

Chile quake occurred in zone of 'increased stress'

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The latest earthquake off Chile occurred just north of the 1960 rupture, which had caused a stress buildup along the fault line. (Volkan Sevilgen, US Geological Survey; Jian Lin, Woods Hole Oceanographic Institution; and Ross Stein, US Geological Survey))

(PhysOrg.com) -- The massive, 8.8-magnitude earthquake that struck Chile Feb. 27 occurred in an offshore zone that was under increased stress caused by a 1960 quake of magnitude 9.5, according to geologist Jian Lin of the Woods Hole Oceanographic Institution (WHOI).

The <u>earthquake</u>, some 300-500 times more powerful than the magnitude 7.0 <u>quake</u> in Haiti Jan. 12, ruptured at the boundary between the Nazca and South American tectonic plates. The temblor was triggered when the



"subducting" Nazca plate was thrust under the South American plate, uplifting a large patch of the <u>seafloor</u> and prompting tsunami warnings throughout the Pacific Ocean. The two plates are converging at a rate of 80 mm per year, says Lin, "which is one of the fastest rates on Earth."

Lin and colleague Ross S. Stein of the U.S. Geological Survey in Menlo Park, Ca., have studied the region extensively, and alerted the scientific community to a build up of stress along the interface of the two plates in a 2004 paper in the <u>Journal of Geophysical Research</u>.

"In 2004, we calculated that the 1960 magnitude 9.5 earthquake has caused large stress increase on both the northern and southern ends of its rupture," said Lin. That quake, centered a few hundred kilometers south of Saturday's earthquake, was the largest instrumentally recorded earthquake in the world. It killed 1,655 people in southern Chile and unleashed a tsunami that crossed the Pacific, killing 61 people in Hawaii and 185 in Japan. Saturday's "quake picked up where the 1960 rupture ended in the north," Lin said.

"This story is quite similar to the Dec. 26, 2004 magnitude-9.0 Sumatra earthquake, which was followed by a magnitude 8.7 quake on its southern end on 28 March 2005," he said. "The only difference is that it took 50 years for the northern neighboring section of the 1960 [Chile] earthquake to rupture, while it took only 3 months for the southern adjacent segment to rupture in Sumatra.

"We do not yet have good enough science to say why one place took only 3 months and another took 50 years. But even 50 years is short enough [to fall within] in a person's lifetime. Thus, we should consider the earthquake interaction possibilities seriously."

In Haiti, Lin point out that and others have calculated that the Jan. 12 rupture has heightened stress further east along the Enriquillo Fault,



thereby increasing chances of a quake in that region, which "comes within five kilometers of Port-au-Prince," he said.

The latest Chile quake, which had killed more than 700 people as of Mar. 1, was centered some 65 miles west-southwest of Talca, Chile, about 21.7 miles below the ocean's surface, "relatively shallow for a subduction quake," said Lin. It struck about 200 miles southwest of Santiago, the country's capitol. Saturday's earthquake had a "much longer" rupture zone—500-600 km—than that of the Haiti quake—35-50 km, Lin said.

"So why was the Haiti quake so much more catastrophic than the Chile quake?" he asked.

"First, as a nation, Chile is much better prepared for earthquakes than Haiti. People in Chile today still remember the pain of the 1960 quake," Lin said. In addition, coastal Chile has a history of other very large earthquakes. Since 1973, there have been 13 events of magnitude 7.0 or greater. Approximately 870 km to the north of the Feb. 27 earthquake is the source region of the magnitude 8.5 earthquake of November 1922. That great quake significantly killed several hundred people and caused severe property damage. The 1922 quake generated a 9-meter local tsunami that inundated the Chile coast near the town of Coquimbo; the tsunami also crossed the Pacific, washing away boats in Hilo harbor, Hawaii.

"In contrast, the last catastrophic earthquake in Haiti was 240 years ago," Lin said, "and thus few people were aware of a string of 'earthquake bombs' lying next to Port-au-Prince until Jan. 12.

"Second," he said, "the economy of Chile is much better than that of Haiti. Thus, building codes are better developed and enforced in Chile. The contrasts between the aftermaths of the Chile and Haiti quakes



reminded us, once again, that 'earthquakes do not kill people, buildings do.'"

The Chile temblor dispatched tsunami waves onshore to Chile and across the <u>Pacific Ocean</u> toward Hawaii and the west coast of the US mainland, primarily California, and experts warned that tsunami waves were likely to hit Asian, Australian and New Zealand shores within 24 hours of the earthquake. Waves 6 feet (1.8 meters) above normal hit Talcahuano near Concepcion 23 minutes after the quake, and President Michelle Bachelet said a huge wave swept into a populated area in the Robinson Crusoe Islands, 410 miles (660 kilometers) off the Chilean coast. There were no immediate reports of major damage from the waves.

Though the predicted tsunami waves did reach Hawaii, California, New Zealand and other Pacific Rim regions, they proved to be relatively small and had minimal impact. "Even though the waves turned out to be not devastating", Lin said, "it was an important opportunity for communities in coastal regions to improve the preparedness for potential greater tsunamis in the future."

The WHOI research vessel Atlantis was operating off the coast of northern Chile when the magnitude 8.8 earthquake struck on Saturday. WHOI confirmed that R/V Atlantis and all on board are safe. There were no ill effects to R/V Atlantis or those on board from the quake or the subsequent tsunami.

R/V Atlantis has a scheduled port stop beginning on March 3, 2010, in Arica, Chile, which is on the northern coast of Chile. The WHOI Marine Operations Department is assessing the situation with their port agents to determine how or if that port stop will be affected.

A number of WHOI staff are onboard the R/V Melville, operated by Scripps Institution of Oceanography, which is conducting research at the



Chile Triple Junction. WHOI received an email from an employee onboard the ship, and was told that all onboard are fine. The blog associated with this expedition

(http://oceanexplorer.noaa.gov/explorations/10chile/) had not been updated on Saturday because, WHOI was told, the ship's communication capability was being used to communicate by those onboard with family on shore.

Provided by Woods Hole Oceanographic Institution

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