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TITLE: Electromagnetic, seismic and petro-physical investigations of the lithosphere–asthenosphere boundary in central Tibet

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ABSTRACT BODY: Combined seismological and electromagnetic investigations of the lithosphere and underlying asthenosphere have the potential to yield superior inferences than using either one on its own. Central Tibet offers an excellent natural laboratory for testing such approaches, given the high quality seismological and magnetotelluric (MT) data available as a consequence of INDEPTH studies. In particular, the presence and lateral and vertical extent of the Indian lithosphere beneath Tibet is highly debated. Integrated petrological-geophysical modeling of MT and surface-wave data, which are differently sensitive to temperature and composition, allows us to reduce the uncertainties associated with modeling these two data sets independently, as commonly undertaken.

For the MT data, we use selected distortion-corrected MT transfer functions, from INDEPTH Phase III line 500 across central Tibet for 1D modeling. The selected data fit well the 1D assumption and exhibit large penetration depth. Our deep resistivity models can be classified into two different groups: i) the Lhasa Terrane and ii) the Qiangtang Terrane. For the Lhasa Terrane group, the models show the existence of two high conductive layers localized at depths of 60-80 km and more than 200 km, whereas for the Qiangtang Terrane these conductive layers appears to be occur at shallower depths, namely 30-50 km and 120 km depth respectively.

Our dispersion curves for Rayleigh and Love surface waves were measured using seismograms recorded by stations of INDEPTH and PASSCAL experiments. Dispersion curves for central Lhasa and Qiangtang terranes show similarly low phase velocities at periods sampling the thick crust beneath the regions, but differ at periods sampling the mantle. Inverting the dispersion data for 1D, radially-anisotropic Vs profiles, we find that beneath central Qiangtang terrane shear velocity is lower than the global average down to 75 km below the Moho, indicating relatively high temperatures, whereas beneath Central Lhasa terrane S-velocities are close to global-average values.

We perform the integrated petro-physical modeling of MT and surface-wave data using the software package LitMod. The program facilitates definition of realistic temperature and pressure distributions within the upper mantle, and characterizes the mineral assemblages given bulk chemical compositions as well as water content. This allows us to firstly define a bulk geoelectric and seismic model of the upper mantle based on laboratory and xenolith data for the most relevant mantle minerals, and secondly to compute synthetic geophysical observables that are compared with measured data (i.e., MT responses, surface-wave dispersion curves, topography, and surface heat flow). Our preliminary results suggest an 80-120 km-thick, dry lithosphere in the central part of the Qiangtang Terrane. In the central Lhasa Terrane the data can be explained by a relatively warm 100-120 km-thick Tibetian lithosphere underlain by an 80-120-km-thick Indian lithosphere. The mid-lower crust in Lhasa shows strong seismic and electric anisotropy, with a predominant E-W oriented high velocity/conductivity axis.

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INDEX TERMS: [8124] TECTONOPHYSICS / Earth's interior: composition and state, [0699] ELECTROMAGNETICS / General or miscellaneous, [7255] SEISMOLOGY / Surface waves and free oscillations.