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Northern Tibet crustal and lithospheric mantle structures inferred from INDEPTH magnetotelluric data

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In preparation for the Magnetotelluric (MT) Phase IV of the INDEPTH (International Deep Profiling of Tibet and Himalaya) project, focusing on the northern margins of the Tibetan plateau, MT data from the INDEPTH Phase III 600-line were re-analyzed and re-modelled. Previous inversions of the data from the 600-line used the MT TE-mode, TM-mode and vertical magnetic field data to derive minimally smooth models. The final smooth model published was characterized by a uniform mid-crustal conductor extending from the Kunlun Shan to the south end of the 600 profile and ending abruptly at the Kunlun Fault. The high conductivity of the middle lower crust south of the Kunlun Shan was interpreted as due to partial melting.
The new modelling is not only using newer responses but also newer inversion codes, including a code that seeks optimal models with 2D anisotropic structures.
Although, in general, the dominant features in the new model are the same as the prior models, the new model is far more focussed, and fits the data better, both overall and locally. It is less “smooth” and geometrically more complex, exhibiting greater lateral variability. The South Kunlun Fault (SKLF) can be identified as a boundary between a conductive middle crust weakened by (wet) partial melt, and a dry and cold resistive crust north of the fault, and can be reasonably concluded to be a rheological boundary. However, crustal anisotropic modelling raises an interesting issue concerning a possible injection of partial melt further north, creating melt interconnectivity in the northeast direction only. South of the SKLF, the high conductive crustal anomaly does not extend to the slightly more resistive upper mantle. North of the SKLF, the upper mantle becomes more and more resistive. This evolution of the lithospheric mantle along the profile correlates with a reduction of crustal thickness from the north of the Qiangtang terrane to the south of the Qaidam basin. The main lateral resistivity changes beneath the Plateau are representative of changing conditions, such as lithology, temperature, water content variability or dehydration processes affecting crustal rheology. This particular behavior of the crust may be linked to the thrusting history of the northern part of the Plateau and the high thickness of the crust leading to particular conditions of pressure and temperature. The mid-crustal conductive features exhibit a compelling spatial correlation with the surface thrusting of the northern Tibetan plateau, implying structural control of the conductivity distribution. This correlation might highlight the time relation between the tectonic features of the area and partial melt.