Geophysical Research Abstracts
Vol. 18, EGU2016-17218, 2016
EGU General Assembly 2016

Remanent and induced contributions of the Earth's magnetization

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Inverting the magnetic field of crustal origin for the magnetization distribution that generates it suffers from non-uniqueness. The reason for this is the so-called annihilators, i.e. structures that produce no visible magnetic field outside the sources. Gubbins et al., 2011 uses the complex vector Spherical Harmonics notation in order to separate the Vertical Integrated Magnetization (VIM) distribution into the parts that do and do not contribute to the magnetic field measured in source free regions. We use their formalism and convert a crustal SH model based on the WDMAM into a model for the equivalent magnetization. However, we extend their formalism and assume that the magnetization is confined within a layer of finite thickness. A different thickness is considered for the oceanic crust than for the continental one.

It is well known that the large scales of the crustal field are entirely masked by the Earth's main field. Therefore, we complement the WDMAM based magnetization map (SH degrees 16 to 800) with the magnetization map for the large wavelengths (SH degrees 1-15) that was recently derived by Vervelidou and Thébault (2015) from a series of regional statistical analyses of the World Digital Magnetic Anomaly Map.

Finally we propose a tentative separation of this magnetization map into induced and remanent contributions on a regional scale. We do so based on the direction of the core magnetic field. We discuss the implications of these results in terms of the tectonic history of the Earth.