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STRUCTURE AND PHYSICAL PROPERTIES OF THE TECTOSPHERE IN THE METASTABLE EUROPE

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INTRODUCTION

The Earth's structure and the geodynamic processes that originate it are strictly interconnected: an accurate knowledge of the Earth's structure and its physical properties is fundamental for the understanding of the dynamics of our planet and critical for realistic simulations of seismic ground motion. On the other side the separation and the definition of the different dynamic processes acting in a certain area help to better understand the structure and the physical properties of the investigated region. In recent years much emphasis has been given to the inversion of observed phase and waveform data for the best fitting set of model parameters at a variety of scale-lengths.

RESULTS

The first step to better understand and define the structural model and the physical properties of the tectosphere in Europe has been the compilation a 3-D regionalized digital model of the European Crust and mantle velocity down to depths of approximately 400 km [1]. This data set is intended to be used as a reference for seismological studies and also as a constraint to study the physical properties of the Earth. The model represents the European area from 25° W to 35° E, and from 30° N to 70° N. It is entirely based upon the existing geological and geophysical literature and it incorporates topographic and bathymetric features. The resulting model (denominated I-data set) is defined by 6400 vertical structures at nodes with an average separation of about 100 km. The I-data set has been compared quantitatively with some of the recent models obtained from body and surface wave tomography and it is found that the S-wave velocity in the I-data set and in the EUR-S91 differs by no more than about 4% in most of the area. In addition to some purely theoretical developments [2], we started to validate the I-data set by means of a 3-D gravity model using a three dimensional interactive modelling in which the effect on gravity, of homogeneous polyhedra, is calculated by transforming a volume integral into a sum of line integrals. Because of the limits of the 3-D gravity program the investigation has been performed using windows having dimensions compatible with the complexity of the structural model. The modelled gravity field has been directly compared with the Bouguer anomaly where possible. In the region in which observed gravity anomaly is not available we reduce the calculated gravity anomaly to geoid undulations and then we compare these undulations with the corresponding undulations of the geoid model OSU91. The model has been validated in the area of the Tyrrhenian Sea and the surrounding region by comparison between observed and calculated gravity anomalies: the comparison shows a pretty good agreement in values and trend. For the Scandinavian region, since Bouguer anomaly data were not available, validation has been performed using geoid undulations. Preliminary results show that there is quite a good agreement between the undulation from calculated gravity field and the undulation from the OSU91 model for profiles between 65° N and 55° N. When studying the Earth's structure by geophysical methods, gravimetry is usually considered an auxiliary method, which supports the results of seismic observations or helps to validate structural [4]. However the gravity field can be a good indicator of the degree and the way in which superficial topographic features are compensated at depth and can be very useful to sort out the contribution of different dynamic processes [3, 6, 7]. Using the technique elaborated by Dorman and Lewis in 1970, assuming that a linear relationship can be defined between gravity and topography it is possible to calculate the portion of the gravity field related with the topography that represents the field of the isostatic correction and the portion of the Bouguer gravity anomaly that is associated to processes different from the isostatic compensation. This information identifies two different contributions in the gravity anomaly field. Using this technique it has been possible to estimate the Moho undulations caused by an isostatic process by inverting the field of the isostatic correction [8]. Particular attention has been paid to the Italian peninsula, which is characterised by a very complex mantle-crust system and Plio-Quaternary magmatism. This region is a very suitable test area where to combine petrological and geochemical studies of magmas with geophysical data and to define an integrated model for the structure and composition of the crust-mantle system. The origin and the evolution of the principal geodynamic processes acting in this area are not completely understood, even if the region has been investigated by many geophysical and geological surveys and many geological and geophysical model are available. Therefore this relatively small region is very interesting from a geodynamical, petrological and geochemical point of view. In this project petrological, geochemical data on mafic volcanics, and geophysical data along peninsular Italy and the southern Tyrrhenian Sea have been studied to build up an integrated model of the tectosphere under the Italian peninsula and the surrounding areas [5].

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