PROJECT PROGRESS REPORT (06/16/1998 - 9/15/1998):

**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 locating events and identifying shear-wave splitting in the mammoth area. A total of 2250 split shear wave observations were recorded in the four month period that our network was in place.

Fast polarization direction map in Figure 1 shows that most of the stations in the mammoth area display consistent direction throughout the main field, between 300° azimuth to 0° azimuth. Some exemptions to the consistent crack alignment (fast polarization direction) can be seen in station M19, and some stations display inconsistent trend as can be observed in stations M25, M18, and M07. It is possible that station M19 was misaligned during installment. Figure 2 shows the cumulative rose diagram for all observations with a clear preferred direction. Figure 3 also shows that most of the observations of fast split shear wave are in the same direction and that those observation are distributed throughout the target area. 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 4 and 5 show results of the crack density inversion assuming regional crack azimuth of 340° . Almost 2000 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 4 and cross-sections in Figure 5 show two areas of high crack density: one northeast of the Casa Diablo area at depth of 1 to 3 km, and one near the Mammoth airport and station 9 at depth of 2 to 3 km.

Figure captions

Figure 1. Fast shear wave polarization 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. Composite rose diagram for all fast shear wave observation in Mammoth.

Figure 3. Map showing fast polarization distribution in the Mammoth area. Each line connects source and receiver for one observation. The direction ball at the lower left corner mark the color coding for this plot.

Figure 4. 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 5. Crack-density cross sections for the Geyser area. Cross section locations are mark at Figure 4. Numbers and colors refer to relative density of cracks, with high density in red. The vertical and horizontal axes are in kilometers.

Mammoth Polarization direction

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5A