Crustal thickness estimation from GOCE satellite mission gravity data

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The boundary between Earth crust and mantle, the so called Moho, is commonly estimated by means of seismic or gravimetric methods. The former methods can be locally very accurate since seismic profiles give an almost direct observation of the actual crustal structure, but can be quite far from reality in large regions where no data are available. The latter methods, although often based on simplified hypotheses to guarantee the uniqueness of the solution, are nowadays becoming more and more important thanks to the improved knowledge of the gravitational field. In particular satellite gravity missions, like the European Space Agency mission GOCE (Gravity field and steady-state Ocean Circulation Explorer) [1], provide a very accurate and spatially homogeneous dataset that can be used to validate the existing global crustal models or to estimate a new one by constraining the relation between Moho depth and crustal density.

In this work a new crustal model (GEMMA model) with a spatial resolution of 0.5°x0.5° and constrained with GOCE observations is computed. For this purpose several additional external information has been used, such as topography, bathymetry and ice sheet models from SRTM, a recent 1°x1° sediment global model and some prior hypotheses on crustal density. In particular the main geological provinces, each of them characterized by its own relation between density and depth, have been considered. A model describing lateral density variations of the upper mantle is also taken into account. Starting from this prior information, an inversion algorithm is applied to the GOCE space-wise grid of second radial derivatives of the gravitational potential [2] to estimate the bottom of the crust. The computed Moho global model is well consistent not only with other global/regional models, but also with the actual gravity field, thus overcoming the main limitation of seismic Moho models (e.g. CRUST2.0).

[1] Drinkwater *et al*. (2007) ESA Special Publication, **627**, 1-8
[2] Reguzzoni & Tselfes (2009). J Geod, **83**, 13-29.

Stable Isotope Tracing of Manufactured Nanoparticles

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Studies of biological uptake and environmental fate of manufactured nanoparticles (NPs) are often hampered by the difficulty of distinguishing these materials from the normal background levels of elements and natural NPs in environmental samples. Needed are methods for tracking engineered NPs in bulk samples from exposures that are carried out at realistic particle concentrations rather than the much higher levels that are often dictated by the lack of suitable analytical protocols. For metal and metal oxide NPs, this can be achieved by stable isotope tracing, employing NPs that are prepared from a single isotope of the target element.

We are currently investigating stable isotope labeling and tracing for ZnO, CeO_2 and Ag NPs, all materials that have a wide range of applications in industrial and consumer products. Using suitable isotopes and NP preparation methods, stable isotope labeling is cost-effective for these elements. When combined with high precision mass spectrometry for detection, the methodology provides unprecedented sensitivity for NP tracking. For example, biological uptake of ZnO NPs can be detected even at Zn background levels, which exceed the NP concentrations by more than a factor of 10,000.

The application of such methods enables accurate tracing of NP fate and transfer in a wide range of exposure systems and biota. Importantly, the results are able to directly address the key question of whether organisms take up nanoparticles directly or whether the elements are taken up only after particle dissolution.

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