)  
Rocco RONGO (Università della Calabria)  
Franco RUSSO (Università della Calabria)  
Maurizio SONNINO (Università della Calabria)  
Franco VIOLO (Presidente ORG Calabria)  
Alessandro ZUCCARI (Società Geologica Italiana)

In copertina: "Morpho-Bathymetry of the Mediterranean Sea", CIESM, Ifremer Special Publication, France. 1/3.000000 scale map.

RENDICONTI ONLINE DELLA SOCIETÀ GEOLOGICA ITALIANA

*Direttore responsabile:* DOMENICO CALCATERRA

Iscrizione ROC 18414.

Publicato online il 1 Settembre 2012.

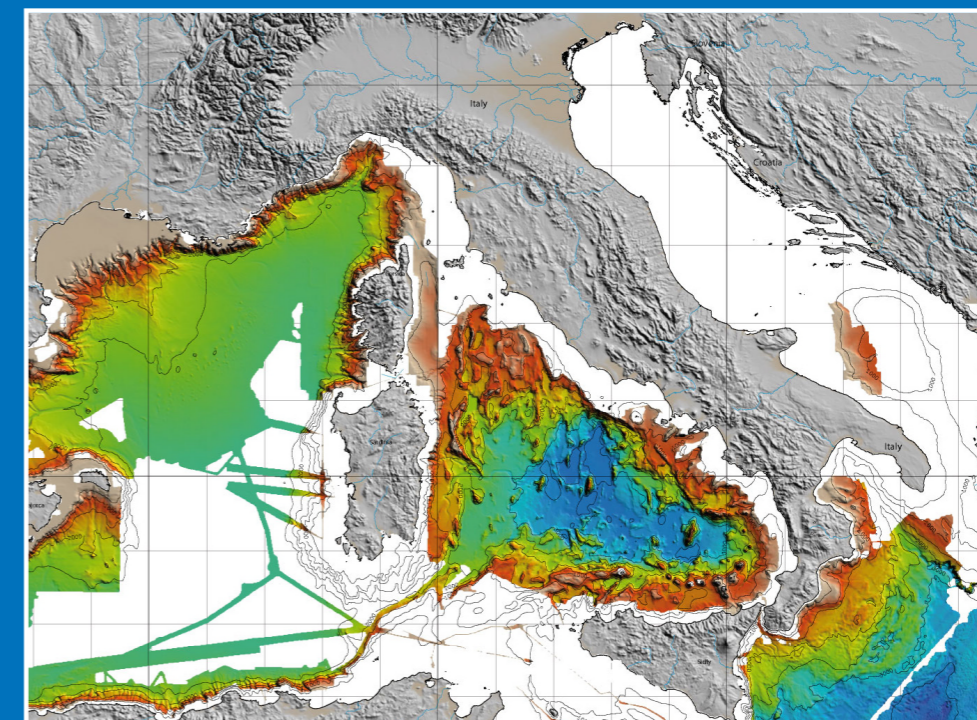
Rendiconti Online della Società Geologica Italiana - vol. 21 (2012) pp. 1-793.

RENDICONTI *Online*  
della  
*Società Geologica Italiana*

*Volume 21 (parte prima)*

**86° Congresso Nazionale della Società Geologica Italiana**

Arcavacata di Rende 18-20 Settembre 2012



NOTE BREVI E RIASSUNTI

A cura di: Salvatore Critelli, Francesco Muto, Francesco Perri,  
Fabio Massimo Petti, Maurizio Sonnino, Alessandro Zuccari



ROMA  
SOCIETÀ GEOLOGICA ITALIANA  
2012  
www.socgeol.it

## New data on a cave along the coast of Polignano a Mare (Apulia) by means of geological, geophysical and speleological researches

MARIO PARISE (1, 2), VINCENZO MARTIMUCCI (2), NUNZIA PENTIMONE (2, 3) & PIETRO PEPE (2, 3)

Key words: *coastal karst, geophysics, speleology, Apulia.*

### INTRODUCTION

The territory of Polignano a Mare, along the Adriatic coast S of Bari, is among the most important as regards coastal karst in Apulia. Over 70 caves, the great majority of which is located along the coast, represent the karst heritage of the area (FAVALE, 1994). Grotta della Rondinella (cadastral number PU 71) is located N of Polignano a Mare; a wide access allows to enter by the sea, leading to a nice pebble shore, whilst inland a collapse sinkhole represents the main access, produced by fall of the rock diaphragm above the cave. Even though the cave is in a coastal sector heavily frequented by tourists, it was never adequately safeguarded, and, as many other coastal caves in the area, commonly experiences negative effects due to anthropogenic disturbance. The present contribution describes the general aspects of some recent researches, carried out thanks to private funds, aimed at reaching a better knowledge of the karst features of the system.

### GEOLOGY

In the Low Murge of Apulia, a territory that is characterized by many significant surface and subsurface karst landforms (PARISE, 2007, 2011), the coastline of Polignano a Mare is certainly the sector of greatest interest as regards coastal karst, as well as karst hydrogeology (GRASSI, 1973; ZEZZA, 1974). Many caves are located along the Polignano coast, mostly due to the action by the sea waves on the limestone cliffs.

Known since the first karst studies as one of the most important cave in the area (COLAMONICO, 1919; OROFINO, 1967), Grotta della Rondinella was later on studied for its breccia deposits (RUDNICKI, 1990), and for mineralogical analysis that brought to discover a new variety of francoanellite, that is the phosphate mineral phase

$H_6K_3Al_5(PO_4)_8 \cdot 13H_2O$ , which represents a lower hydrate of taranakite (BALENZANO *et alii*, 1979).

Located in a stretch of the coastline with cliffs lower than 10 m, Grotta della Rondinella is the larger karst cave in the sector north of Polignano a Mare. The geological setting of the Cretaceous bedrock, showing bedding in layers comprised between 10 and 70-80 cm, has an overall sub-horizontal attitude, with local variations due to folds and flections, with increase in dip toward the cliff. An average dipping toward the north and the east is recognizable. The Plio-Pleistocene calcarenites are visible only north of the cave, nearby the Chiar di Luna Cave (PU 825), where the contact with the Cretaceous limestones is marked by a breccia with terra rossa matrix.

Near Grotta della Rondinella the attitude is strongly conditioned by the flexure related to the collapse sinkhole that is the inland entrance to the cave (Fig. 1), as shown by the clear syncline. Moving away from the cave entrance, on the other hand, the bedding goes back to sub-horizontal, with average dip of a few degrees toward ENE.



Fig. 1 – The sinkhole representing one of the accesses to Grotta della Rondinella.

Several discontinuity systems are recognizable in the area, affecting the Cretaceous bedrock: the main one is about perpendicular to the coast, whilst further discontinuities are related to the tensional release parallel to the coastline. These latter locally become of primary importance in controlling evolution of the present coastal morphology.

The well-cemented calcareous breccia, with terra rossa matrix, is visible in correspondence of the collapse sinkhole, as well as within the karst system, in erosional pockets located at variable heights of the cave roof. RUDNICKI (1990) interpreted these deposits as related to palaeo-karst phases started after the

(1) CNR, Istituto di Ricerca per la Protezione Idrogeologica, Bari; [m.parise@ba.irpi.cnr.it](mailto:m.parise@ba.irpi.cnr.it)

(2) Federazione Speleologica Pugliese

(3) Apogeo, Altamura



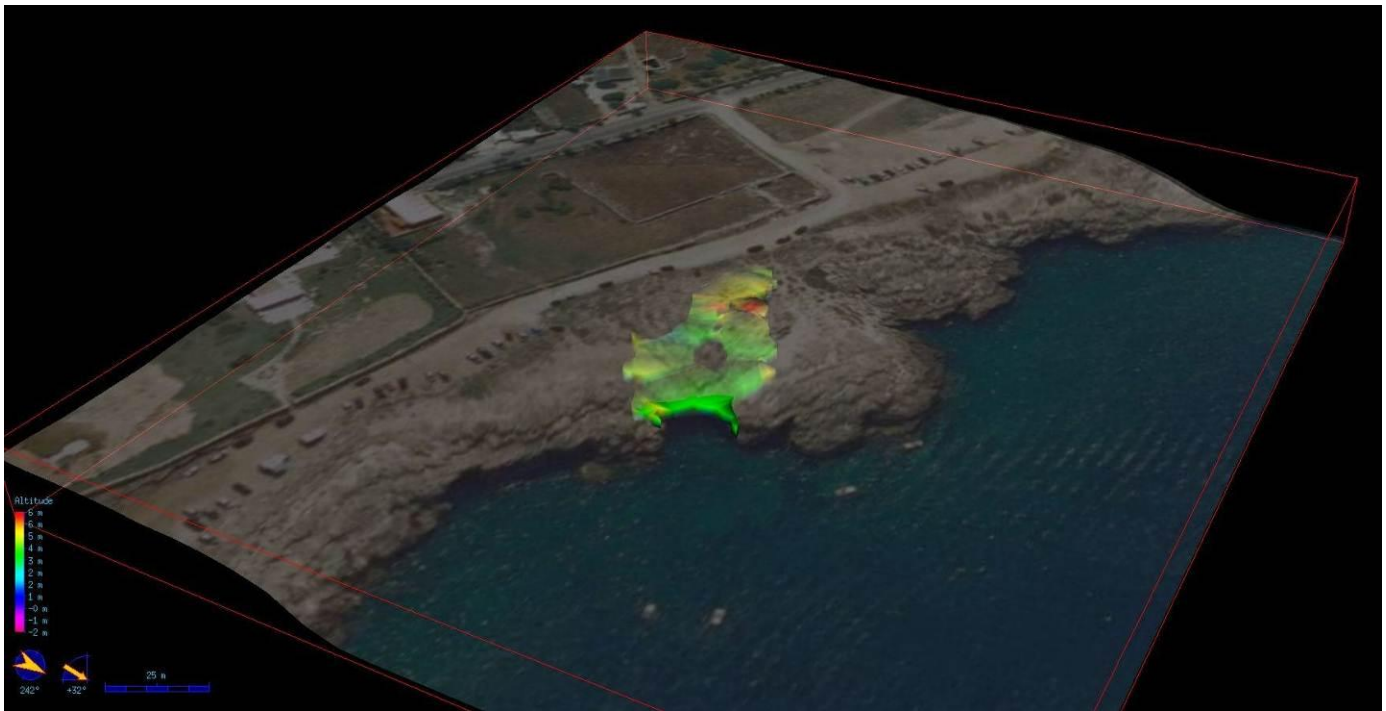


Fig. 2 – Perspective view of Grotta della Rondinella (Therion software elaboration), showing in the foreground the entrance from the sea. The black circular form in the center of the cave is the sinkhole shown in figure 1.

post-Cretaceous emersion, with later filling as a consequence of the sea level changes that interested this stretch of Adriatic coastline. Eventually, the Plio-Pleistocene deposits covered the older materials, and the subterranean hydric activity restarted after the last phase of land emersion.

The karst system was recently re-surveyed, using the modern technologies of cave surveying (Fig. 2): the survey highlights a prevailing development in E-W direction. Entering the system from the sinkhole, the passage to NW brings, moving above the fallen blocks (Fig. 3), to the sea (Fig. 4). On this side of the cave, along the northern wall, cave diving surveys allowed to find a previously unknown intrastratal gallery, controlled by tectonics along a N-S joint. The gallery develops for some 10 m, starting with height greater than the

width (2,5 x 1,5 m), and then lowering to slightly more than 1 m, with a width of 5-6 m. Moving around the sinkhole deposits, one can reach a junction leading to the SE to the inner pebble beach. To the W, on the other hand, after a 1,5 m-high step, one may enter the main cavern of the system, with height between 2 and 4 m, and the base for large portions occupied by flowstones. At the cavern margins, narrow and highly dipping passages lead to the lower level, about 3 m below.

Within the cave, the main hypogean morphologies consist of highly karstified rock strata in the Mesozoic carbonate succession, showing development of multiple phreatic conduits, and the solution breccias described by RUDNICKI (1990). These latter typically originate in hydrothermal karst environment, but at Rondinella they derive from the action of meteoric waters, likely combined with ancient collapses that caused the sinkhole. Existence of a palaeo-karst system, and of a multi-stage evolution of Grotta della Rondinella, is also proved by the presence of at least two levels in the cave, as before described.

The structural survey performed in the karst system was aimed at identifying the likely controls exerted by discontinuity systems in the development of the underground voids. Statistics of surveyed data documented the presence of four discontinuity systems, the main ones being oriented NNE-SSW and N-S, with subordinate NW-SE and WNW-ESE systems. From the analysis of these data it appears that the cave strongly developed along intrastratal partings, at the same time with a structural control by tectonic discontinuities. Even within the cave the bedding is extremely variable, as already observed outside of it, as an effect of the flexure in the stratigraphy, related to occurrence of the collapse sinkhole.



Fig. 3 – View, from inside the cave, of the sinkhole deposits, where is present the inland access to the karst system.

## GEOPHYSICAL SURVEYS

Two different geophysical methodologies were implemented in order to verify their validity to locate a known cave, and to look for evidence of further underground voids:

- a 3D electrical tomography (data elaboration by means of the ERTLAB programme by Geostudi Astier, Livorno);
- radar lines, covering an area of some 26000 m<sup>2</sup> by means of the contemporaneous use of two antennas: the 270 Mhz antenna was used to investigate different depths, with variable resolution, whilst the 70 Mhz antenna to get with good resolution the subsoil down to maximum depth of 15m. Data acquisition and elaboration were performed using the RADAN software, including the 3D QuickDraw module.

Choice of the two methodologies was dictated, given the local geological setting, by a preliminary analysis of both the known data and those resulting from the speleological surveys. Taking into account the depth and size of the karst system, the following methods were selected:

- the 3D geoelectrical method, with 96 electrodes



Fig. 4 – The entrance from the sea, showing the fessure in the carbonate strata, and the marine notch (to the right of the picture).

distributed over a rectangular grid with 3 m-spacing, along lines consisting of 16 electrodes each;

- georadar surveys with medium (270Mhz) and low frequency (70Mhz) antennas.

The resistivity data, properly inverted, indicate presence of positive resistivity anomalies, visible both qualitatively through 3D volume representations, and horizontal planes at variable depths from the ground surface. This latter representation allows to have geometrical indications on the pattern of the anomalies in depth.

The radar surveys, on the other hand, appear to be more disturbed and less precise in this geological setting.

Overall, the anomalies found highlight the likely presence of further cavities W and NW of the terminal room of the known cave system of Grotta della Rondinella, at depths from 4,5 m to about 9 m.

## CONCLUSIONS

The data here summarized represent an increase in the knowledge about Grotta della Rondinella and, more in general, karst of the area of Polignano. Beside better delimiting the development of the cave, the modern surveys added a previously unknown flooded gallery to the system. Further, they resulted extremely useful to plan the geophysical surveys which, in turn, highlighted the likely presence of other underground caverns, thus testifying the importance of the studied karst system.

## REFERENCES

- BALENZANO F., DELL'ANNA L. & DI PIERRO M. (1979) - *Francoanellite from the "Grotte della Rondinella" (Little swallow cave) in Apulia (southern Italy): a new occurrence and new data*, N. Jb. Miner. Mh., 363-372.
- COLAMONICO C. (1919) - *Fenomeni carsici a Polignano a Mare*, Boll. Stat. Amm. Comune di Bari, 4.
- FAVALE F.F. (1994) - *Le grotte di Polignano*. Federazione Speleologica Pugliese, pp. 250.
- GRASSI D. (1973) - *Fondamentali aspetti dell'idrogeologia carsica della Murgia (Puglia), con particolare riferimento al versante Adriatico*, Geologia Applicata e Idrogeologia, **8** (2), 285-312.
- OROFINO F. (1967) - *Polignano e le sue grotte*, L'Alabastro, 1-2, 12, Castellana-Grotte.
- PARISE M. (2007) - *Alcune considerazioni su speleogenesi e morfologia delle grotte pugliesi*. In: Inguscio S., Lorusso D., Pascali V., Ragone G., Savino G. (Eds.) - *Grotte e carsismo in Puglia*. Regione Puglia, 59-64.
- PARISE M. (2011) - *Surface and subsurface karst geomorphology in the Murge (Apulia, southern Italy)*, Acta Carsologica, **40** (1), 79-93.
- RUDNICKI J. (1990) - *Origine delle brecce di collasso e loro importanza nel sistema freatico della circolazione carsica*, Itinerari Speleologici, **4**, 9-16.
- ZEZZA F. (1974) - *Il ruolo delle facies carbonatiche nelle manifestazioni sorgentizie di tipo carsico della fascia costiera murgiana*, Geologia Applicata e Idrogeologia, **9**, 27-38.