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An Integrated Approach to Territorial Data Analysis at the Einstein Telescope Site in Sardinia, Italy

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ET Sardinia site



Area surrounding the Sos Enattos mine, located in northeastern Sardinia, within the province of Nuoro



Minimal anthropogenic and industrial activity, ensuring a preserved natural environment



Rugged terrain with unique and distinctive geological formations



Rock formations, such as orthogneiss and granitoids, exhibiting excellent geomechanical properties



High geodynamic stability Corsica-Sardinia microplate, known for its : absence of active faults very low crustal deformation extremely low rate of seismic activity in historic records





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ET Sardinia site



Assess site suitability for underground installation through comprehensive analysis



Conduct extensive geodetic and geophysical surveys across a large area



Establish a dedicated geographical database for data collection and analysis



Enhance the analysis of surface and subsurface characteristics by utilizing territorial data and integrating 3D digital models to facilitate advanced design stages and inform decision-making processes







Connect across a comprehensive web GIS



Accommodate organization's needs with dynamic mapping



Sharing GIS work with specific groups



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Ministero dell'Università e della Ricerca





3G4ET_GIS V.1 Open-Source sharing Platform - QGIS

NJXTGIS

- Integration of digital maps and data gathered from surveys and site investigations to create a comprehensive, georeferenced database offering a synoptic view of available information
- Facilitates efficient sharing, visualization, and querying of raster and vector datasets (excluding editing capabilities)
- Advanced tools are necessary for effective data management within collaborative environments



Public link: <u>https://et-webgis.nextgis.com/resource/276/display?panel=layers</u>













3G4ET_GIS V.2 - Advanced sharing Platform - ARCGIS





- Enhanced and well-informed decision-making processes
- Improved performance and efficiency
- Strengthened security measures
- Simplified multi-user collaboration
- Seamless integration with other GIS/WebGIS tools













GIS - BIM Integration

GIS-BIM EX Rimisa and Rampa Tupeddu



BIM Preliminary vertex layout detector







Detailed building information



Connection between structures to their geographic context



Lifecycle management support



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3D - Geological model – V.1.0

 \Rightarrow Based on available geological and geophysical data \Rightarrow Main subsurface geological trends and associated rock volumes



Mixed grained Leucogranite (Permian)

MS0 - Oligoclase and gametmicaschist and paragneiss (pre-Cambrian/early Ordovician)

Onani-Bitti granodiorite (Permian)

OGA - Augengneiss (middle Ordovician)

MSS - Staurolite and gamet paragneiss and micaschist (pre-Cambrian/early Ordovician)

MAM - Mamone granodiorite orthogneiss (pre-Cambrian7early Ordovician)

MSA - Abite and gamet micaschist and paragneiss (pre-Cambrian/aerly Ordovician)

OGG - Fine grained orthogneiss with mica (middle Ordovician)



A second version is set to be finalized by the end of 2025, incorporating an expanded dataset derived from gravimetry surveys, a detailed morphostructural map generated from LIDAR surveys, and an interpretation of drilling borehole stratigraphy













DTM – Airborne Lidar Survey





25 Ground Control Points - GNSS



Index	[m]
Minimum	-0,0550
Maxmum	0,0850
Mean	0,0135
Median	0,0190
SD	0,0413

Distribution of elevation differences



Elevation difference (m)



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DTM – SoS Enattos areas

















DTM – MORPHOMETRIC ANALYS

Slope distribution

Classes (°)

Aspect distribution

Mean Curvature distribution

Classes

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Aerophotogrammetric survey

- Geometrically corrected images, enabling precise distance and area measurements
- Enables comparison over time when combined with historical orthophotos
- Aids in infrastrutture design, environmental impact assessment, and urban planning

Photogrammetric Acquisition		
Ground pixel resolution	9 to 15 cm	
ateral overlap between frames	45%	
∟ongitudinal overlap	60%	

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Aerogravimetric survey

- Conducted within the framework of the PRIN
 2022 project in collaboration with INGV
- Contribution to:
 - Improve the local geoid model
 - Obtain a precise mapping of underground features

Example of absolute gravimeter

GNSS - Ground Control Points

Survey grid: flight lines and coverage area

Conclusions and future developments

- A comprehensive cartographic and territorial database, developed under the ETIC project, forms the basis for evaluating territorial risks and generating morphometric maps to identify tectonic structures, landslide-prone areas, and hydrographic networks
- The dataset enhances the assessment of meteorological and climatic parameters, offering improved hazard condition evaluations through comparisons with historical data
- Continuously refined and updated with site-specific imagery and data from ongoing studies and future surveying, the platform remains adaptive, leveraging multidisciplinary data and advanced modeling techniques
- It provides a scalable framework for supporting the Einstein Telescope site feasibility in Sardinia and serving as a model for **environmental impact assessments**

