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Mapping Subsurface Faults in Southwest Iceland Using Relatively Located Microearthquakes

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The two M=6.5 earthquakes in the South Iceland Seismic Zone(SISZ) in June 2000 induced thousands of microearthquakes throughout southwest Iceland. Approximately nineteen thousand events recorded in the area during the following six months have been relocated using a double difference location method. The method uses cross correlation of similar wave forms to determine relative travel times of waves from events to stations with increased accuracy, and then inverts these relative travel times for an improved location. This increases the location accuracy to such a degree that individual fault patterns become resolvable, thus enabling fault mapping. Mechanisms are calculated for each event by inversion of spectral amplitudes and polarities. Joint interpretation of the event distributions with focal mechanisms allows the determination of slip direction on individual faults. The aftershock activity on the two main faults reveals various finer details of fault structure. The June 17th (J17) fault is 11.5 km long and 10 km deep and aftershock activity appears mostly restricted to the fault edges. The main shock is located in the middle of the fault plane, at approximately 6 km depth. The hypocenter of the June 21st event is at 5 km depth on a 16 km long fault, which deepens towards south, where the activity is also the strongest.

Within minutes of the J17 event, four M$\sim$5 events occured, one near the south end of the J17 fault and the other three on Reykjanes Peninsula. Two were dynamically triggered by shear waves from the main event. Their exact location and mechanism determination has proven problematic since the waveforms are clipped and ride on top of the J17 shear waves. Though not contiguous, the aftershock distribution on these two faults provides invaluable constraints on the fault areas and event magnitudes. The plane of the most eastern event is well defined by the aftershock activity, but hardly

any aftershocks have been mapped on the fault plane of the most western event.

Innumerous smaller faults in southwest Iceland were illuminated by increased activity. Most faults strike close to north and show a dominant right-lateral slip direction, often with a small normal component, as commonly observed in the SISZ. In the Western Volcanic Zone, north-east fault directions are more common, but right-lateral motion is still the dominant slip direction. In some areas, fault strikes deviate from the general trend, for example near Hengill where east-west directions are also observed. These are predominantly left-lateral strike-slip faults, with a small normal component. A detailed map of subsurface faults with slip directions will be an important contribution to the refinement of a tectonic map and for mapping of the stress field in southwest Iceland.