Moho Doublet in Southern Tibet and Its Tectonic Implication

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Since the India and Eurasia collision ~65 Ma ago (Ding et al., 2005), the Indian plate continues to wedge into the north, causing crustal shortening of ~3000 km between the two continents. The question is where and how the subducted Indian Plate has gone? In order to answer this question a comprehensive geophysical profile (ANTILOPE-III) has been carried out, supported by SinoProbe to detect the detailed structure of the crust and upper mantle of southern Tibet. The profile passes through the two rift valleys developed in southern Tibet - the Dangreyong-Xurucuo Rift, and the Shenza-Xietongmen Rift.

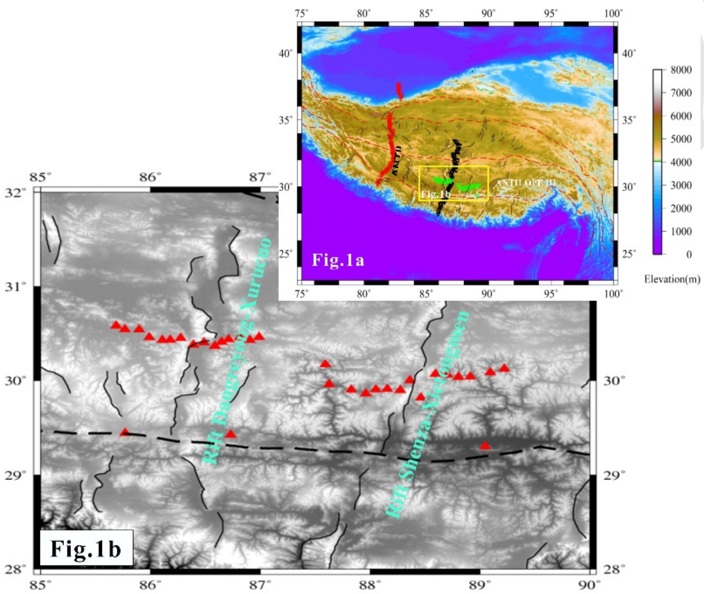

Figure 1. The location of the rifts in southern Tibet and the position of the broadband seismic station profiles crossing the rifts.

Totally, about 30 seismic stations have been installed along the profile. The recording time was about 13 month. By Receiver Function, S wave splitting and seismic anisotropy research the crust-mantle velocity structure, underground interfaces and the characteristics of seismic anisotropy through these two rifts have been obtained. This research has clearly located a Moho doublet (Fig. 2), which can be interpreted as the Indian Moho below the Tibetan Moho. The Tibetan Moho is very flat and stable, whereas the Indian Moho is broken and changes from west to east. It seems, however, strange that the rifts in southern Tibet have possibly influenced the lower structure (Indian Moho) and not the upper structure in the lower crust (Tibetan Moho). Therefore, there is perhaps no such direct link between rifts and the (Indian) Moho. This could mean that the Indian mantle lithosphere was strongly deformed or even split during penetrating into the Tibetan mantle. This kind of Moho doublet challenges the property of the “rifts” developed in southern Tibet. How could these “rifts” form without a Moho cutoff and upper mantle uplift? These north-south oriented structures may have formed within the shallow part of the crust by crustal extension, caused by mantle flow during north-south compression. In this case, according to the definition of the rift, the north-south directed structures developed in southern Tibet are not typical rifts at all, or mature rifts, but at most rifts at their infancy stage.

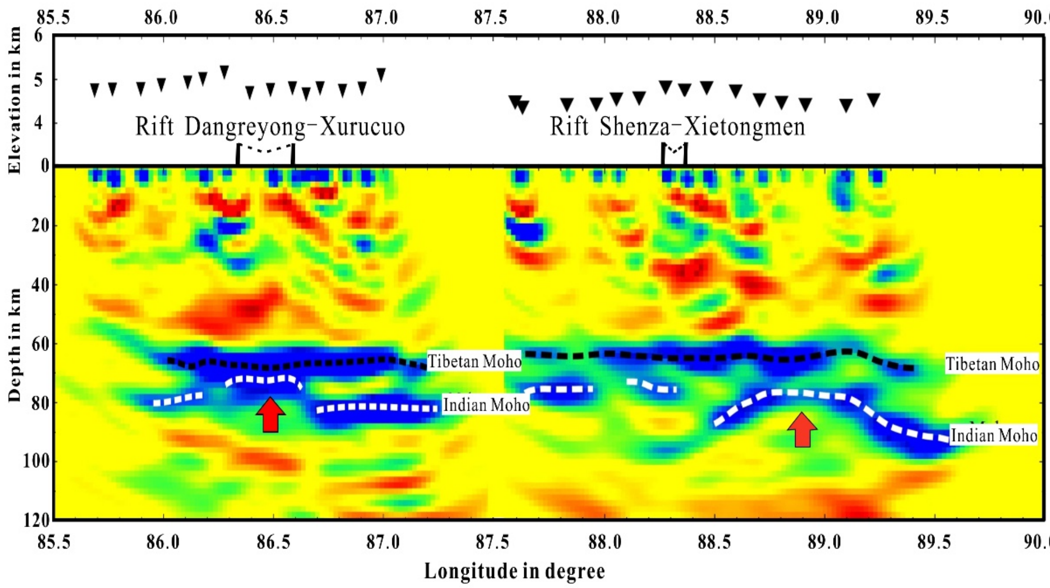

Figure2. Velocity of the crust and upper mantle along the ANTILOPE-III profile crossing the Dangreyong-Xurucuo and Shenza-Xietongmen Rifts.

At present, the Tibetan plateau is composed of three plates such as the Indian plate in the south, the Asian plate in the north and the Tibetan “plate” sandwiched between the two (Zhao et al., 2010). The Tibetan plate features high temperature, low speed, and high seismic anisotropy. The subducted Indian lithospheric mantle falls down to the Tibet "plate", as a “melting furnace”, and may flow eastwards under the influence of the extrusion stress. When it meets the rigid Sichuan Basin, the hot and soft material moves in four directions: to the southeast forming the Yunguichuan plateau; to the northeast helping the uplift of the northeastern Tibetan Plateau; going upward forming the Longmenshan Mountains and falling down into the Sichuan Basin after denudation; and going downwards into the deep mantle (here the thickness of the upper mantle transitional zone has increased, indicating that some material with low temperature went through it.

References

Ding, L, Kapp, P., Wan, X.Q. 2005. Paleocene-Eocene record of ophiolite obduction and initial India-Asia collision, south central Tibet. Tectonics, 24 (3): TC3001. DOI: 10.1029/2004TC001729.

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