

# New data on geological investigations at Einstein Telescope site of Sardinia (Italy)

Dr. DORE, Elisabetta<sup>1</sup>; Dr. BUTTAU, Cristina<sup>1</sup>, Dr. CALIA, Fabio<sup>1</sup>; Prof. DA PELO, Stefania<sup>1</sup>; Dr. COCCO, Fabrizio<sup>1</sup>, Dr. BIDDAU, Riccardo<sup>1</sup>; Dr. DESSÌ, Francesco<sup>1</sup>; Prof. FERRERO, Silvio<sup>1</sup>; Prof.FUNEDDA, Antonio<sup>1</sup>; Prof. MELIS, Maria Teresa<sup>1</sup>; Dr. PANI, Miriana<sup>1</sup>; Dr. ROSSIGNOL, Camille

1. Dipartimento di Scienze Chimiche e Geologiche-Universita' degli Studi di Cagliari Cittadella Universitaria Blocco A-Monserrato (Italy)

## ABSTRACT

In the framework of the SAR-GRAV and FdS-2021 projects, new investigations in the area (Fig.1) comprised within the potential vertexes (Bitti-Lula-Mamone) limiting the ET triangle have been performed with the aim to assess the geological, structural and neotectonic, and hydrogeological conditions. For this purpose, we adopted a multidisciplinary approach involving detailed structural, geological and petrological investigations, and groundwater sampling and analysis (both water chemistry and stable isotopes  $\delta D^{,} \delta^{17}O$  and  $\delta^{18}O$ ) (Fig.2).



## Geological setting

The geological setting is characterized by metamorphic and magmatic rocks belonging to the Variscan basement. The metamorphic rocks mainly consist of mica-schists, paragneisses and orthogneisses; the magmatic rocks, belonging to the Variscan batholith, are mainly granites and granodiorites<sup>,</sup> and related dyke complex (Carmignani et al., 2016) (Fig.3-4).

Make a comparison with the available published maps<sup>,</sup> new field data show a more complex geological setting of the study area, characterized by a higher variability of the outcropping lithologies and structures. In particular, a 500 m<sup>2</sup> granite intrusion has been detected far from and apparently not in continuity with the other mapped intrusions. Moreover, near to the granite intrusion occur several NE-SW striking aplitic dykes, variable in thickness from a few to tens of meters, never mapped until now NW-SE striking mafic dyke are also present in the area (Fig.6-7). The main structural features are the SE-dipping schistosity affecting the metamorphic rocks, and strike-slip faults with a predominantly NE-SW orientation, often paired with dykes.



![](_page_0_Figure_11.jpeg)

![](_page_0_Figure_12.jpeg)

![](_page_0_Picture_13.jpeg)

#### Fig. 1-The study area (Google Earth)

- Preliminary petrological data (Fig.5) confirm previous works, and will be supported
- by new P-T-t estimates in the near future. Geological structures strongly control geometry of aquifers and groundwater potential in the area.

Fig.3 a)Tectono-metamorphic zonation in Sardinia. b) Tectonic sketch map of Variscan basement in Sardinia (modifed after Oggiano et al. 2010); c) Schematic geological cross-section (modifed after Cocco et al. 2018) of the Variscan basement (not to scale) Cocco et al. 2022

90

![](_page_0_Picture_18.jpeg)

## (Fig.5)

0 ET03

## Preliminary results from petrological investigation of the area

The petrological study of the lithologies cropping out in the area has started with the characterization of the micaschists. These micaschists are characterized by the presence of subhedral to euhedral garnet porphyroblasts with very variable size, from 1 to 5 mm and pre- to synkinematic in nature with respect to the main schistosity D2 (see also Cruciani et al., 2022), materialized by oriented flakes of white mica. The garnet crystals display a variable degree of resorption, in

some cases almost complete, with overgrowth of biotite, quartz and locally also chlorite, both in cracks in the ganet and along the borders.

Preliminary EMP results on the micaschists reveal that, in

![](_page_0_Picture_24.jpeg)

the investigated samples, the garnet is an almandine rich solid solution with a clear zoning. In particular, the larger porphyroblasts display a variable content in spessartine (Mn-rich end-member) and grossular (Ca end-member), higher in the center with respect to the mantle and the rim. Both almandine (Fe-rich end-member) and pyrope (Mg-rich end-member) show opposite distribution. These features are interpreted as resulting from garnet growth along a prograde P-T path and are similar to those reported by Cruciani et al. (2022) in the mylonitic schists of the Posada-Asinara Shear Zone.

![](_page_0_Picture_26.jpeg)

![](_page_0_Figure_27.jpeg)

Sample ET3B: micaschists near Mamone

![](_page_0_Figure_29.jpeg)

Pyrope

Fig. 4 Geological map and perimeter of ET telescope

![](_page_0_Picture_31.jpeg)

Fig. 6 Structural and hydrogeological survey crew. (Winter, 2024)

![](_page_0_Picture_33.jpeg)

Fig. 7 Aerial photos are used in the preliminary interpretation of the geological contact and fracture network to achieve the interconnection and fracture density map. Lineament interpretation is done at different scales (M. Pani 2024)

## Hydrogeochimical data

Twenty-four springs were sampled in in the area comprised within the potential vertexes limiting the ET triangle. Isotopic composition, indicates a meteoric origin of water (close to the SIMWL, Giustini et al., 2016 http://dx.doi.org/10.1016/j.ejrh.2016.04.001).

Chemistry of groundwater varied from CI-Na to Ca-Mg-HCO3 compositions (from granites to quarzodiorites and gabbres).

Relevant metal concentrations (Fe up to 177 µg/l; Mn up to 57 µg/l; Al up to 32 µg/l), have been found higher than the regional median concentrations calculated in Sardinian groundwaters. Further investigation would be recommended in order to evaluate the groundwater baseline conditions in the area.

![](_page_0_Figure_39.jpeg)

![](_page_0_Picture_40.jpeg)

Fig. 8 Detail of interpretation of lineaments by satellite immage (Mamone Zone). Main lineaments in yellow and minor lineaments in red

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