Geophysical Research Abstracts, Vol. 7, 10417, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10417

The Relationship between Stress, Structure and Seismic Anisotropy in the Region surrounding the San Andreas Fault near Parkfield, CA

N. L. Boness and M. D. Zoback

Department of Geophysics, Stanford Univeristy, California, USA (nboness@stanford.edu / Fax: +1 650 725-7344 / Phone: +1 650 723-3464)

The region surrounding the San Andreas Fault Observatory at Depth (SAFOD) near Parkfield, CA is an ideal location to study the effect of crustal structure and the state of stress on seismic velocity anisotropy because the direction of maximum horizontal compression is at a high angle to the predominantly northwest-southeast structural trend. To study seismic anisotropy in the crust at multiple scales we utilize a suite of geophysical logs from the SAFOD boreholes, earthquake data recorded on the Pilot Hole array, the High Resolution Seismic Network (HRSN) operated by U.C. Berkeley, the Northern California Seismic Network (NCSN) and the Southern California Seismic Network (SCSN). At the smallest spatial scale, data from the 2.2-km-deep pilot hole and upper section of the main SAFOD borehole provides a unique opportunity for studying the in-situ physical properties of the crust adjacent to the San Andreas Fault Zone. Dipole sonic logs in the SAFOD boreholes indicate that the shear-wave velocity anisotropy of the rocks surrounding the wellbore is on the order of 3 to 10% and controlled by the tectonic stress field. An analysis of earthquake seismograms shows that ray paths through the Salinian granite adjacent to the fault exhibit fast shear wave polarizations aligned with the direction of maximum horizontal compression, in agreement with the SAFOD measurements. In contrast, ray paths along the San Andreas fault and through fault-parallel sedimentary structures yield fast directions consistent with the northwest-southeast structural trend. An analysis of regional seismic data in California shows a similar signature, indicating that seismic anisotropy may be useful in mapping the stress field within the crust surrounding the San Andreas Fault. We conclude that within the San Andreas Fault Zone, the structural fabric is the dominant mechanism responsible for velocity anisotropy whereas in the surrounding crust,

the direction of maximum horizontal compression is the most important controlling factor.