(b) abstract

Award No. **03HQGR0019**

TITLE Approaching Seismology in the Source: Earthquake Source Studies at LVEW and SAFOD

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(c) TECHNICAL ABSTRACT

In this project we studied the near-source structure, surrounding rock and fluid properties, and source parameters of microearthquakes recorded on deep-well geophysical instruments at Long Valley and Parkfield. In July 2002 we placed a Vertical Seismic Profiling array of 3-component seismographs in the 2.1 km deep SAFOD Pilot Hole. Based on data from this array, we report here the discovery of at least 2 new fault strands in the area of the Pilot Hole. We propose to collect and analyze more microearthquake data from the array, but now focusing more on near-source rock and fluid properties and source parameters. In August 2003, in cooperation with the USGS and Carnegie Institute of Washington, we installed a smaller VSP array in the 2.6 km deep Long Valley Exploratory Well.

The discovery of the new fault strands at the SAFOD site was accomplished through a Kirchhoff-type migration of microearthquake VSP signals. The migration process allowed the origin points of secondary seismic phases to be imaged, thereby revealing not only reflections from the San Andreas fault, but the new faults as well. We propose to use this same technique to image the local structure around the new VSP array in the LVEW. Base on earlier, surface recordings, we anticipate seeing several features.

We also analyzed MEQ seismic data from the bottom of the LVEW for their source characteristics. These data were gathered at a sampling rate of 1000 Hz. The data set included events that took place within a few hundred meters of the well bottom and magnitudes as small as ML ~ -1.5 or less. The signals of these events appear to show source scaling in energy and apparent stress with respect to size over seven orders of magnitude in moment. Some events suggest that their sources are made up of rapid multiple slips. Analysis of these data showed that different attenuation models did not change the estimates of source parameters for the closest events therefore suggesting that the location of the instrument enables us to look primarily at the source process with little effect from the path.

(c) NON-TECHNICAL ABSTRACT

Our project has resulted 3 significant contributions to the USGS NEHRP program:

1. We have located at least 2 new fault zones between the San Andreas fault and the internationally supported SAFOD drilling site, where current work is being done to drill throught the San Andreas at unprecedented depths of 3 km. These fault are important because the drilling will cut through them and they may be a major part of the SAF's mechanical operation.

2. In collaboration with the USGS and Carnegie Institution of Washington DC we have install a geophysical observatory in Long Valley Caldera in the LV Exploratory Well during the summer of 2003. This observatory is important because it can detect very small changes in the volcanic system underlying the LV area.

3. We have analyzed earlier earthquake data from the LVEW, gathered in preparation for the 2003 installation and found unique earthquake sources. This work is important because it give insight into the multiple ways a volcanic system can produce earthquakes.