



Sinkholes along karst coastal areas: driving factors

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Project of Research of National Interest
 PRIN PNRR 2022
Future scenarios in coastal karst: saltwater intrusion, loss of water resources and sinkhole development as effects of climate changes
 FU.CO.KA.

Second meeting with the Steering Committee
 Wednesday 22 January 2025, 10:00 a.m.
 Dipartimento di Scienze della Terra e Geoambientali, Campus Universitario, Bari

Programme of the meeting

Presentations from the Research Units:

- M. PARISE: *Introduction to the meeting*
- G. LEONE, M. GINOLFI: *The website of the FU.CO.KA Project: structure and state of art*
- V. DE SANTIS: *Geomorphological framework of the study areas*
- M. PARISE, I.S. LISO: *Sinkholes along karst coastal areas: driving factors*
- L. DE CARLO, R. MASCIALE, G. PASSARELLA, A.C. TURTURRO, M.C. CAPUTO: *Geophysical survey in a coastal aquifer for monitoring saltwater intrusion dynamics*
- M.C. CAPUTO, L. DE CARLO, R. MASCIALE, A. VOLPE: *Study of interactions between a freshwater lake and groundwater in a Mediterranean coastal area by means of hydrochemical indicators*

Discussion and comments from the Steering Committee:

- ZORAN STEVANOVIC, Serbia
- EVANGELOS TZIRITIS, Greece
- MOHAMMAD FARZAMIAN, Portugal

Conclusions

For further information:
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Research Units of FU.CO.KA. Project
 ✓ Dipartimento di Scienze della Terra e Geoambientali, Università Aldo Moro, Bari (Principal Investigator: Prof. Mario Parise)
 ✓ Dipartimento di Scienze e Tecnologie, Università del Sannio, Benevento (Scientific Responsible: Prof. Francesco Fiorillo)
 ✓ Istituto di Ricerca sulle Acque, CNR (Scientific Responsible: Dr.ssa Maria Clementina Caputo)

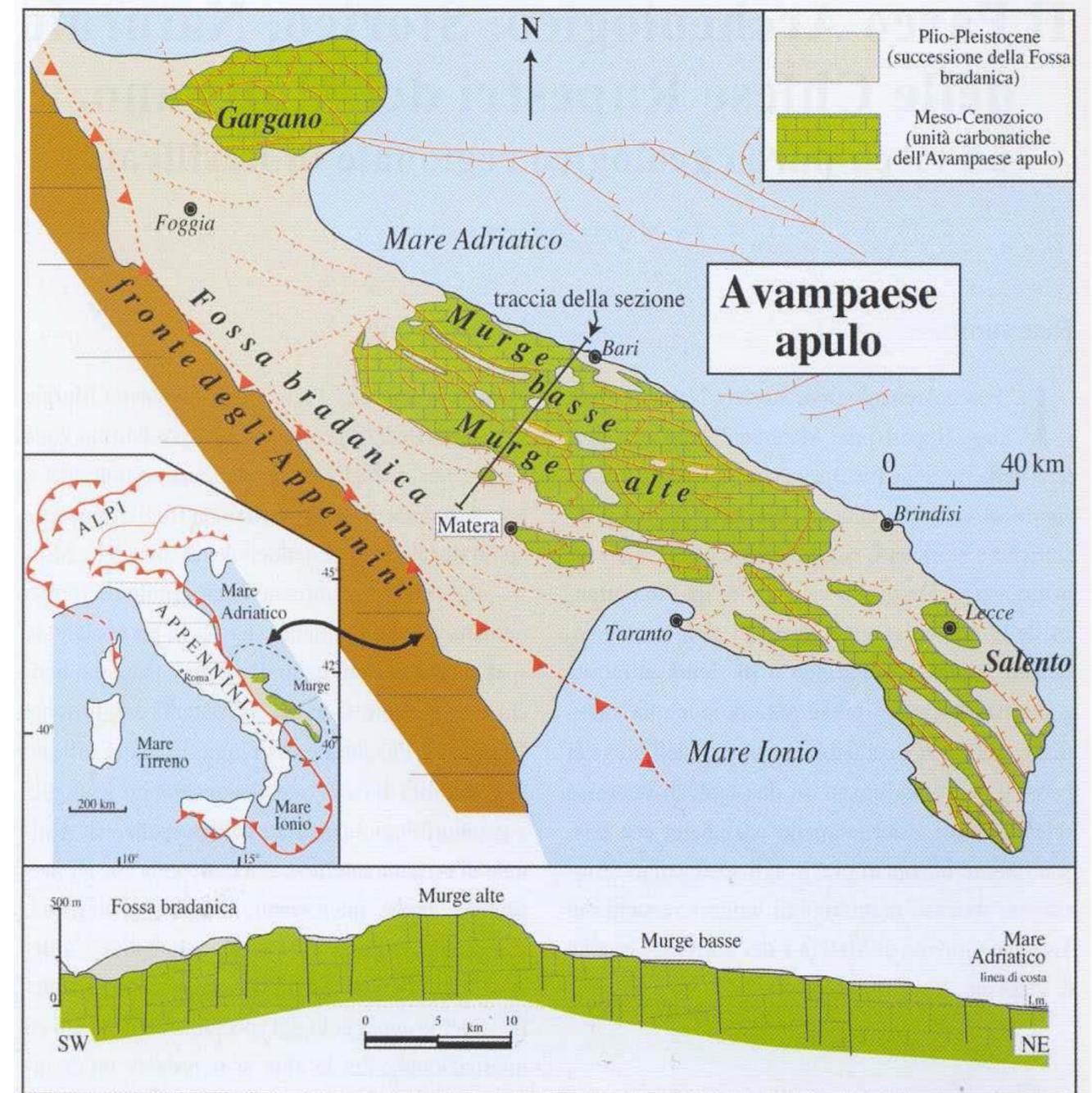
APULIA



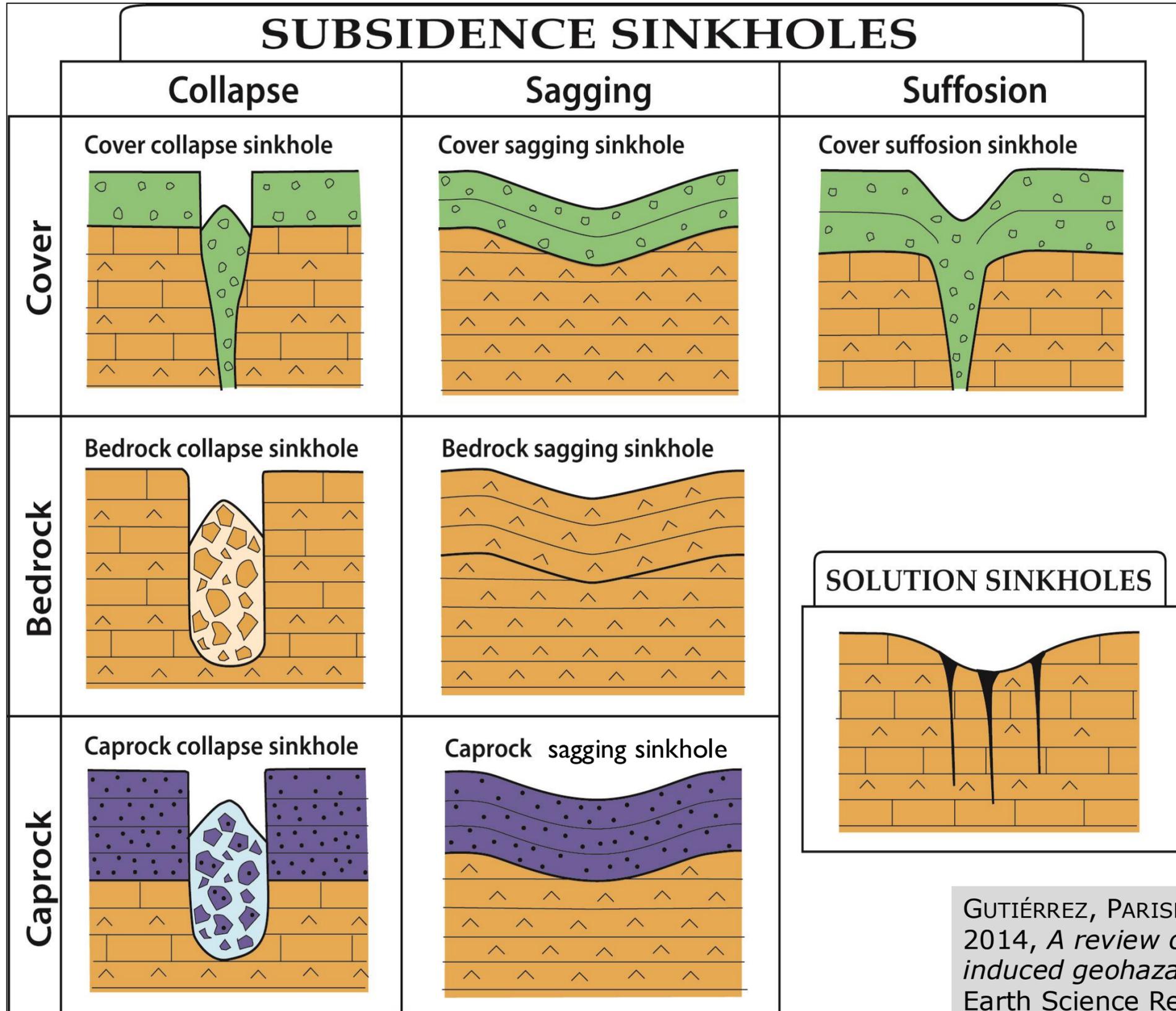
Among the most significant regions in the Mediterranean Basin as regards karst and percentage of outcrops of soluble rocks

Three main karst areas:

- Gargano
- Murge
- Salento



Pieri et al., 1997



GUTIÉRREZ, PARISE, DE WAELE & JOURDE, 2014, *A review on natural and human-induced geohazards and impacts in karst.* Earth Science Reviews 138, 61-88.

Pulo

variations: *puro*, *pure*, *pulicchio*

after the greek **πύλη** = gate, narrow access

In the form **πύλαι** it is also used as narrow valley



Gravina: il Pulicchio

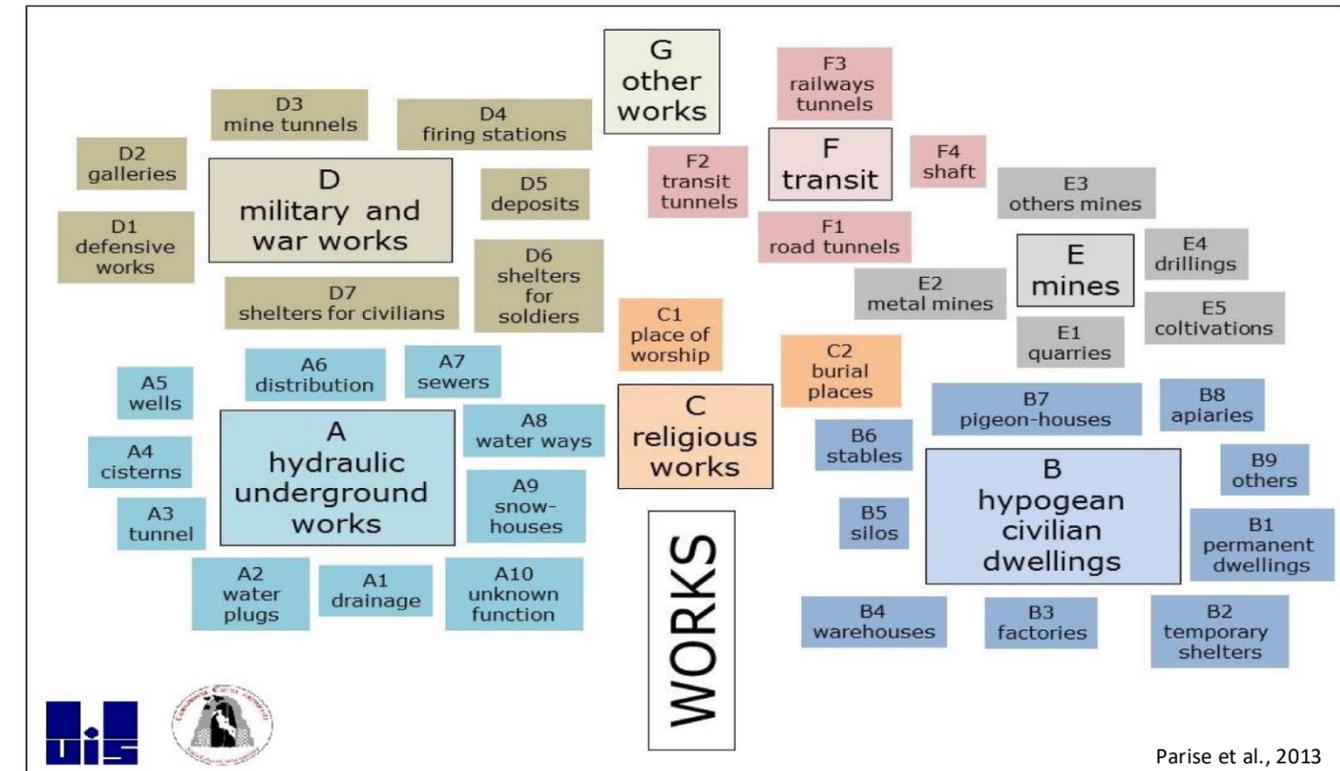
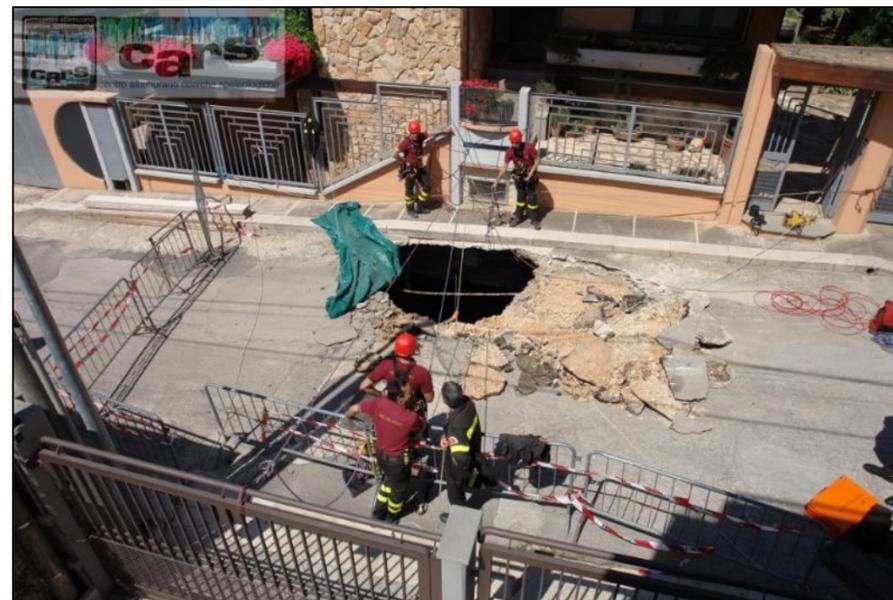


Il Pulo di Altamura

SINKHOLES: not only a natural hazard



Artificial sinkholes are widespread in Apulia, due to high number of man-made cavities



SINKHOLES

Predisposing, preparatory, triggering factors

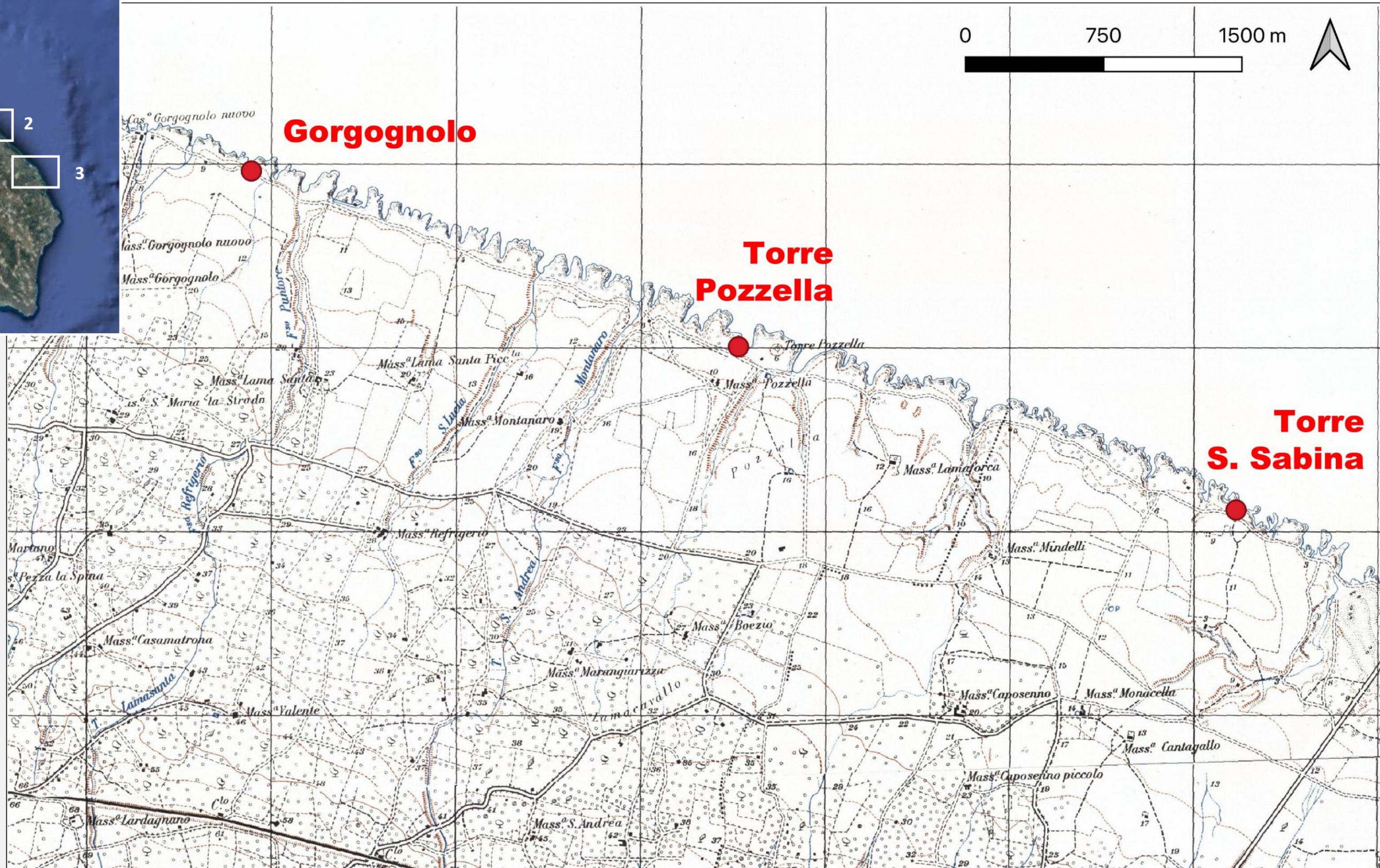
Distinction between predisposing, preparatory and triggering factors/processes is made on a **temporal basis**

Predisposing: invariable on the observation scale

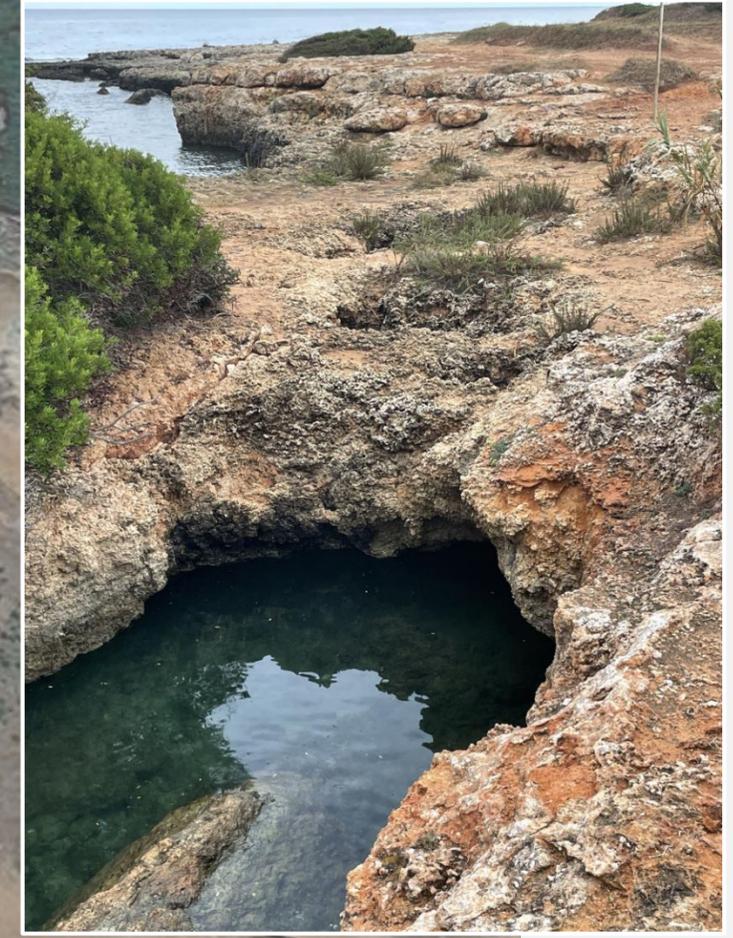
Preparatory: show changes or cyclical trends during the same period

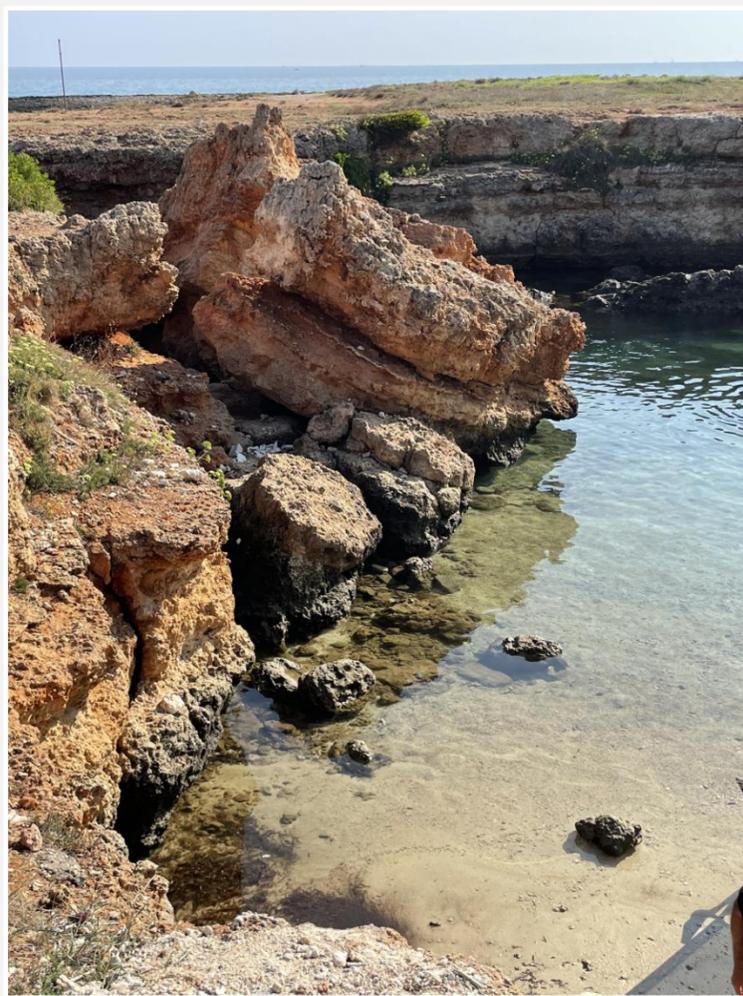
Triggering: factor/process acting in a very short and well-defined time

â Predisposing Factors â		Log			Sinkholes Typologies	
Macro-category	Main Factors	qualit.	semi-quant.	quant.	Slow Sinkholes	Rapid Sinkholes
Geology	Lithology	x				
	Structural features (large scale)	x	x		X	X
	Stratigraphic features	x				
	Karstification degree		x		X	X
	Talus/Weathering		x		X	X
	Slope morphology/Topography			x	X	X
	Upslope area			x		
Geomorphology	Undercutting	x				
	Erosion by running water	x				X
	Glaciers and snowfields	x				
	Distance from coastline			x	X	X
	Overburden thickness			x	X	X
	Cave geometry and size			x	X	X
	Presence of previous events	x	x		X	X
Physical and mechanical properties	Rock mass structure		x	x	X	X
	Grainsize distribution/Particle shape		x	x		
	Porosity/Density			x	X	X
	Shear strength			x		
	Mineralogy and plasticity			x		
	Hydraulic Properties		x	x	X	X
	Seismic activity		x	x		
Seismotectonics	Faulting System/Distance to faults	x		x	X	X
	Site effects (amplification/resonance)			x		
Land Cover & Vegetation	Land Use/Land Cover		x		X	X
	Soil Type/Soil Thickness		x	x	X	X
	Vegetation	x	x		X	X
Hydrogeology	Groundwater/Saturation		x	x	X	X
	Rising acid fluids	x				
Climate	Water inflow/outflow during flood/seastorm	x	x		X	X
	Rainfall Regime			x	X	X
	Temperature Regime			x		
Anthropogenic Factors	Structures/Infrastructures/Buildings			x		X
	Groundwater/Gas/Oil exploitation			x		
	River banks/levees typology		x			
	Slope/Drainage changes		x	x		







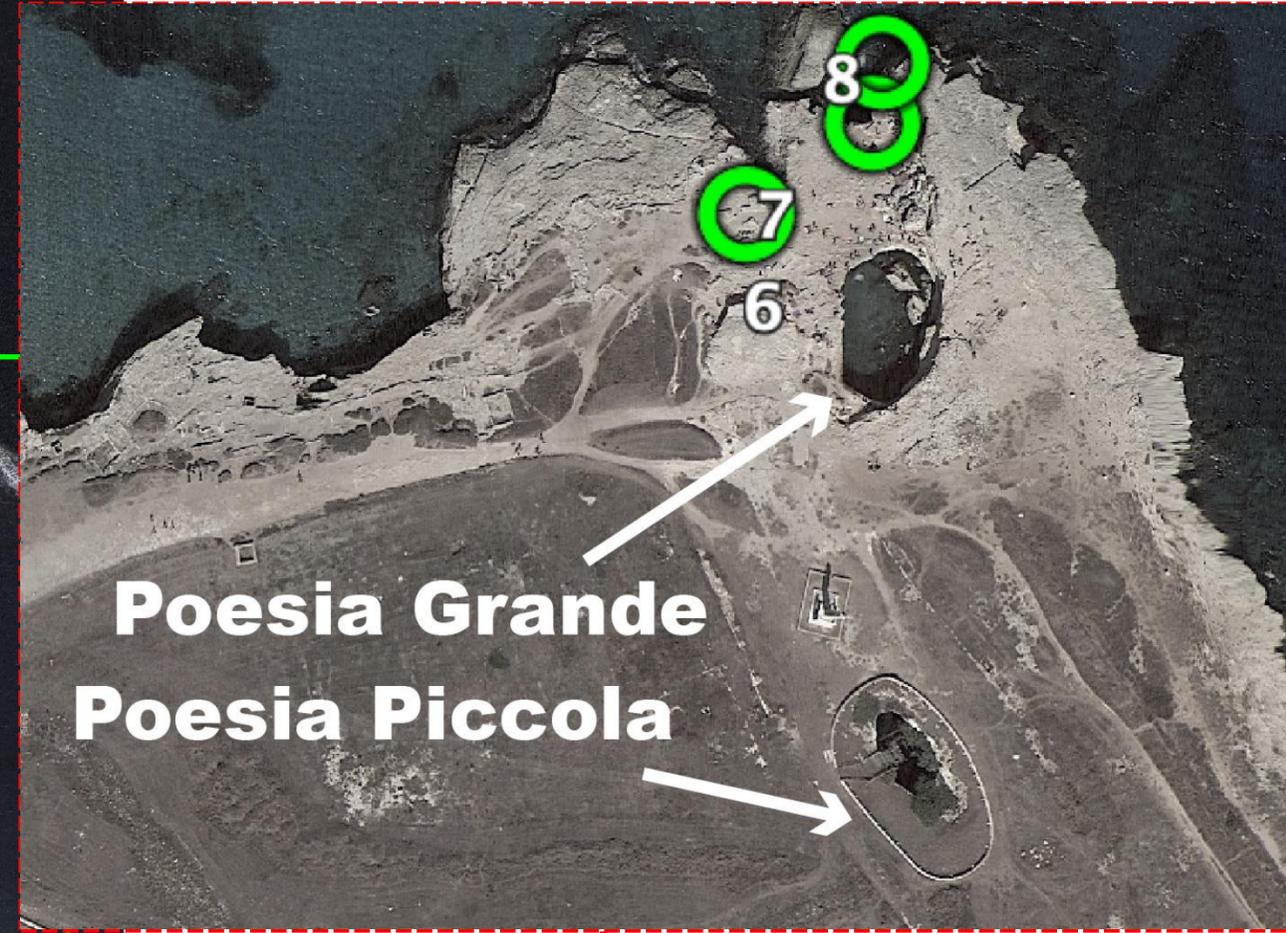


Study areas

Adriatic side: from Frigole to Otranto



Ionian side: Torre Castiglione – Palude del Capitano





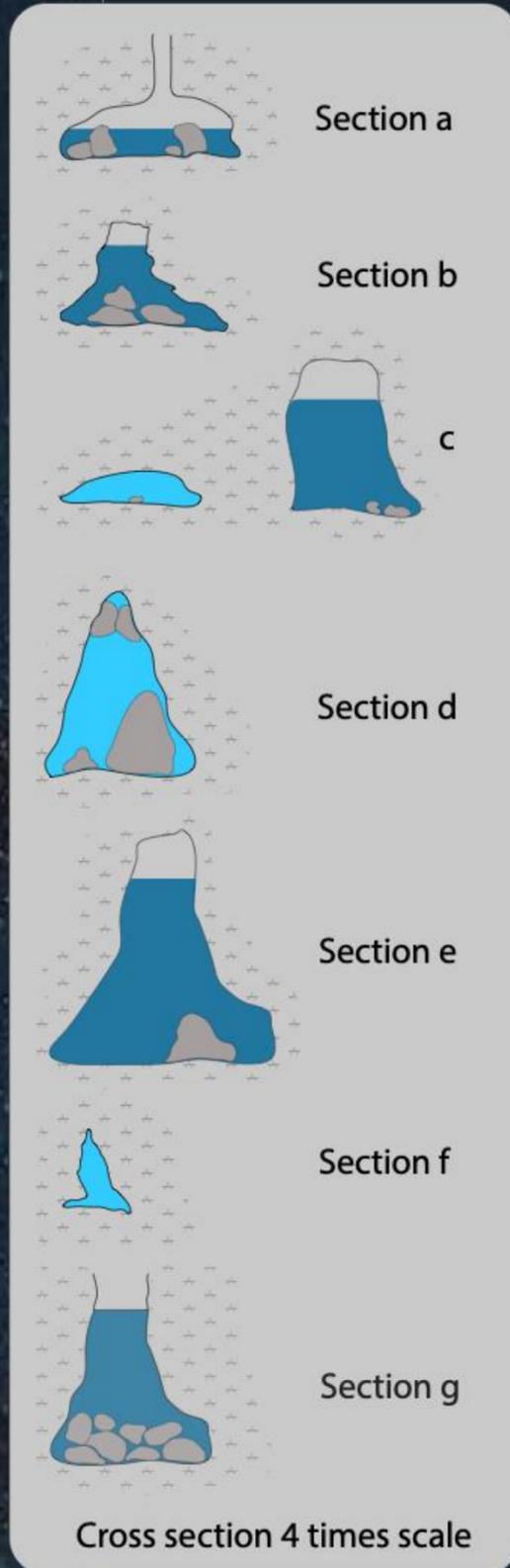
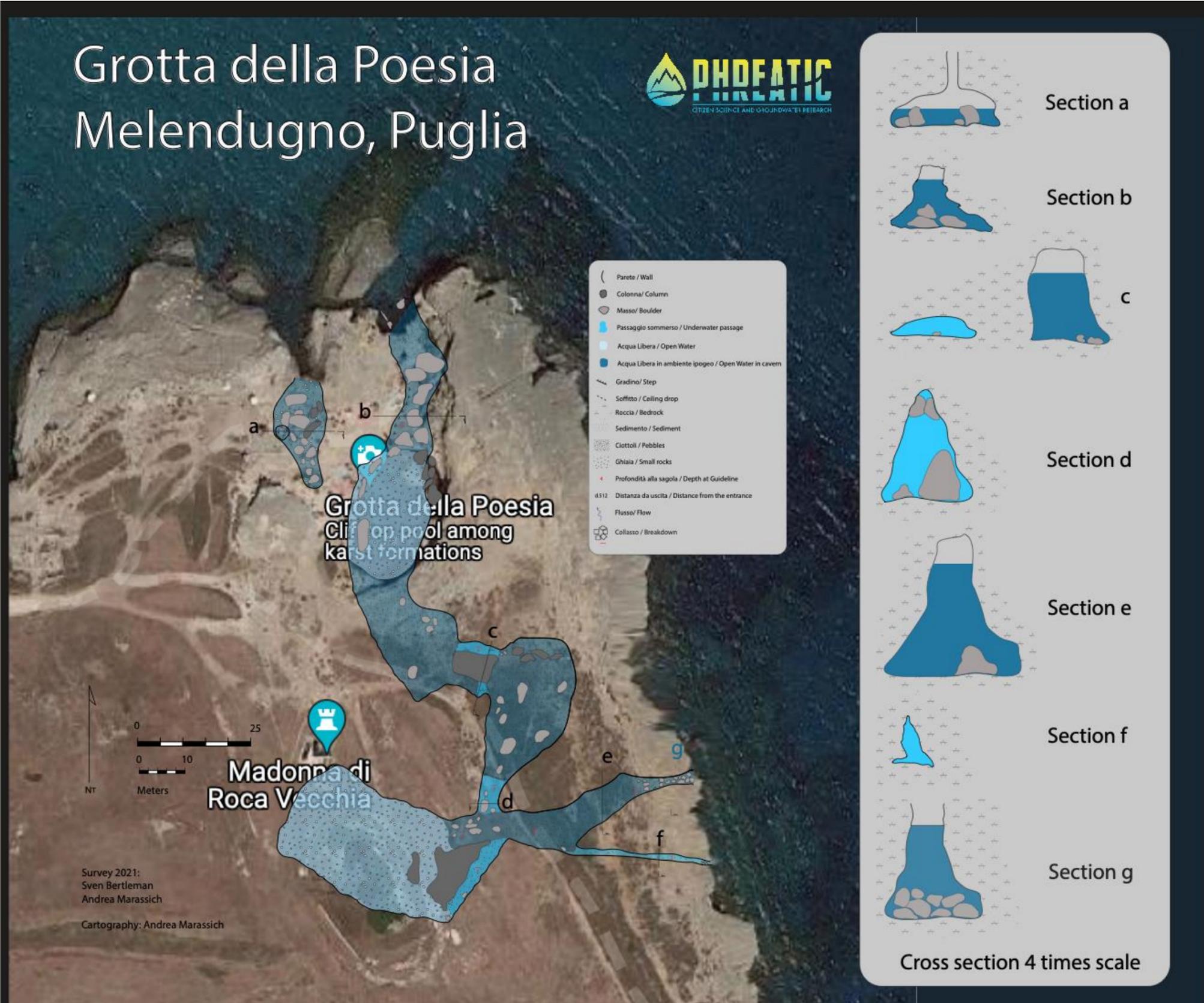
Grotta della Poesia Grande
PU 127



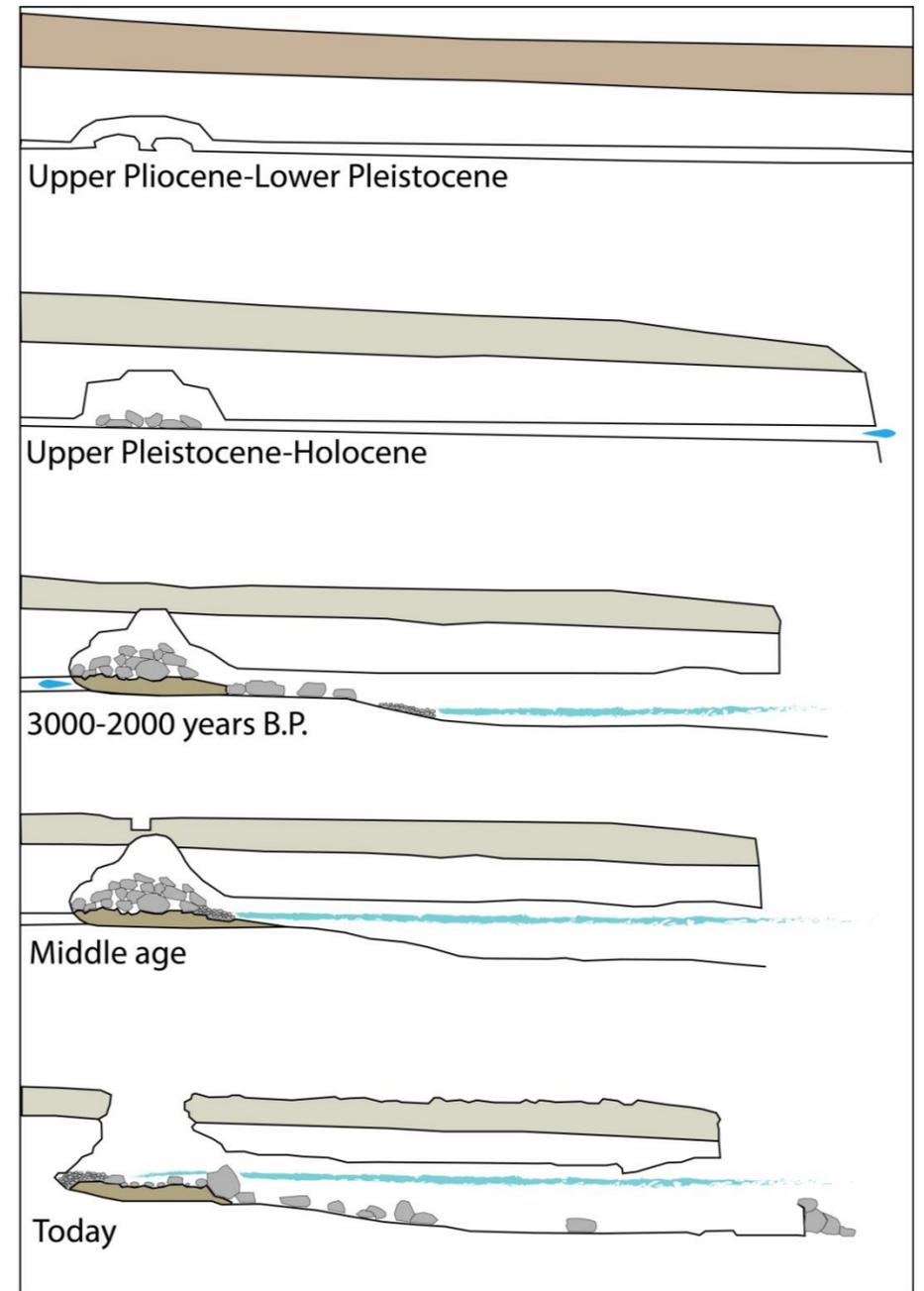
Grotta della Poesia Piccola
PU 128



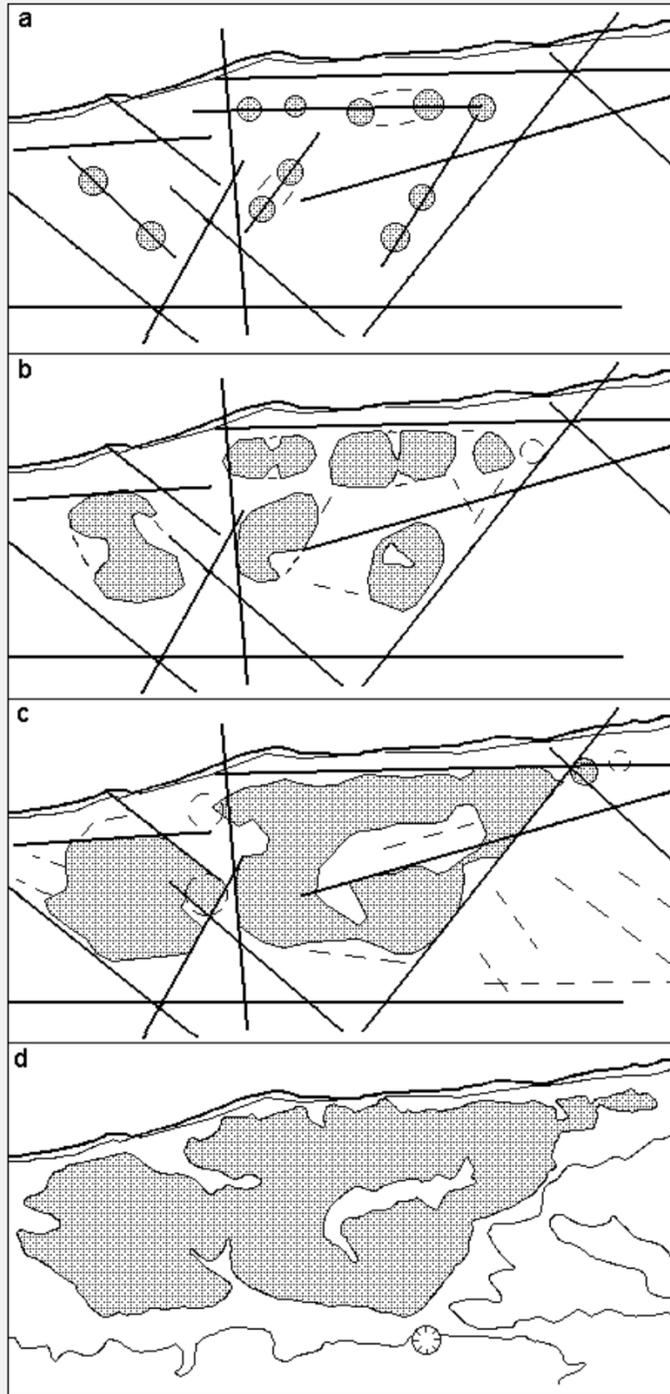
Grotta della Poesia Melendugno, Puglia



Cross section 4 times scale



Liso & Parise, 2023



Delle Rose and Parise, 2002;
Liso and Parise, 2023



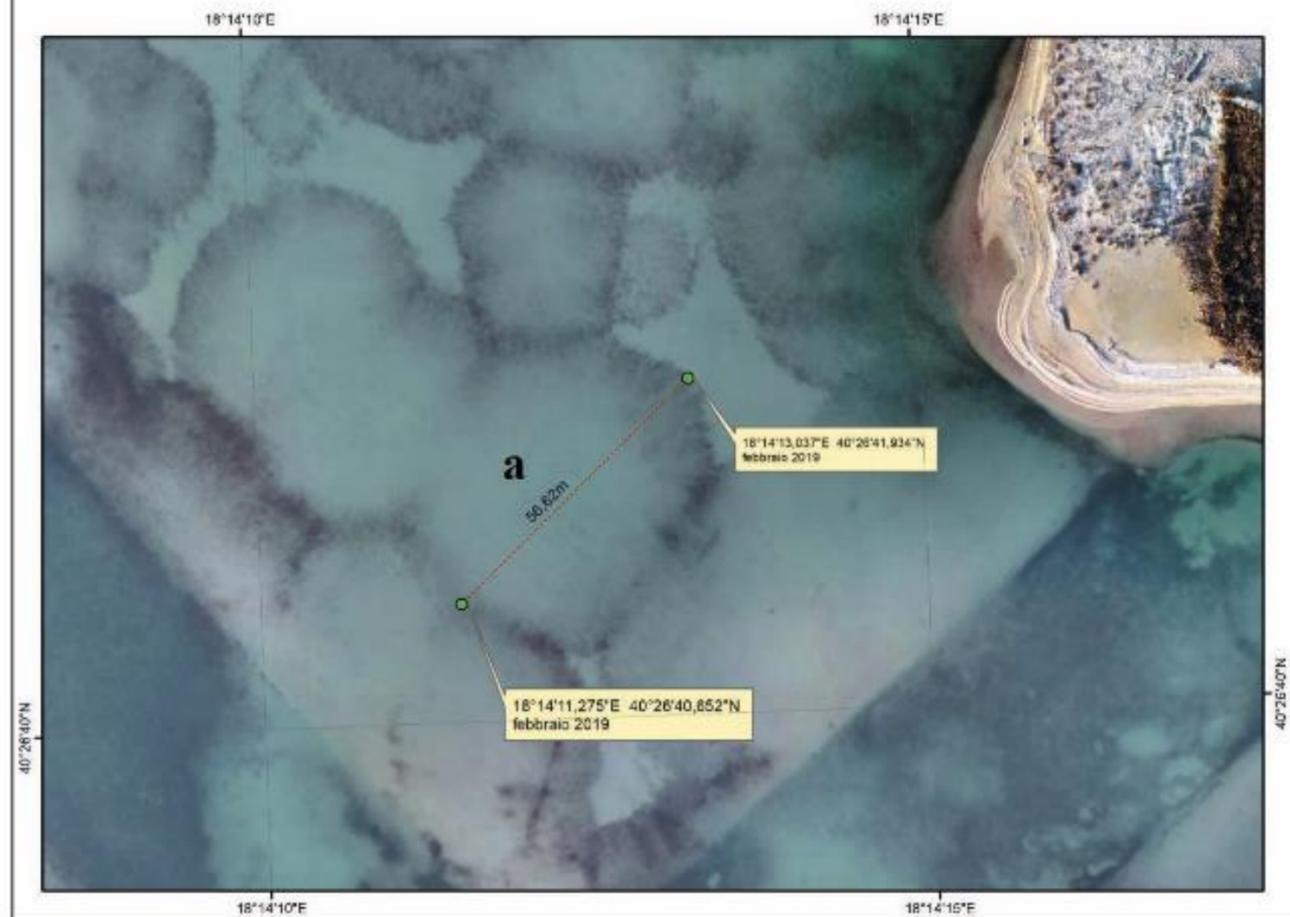
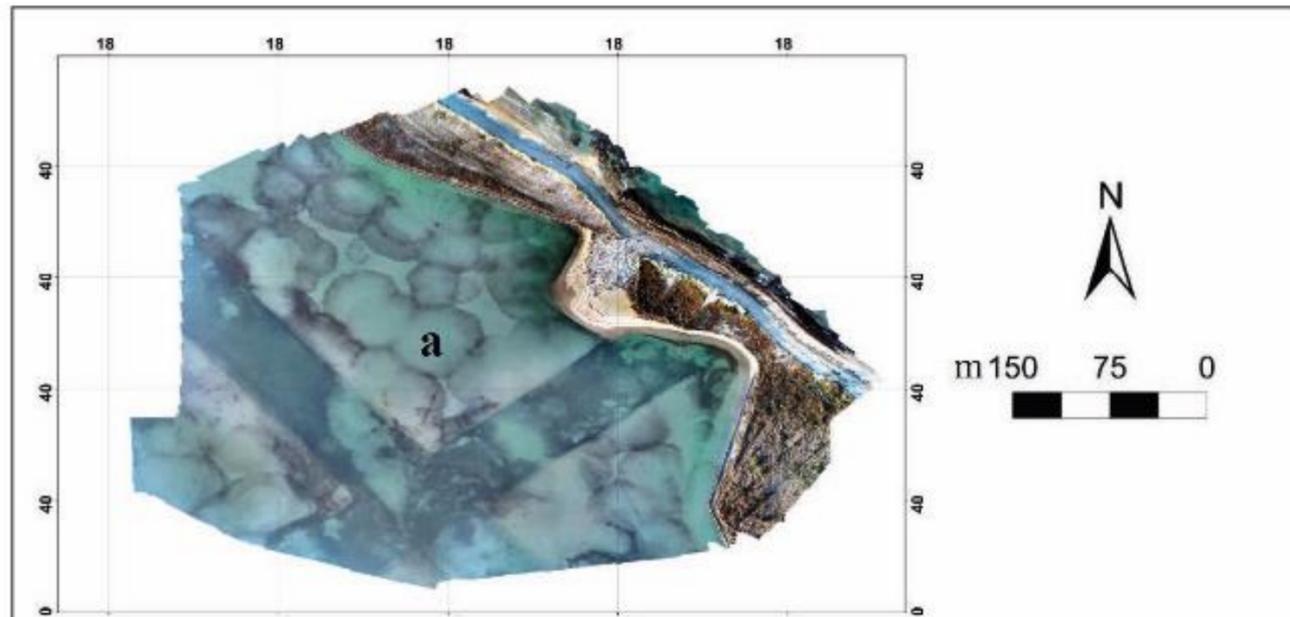


- Artificial lagoon
- Linear extension: 5628 m
- Area: 424.634 m²
- Use: sanitary to eradicate malaria, fishing and agriculture
- Sinkholes are dominant close to the lagoon internal channels

**Acquatina di Frigole,
Adriatic coastline**



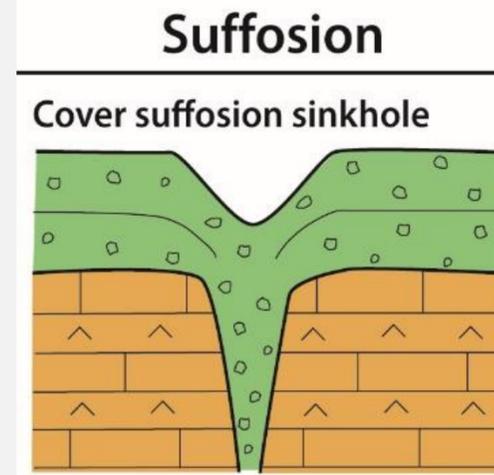
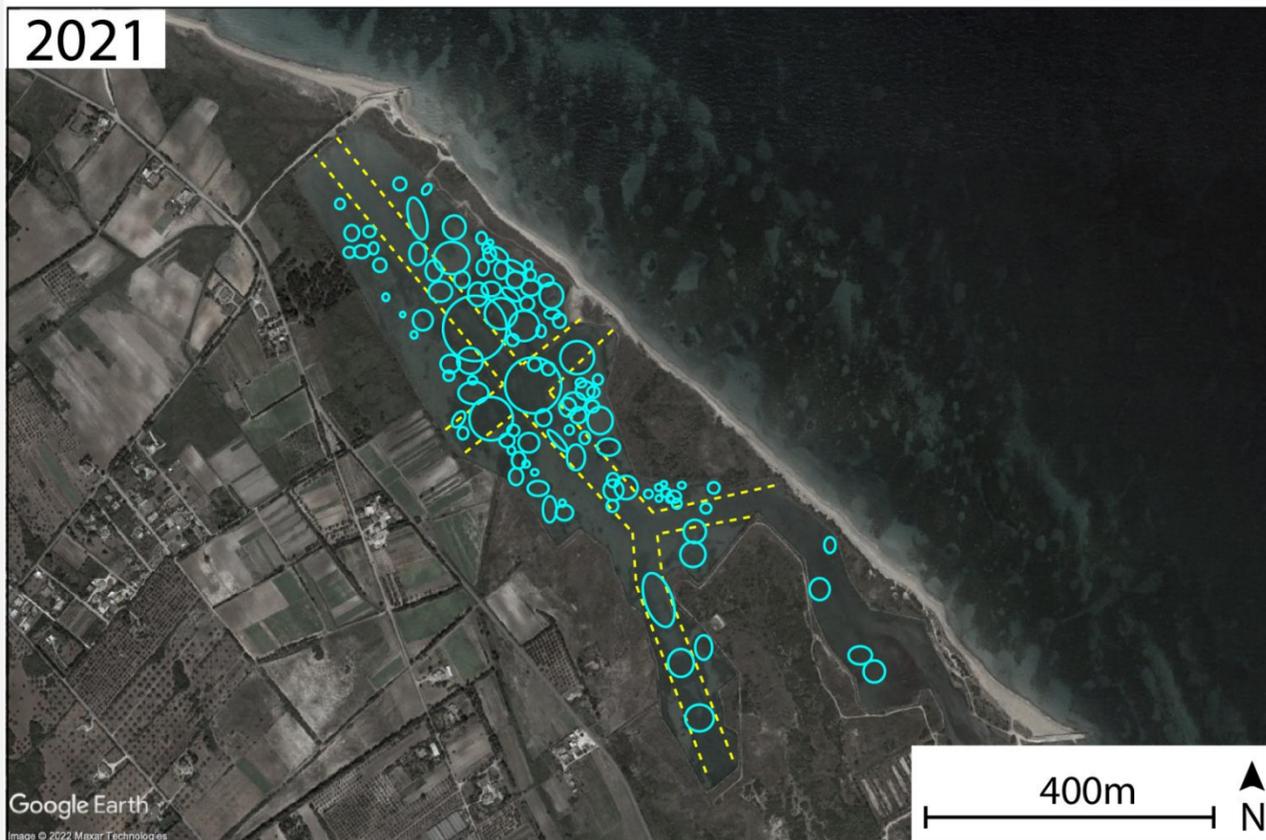




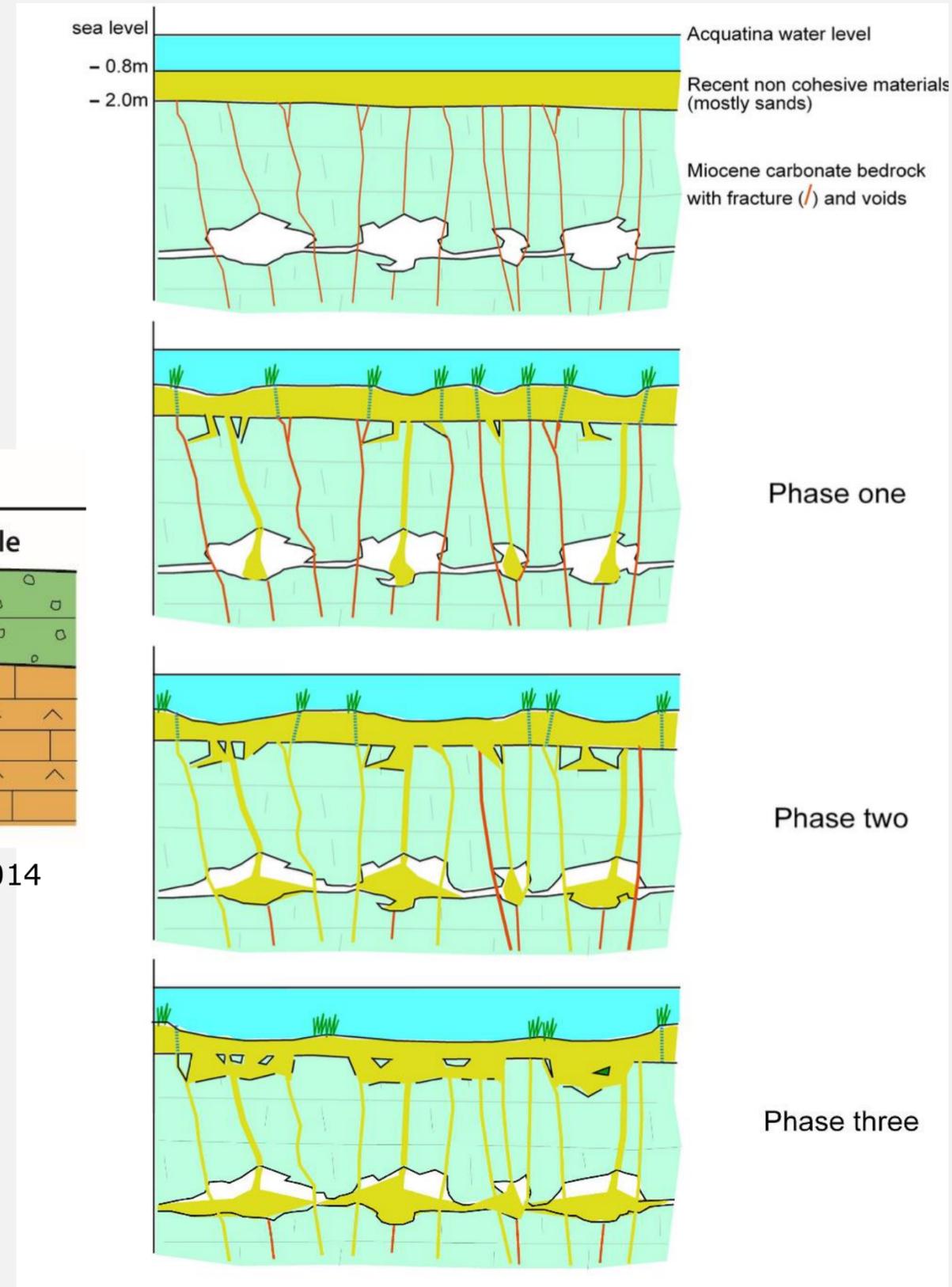
ROV (Remotely Operated Vehicle)

- Waterproof camera
- Thermometer
- Sonar
- Single beam
- GPS system





Gutiérrez et al., 2014
Parise, 2022





Study areas

Ionian side: Torre Castiglione – Palude del Capitano





Environ Earth Sci
DOI 10.1007/s12665-013-2297-z

ORIGINAL ARTICLE

Morphometric analysis of sinkholes in a karst coastal area of southern Apulia (Italy)

A. Basso · E. Bruno · M. Parise · M. Pepe

Available online at www.sciencedirect.com

ScienceDirect

Engineering Geology 99 (2008) 198–209

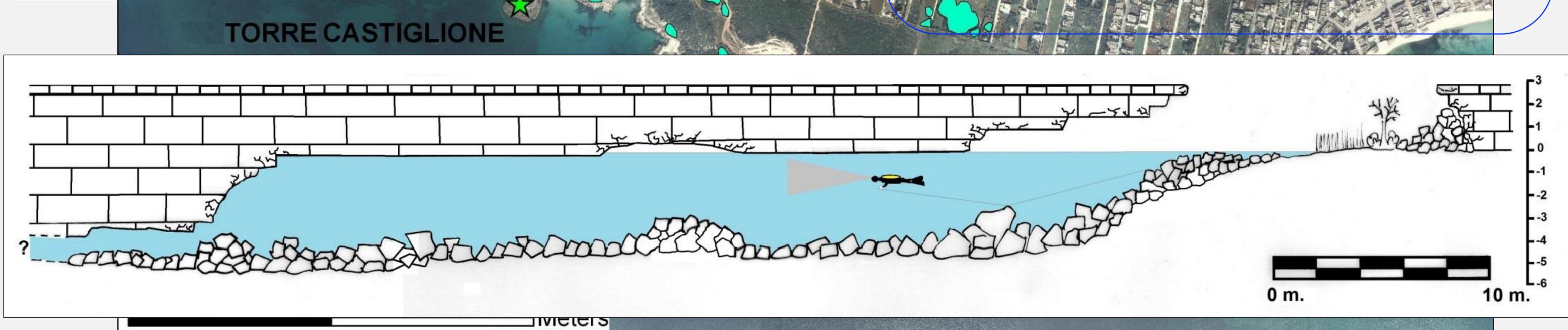
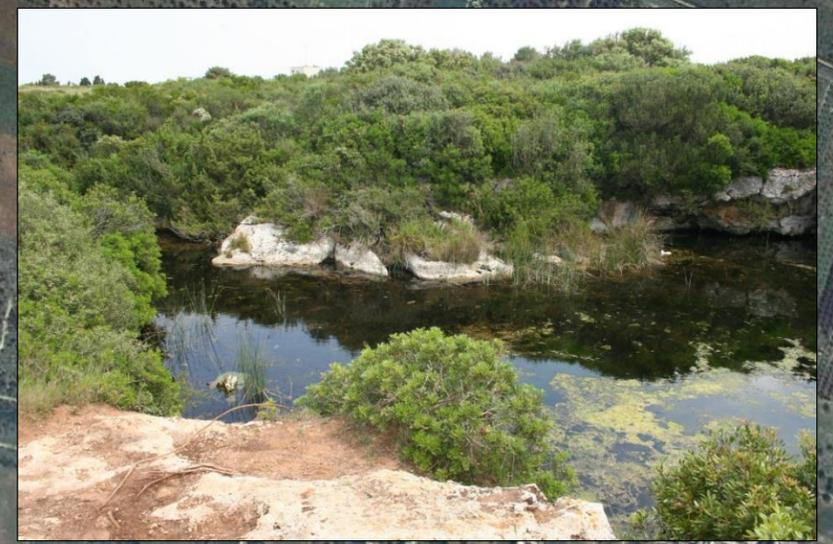
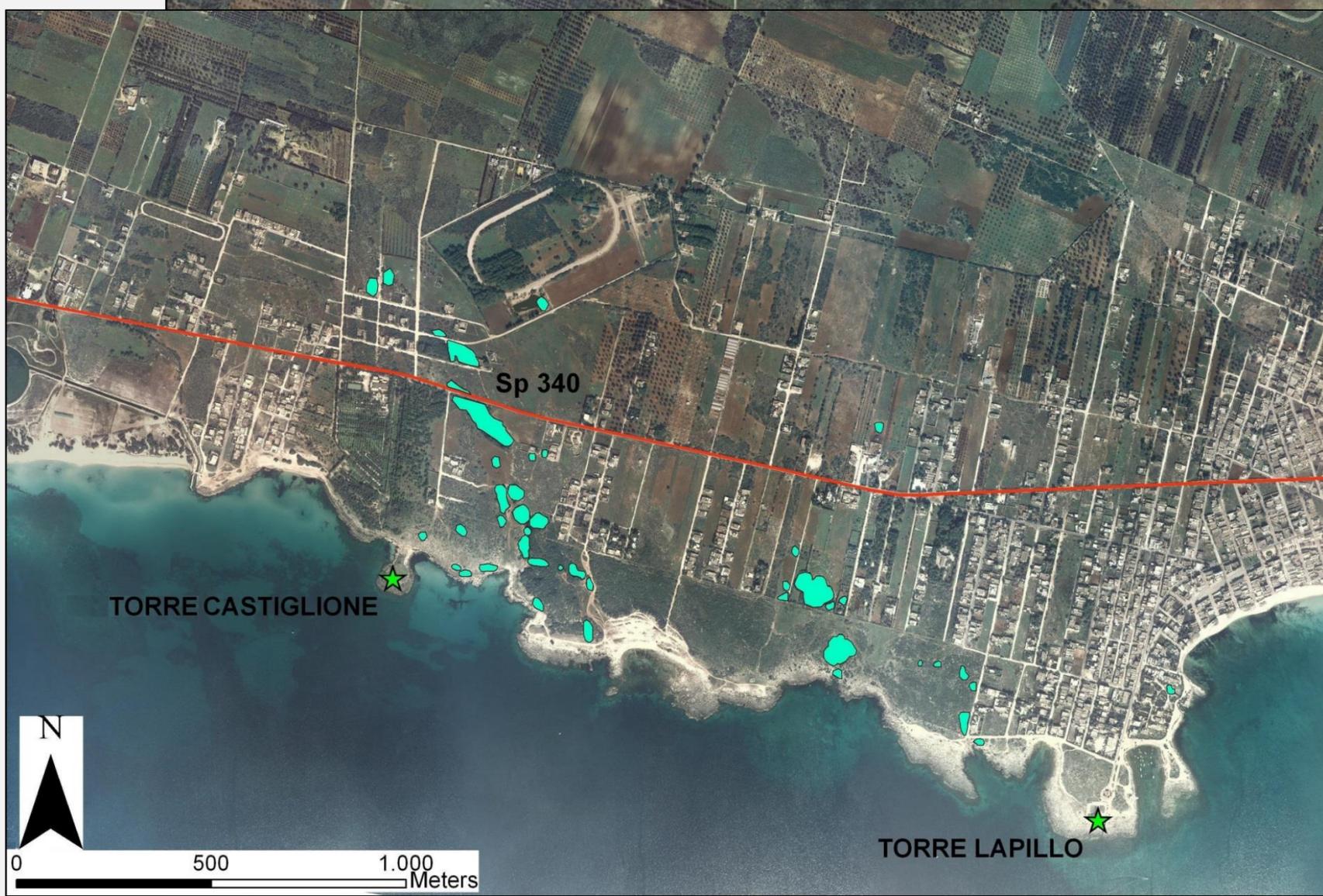
ENGINEERING GEOLOGY

www.elsevier.com/locate/enggeo

Development and morphometry of sinkholes in coastal plains of Apulia, southern Italy. Preliminary sinkhole susceptibility assessment

E. Bruno ^a, D. Calcaterra ^{a,*}, M. Parise ^b



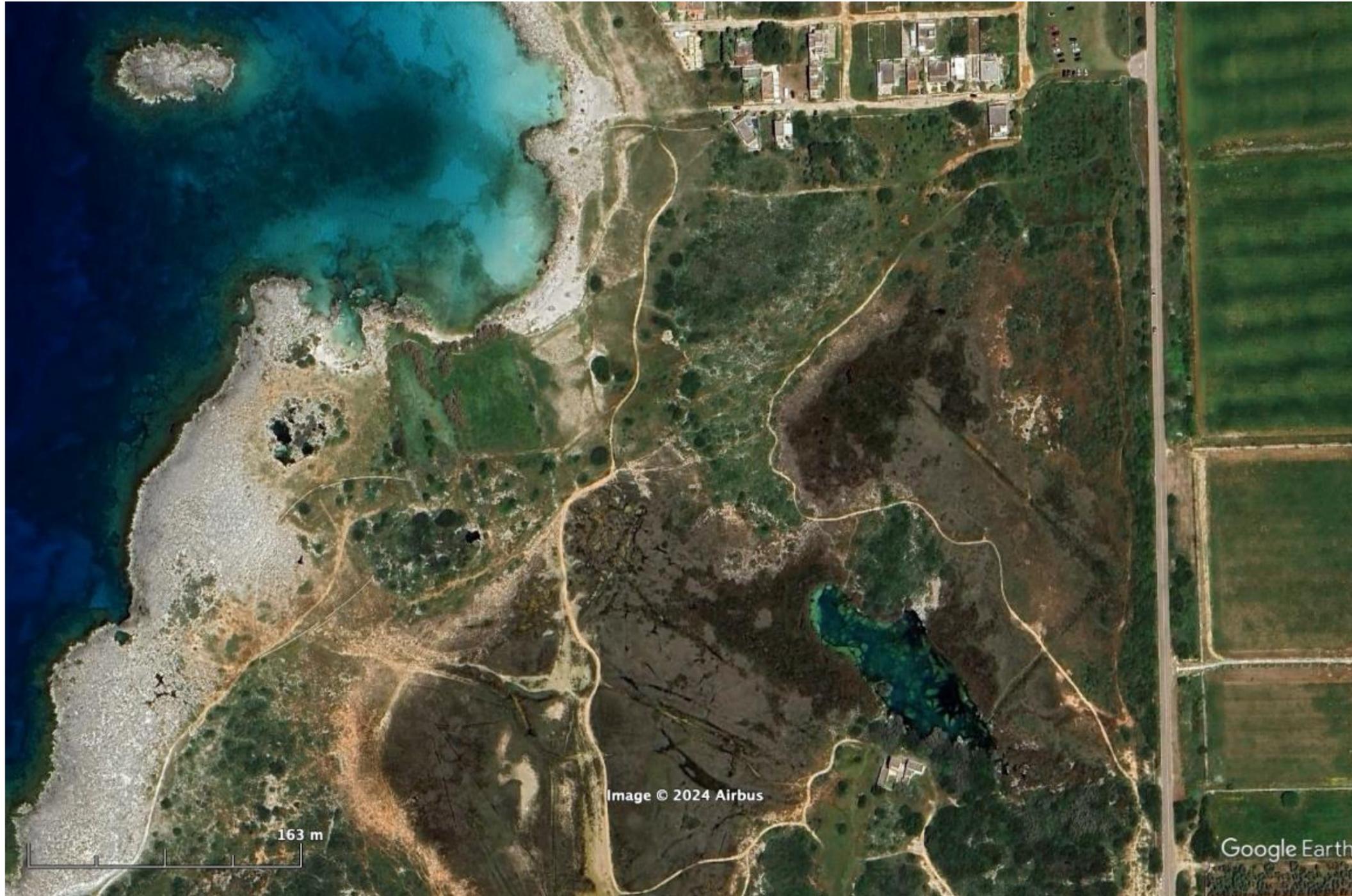


Spunnulate



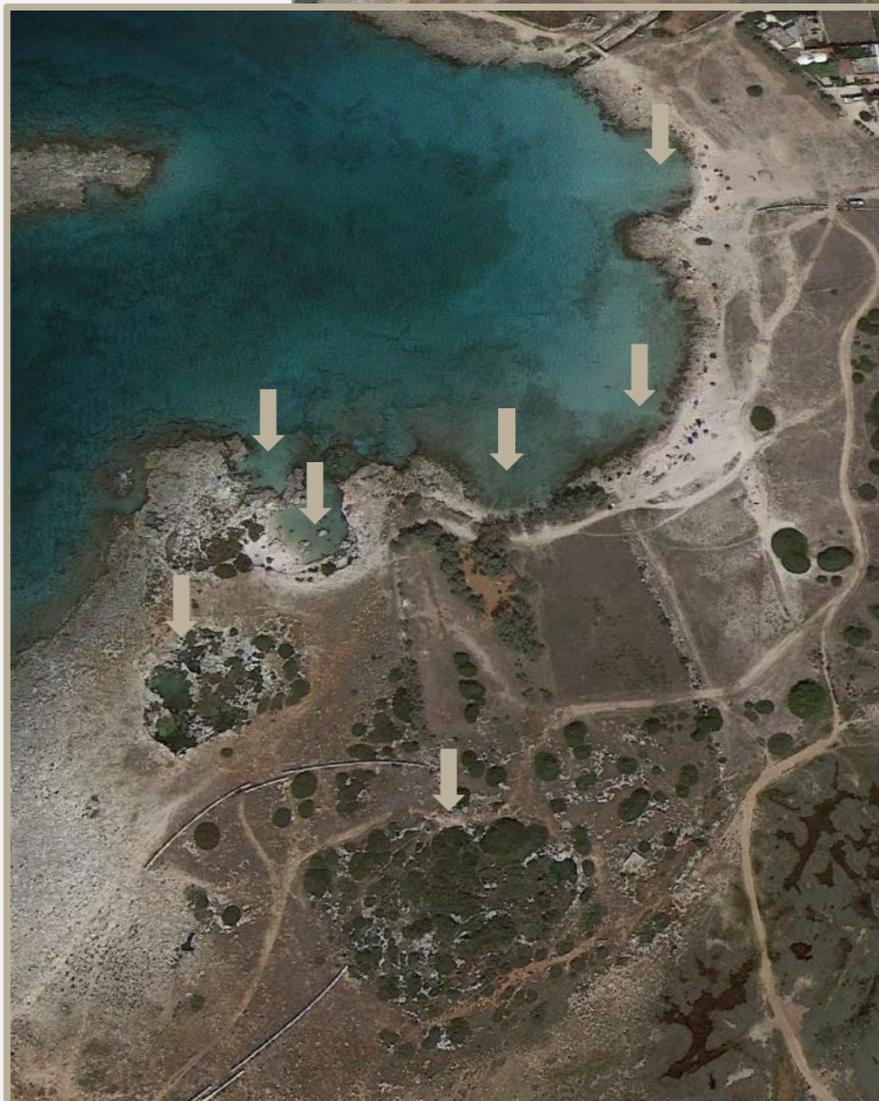
Study areas

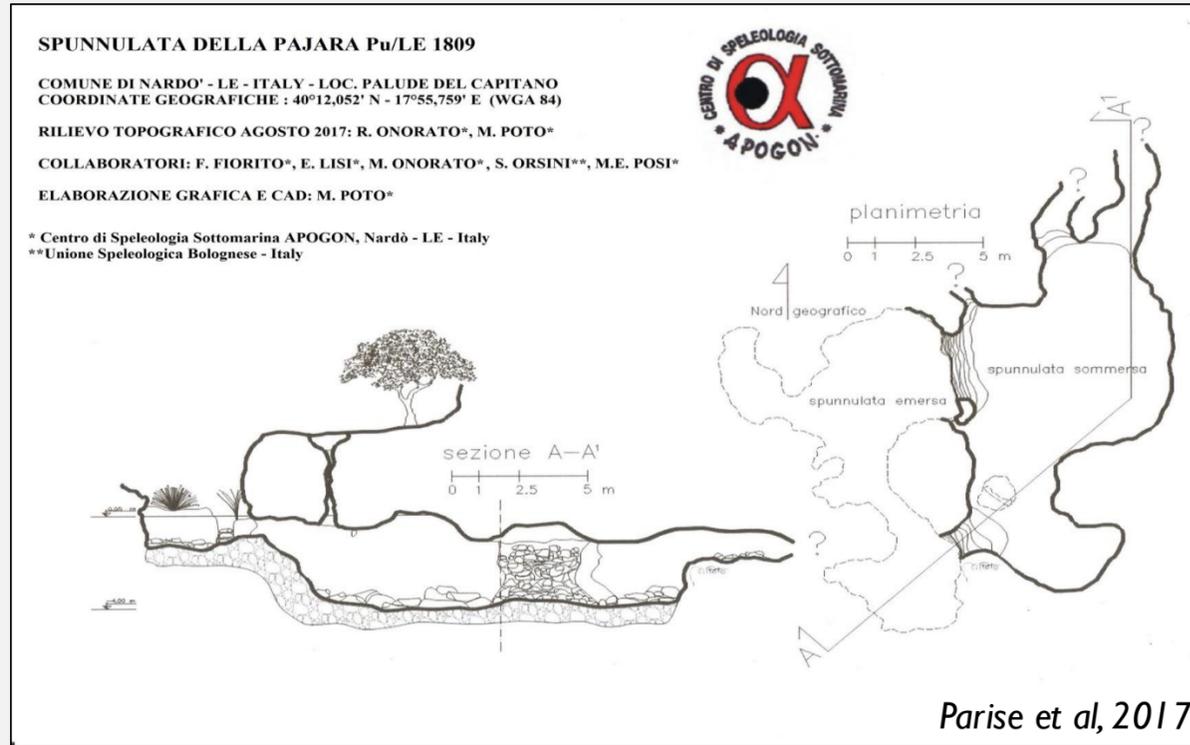
Ionian side: Torre Castiglione – Palude del Capitano







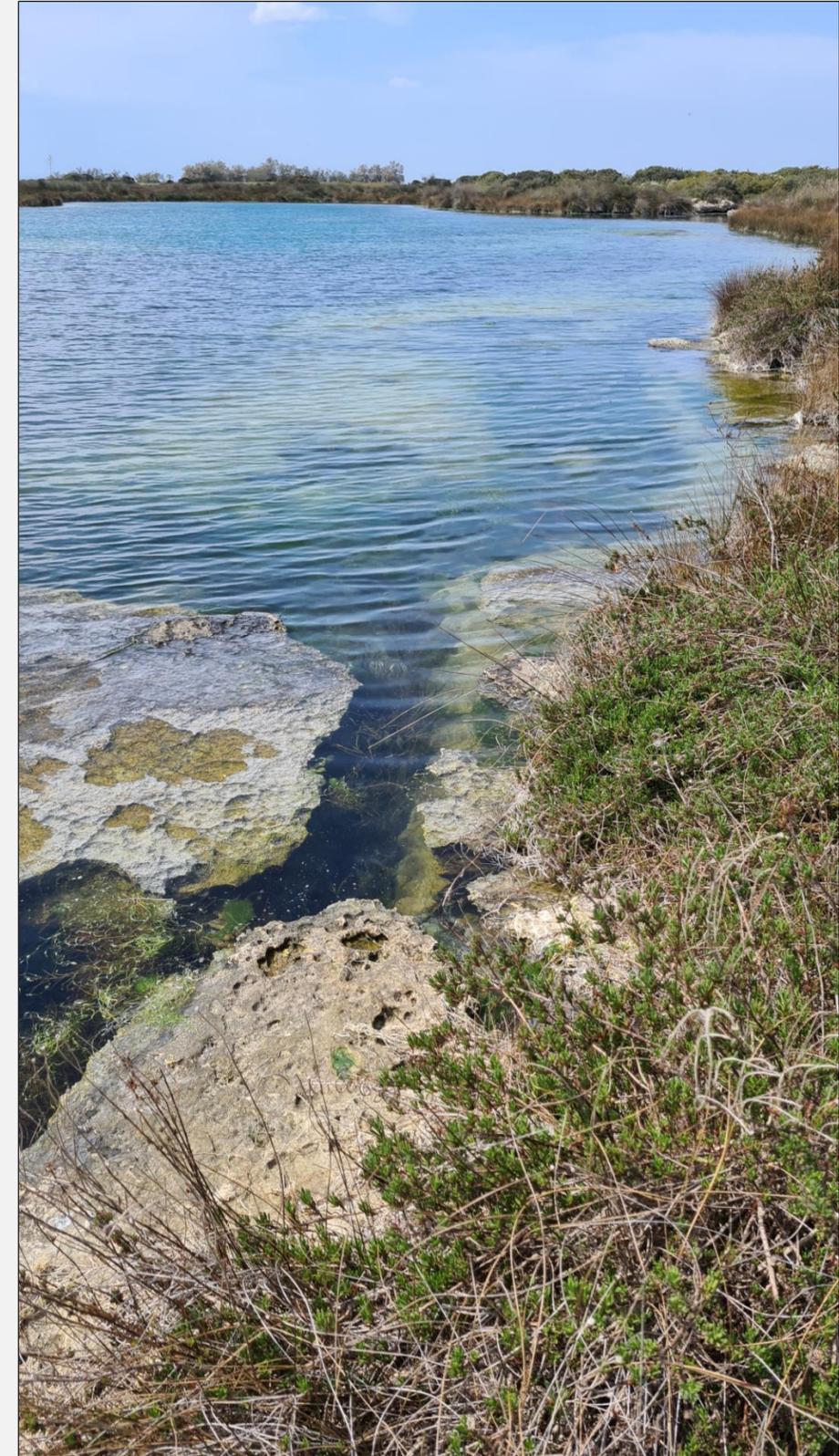


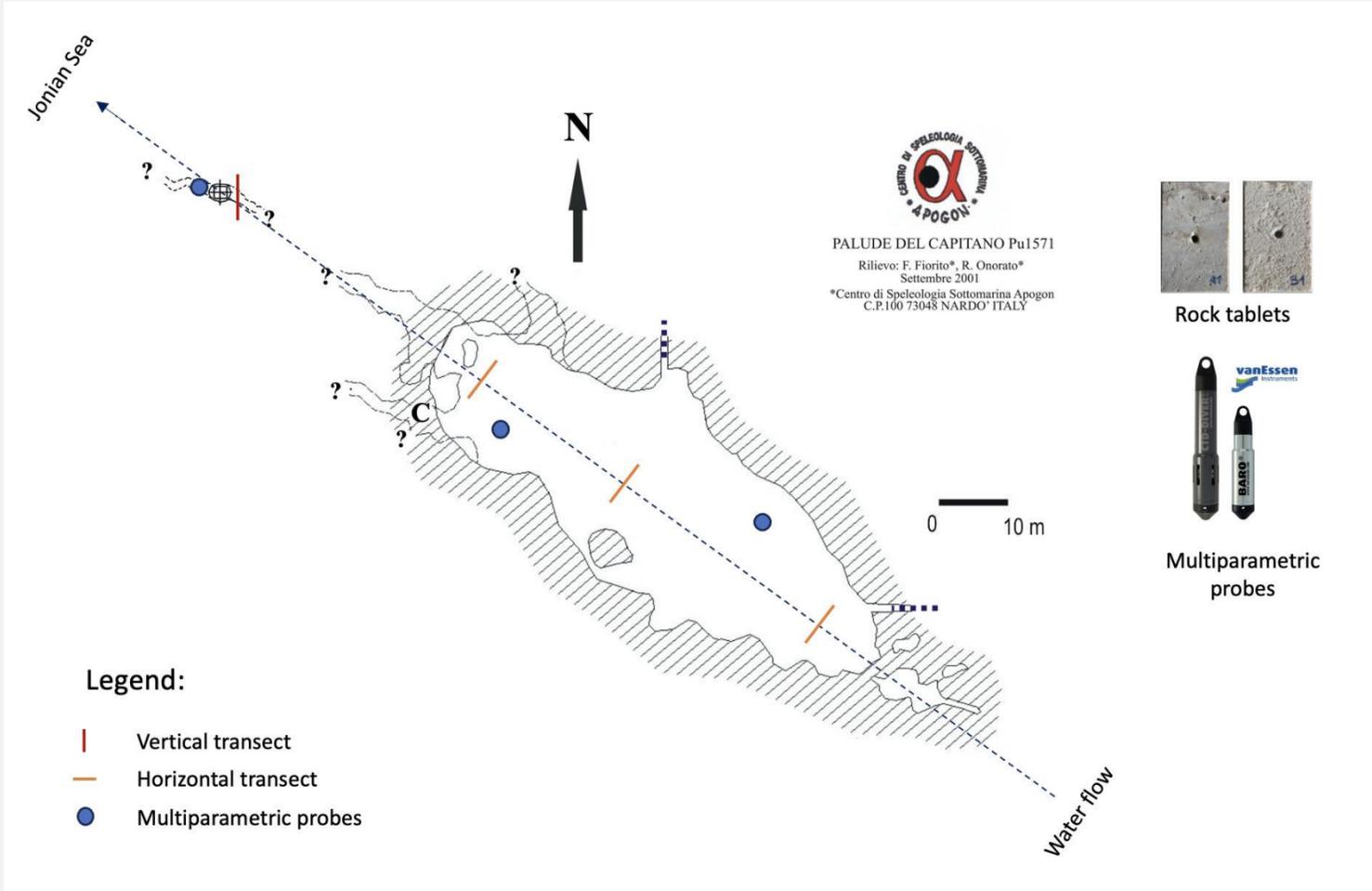


Sinkholes develop within the Plio-Pleistocene calcarenites lying on Mesozoic limestone.

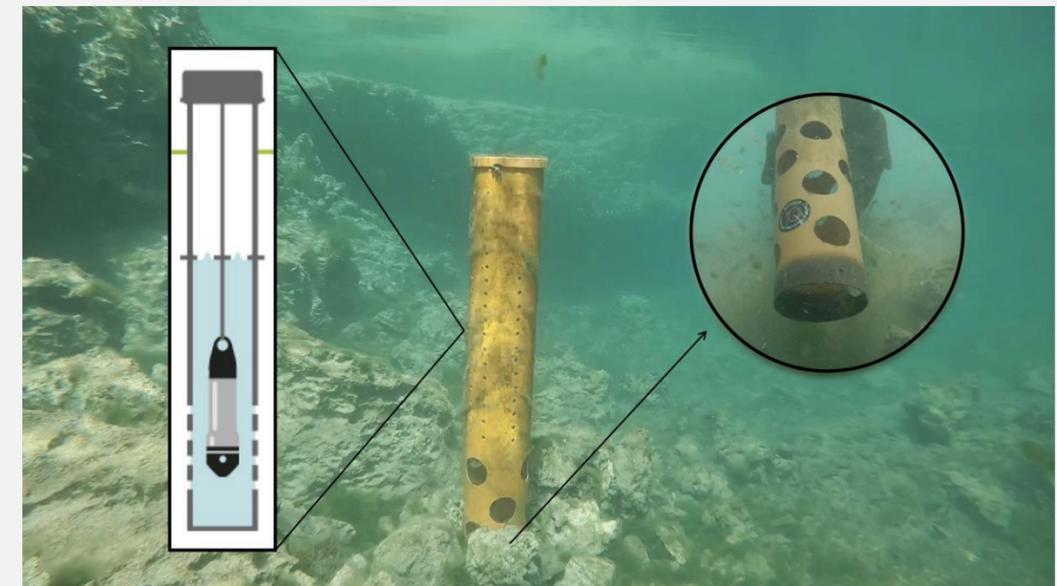
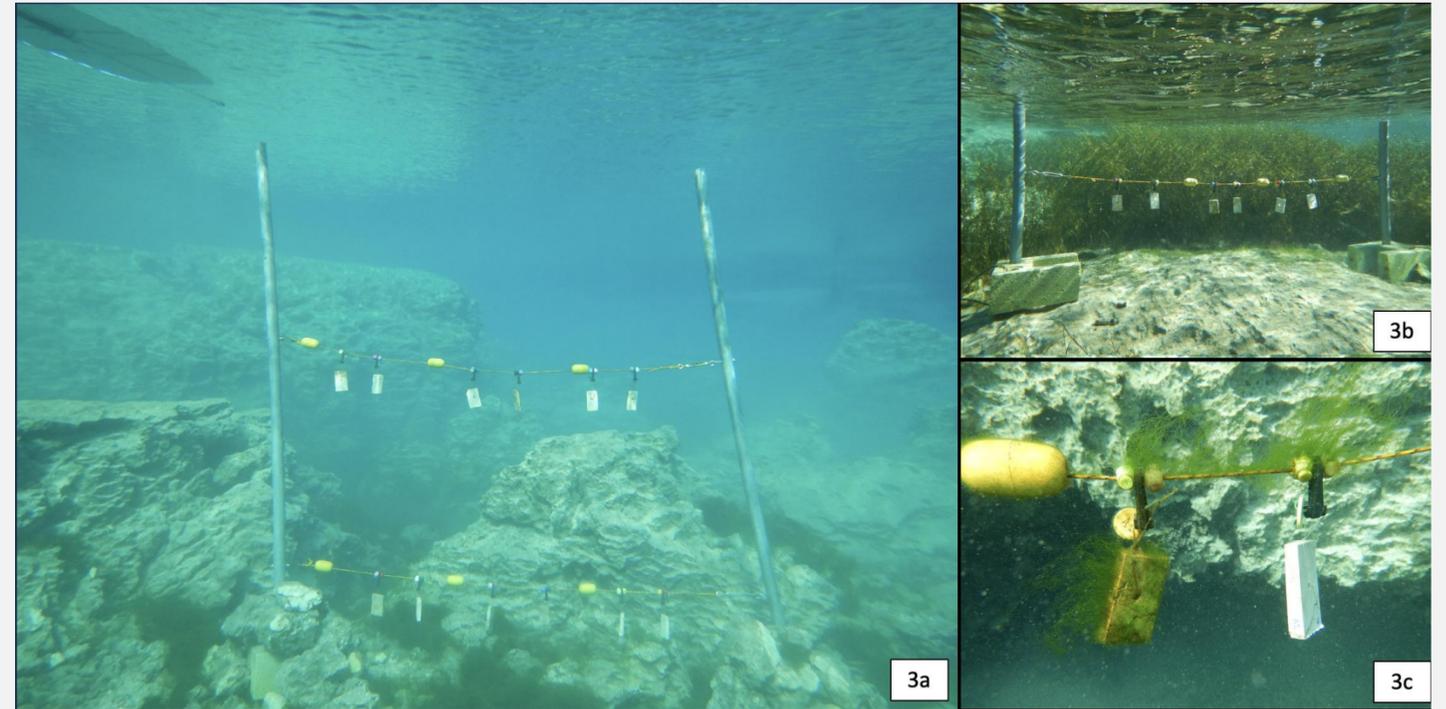


Limestone anastomosis





ΑΠΟΓΟΝ





Thank you for the attention