

Nuclear Explosion Monitoring Research and Engineering (NEMR&E) Program
Quarterly Report DOE DE-FC52-06NA27319

Research Title: “Advanced Waveform Simulation for Seismic Monitoring Events”

Name: Donald V. Helmberger, Jeroen Tromp, and Arthur J. Rodgers

Institution: California Institute of Technology

Reporting Period: August 1, 2008-October 31, 2008

Technical Progress:

A. Description of Activities

This quarter, we have focused on several tasks:

(1) Building a high-quality catalog of earthquake source parameters for the Middle East and East Asia. In East Asia, we computed source parameters using the CAP method for a set of events studied by *Herrman et al.*, (MRR, 2006) using a complete waveform technique. Results indicated excellent agreement with the moment magnitudes in the range 3.5 -5.5. Below magnitude 3.5 the scatter increases. For events with more than 2-3 observations at different azimuths, we found good agreement of focal mechanisms. Depths were generally consistent, although differences of up to 10 km were found. These results suggest that CAP modeling provides estimates of source parameters at least as reliable as complete waveform modeling techniques. However, East Asia and the Yellow Sea Korean Paraplatform (YSKP) region studied are relatively laterally homogeneous and may not benefit from the CAP method's flexibility to shift waveform segments to account for path-dependent model errors. A more challenging region to study is the Middle East where strong variations in sedimentary basin, crustal thickness and crustal and mantle seismic velocities greatly impact regional wave propagation. We applied the CAP method to a set of events in and around Iran and found good agreement between estimated focal mechanisms and those reported by the Global Centroid Moment Tensor (CMT) catalog. We found a possible bias in the moment magnitudes that may be due to the thick low-velocity crust in the Iranian Plateau.

(2) Testing Methods on a Lifetime Regional Data Set. In particular, the recent 2/21/08 Nevada Event and Aftershock Sequence occurred in the middle of USArray, producing over a thousand records per event. The tectonic setting is quite similar to Central Iran and thus provides an excellent testbed for CAP+ at ranges out to 10°, including extensive observations of crustal thinning and thickening and various Pnl complexities. Broadband modeling in 1D, 2D, and 3D will be presented.

(3) Shallow Crustal Structure and Sparse Network Source Inversions for Southern California. We conducted a detailed test of a recently developed technique, CAPloc, in recovering source parameters including location and depth based on tomographic

maps. We tested two-station solutions against 160 well determined events which worked well except for paths crossing deep basins and along mountain ridges.

B. Progress - on track.

C. Progress is following the stated Work Statement.