Title: High-resolution Gravity model of Pantelleria island

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Proposal

Nowadays there are global efforts and urging needs of fossil fuel use reduction; Although the Italian peninsula has a large potential for the development of geothermal energy, this renewable resource is still largely underexploited. Geosciences can help to identify and design systems to use renewable energy sources in a nature-sensitive manner.

In this context, Pantelleria island (Sicily) represents an interesting target since there are clear evidences of an high potential geothermal site, such as high temperature gradients (>150°C/km), hot fluids and intense CO_2 discharge at the surface, and active resurgent volcanism. Pantelleria, located in the central portion of the Sicily Channel Rift Zone, is a volcanic field built by the superposition of typical volcanic products related to continental rifts settled on a basement of thinned continental crust (20 km) belonging to the northernmost part of the African plate. Each project for geothermal energy exploitation need the development of a preliminary assessment aimed at identifying the geothermal resource, in terms of surface extent, volume, rock and fluid properties.

Aim of this project is to contribute to the characterization of Pantelleria geothermal reservoir and to the assessment of its geothermal potential. This objective will be achieved through gravimetric investigations aimed at developing a high-resolution model of the island.

Research Program

At least 250 points of measurement will be critically revisited from previous land and marine gravity surveys dating back 70's and 80's and new ones will be collected in the framework of the Project " PANTelleria islAnd geotheRmal ExploratIon"- Progetto INGV Pianeta Dinamico", currently funded, to achieve a mean density of 3 sites/km^2 and a reconstructed field resolution adequate to model the island structure. A more detailed investigation, with a greater density of measuring points, will be carried out in areas of greater volcano-tectonic interest, namely: 1) in the central sector separating the two blocks deduced from previous studies, in order to better delineate the course of the main tectonic structures dislocating the two blocks; 2) in the fractured area around the raised block of Montagna Grande, where previous geochemical studies have indicated a preferential path for rising fluids. A more detailed gravimetric survey in this latter area could turn extremely useful for studies aimed at identifying the areas with the greatest geothermal potential and in identifying the most productive areas where to drill geothermal wells.

Several techniques of processing and modelling of gravity data will be used to produce maps of gravity anomalies and enhance the information they contain. For instance the "Edge analysis" to identify both stratigraphic and structural boundaries for a fast, preliminary interpretation. The characterization of the main sources of gravity anomaly will be carried out by means of techniques of 3D imaging based on a multiscale analysis of the potential fields that already provided encouraging results in studies of volcanic areas at various scales. Finally, models of the density distribution in the subsurface will be obtained through the constrained 3D inversion of gravimetric anomalies. The constraints to the inversion will also be derived from the modelling of other geophysical data (e.g., MT) acquired in the frame of the "PANTelleria islAnd geotheRmal ExploratIon" project.

Time table

1st Year: Survey of literature data (dealing mainly with techniques of processing and modelling of potential field data, geophysical, geological and geochemical data of Pantelleria); acquisition of gravity data. Attending PhD Courses mainly focused on data analysis, techniques of processing and modelling of potential field data;

2nd Year: 2-6 months abroad internship aimed at studying advanced techniques of modelling of potential field data in volcanic areas; data processing and analysis: critical review and assimilation of data from previous land and marine gravity surveys along with the new collected ones; implementation of forward and inverse models. Presentation of research results at international conferences and in peer-reviewed articles.

3rd Year: Development of the high-resolution gravity model of the island and of its geothermal reservoir. Presentation of results at international conferences and in peer-reviewed articles. Writing of PhD thesis.

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