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Detection of partial melt in continental collision zones using different magnetotelluric tensor relationships: Results from synthetic models and real data

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Three magnetotelluric (MT) tensor relationships - the single-station MT impedance tensor (Z), the single-station vertical geomagnetic transfer function (GTF) and the multiple-station horizontal geomagnetic transfer function (HGTF) - were investigated for their effectiveness in detecting the presence of partial melt in continental collision zones. Realistic synthetic models, based on prior field studies, were used to characterize the sensitivity of each tensor relationship constraining the presence of partial melt at lower-crustal and upper-mantle depths. From the MT response of the synthetic models, each type of data was inverted separately and jointly with the others, thus determining the properties and advantages of each when modeling the subsurface. Non-linear sensitivity tests were carried out to determine the resolution that can be expected in constraining electrical resistivity anomalies associated with the presence of partial melt. Results obtained show which configuration of the HGTF is more sensitive to partial melt.

The analysis of partial melt sensitivity was also performed using real data from a MT survey carried out in the Pyrenees. The data comprise a total of 82 broadband MT sites and 29 long period MT sites distributed along four profiles across the Pyrenean mountain range between the Atlantic Ocean and the Mediterranean Sea. Using the results from the synthetic models, real MT data in the Eastern Pyrenees were used to constrain if the partial melting area associated with the Iberian subducted lower crust observed below the Western, the West-central and the Central Pyrenees continues to the East. A non-linear sensitivity test was undertaken to determine the boundary to the east of this geoelectrical anomaly associated with partial melt.