

15 years of magnetotelluric monitoring of the subduction megathrust in northern Chile: progress and perspectives

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SUMMARY

The contact between the continental South American and oceanic Nazca plates in northern Chile (18°-24° S) is considered as a mature seismic gap capable of generating large (magnitude M~8) subduction earthquakes in the coming decades. This area has been monitored since 2007 by the Integrated Plate Boundary Observatory Chile (IPOC) network of geophysical and geodetic stations, which includes an array of 11 long-period magnetotelluric sites aimed at detecting changes in the deep fluid distribution during the seismic cycle. In this contribution, we summarize the main findings obtained since the IPOC array became operational, an interval that includes the occurrence of the 2007 Mw 7.7 Tocopilla and 2014 Mw 8.1 Iquique earthquakes in the monitored region, apart from some aseismic slow slip events.

The acquired data show that both impedance and vertical magnetic transfer functions exhibit systematic variations correlated with external magnetic field cycles (seasonal, annual, 11-year), which must be considered before interpreting changes in the internal electrical resistivity structure. Statistically significant variations in the temporal variability of transfer functions were identified in a time interval and area that are correlated with an aseismic slip event interpreted in the deep segment of the plate contact, which preceded the 2014 Mw 8.1 Iquique earthquake. However, the source of these anomalous transfer functions variations is more likely explained by electrical resistivity changes in the upper continental crust, according to the results of our numerical modeling. The IPOC monitoring results and previous magnetotelluric studies suggest a low concentration and/or interconnectivity of electrically conductive fluids in the deep segment of the plate contact in northern Chile. However, we cannot exclude the presence of high resistivity fluids, especially considering the resistivity of fluids derived from metamorphic processes reported in some laboratory studies. Based on these findings, we discuss the perspectives of MT monitoring of subduction megathrusts.

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