Helmholtz Centre Potsdam
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MAGNETOTELLURIC STUDY OF THE SOUTHERN PAMIR

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Introduction

Geological Setting

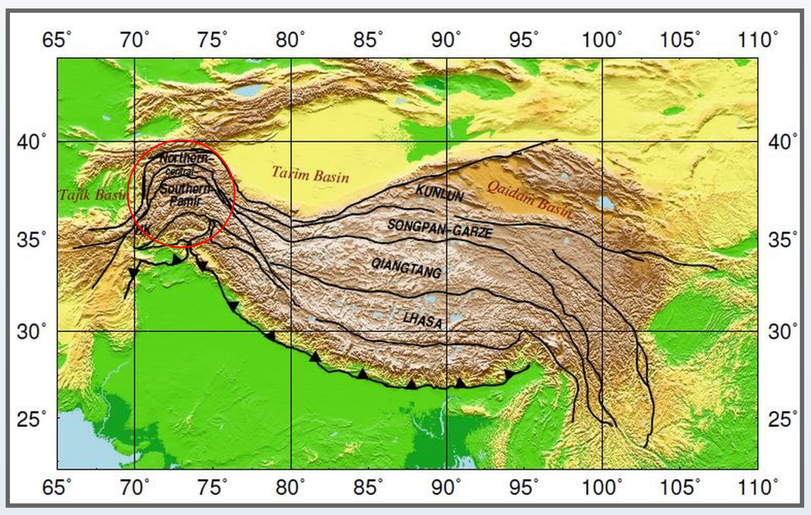


Fig. 1: Pamir-Tibet-Himalaya orogen

The Pamir region at the western prolongation of the Tibet-Himalaya orogen is a high plateau which accommodated the India-Asia collision by crustal shortening and thickening.
The same east-west-trending orogenic belts, corresponding to continental terranes which amalgamated with Asia prior to the collision with India, wrap around the Pamir and Tibet. Today, there is strong geophysical evidence that a slab of Asian lithosphere has been underthrust south-southeastward beneath the Pamir (see Fig. 3).

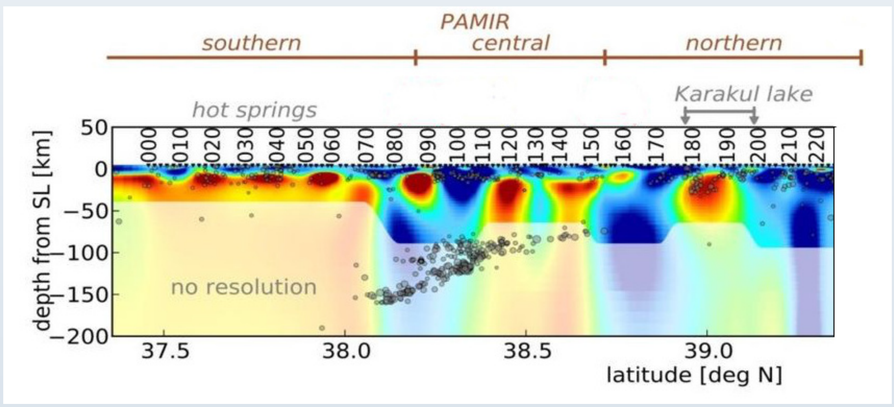
Motivation

Recent results of a magnetotelluric study from Saß et al. (2014) state (see Fig. 2):

- large conductivity anomaly in the southern Pamir (upper boundary ca. 12-15 km below surface)
- possibly felsic material containing interconnected melts
- generation of crustal flow channels in a week and partially molten middle-lower crust may be responsible for the flat topography of the Pamir plateau and allows for crustal collapse of the plateau.

The interesting question is: How wide is the east-west extent of the conductive anomaly.

Fig. 2: 2D resistivity model of Pamir from Saß et al. (2014). Circles mark earthquake locations (Sippl et al. 2013)



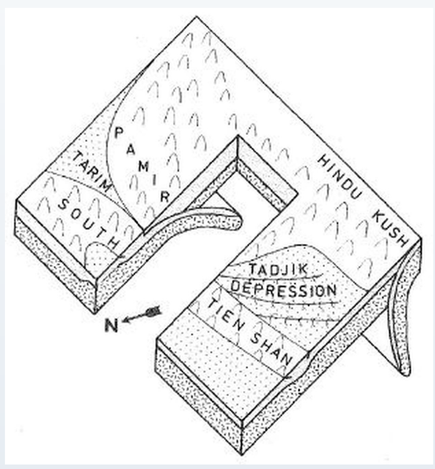


Fig. 3: Block diagram from Burtman and Molnar (1993). A slab of Asian lithosphere has been underthrust south-southeastward beneath the Pamir. A different slab has been underthrust north-northwestward beneath the Hindu Kush. The presence of cold material is witnessed by vigorous intermediate-depth earthquake activity.

Preliminary Inversion Results

Field experiment

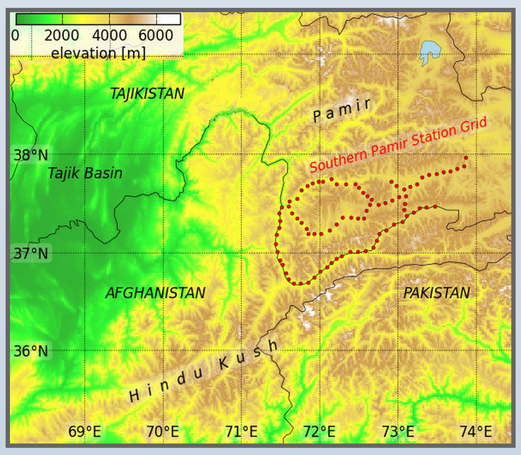
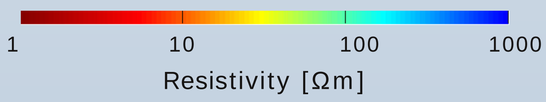


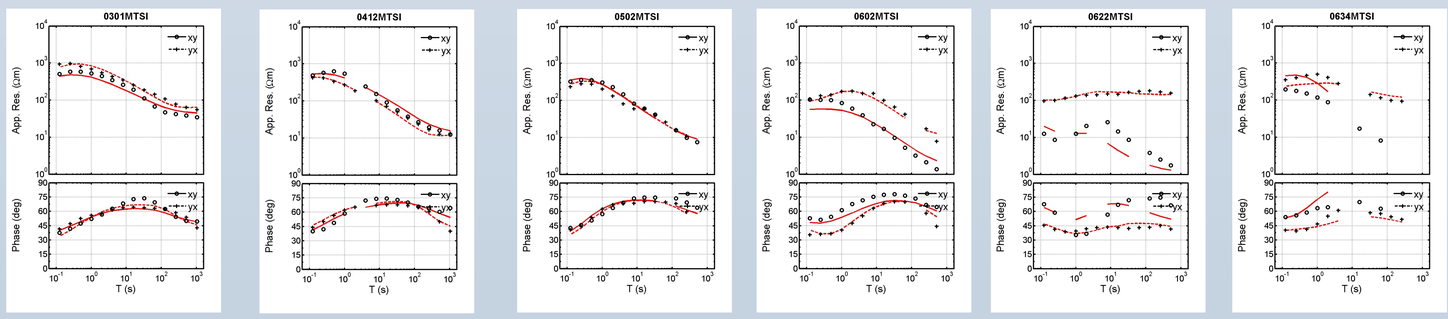
Fig. 4: In summer 2013 we installed 85 wideband magnetotelluric sites in the southern Pamir. The site spacing was approximately 8 km. The study was conducted within the Tien-Shan-Pamir Monitoring Program



Inversion

We run a series of 3D inversions using the "Modular Electromagnetic Inversion System" (ModEM, Meqbel 2009, Egbert and Kelbert 2012).
All components of the impedance tensor as well as vertical magnetic transfer functions were used. Not all sites from the TIPTIMON experiment were taken into acount, since the data processing has not been completed yet. While the data quality is excellent in the sparsely populated southeastern Pamir plateau, it is heterogeneous or disturbed by EM noise in the populated southwestern Pamir.
Additionally, the Southern Pamir data of the TIPAGE experiment (Saß 2014) were included.

Fig. 5: Data fit is generally good.



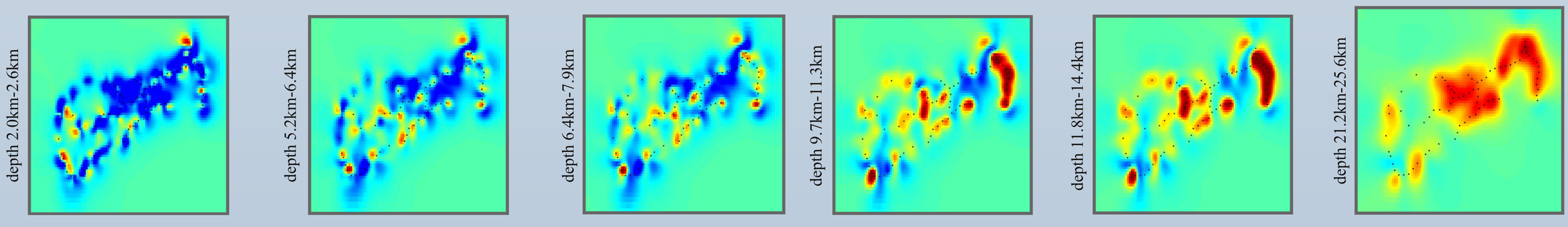


Fig. 6: 3 D inversion showing horizontal slices at different depths

Results

3D inversion reveals following features:

- At the shallow depths, the entire Pamir appears to be resistive reaching values around 1000 Ωm.
- There is a conductive anomaly, which starts in the most eastern part of the Pamir plateau at approximately 9 km, becomes larger with the depth and spreads over the entire eastern half of the plateau at the depths of 20 - 25 km.
- The conductivity anomaly is delimited to the west. This may be an indication against the crustal flow assumption (Saß et al. 2014).
- The limit of the conductivity zone is possibly the gigantic metamorphic Shakdara dome, which dominates the whole southwestern Pamir and is expected to be resistive. However, the data of the southwestern Pamir used in the inversion were incomplete, because processing of the noisy sites (western survay area) has not been finished yet.
- Future work will focus on a further improvement of the transfer function quality and probing of the inversion results. Interesting investigation issues would be the extension of the experiment to the east, or a longer recording time for the sites in southwestern Pamir, in order to test the possibility that the conductor starts at a greater depth in this part.

References

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