Evolution of Crustal and Upper-Mantle Structure in Northern Tibet from INDEPTH Magnetotelluric Data

Florian Le Pape[1], Alan G. Jones[1], Jan Vozar[1], Martyn J. Unsworth[2], Wei Wenbo[3], the INDEPTH MT Team

[1] Dublin Institute for Advanced Studies, Dublin, Ireland, flepape@cp.dias.ie
[2] Department of Physics, University of Alberta, Edmonton, AB, T6G 2J1, Canada
[3] China University of Geosciences Bejing, Beijing, 100083, China

The overall goal of the INDEPTH (International Deep Profiling of Tibet and Himalaya) Phase IV is to develop a better understanding of the structure and evolution of the northern margins of the Tibetan plateau. During Phase III in 1999, broadband and long-period magnetotelluric data were collected in Northern Tibet across the Kunlun Shan. The MT stations, placed along the northern part of the Lhasa to Golmud highway, defined the so-called 600-line profile extending from the middle of the Qiangtang Terrane to the southern edge of the Qaidam Basin. 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 (Unsworth and others, 2004). The final model obtained is 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 previously identified as due to partial melting.

As part of Phase IV, seismic data crossing again the Kunlun Shan are being acquired east of the 600 line. In Spring 2010 the long-period MT (LMT) acquisition of INDEPTH Phase IV will commence, including a profile east of the 600 line to complement the seismic data. In anticipation of the upcoming survey, the existing MT 600-line data were re-analysed and re-modelled. As found previously, south of the Kunlun Shan the middle and lower crust are conductive, and north of the Kunlun fault the crust and the upper mantle are resistive. However, the new models are geometrically more complex, exhibiting greater lateral variability. Although in general the dominant features are the same as the prior models, in detail, spatial correlation with surface thrusting implies structural and/or lithological control on the enhanced conductivity. This particular behaviour of the crust may be linked to the thrusting history of the north part of the plateau and the high thickness of the crust leading to particular conditions of pressure and temperature.

The Kunlun Fault can be characterized as a rheological boundary in the middle and lower crust of northern Tibet, between a crust weakened by partial melting and a more stable (dry, cold) crust north of the fault. The lateral resistivity changes along the profile are representative of changing conditions, such as lithology, temperature, water content variability or dehydration processes affecting the crustal rheology.

Reference

Unsworth, M., and others, 2004, Crustal and upper mantle structure of northern Tibet imaged with magnetotelluric exploration, J. Geophys. Res., 109, B02403-1 - B02403-18, doi: 10.1029/2002JB002305.

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