

Postseismic movement of the 1960 Chile earthquake and deformation cycle

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Postseismic uplift midway along the 1960 Chile rupture appears to be slowing down. We studied the uplift near Puerto Montt, 70 km east of the Pacific coast. Puerto Montt is located on the boundary between the 1960 earthquake's coseismic downwarp and a coseismic and/or postseismic upwarp farther inland. This deformation was mapped by George Plafker in 1968, and the postseismic uplift was checked by him and others in 1989. The postseismic uplift has been attributed to afterslip on the plate interface, stress relaxation in the forearc mantle, or both. In 2004 and 2006, we obtained further information about shoreline change before and after the earthquake from the Pacific coast to 120 km eastward inland, about midway along the length of the 1960 rupture. Following in Plafker's footsteps, we used several criteria for distinguishing between coseismic and postseismic movement. We asked eyewitnesses whether sea level changed at the time of the earthquake, and whether it has changed in recent decades. We also looked for emerged landforms and for environmental changes in vegetation. Where reliable testimony or natural features provided exact reference points, we measured differences in height by means of total station. Forty-five places yielded numerical estimates of land-level changes since 1960. All the points seem to have gradually been uplifted in a few decades after the earthquake. The largest total amount of displacement during past 45 years (co- and post-seismic uplift) was estimated to be 2.1 m in Chamiza, 10 km east from Puerto Montt. According to the interviews, most of the uplift occurred during or in the first month the earthquake. The total amount of uplift tends to decrease eastward from Chamiza. The easternmost point (60 km east from Puerto Montt) did not rise or fall during the 1960 earthquake, but gradually rose nearly 1 m in the first 40 years thereafter. The postseismic uplift has probably been canceled by subsidence later in earthquake deformation cycles. The Puerto Montt tide gauge record shows little or no uplift in the 1990s. Similarly, some eyewitnesses in and near Chamiza say that the sea has begun to rise in the past decade. Although historical (1575) and prehistoric earthquakes perhaps comparable to the 1960 event produced stratigraphic evidence for tsunamis and coseismic subsidence 55 km to the west, near Maullin, we have not found marine terraces that would indicate net late Holocene uplift in the Puerto Montt area.