Chapter 10

Summary

This study is concerned with the (re-)analysis of electromagnetic data recorded within several campaigns in the Central (∼21°S) and Southern (∼39°S) Andes in terms of a full array data analysis, taking more advantage of the simultaneity of the data, by calculating and analyzing also geomagnetic inter-station transfer functions. Though the analysis of such perturbation data is known since the beginnings of geo-electromagnetics, it is rarely performed and modern modelling techniques are all concerned with local impedance and (rarely) local geomagnetic transfer functions. Due to this circumstance, and the fact that array data of two study areas have been analyzed, this work addressed very different topics, which are summarized below.

- Multivariate processing of data from small groups of stations is a good means to handle array data as they are available from the two study areas. Combination of these arrays to one final synthetic array is aspired (see below), but only if spatial overlap of the arrays is sufficient and if data quality of overlapping stations is high, transfer functions obtained from the synthetic array are quantitatively analyzable.
- Inter-station geomagnetic transfer functions bear additional information on the subsurface conductivity and can help to understand the commonly analyzed local impedance tensors and induction arrows, especially if the subsurface conductivity distribution is three-dimensional (quasi-static effects in the Coastal Cordillera).
- A two-dimensional inversion of geomagnetic inter-station transfer functions can be implemented with a straight forward calculation of sensitivities. The 2-D inversion problem for such data has in principle a unique solution. The value of such investigation depends strongly on the conductivity distribution (in a 1-D earth, these data are zero) and the choice of the reference. Over laterally extended strong conductivity anomalies, investigation of horizontal perturbation data can resolve the vertical conductivity distribution and support an analysis of impedance data, which are more likely subject to distortion effects.
- Inversion of data with various references is also possible, though most probably not equally effective. Uniqueness of inversion solutions is not generally given for such data sets.
- Since data from the campaigns in the Central Andes cannot be related to the same reference, the potential of an inter-station data analysis could not fully be exploited.

- Geomagnetic data generally confirm the anomalies derived in the previous analysis, indicating, however, laterally enhanced conductivities in the eastern part of the Altiplano, which is revealed by 2-D inversion calculations, if magnetic data are included in the inversion procedure. This is not reflected in inversions of impedance data alone.
- In southern Chile, the organizational structure of the array data is better suited for a calculation and analysis of perturbation data, since all data can be related to one common reference. However, encountered anomalies are so weak, and therefore values of horizontal perturbation data are so small, that they cannot give significantly more insights into the subsurface conductivity distribution than local data.
- Isotropic two-dimensional modelling of data from the Southern Andes revealed enhanced conductivities of $\sim$10 Ωm below and east of the volcanic arc in a depth range between 20 km and 40 km.
- Induction vectors in South Chile have clear signature of continental mid to lower crustal horizontal electrical anisotropy, with anisotropy strike oblique to the structural resp. morphological strike. The modelled strike direction is not well constrained (between N25°E and N70°E). One possible explanation for the proposed anisotropy would be magmatic dykes below the surface, oriented parallel to the direction of maximum horizontal stress, and not confined to a narrow band below the volcanic arc.

Future modelling involving all types of transfer functions will further constrain the electrical image of the Southern Andes. Simultaneous deployment of electromagnetic field stations in the Longitudinal Valley and the Altiplano of the Central Andes, as planned for the near future, will connect the Chilean data set with the Bolivian data, and therefore valorize these data sets with regard to an analysis as performed in this study.