Geophysical Research Abstracts
Vol. 16, EGU2014-2329, 2014
EGU General Assembly 2014

3D interactive forward and inversion gravity modelling at different scales: From subduction zone modelling to cavity detection.

Hans-Jürgen Götze (1) and Sabine Schmidt (2)

(1) Christian-Albrechts-Universität zu Kiel, Institut für Geowissenschaften, Abt. Geophysik, Geophysik, Kiel, Germany (hajo@geophysik.uni-kiel.de, +49 431 880-3805), (2) Christian-Albrechts-Universität zu Kiel, Institut für Geowissenschaften, Geophysik, Kiel, Germany (sabine@geophysik.uni-kiel.de, +49 431 880-4562)

Modern geophysical interpretation requires an interdisciplinary approach, particularly when considering the available amount of 'state of the art' information. A combination of different geophysical surveys employing seismic, gravity and EM, together with geological and petrological studies, can provide new insights into the structures and tectonic evolution of the lithosphere, natural deposits and underground cavities. Interdisciplinary interpretation is essential for any numerical modelling of these structures and the processes acting on them
Interactive gravity and magnetic modeling can play an important role in the depth imaging workflow of complex projects. The integration of the workflow and the tools is important to meet the needs of today's more interactive and interpretative depth imaging workflows. For the integration of gravity and magnetic models the software IGMAS+ can play an important role in this workflow. For simplicity the focus is on gravity modeling, but all methods can be applied to the modeling of magnetic data as well. Currently there are three common ways to define a 3D gravity model. Grid based models: Grids define the different geological units. The densities of the geological units are constant. Additional grids can be introduced to subdivide the geological units, making it possible to represent density depth relations. Polyhedral models: The interfaces between different geological units are defined by polyhedral, typically triangles. Voxel models: Each voxel in a regular cube has a density assigned. Spherical Earth modeling: Geophysical investigations may cover huge areas of several thousand square kilometers. The depression of the earth's surface due to the curvature of the Earth is 3 km at a distance of 200 km and 20 km at a distance of 500 km. Interactive inversion: Inversion is typically done in batch where constraints are defined beforehand and then after a few minutes or hours a model fitting the data and constraints is generated.
As examples I show results from the Central Andes and the North Sea. Both gravity and geoid of the two areas were investigated with regard to their isostatic state, the crustal density structure and rigidity of the Lithosphere. Modern satellite measurements of the recent ESA campaigns are compared to ground observations in the region. Estimates of stress and GPE (gravitational potential energy) at the western South American margin have been derived from an existing 3D density model. Here, sensitivity studies of gravity and gravity gradients indicate that short wavelength lithospheric structures are more pronounced in the gravity gradient tensor than in the gravity field. A medium size example of the North Sea underground demonstrates how interdisciplinary data sets can support aero gravity investigations. At the micro scale an example from the detection of a crypt (Alversdorf, Northern Germany) is shown.