A BROADBAND SEISMIC EXPERIMENT IN YUNNAN, SOUTHWEST CHINA

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ABSTRACT

A broadband portable seismic network has been deployed in Yunnan, southwest China, to collect seismic data for advanced studies on regional crustal and mantle structures, earthquake prediction, and regional characteristics of wave propagation and seismic sources. The region in southwest China is situated in an evolving tectonic region transitioning between the uplifted Tibetan plateau to the west and the Yangtze continental platform to the east. The region displays varying crustal thickness from 35 km to over 60 km with seismic activity strongly associated with the locally mapped active faults.

The temporary seismic network, consisting of 25 portable broadband and narrow-band seismic stations, is deployed in the region of 98°E-105°E, 21°N-29°N. There are also 23 permanent digital broadband seismic stations recording in the region. Yunnan has the strongest intra-plate seismic activities in China. Moreover, there are several strong seismic zones in its surrounding areas, such as Tibet, Sichuan, Burma, and India. The strong seismicity in Yunnan and its surrounding areas provides the foundation for success of this deployment. Preliminary analyses have yielded an enhanced ground truth database, a 3-D structure model (together with some other analyses) for improving location, and characteristic spectral ratios for different events. Moreover, analysis of the recordings of some events of special interest, such as the January 26, 2001, M7.7 India earthquake and the February 14, 2001, M5.0 Yajiang, Sichuan, earthquake, has provided useful information on the source, path, and site effect, that are important for regional seismic studies.

KEY WORDS: Yunnan, Southwest China, broadband network, regional seismology, crustal structure

OBJECTIVE

The major purpose of this project is to collect fundamental ground truth data for advanced studies on regional crustal and mantle structures, earthquake prediction, and regional characteristics of wave propagation and seismic sources in Yunnan, China, through deploying a broadband portable seismic network in the area. The region in southwest China is situated in an evolving tectonic region transitioning between the uplifted Tibetan plateau to the west and the Yangtze continental platform to the east. The region displays varying crustal thickness from 35 km to over 60 km with seismic activity strongly associated with the mapped active faults. Figure 1 shows the topography of the Yunnan province. Yunnan has the strongest intra-plate seismic activities in China. There are several strong seismic zones in its surrounding areas, such as Tibet, Sichuan, Burma, and India. Moreover, there is an abundance of mining activities in this area. The strong seismicity and the intensive mining activities in Yunnan and its surrounding areas provide the foundation for success of this deployment.

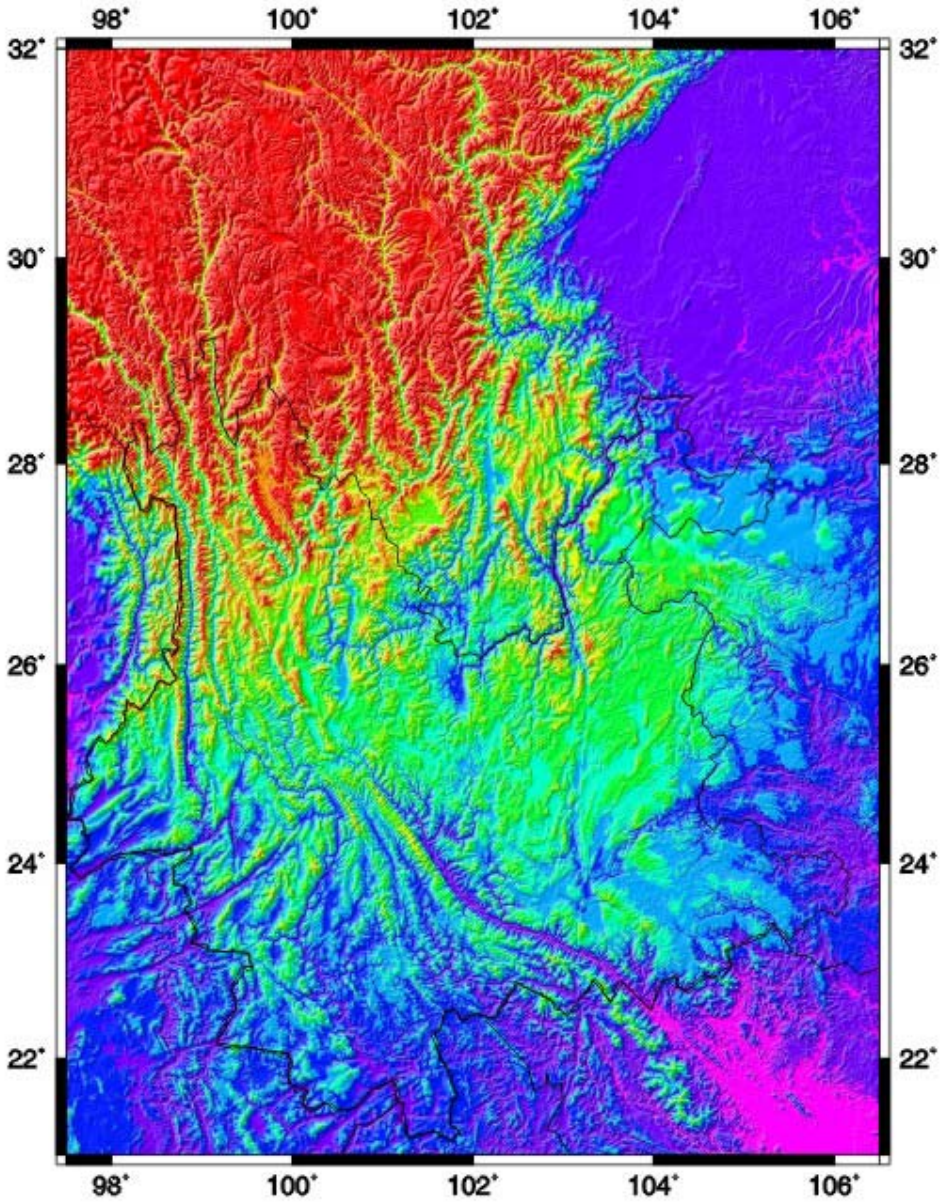

Figure 1. The topography in Yunnan, China. Large river valleys are often the places that the active faults cut through.

RESEARCH ACCOMPLISHED

More than 25 broadband portable stations have been deployed in Yunnan, China, jointly by Multimax Inc. and the Institute of Geophysics, China Seismological Bureau. The region covers 98°E-105°E, 21°N-29°N (Figure 2).

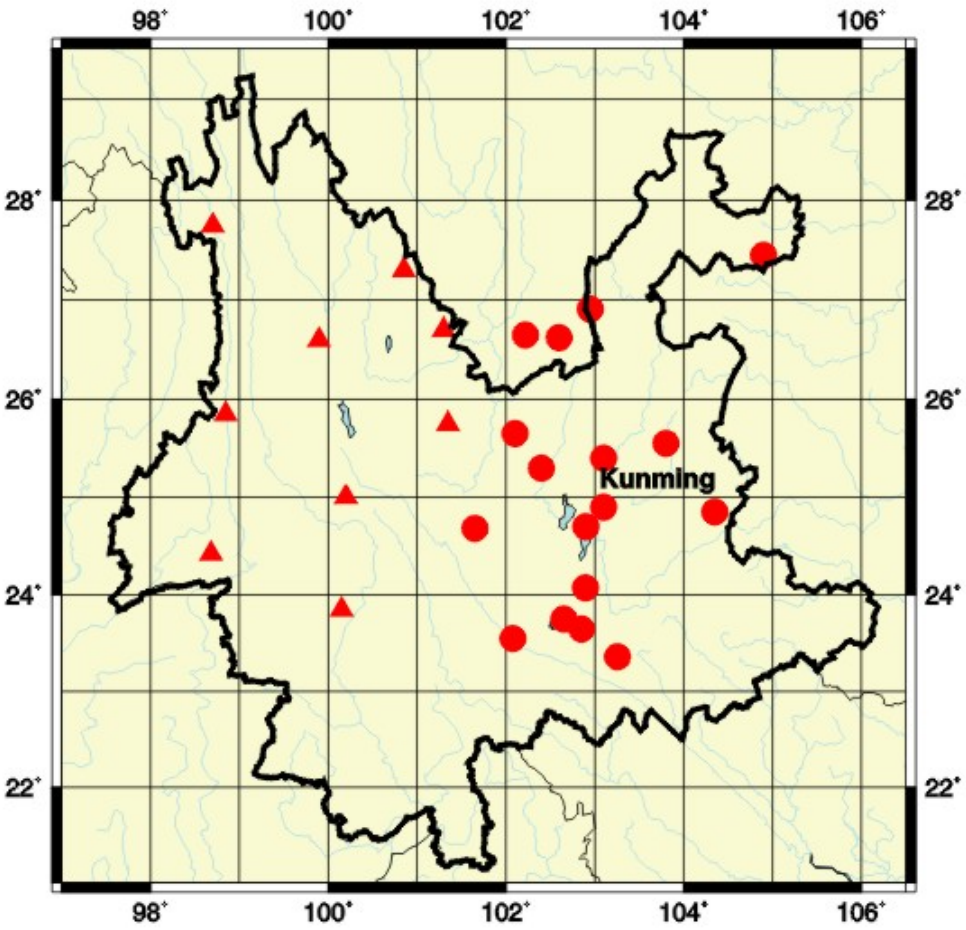

Figure 2. The stations of the portable broadband seismic network. Triangles are PASSCAL-type stations deployed by Multimax Inc. Circles are Chinese broadband instruments deployed by the Institute of Geophysics, CSB.

Most of the instruments are deployed alongside the existing short-period stations of the Yunnan Seismological Bureau (Figure 3a). The instruments are installed in vaults that are typically 30 meters deep extending horizontally into the hillside (Figure 3b). The local provincial bureaus provide the support in the security and maintenance of the instruments. Due to the remoteness of some of these stations, consistent power source remains a major issue that requires a high level of maintenance from our local collaborators. U.S. technicians return to the sites at regular intervals to perform data collection and maintenance of the instruments. The deployment and data collection will continue through June of 2002.

At the present stage of research, the data are being retrieved and transferred to Beijing and Washington from the field sites. The systematic analyses will be performed once a more complete data set becomes available. Several examples of different events recorded at various distances are shown in Figures 4 through 7 displaying the data quality.

Figure 3(a): Top – Broad-band instruments installed side by side to short-period Chinese SK-type instruments
Figure 3(b): Bottom – Entrance to vault housing the seismic instruments at one site in Yunnan, China

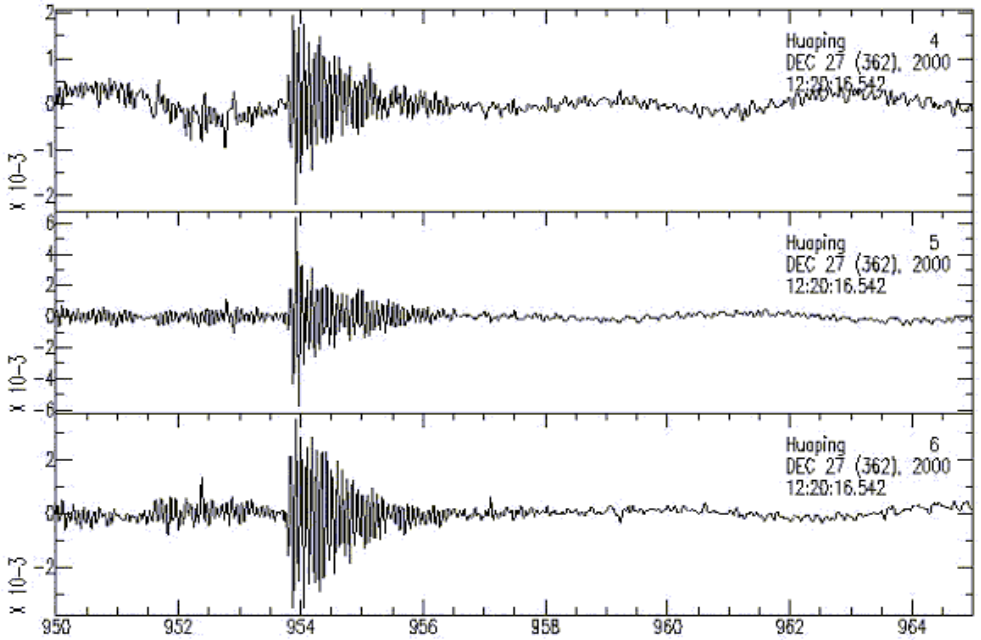

Figure 4. An example of local events. These events are in large amount. Some of them are explosions at local mines.

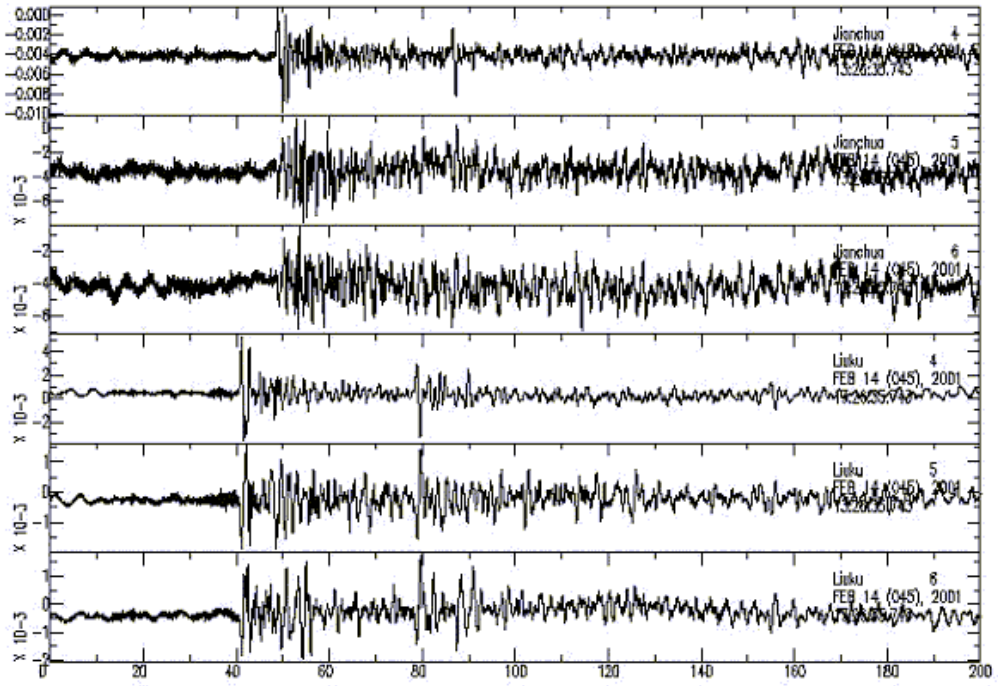

Figure 5. Example waveforms of a local (Δ~5°) M5.0 earthquake that occurred in Yajiang, Sichuan Province.

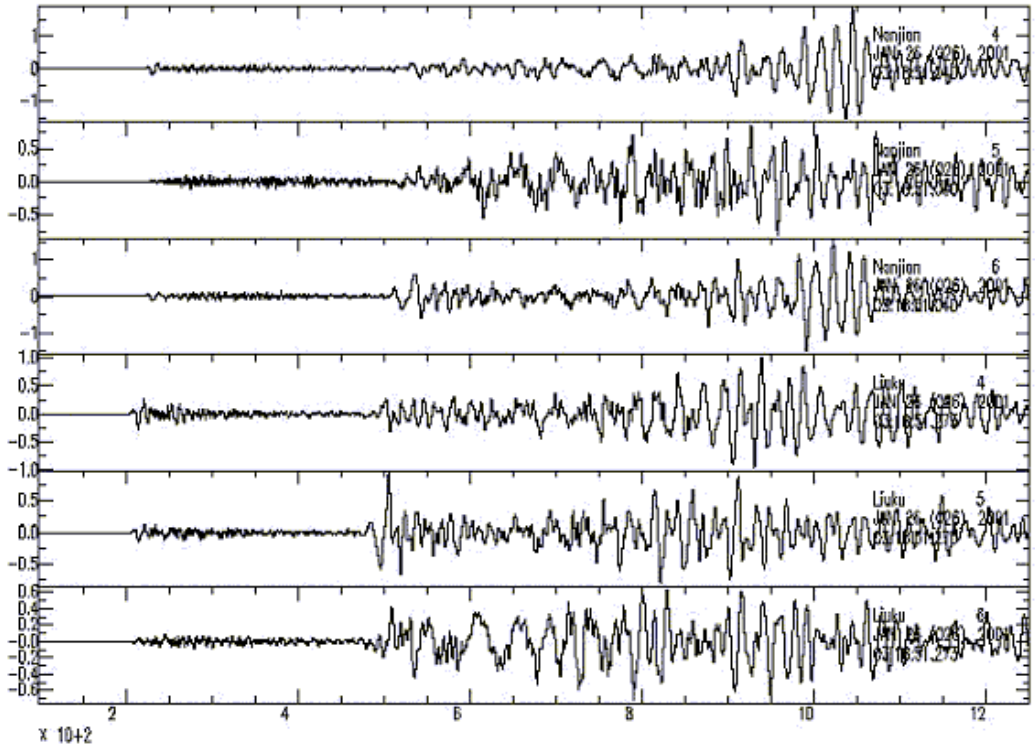

Figure 6. Example waveforms of a regional (Δ~26°) M7.7 large earthquake that occurred in India.

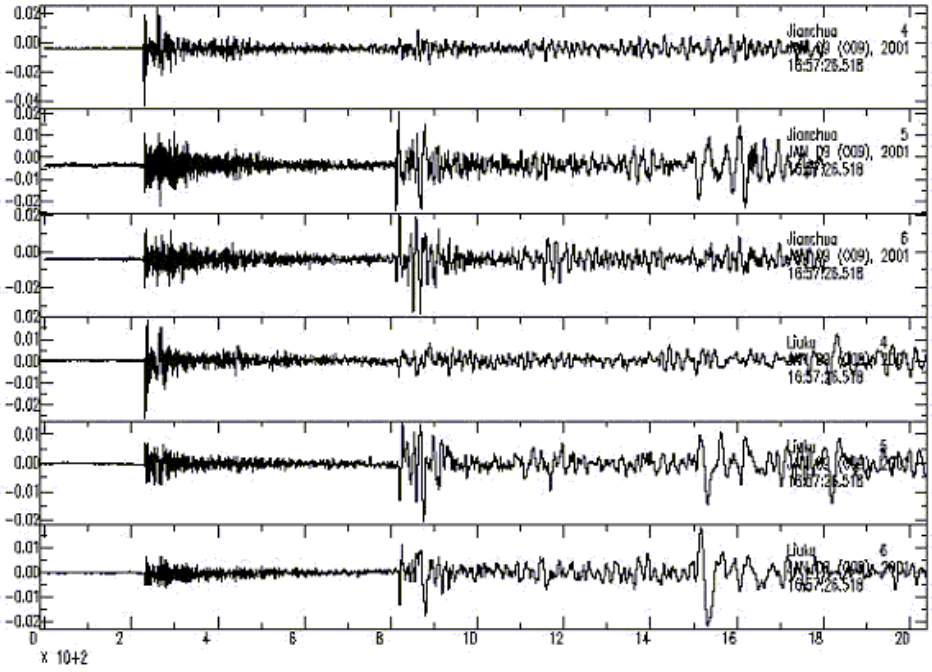

Figure 7. Example waveforms of a teleseismic (Δ~77°) M7.0 large earthquake that occurred in Vanuatu Islands.

CONCLUSIONS

High-quality waveform data with a full compliment of epicentral distances have been recorded by the portable broadband network. The complete dataset of this deployment will contribute tremendously to the ground truth information of Yunnan area. Such data are very important for studies in seismic source, earthquake prediction, and earthquake hazard reduction.

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