Geophysical Research Abstracts
Vol. 16, EGU2014-9080, 2014
EGU General Assembly 2014

Calculation and Analysis of magnetic gradient tensor components of global magnetic models

Markus Schiffler (1,2), Matthias Queitsch (1,2), Michael Schneider (2,3), Ronny Stolz (2), Wolfram Krech (2), Hans-Georg Meyer (2), and Nina Kukowski (1)

(1) Institute of Geosciences, Friedrich-Schiller-University Jena, Jena, Germany (markus.schiffler@uni-jena.de), (2) Leibniz Institute of Photonic Technology Jena, Dept. of Photonic Detection, Jena, Germany, (3) Institute of Biomedical Engineering and Informatics, Ilmenau University of Technology, Ilmenau, Germany

Magnetic mapping missions like SWARM and its predecessors, e.g. the CHAMP and MAGSAT programs, offer high resolution Earth's magnetic field data. These datasets are usually combined with magnetic observatory and survey data, and subject to harmonic analysis. The derived spherical harmonic coefficients enable magnetic field modelling using a potential series expansion.

Recently, new instruments like the JeSSY STAR Full Tensor Magnetic Gradiometry system equipped with very high sensitive sensors can directly measure the magnetic field gradient tensor components. The full understanding of the quality of the measured data requires the extension of magnetic field models to gradient tensor components.

In this study, we focus on the extension of the derivation of the magnetic field out of the potential series magnetic field gradient tensor components and apply the new theoretical framework to the International Geomagnetic Reference Field (IGRF) and the High Definition Magnetic Model (HDGM). The gradient tensor component maps for entire Earth's surface produced for the IGRF show low values and smooth variations reflecting the core and mantle contributions whereas those for the HDGM gives a novel tool to unravel crustal structure and deep-situated ore bodies. For example, the Thor Suture and the Sorgenfrei-Thornquist Zone in Europe are delineated by a strong northward gradient.

Derived from Eigenvalue decomposition of the magnetic gradient tensor, the scaled magnetic moment, normalized source strength (NSS) and the bearing of the lithospheric sources are presented. The NSS serves as a tool for estimating the lithosphere-asthenosphere boundary as well as the depth of plutons and ore bodies. Furthermore changes in magnetization direction parallel to the mid-ocean ridges can be obtained from the scaled magnetic moment and the normalized source strength discriminates the boundaries between the anomalies of major continental provinces like southern Africa or the Eastern European Craton.