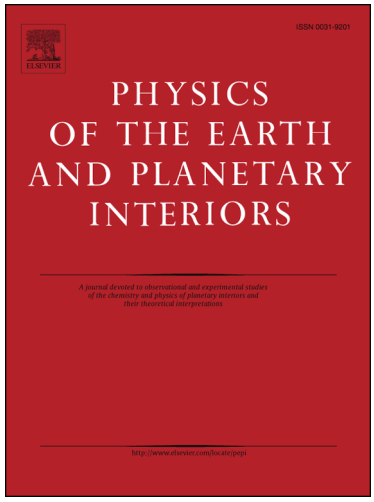

Magnetic signatures of the orogenic crust of the Patagonian Andes with implication for planetary exploration

Marina Díaz Michelena, Rolf Kilian

PII: S0031-9201(15)00111-9
DOI: http://dx.doi.org/10.1016/j.pepi.2015.08.005
Reference: PEPI 5859

To appear in: *Physics of the Earth and Planetary Interiors*

Received Date: 4 February 2015
Revised Date: 10 August 2015
Accepted Date: 20 August 2015

Please cite this article as: Michelena, M.D., Kilian, R., Magnetic signatures of the orogenic crust of the Patagonian Andes with implication for planetary exploration, *Physics of the Earth and Planetary Interiors* (2015), doi: http://dx.doi.org/10.1016/j.pepi.2015.08.005

Magnetic signatures of the orogenic crust of the Patagonian Andes with implication for planetary exploration

Marina Diaz-Michelena and Rolf Kilian

Physics of the Earth and Planetary Interiors

Abstract

The Patagonian Andes represent a good scenario of study because they have outcrops of diverse plutonic rocks representative of an orogenic crust on Earth and other planets. Furthermore, metamorphic surface rocks provide a window into deeper crustal lithologies. In such remote areas, satellite and aerial magnetic surveys could provide important geological information concerning exposed and not exposed rocks, but they integrate the magnetic anomalies in areas of kilometres. For the southernmost Andes long wavelength satellite data show clear positive magnetic anomalies (> + 100 nT) for the Patagonian Batholith (PB), similar as parts of the older martian crust. This integrated signal covers regions with different ages and cooling histories during magnetic reversals apart from the variability of the rocks.

To investigate the complex interplay of distinct magnetic signatures at short scale, we have analysed local magnetic anomalies across this orogen at representative sites by decimeter-scale magnetic ground surveys. As expected, the investigated sites have positive and negative local anomalies. They are related to surface and subsurface rocks, and their different formation and alternation processes including geomagnetic inversions, distinct Curie depths of the magnetic carriers, intracrustal deformation among other factors. Whole rock chemistry (ranging from 45 to > 80 wt.% SiO_2 and from 1 to 18 wt.% FeO_{tot}.), magnetic characteristics (susceptibilities, magnetic remanence and Königsberger ratios) as well as the composition and texture of the magnetic carriers have been investigated for representative rocks. Rocks of an ultramafic to granodioritic intrusive suite of the western and central PB contain titanomagnetite as major magnetic carrier. Individual magnetic signatures of these plutonic rocks reflect their single versus multidomain status, complex exolution processes with ilmenite lamella formations and the stoichiometric proportions of Cr, Fe and Ti in the oxides. At the eastern margin of the PB the investigated plutons and mafic dykes have been emplaced and equilibrated at 4 – 6 km depth. They do not contain magnetite but include variable amounts of ferrimagnetic monoclinic C4 pyrrhotite, which was formed along fractures zones by a hydrothermal gold-bearing mineralization. The intensity of their positive magnetic anomalies (up to + 220 nT) is well correlated with the amount of pyrrhotite (1 to 4 vol.%). In all cases, high resolution ground surveys variations of the magnetic signature down to 20 nT