

Upper Miocene Subaerial Sturzstroms from the Vallecito Mountains, Anza-Borrego Desert State Park, California

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Abstract

Fractured plutonic rock high on the steep, east-facing front of the Vallecito Mountains was shed in large masses that fell, shattered and flowed as catastrophic sturzstroms. Two of these upper Miocene deposits in the Split Mountain-Fish Creek Mountains area were examined for paleoflow indicators.

The older red-and-gray sturzstrom was derived mostly from foliated sphene-amphibole-biotite tonalite and quartz-rich granite. Crushed rock step-ups ($n = 19$) indicate a N70E paleoflow.

Lying on top of the red-and-gray sturzstrom in places is the Split Mountain sturzstrom, a ~300 million m^3 deposit of crushed plutonic rock. The proximal portion of this sturzstrom is dominated by foliated biotite tonalite whereas the distal material is shattered quartz-rich granite varieties. The deposit is reverse graded with the largest clasts sitting on top. Clasts are angular, extremely poorly sorted and many display jigsaw-puzzle fabric. Several narrow canyons eroded through the sturzstrom expose paleocurrent indicators. Crushed pegmatite streamers yield an average paleoflow of S72E ($n = 43$). Grooved clasts in the underlying braided-stream deposits and lowermost sturzstrom yield an average paleoflow of N86E ($n = 8$). The sturzstrom flow produced a large volume of powdered rock that injected and flowed into gaps and fractures within the sturzstrom mass. The powder is well preserved and abundantly displayed on canyon walls as powdered injection pipes (PIPs). Seen within the pipes are pebble trains, aligned biotites and cross-cutting relationships.

The Split Mountain sturzstrom deposit caps a thick, nonmarine section but is overlain by an even thicker marine section. The same tectonic event that initiated the sturzstrom may have allowed sea water into the region.