

Learning from Earthquakes

M_w 7.8 Tarapacá, Chile, Earthquake of June 13, 2005

This article was submitted by Efraín A. Rondinel-Oviedo of Drexel University, who holds a degree in civil engineering from the Catholic University of Peru. He is currently studying ground failure in the 2001 M_w 8.4 southern Peru earthquake as part of his doctoral research at Drexel. The information below was obtained through telephone interviews with local authorities, from articles published in the Chilean newspaper "La Nación," (www.lanacion.cl), University of Chile and CISMID (Peru) reports, and interviews broadcast on the Peruvian radio station. "Radio Uno" (www.radiouno.com.pe).

On June 13, 2005, at 18:45 local time (22:45 UTC), the region of northern Chile and southern Peru was shaken by a large earthquake with a moment magnitude (M_w) of 7.8. The earthquake epicenter was located in the Andes, approximately

125 km ENE of Iquique (Chile) and 250 km SSE of Tacna (Peru). The event was felt as far as Bolivia (La Paz) and Brazil (São Paulo).

Ground shaking was strongest in northern Chile, where modified Mercalli intensities (MMI) of VII and VI were estimated for the towns of Iquique, Calama, and Tocopilla. The strong-motion stations in Iquique and Pica recorded peak horizontal ground accelerations (PGA) of 0.26 g and 0.72 g respectively. Less severe but nevertheless significant shaking was felt in southern Peru, where MMI values were estimated to be V to IV in the towns of Tacna, Moquegua, Punto de Bombón, and Ilo. A PGA of 0.12 g was recorded in Tacna.

The earthquake killed 11 people, including a family of six that perished in a landslide located between the towns of Iquique and Alto Hospicio. At least 100 people sustained injuries during the event. The earthquake destroyed at least 180 houses and damaged approximately 1,400, most of which were of adobe construction. It is estimated that more than 60% of the houses

significant portion of the transportation infrastructure in the region was severely damaged. Much of this was the result of landslides, which occurred at locations throughout northern Chile, including Chumiza, Huara, Camiña, Mamiña, Pica, Tarapacá, Pisagua, and Mocha. Landslides disrupted traffic along many highways in the region, including the Panamericana, the major north-south artery.

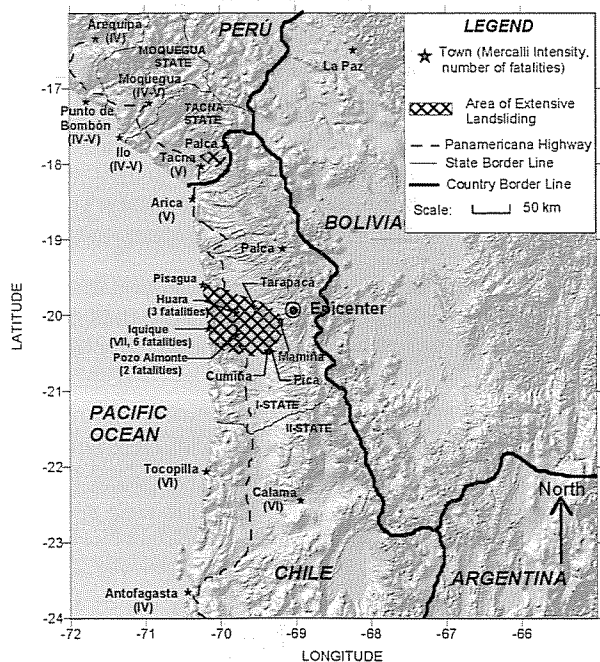
In southern Peru the damage was less severe than in northern Chile and no fatalities were reported. In the state of Tacna, approximately 30 houses were damaged and many of the surrounding adobe walls tumbled. A large landslide occurred along the Tacna-Palca highway (km 27), and a number of small, isolated rock falls were reported along other highways. In the state of Moquegua, only minor damage was reported. Here isolated rock falls occurred along the Ilo-Desaguadero highway (Peru-Bolivia) and close to the Moquegua state tunnels in the Panamericana highway.

Earthquakes in the region are produced by the subduction of the oceanic Nazca plate beneath the South American plate, with an interplate displacement rate of 7.8 cm/year in an ENE direction. This process is responsible for not only the seismic activity of the region but also the creation of the Andes mountains. The large subduction events often occur on the interface between the subduction plate and the overriding plate with depths of 50 km or less. The earthquake of June 13, 2005, was deeper, occurring on the subducted plate at a depth of 117 km.

Many large earthquakes have occurred in the region in the past, including the 1922 M_w 8.5 Chile-Argentina border earthquake, the 1960 M_w 9.5 Chile earthquake (the largest ever recorded), and the 2001 M_w 8.4 southern Peru earthquake.

suffered irreparable damage in many of the small towns in the Andes. In this region the impact of the earthquake was exacerbated by road closures that effectively isolated these communities and required relief supplies to be delivered by military planes. The earthquake left 30 electric substations out of service, which cut off the water supply to the region located near the town of Iquique.

Critical structures such as coastal ports, hospitals, and airports generally fared well in the earthquake; however, a



Intensities and landslides distribution in the affected region.