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An Integrated Geophysical Study at the Northern Gulf of Mexico

Eray Kocel

Continental rifting and the subsequent development of new oceanic crust involve the complex interaction of tectonic, magmatic and geodynamic processes that results in a variety of passive margin styles. Based upon the amount of volcanism that occurs, passive margins may be classified as volcanic or non-volcanic. Differences between these two types are reflected not only in the amount of volcanism, but also in the crustal structure of the ocean-continent transition. The transition takes place over a relatively short distance for volcanic margins when compared with non-volcanic. The transition for volcanic margins is also characterized by thick, lower crustal layers with anomalously high P-wave velocities and high densities. Consequently the width of the ocean-continent transition, and the thickness and layering of the crust underlying the transition may be used to determine the nature of the margin. Analyzing subsurface features associated with the transition requires detailed geophysical and geological information.

In spite of the many studies carried out in the Gulf of Mexico there is still very little detailed information regarding its overall crustal structure, including the location, size, and orientation of the ocean-continent transition. One consequence of this is that a number of different models have been proposed to explain its opening history. These models make different predictions regarding the geometry and distribution of the various crustal types.

The purpose of the proposed research is twofold: (1) to identify and map different crustal types in the northern Gulf of Mexico including the location and width of the ocean-continent transition, and (2) to use this information to evaluate the various tectonic models that have been proposed for the development of the basin.

The proposed research will examine a range of geophysical data sets over the northern Gulf that includes marine and satellite gravity, seismic reflection and refraction, and magnetic data. These data will be used to create several 2D crustal scale models of the ocean-continent transition in the northern Gulf of Mexico beginning in the north over established continental crust and ending in the south where refraction data indicate oceanic crust. To simulate the complexity of the subsurface, these models will comprise several constant density layers with variable geometry that map the sedimentary, upper and lower crustal boundaries. ■

Crust and Upper Mantle Structure in Northeast of Tibet from Rayleigh Wave Tomography

Lun Li

Northeastern Tibet is an important place for understanding the growth of the Tibet plateau and its eastward extrusion. To distinguish the model responsible for the development of northeastern Tibet, we have analyzed Rayleigh wave data recorded by the Northeast Tibet Seismic (NETS) array and applied the Two-Plane-Wave (TPW) tomography method to compute average and 2-D phase velocities.

Vertical component seismograms from 70 events at 35 stations were filtered at 17 center frequencies with a narrow bandwith of 10 mHz. Average phase velocity varies from 3.21 km/s at 20 s to 3.84 km/s at 100 s. Compared to the average phase velocities in southeastern Tibet, these values are higher in the period range of 20-50 s and lower at longer periods, probably indicating a faster and thinner crust and slower upper mantle in northeastern Tibet. We also obtained average phase velocities in three sub-regions which are separated by the Kunlun and Haiyuan fault.

The northernmost subarea including part of the Odos block is characterized with the highest phase velocity while the area to the south of the Kunlun fault is the slowest in northeast Tibet. 2-D variation of phase velocity was calculated in the periods from 20s to 100s. The low velocity anomaly is imaged along and to the south of the Kunlun fault at each period. And relative high velocity is consistently imaged to the north of Kunlun fault. 3-D shear wave inversion was conducted to understand the crust and upper mantle structure from the obtained phase velocities. A relative low velocity zone is image beneath Kunlun fault in the lower crust and upper mantle. The mechanisms responsible for this low velocity zone will be interpreted to help understand the tectonic and the role of Kunlun fault playing in the rising of Northeast Tibet. ■