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COMMENT ON THE ARTICLE "ENGINEERING-GEOLOGICAL INSIGHTS INTO THE GYPSUM-BEARING DEPOSITS OF PUNTA DELLE PIETRE NERE (PUGLIA REGION, ITALY)"

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EXTENDED ABSTRACT

Nel recente lavoro di Calcaterra *et alii* (2024), vengono presentati i risultati di indagini condotte nell'area di Punta delle Pietre Nere, finalizzate a comprendere meglio la geometria dei limiti sepolti dei depositi gessosi, la profondità di questi ultimi, le caratteristiche geologiche dei terreni di copertura e le condizioni di flusso delle acque sotterranee. A tale proposito, si sottolinea il ben noto verificarsi di sinkholes nel villaggio di Lesina Marina e nei suoi dintorni. Secondo gli Autori, nella zona a sud di Lesina Marina, i risultati riportati consentono di delineare una limitata distribuzione dei gessi nel sottosuolo, con caratteristiche non confrontabili con l'area di Lesina Marina. Gli stessi Autori, quindi, concludono che "la maggiore conoscenza acquisita sulla distribuzione dei gessi nel sottosuolo di quest'area presenta un ulteriore valore positivo se si considera che, in passato, l'incertezza dei dati costituiva un fattore fortemente limitante per le possibilità di sviluppo insediativo locale".

Sulla base di dati di letteratura sia dell'area di studio che di contesti geologici simili, e alla luce degli stessi risultati riportati in Calcaterra *et alii* (2024), in questo comment article riportiamo alcune criticità che rendono questionabili le loro conclusioni e suggeriscono una maggiore cautela con particolare riferimento alle speculazioni finali.

ABSTRACT

The present comment article discusses the recent paper by Calcaterra *et alii* (2024), in which they present the results of site-specific investigations in the Punta delle Pietre Nere area, enabling to better understand the buried limits of the chalky deposits, their depth, the geological characteristics of the covering soils and the groundwater flow conditions. According to these Authors, the distribution of gypsum-bearing deposits in the subsoil of the area is now better defined than in the past, when the uncertainty of the data represented a factor strongly limiting the local possibilities of settlements' development. The present comment highlights as, unfortunately, the paper by Calcaterra *et alii* (2024) does not at all reduce the uncertainties of the literature data, many of which neglected and not discussed by these Authors.

COMMENT

Dominant gypsum rocks, derived from a Triassic anhydrite protolith, crop out along the up to 7 m high slopes of the artificial Acquarotta canal, over a length of about 1.5 km; fragments of these gypsum rocks can be found at the surface of the plain on the side of the canal, in an area of limited size of about 1 km^2, i.e., the so-called Punta delle Pietre Nere area. Due to the unusual presence of this gypsum rock mass, and related high number of cover collapses and suffosion sinkholes (*sensu* Gutierrez *et alii*, 2014) formed in the gypsum karst, that threaten the village of Lesina Marina, the Punta delle Pietre Nere area was object of several geological and engineering-geological studies. Among these studies, the recent paper by Calcaterra *et alii* (2024) is welcome since new interesting data on the subsurface knowledge of this area have been added. However, this paper presents some problems of carelessness in the "Geological and hydrogeological setting of the study area", in the "Data and Methods" and in the "Results" sections, which should be closely linked to each other for a desirable comprehensive discussion among literature and new data. But such a discussion is missing in Calcaterra *et alii* (2024).

In the "Geological and hydrogeological setting of the study area" section, Calcaterra *et alii* (2024) cited several direct and indirect surveys included in unpublished reports of housing development plan of the Punta delle Pietre Nere study area. Nothing against these works, although not evaluated by an editorial board of a scientific journal. But the problem is that Calcaterra*et alii* (2024) neglected scientific publications dealing precisely with the geological setting and, even worse, with the direct and indirect surveys carried out in the study area (*i.e.*, Cotecchia & Canitano, 1954; Carella, 1963; Amendolagine *et alii*, 1964; Longhitano *et alii*, 2016; Festa *et alii*, 2016, 2019). It should be noted that the geological map of the Punta delle Pietre Nere area by Carella (1963) represents a valuable document on the areal distribution of the gypsum rock mass, and related included fragments of limestones and mafic and ultramafic rocks, before the extensive land use of that area, which may have hidden some geological information. Moreover, considering the papers by Amendolagine *et alii* (1964) and Festa *et alii* (2016, 2019) would have fix the minero-petrographic setting of the gypsum rock mass. Again, Calcaterra *et alii* (2024) referred to speculative hypotheses advanced in the literature for the upward rising of this mass, neglecting the only publication, *i.e.*, Festa *et alii* (2019), that tried to demonstrate its diapirism, the latter firstly supposed by Cotecchia & Canitano (1954). Finally, Calcaterra *et alii* (2024) lost the opportunity to consider the detailed stratigraphy of the late Quaternary deposits overlying the gypsum rock mass, accurately reconstructed for about forty meters in thickness by Longhitano *et alii* (2016).

In the "Data and Method" section, Calcaterra *et alii* (2024) collected and analyzed the existing studies and technical reports on the study area. Far from being complete (see previous discussion on the "Geological and hydrogeological setting of the study area" section), the results of this analysis, summarized in figure 3, are highly inconsistent. Stratigraphic log results are not coherent with seismic surveys and HVSR ones. Near the multi-parameter survey S1, for example, the pre-existing investigation statigraphic log indicates "Absence of Gypsum" (grey exagon), the HVSR "Presence of Gypsum" (red circle) and the Seismic survey "Presence of Gypsum" (red lines). Since the probable source of this information, cited in Calcaterra *et alii* (2024), is not public available and its content not commented in the paper, the results shown in figure 3 leave a shade of doubt on the reliability of the data analyzed for supporting the subsequent "Result section".

The most relevant comment in the "Results" section concerns the Electrical Resistivity Tomography (ERT). In this respect, original data were presented by Calcaterra *et alii* (2024), with investigation of a soil thickness up to about 80 m from the ground surface. More in detail, a west-east striking ERT profile is shown, parallel to and just 0.6 km south of an ERT profile (AA') by Festa *et alii* (2016). According to Calcaterra *et alii* (2024), the ERT identifies a mass characterized by high resistivity values in the western sector (between 30 and 60 m b.g.l.) of the ERT model, hosted in a background having lower resistivity values. Therefore, these Authors cryptically concluded that the chalky deposits represent only masses embedded in soils, the latter probably represented by silty-clayey materials. This interpretation does not consider: *i*) the several question marks present, and not discussed, in the image of the resistivity model (figure 5); *ii*) the extreme variability of the resistivity values of the gypsum rocks. As regards the areas of the resistivity model with question marks, it should be underlined that these represent significant portions (shallow and deep) of the model and therefore weaken the ERT interpretation as reported in figure 3. For what concerns the resistivity values, the authors do not consider the dependence of the resistivity by several factors (Schön, 2004). In particular, a wide range of resistivity values have been observed for gypsum rocks, both in field and laboratory experiment (*e.g.*, Guinea *et alii*, 2010). Accordingly, in the Lesina Marina area, a very wide resistivity range (from 20 Ω·m to values greater than 300 Ω·m), is found in correspondence of the gypsum rock well constrained by co-located stratigraphic logs (Festa *et alii*, 2016). Furthermore, Festa *et alii* (2016) show that the variability of the electrical response, depends on grainsize of the crystals, anhydrite content, lithologic variation (*e.g.* the gypsum mass can be locally characterized by clay-rich and sandy lithotypes), secondary porosity and water content and salinity. Moreover, they found comparable resistivity values between wet gypsum rocks and Quaternary dry sandy and silty cover deposits.

Still in the "Results" section, original data regarding the processing of both ENVISAT and COSMO-SkyMed SAR images, for the periods 2002-2010 and 2015-2018, respectively, are shown in Calcaterra *et alii* (2024). As estimated by the maps of the average displacement rates, the interferograms obtained for ascending and descending images allowed these Authors to calculate greater uplift rates, up to 7.0 mm/yr, in the neighboring of the Acquarotta canal and down to -3.0 mm/yr, moving away toward the west. In this respect, Refice *et alii* (2016) concluded that their results, after the processing of both ERS and ENVISAT SAR images and the support of petrographic observations, may be related to hydration of the residual anhydrite in the gypsum rock mass, as reported in the "Geological and hydrogeological setting of the study area" section. The uplift rates shown in these two papers, obtained right in the same area of Lesina Marina village, seem quite similar, although this comparison is not discussed at all in Calcaterra *et alii* (2024).

Finally, the lack of an accurate comparative analysis, among the new data and those available in the literature, automatically favors the increase in the degree of speculation of some of the conclusions reached by Calcaterra *et alii* (2024).

REFERENCES

Amendolagine M., Dell'anna L. & Ventriglia U. (1964) - *Le rocce ignee alla Punta delle Pietre Nere presso Lesina (provincia Foggia)*. Per. Mineral., **33**: 337–395.

Calcaterra D., Corniello A., Di Martire D., Forte G., Stevenazzi S. & Tufano R. (2024) - *Engineering-geological insights into the gypsum-bearing deposits of Punta delle Pietre Nere (Puglia Region, Italy)*. Ital. J. Eng. Geol. Env., Special issue **1**: 39-45. Doi: 10.4408/IJEGE.2024-01.S-05

Carella R. (1963) - *Eruttivi di S. Giovanni in Pane e della Punta delle Pietre Nere (Gargano)*. Boll. Soc. Geol. Ital., **82**: 97-109.

Cotecchia V. & Canitano A. (1954) - *Sull'affioramento delle Pietre Nere al Lago di Lesina*. Boll. Soc. Geol. Ital., **73**: 1-16.

Festa V., Tripaldi S., Siniscalchi A., Acquafredda P., Fiore A., Mele D. & Romano G. (2016) - *Geoelectrical resistivity variations and lithological composition in coastal gypsum rocks: a case study from the Lesina Marina area (Apulia, southern Italy).* Eng. Geol., **202**: 163-175. Doi: 10.1016/j.enggeo.2015.12.026

Festa V., Fregola R.A., Acquafredda P., De Giosa F., Monno A. & Ventruti G. (2019) - *The enigmatic ascent of Ca-sulphate rocks from a deep dense source layer: evidence of hydration diapirism in teh Lesina Marina area (Apulia, southern Italy)*. Int. J. Earth Sci., **108**: 1897-1912. Doi: 10.1007/s00531-019-01739-1

Guinea A., Playà E., Rivero L., Himi M. & Bosch R. (2010) - *Geoelectrical classification of gypsum rocks*. Surv. Geophys., 31: 557-580.

Gutierrez F., Parise M., De Waele J. & Jourde H. (2014) - *A review on natural and human-induced geohazards and impacts in karst*. Earth Science Reviews, **138**: 61-88. Doi: 10.1016/j.earscirev.2014.08.002

Longhitano S.G., Della Luna R., Milone Alessia L., Cilumbriello A., Caffau M. & Spilotro G. (2016) - *The 20,000-years-long sedimentary record of the Lesina coastal system (southern Italy): From alluvial, to tidal, to wave process regime change*. Holocene, **26**: 678-698. Doi: 10.1177/0959683615618256

Refice A., Pasquariello G., Bovenga F., Festa V., Acquafredda P. & Spilotro G. (2016) - *Investigating uplift in Lesina Marina (Southern Italy) with the aid of persistent scatterer SAR interferometry and in situ measurements.* Environ. Earth Sci., **75**: 243-256;. Doi: 10.1007/s12665-015-4979-1

Schön J.H. (2004) - *Physical properties of rocks: fundamentals and principles of petrophysics.* 1st ed. Pergamon, Amsterdam, The Netherlands: 600 pp.

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