

Upward Migration of Earthquake Swarms Beneath Mammoth Mountain, California -- Evidence for Movement of Magma in the Lower Crust?

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Mammoth Mountain is a cluster of dacitic domes erupted between 100 to 50 ka standing on the southwest topographic rim of Long Valley caldera in eastern California. Among the signs of episodic unrest observed beneath the mountain since 1980 are brief swarms of lower-crustal, brittle-failure earthquakes, occurring at 20-30 km depth. Overlying these events are two distinct zones of seismicity: mid-crustal long-period earthquakes (10-20 km depth) and shallow brittle failure earthquakes (generally above 8 km). We suggest that the deep brittle-failure earthquakes are occurring within the more mafic lower crust, which can remain brittle to temperatures as high as $\sim 700^\circ\text{C}$. The mid-crustal long-period earthquakes likely occur within the silicic crust, but below the rheological transition from brittle to plastic behavior, expected at temperatures of ~ 350 to 400°C . Above this transition are the shallow brittle-failure earthquakes.

Seismic waveform correlation analysis of deep swarms that occurred beneath Mammoth on June 16-17, 2006 and September 29-30, 2009 reveals that these swarms consist of hundreds of similar events, allowing us to identify and locate ~ 10 times the number of events in the Northern California Seismic Network (NCSN) catalog. For the 2009 episode, preliminary double-difference locations based on cross-correlation measurements suggest that the swarm occurred in a relatively small volume with dimensions of 1 km. Locations show a clear upward migration as the sequence progresses. This swarm occurred 6-8 km almost directly above the 2006 activity, suggesting a possible relationship between these swarms. We are currently exploring models that could link these patterns to stresses related to intrusion or pressurization in the lower crust.