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Characterization of a Crustal Transition Zone in Northern Tibet using Magnetotelluric Modelling

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The overall objective of the final phase of the INDEPTH (International Deep Profiling of Tibet and Himalaya) project has been to develop a better understanding of the structure and evolution of the northern margins of the Tibetan plateau, namely the Kunlun and Altyn Tagh faults. For the Kunlun Fault, both INDEPTH Phase III and new Phase IV magnetotelluric (MT) data were investigated using 2D isotropic and anisotropic modelling, as well as 3D modelling. The resulting resistivity models characterize a northwards penetrative extension of the partially molten Tibetan middle crust, crossing the subvertical Kunlun Fault. Furthermore, the anisotropic observations highlighted by the INDEPTH MT modelling define progressive finger-like melt intrusion beneath the Kunlun Shan. However, this intrusion may not be homogeneous along the whole of the northern Tibetan border along the Kunlun Fault, as its depth and horizontal extension are likely to vary. The partial melt associated with the anisotropic anomaly observed on the INDEPTH resistivity models may have been triggered by strain heating associated with heat production during ductile deformation in a mid-crustal shear zone located beneath the Kunlun fault in the southern Kunlun ranges. This shear zone might be characterized by different levels of strain along the whole of the northern Tibetan border and may have developed into separated channels where the Songpan-Ganzi partially molten crust flows to the north, mechanically weakening the Kunlun crust. Melt penetration across the Kunlun Fault through intrusive channels likely accommodates crustal shortening in northern Tibet, but may also characterize a transition zone between the weak partially molten crust of the plateau and the more rigid Qaidam lithosphere, associated with the growth of the plateau to the north.