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PROJECT PROGRESS REPORT (03/16/1998-06/15/1998):

**A COMPREHENSIVE STUDY OF FRACTURE PATTERNS
AND DENSITIES IN THE GEYSERS GEOTHERMAL
RESERVOIR USING MICROEARTHQUAKE SHEAR-WAVE
SPLITTING TOMOGRAPHY**

**(YEAR 2: TOMOGRAPHIC INVERSION FOR 3-D CRACK DENSITY
DISTRIBUTION AT THE GEYSERS GEOTHERMAL FIELD)**

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SUMMARY

We completed the process of identifying shear-wave splitting in the Geyser area. A total of 2700 observations were recorded with about 1700 observations from the 1988 data and about 1000 observations from 1994.

Fast polarization direction map in Figure 1 shows that most of the stations in the Geyser area display consistent direction throughout the main field, between 0° azimuth to 40° azimuth. Some exemptions to the consistent crack alignment (fast polarization direction) can be seen in stations 9 and station 3, and also in stations 13 and 14 outside the field. Since the stations are in boreholes it is possible that some of the station orientations, calculated using P-wave arrivals from located events, are erroneous. If we treat measurements of polarization direction as a statistical process, same as deep of layer measurement, we can say that in the small area of the station we have aligned cracks.

Figures 2 and 3 show results of the crack density inversion assuming regional crack azimuth of 20° . Almost 2400 raypaths were used to perform this tomographic inversion. There is weak dependency of the results on the regional crack direction, but the main areas of high and low crack density are the same. The changes are mainly in the size of the anomalies. Since the amplitudes of those anomalies depend mainly on the damping parameter we use in the inversion, exact regional crack direction is not a critical parameter of the inversion.

The map in figure 2 and cross-sections in Figure 3 show two areas of high crack density at the top 1 km one at station 8 and the other between stations 6 and 5. At greater depth of 1 to 2 km those two area converge to one high crack density anomaly between stations 3, 4, 11, and 10

Figure captions

Figure 1. Crack azimuth for the Geyser area. The number refer to seismic stations and the length of the line in the rose diagrams refer relative number of S-wave observations within given azimuth bin

Figure 2. Crack density map for the Geyser area. The number refer to seismic stations and the colors to relative density of cracks, with high density in red.

Figure 3. Crack-density cross sections for the Geyser area. Cross section locations are mark at Figure 1. Numbers and colors refer to relative density of cracks, with high density in red. The vertical and horizontal axes are in kilometers.

Geysers Polarization direction

Fig 1

Geyzers East-West cross-sections

Fig 3