Imaging the weathering zone in Chile with active Radio-Magnetotellurics

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SUMMARY

The interdisciplinary DeepEarthShape project focusses on the weathering zone with drillings and a suite of geophysical, geochemical and geobiological approaches. The weathering zone is the uppermost part of the Earth's crust where rocks and soils experience breakdown either mechanically or chemically through the impact of air/gases, water and/or biological organisms. Weathered bedrock and soil belong to the life-sustaining, layer of the Earth's surface. Its thickness depends on the balance between erosion, removing weathered material from the surface, and weathering processes that deepen the interface between weathered and fresh bedrock. Although at shallow depths of 1 – 2 m appreciable amounts of microbial biomass and DNA counts were observed that might be related to weathering processes, our insight into the entire critical zone and its processes is still limited. We do not know for instance a) the depth of weathering; b) the process advancing it; c) whether this advance is driven by water, gases, and/or biological activity and concentrated along faults. Since some of the properties and characteristics of the weathering zone seem to be linked with climate, a set of four study sites is studies within the framework of the DFG Special Priority Program 1803 which belong to different climate zones and thus experience different vegetation, precipitation and erosion. However, the long-stretched coast of Chile represents a prime location to be exposed to these climatic differences but allows at the same time to stay in a similar geological/tectonic complex - the Coastal Cordillera. Therefore, we expect to compare the obtained results from the different study sites and finally test hypotheses concerning the weathering zone.
We utilised a combined geophysical approach using P- and S-wave seismics as well as Radio-Magnetotelluric (RMT) measurements along approximately 200 – 300 m long profiles at the study sites along the Chilean coast. Within the framework of the RMT experiment, we used our horizontal magnetic dipole transmitter in combination with a classical MT station nearby. Here, we will show and discuss 2D and 3D inversion results together with geophysical logging data from the drill holes and lab measurements of core samples. First results indicate that precipitation and shallow fluid enhanced zones e.g. in minor faults and folds can be traced and into the active weathering zone.

Keywords Weathering Zone, Radio-Magnetotellurics, Chile, magnetic dipole transmitter