Crustal architecture beneath eastern China revealed by receiver function analysis

Lingli Li[1,2], Weisen Shen[2,*] , Siyuan Sui[2],
1. Anhui Earthquake Agency, Hefei, Anhui, 230031, China
2. Stony Brook University, NY, 11794, USA

Abstract Eastern China consists of a variety of tectonic units which record complex and widespread deformation history since the Mesozoic (Fig1a). In this study, we conducted a systematic receiver function analysis using a total of 125,600 teleseismic P waveforms recorded by 703 broad-band stations in the time of 2015.01-2019.03. These stations include 570 permanent seismic stations from China Earthquake Network Center, 113 temporarily stations deployed in North-eastern China and 20 temporarily stations in the central segment along Tanlu fault (Fig1b). By using a 2-layer H-κ sequential stacking method (Yeck et al., 2013) to these receiver functions, distributions of sedimentary and Moho depths, sedimentary and crystalline crustal P- and S-wave velocity ratio (Vp/Vs) are obtained (Fig2). The results show high lateral resolution maps of crustal thickness and Vp/Vs ratio with features varying with the tectonic units of Eastern China: 1) The resulting map of sediment thickness shows an average sedimentary thickness of ~ 0.7km in Eastern China, and the distribution of thick sediment highly correlates with the major known basins; 2) The Moho depth map shows a systematic thickening from east to west, highly coherent with the north-south directed gravity lineament in Eastern China; 3) The Vp/Vs ratio of the sedimentary layer is ~ 2, consistent with the high Vp/Vs of sedimentary rocks; 4) The crystalline crust Vp/Vs ratio ranges from 1.60~1.95 with the average value of ~ 1.74, significantly slower than the average value from the USArray. Notably, high values of Vp/Vs (> 1.77) distribute mainly beneath the Songliao basin, Erlian basin, and North China plains, contrast to the South China block, Taikang Hefei basin, Qinling-Dabie and Sulu orogenic belts with the values lower than 1.73. In addition, variations of crustal Vp/Vs are found along the Tan-lu fault: relatively high vp/vs ratios (>1.75) are measured along the south segment of Tanlu fault, while the northern segment shows different Vp/Vs ratio on the two flanks. These resulting images of the crustal architecture of E. China has important implications on the tectonic modifications to the crust in this region, serves as a basis to infer the silica content of the crust when combined the crustal Vs values, and thus sheds light on the formation and evolution of the continental crust in general.

References:

Yeck, W. L., Sheehan, A. F., & Schulte‐Pelkum, V. (2013). Sequential H‐κ stacking to obtain accurate crustal thicknesses beneath sedimentary basins. *Bulletin of the Seismological Society of America*, *103*(3), 2142-2150.

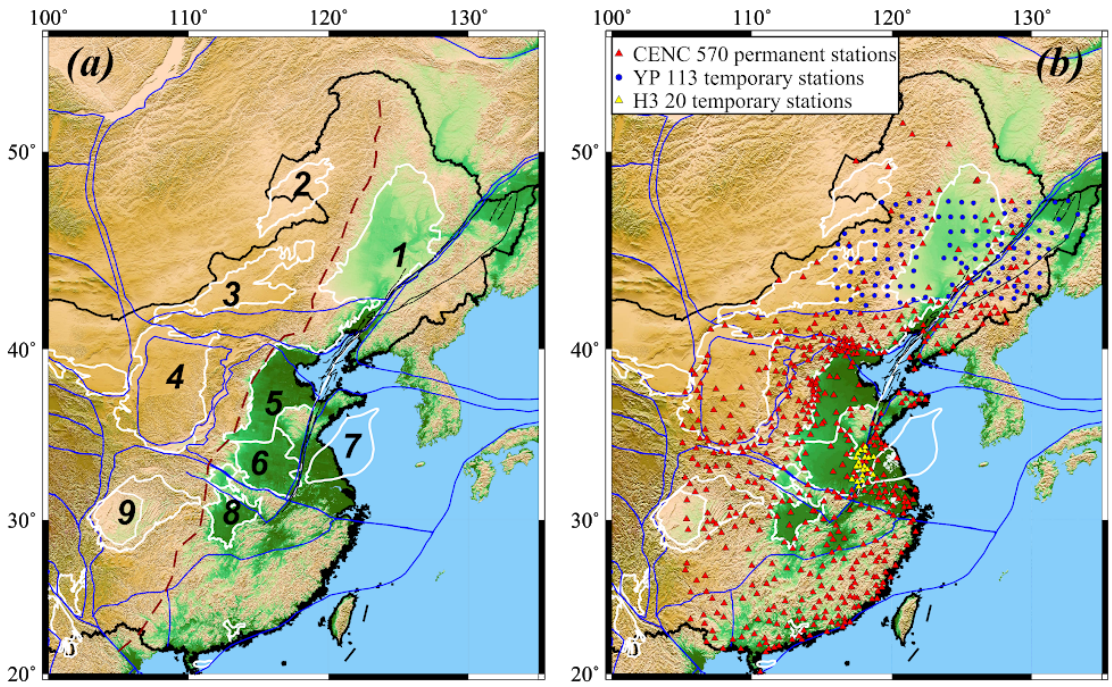

Figure 1. (a) Tectonic boundaries and major basins in Eastern China are shown by blue lines and white contours, respectively. The red dashed line represents the North-South gravity lineament. The sedimentary basins are marked by numbers: 1 (Songliao Basin); 2 (Temtsag Hailar Basin); 3(Erlian Basin); 4 (Ordos Basin); 5(Bohaiwan Basin); 6(Taikang Hefei Basin); 7(Subei Yellow Sea Basin); 8(Jianghan Basin); 9 (Sichuan Basin). (b) Locations of the 703 stations used in this study. Red triangles represent 570 permanent stations from CENC; blue circles denote 113 temporary stations in Northeastern China; yellow triangles denote 20 temporary stations along the south segment of Tanlu fault zone.

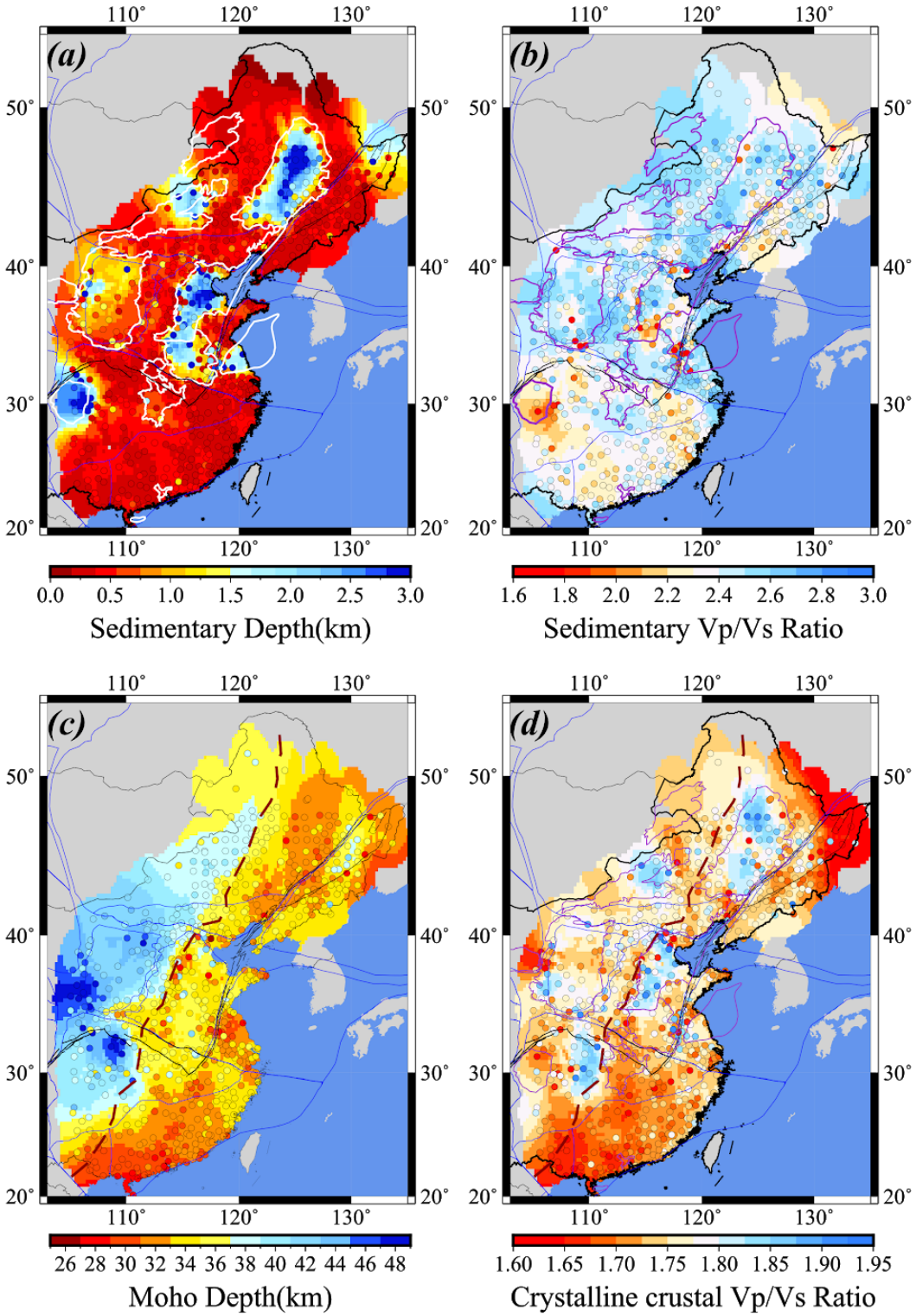

Figure 2. (a-d) Distribution of the sedimentary depth and sedimentary Vp/Vs ratio, Moho depth, and crystalline crustal Vp/Vs ratio, respectively.