Seismic Velocity Structure of Central Asia from Surface-Wave Dispersion

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CHAPTER 1 INTRODUCTION

1.1 Overview

Geologic complexity in central Asia is the direct result of the collision of India with Asia that began in the Eocene (~50 Ma) and continues today. The collision has created some of the most pronounced topography in the world. The Tibetan Plateau has a mean elevation of 5000 m and is the largest plateau in the world. The Tien Shan Mountains rise to a maximum height of 7000 m and are one of the furthest mountain ranges from an active convergent plate boundary. Among the elevated regions are several large basins including the Tarim and Junggar (Figure 1.1.1) that filled with thousands of meters of sediments eroded from elevated terrain. As expected, this actively deforming region has many earthquakes but are mostly confined to the Tien Shan Mountains, only sporadic activity occurs in the basins.

This region of young, rugged geology is not without political interest. Lop Nor, the Chinese nuclear test site, is located (Figure 1.1.2) just north of the Tarim basin and is the site of numerous underground nuclear explosions (the last known in 1996). One specific goal of this study is to map the seismic velocity variations along known source-receiver paths that will improve our ability to investigate small nuclear explosions in the Lop Nor region.

To study velocity variations, Rayleigh and Love waves were analyzed to estimate surface-wave group and phase velocity dispersion for known propagation paths. Group velocities were estimated using a multiple-filter method and isolating the surface-wave for phase velocity estimation. The group velocity estimates agree with previous surface-wave studies of central Asia. Phase velocity estimates were calculated for the 26 events using the single-station method and assuming source phase corrections from available moment-tensor and depth estimates. To reduce the data, the earthquakes are grouped into three clusters and the phase velocities of each cluster are averaged. Finally, the average phase and group velocity dispersion along each path were used to estimate a depth dependent shear wave velocity structure. The results are consistent with previous work.

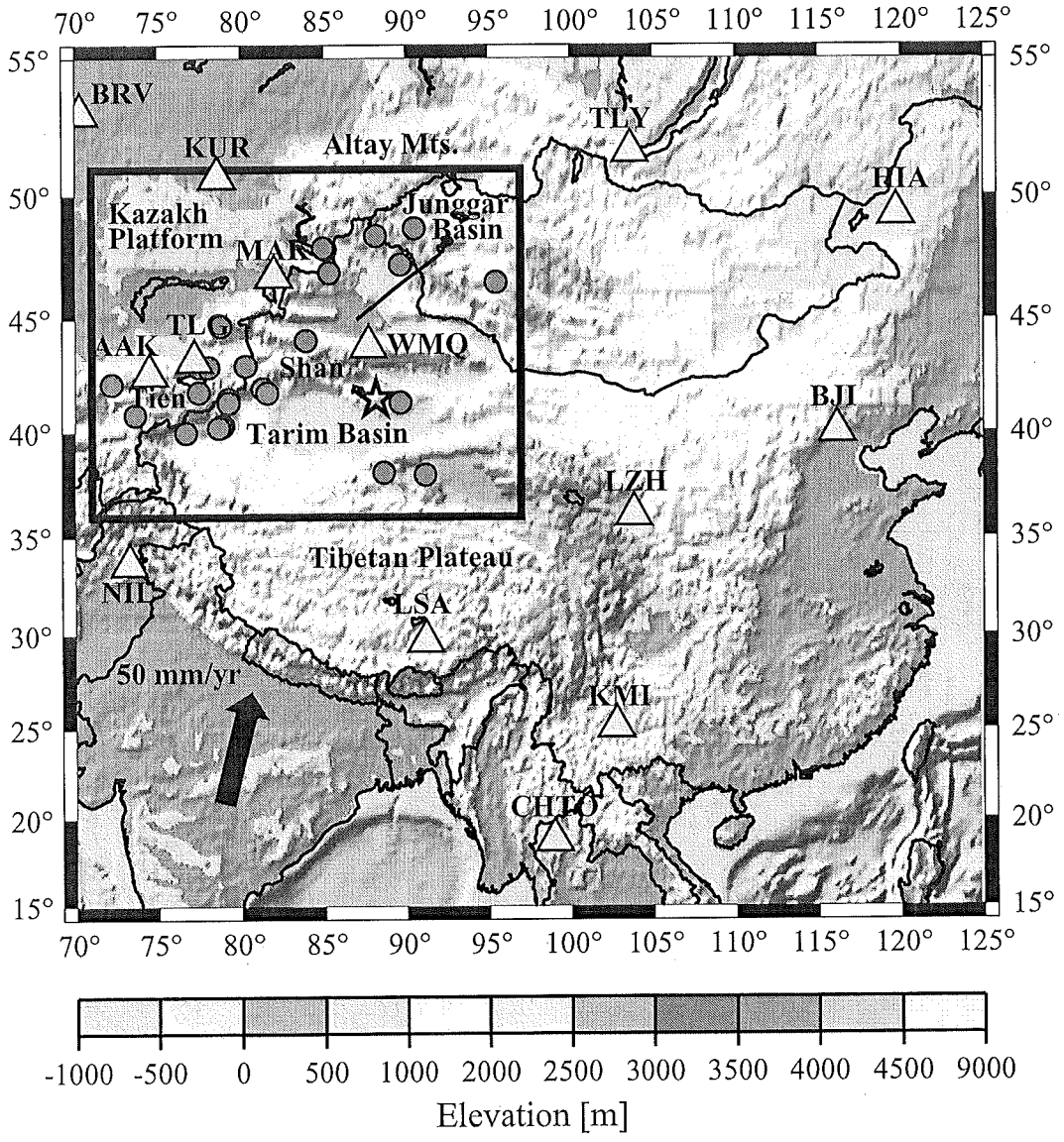

Figure 1.1.1. Regional map of central Asia showing geologic features, the earthquakes (purple circle) and stations (yellow triangles). The bold star indicates Lop Nor, the Chinese nuclear test site. The rectangle identifies the study area, plotted in Figure 1.1.2.

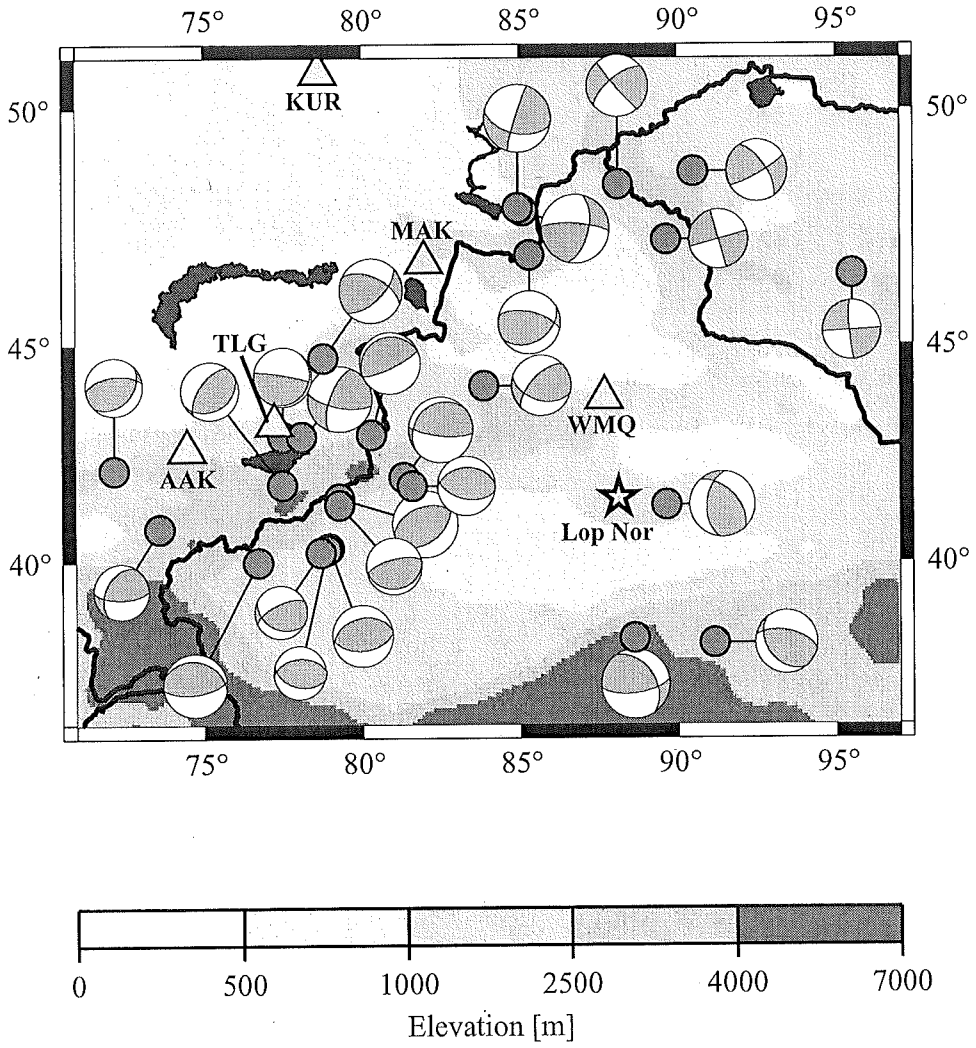

Figure 1.1.2. Expanded map of the study area showing the earthquake locations (purple circles), focal mechanisms (orange circles) and stations (yellow triangles). The bold star indicates Lop Nor, the Chinese nuclear test site.