

Japan quake-tsunami recast undersea terrain

Dan Vergano, USA Today, 12-7-11

SAN FRANCISCO – Undersea views reveal that Japan's colossal earthquake ripped deep fissures in the seafloor and raised undersea cliffs hundreds of feet, while spawning waves that destroyed billion-dollar seawalls, scientists reported here Tuesday.

In a series of reports on the March 11 earthquake, among the strongest ever recorded at magnitude 9.0, researchers here at the American Geophysical Union meeting described a shattered world on the Japanese seafloor that birthed a killer tsunami responsible for the deaths of at least 20,000 people.

"They were doomed to start with," says tsunami expert Costas Synolakis of the University of Southern California. A \$1.6 billion undersea breakwall outside the town of Kamaishi, for example, "didn't protect the town," he says, taking perhaps 6 feet off of a 40-foot tsunami wave. Funneled by narrow sea canyons, waves as high as 130 feet hit some towns, powered by the seafloor's abrupt piston-like bucking during the quake.

"In some places, we cannot see to the bottom of the fissures," says geophysicist Takeshi Tsuji of Japan's Kyoto University. Before-and-after robot submarine visits to three sites about 70 miles off Japan's coasts confirm that the seafloor shifted more than 70 feet eastward and dropped more than 30 feet in some locales, along the fault between the Pacific Ocean and the Japanese crustal plate.

Fissures stretch the length of football fields and a cliff several hundred feet tall looks freshly exposed at one spot, more than 2 miles deep.

"It was a peaceful seafloor, but after the earthquake everything moved," Tsuji says. The seafloor study, and satellite images reported Monday, help further explain the tsunami's severity.

- Parts of the seafloor on the eastern side of the fault dropped, while the far side popped upward and westward, delivering a double-barreled tsunami.
- The NASA Jason-1 oceanographic satellite revealed waves merging offshore to heights far exceeding expectations, channeled by undersea ridges. "We call them fingers of God," Synolakis says.
- Preventive measures such as planting stands of pine trees on coasts proved useless for stemming waves. Japanese researchers such as Kazuhisa Goto of Japan's Tohoku University reported that they now realize that a tremendous tsunami that struck Japan in 869 A.D. should have served as a warning to the island nation.

The earthquake struck with such force, the fourth-largest one ever measured in the world by seismologists, that it dealt Japan two waves of shaking: one originating at the fault itself and one emanating from a displaced reflection of the quaking, which shook the seafloor closer to the coast, says geologist Keith Koper of the University of Utah in Salt Lake City.

"It was like an orchestra, with the tubas playing on one side," he says, and the flutes playing on the other.

The quake lasted for three minutes, "an enormous amount of time for an earthquake," Koper says, precisely because of the undersea orchestration of the quake shaking the seafloor.

"The more we understand the physics of earthquakes and tsunamis, the better we can warn people the next time," says Dapeng Zhao of Japan's Tohoku University. "That is why we study this."