"Mega-Tsunami" Threat of the Cumbre Vieja Volcano in Canary Islands

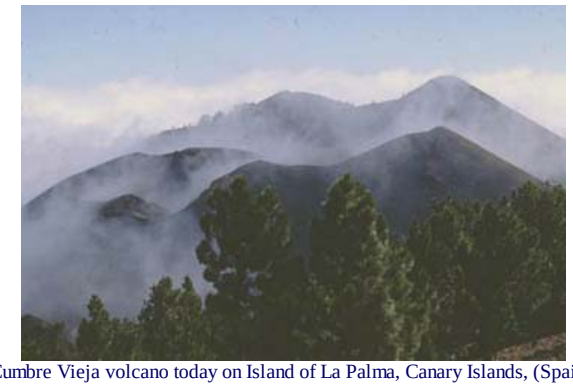
Satellite photo of 4-mile-high Cumbre Vieja, La Palma, Canary Islands, (Spain) volcano, west of La' Youn, Morocco, Africa. Three miles of the volcano are below the surface of the Atlantic Ocean; just over one mile is above the surface. Image courtesy of the **Image Analysis Laboratory, NASA Johnson Space Center.**

January 21, 2005 Santa Cruz, California - The seven Canary Islands owned by Spain rise above the Atlantic Ocean west of Morocco, Africa. One of them, La Palma, is not only the steepest island in the world, but has also been the most volcanically active of the Canaries in the past 500 years. On it is the 4-mile high volcano called *Cumbre Vieja*, which means "Old Summit." The volcano has been re-building itself for the past 15,000 years since it last blew apart and collapsed huge amounts of rock into the surrounding ocean, sending out a giant tsunami that has been detected in deposits as far away as the Bahamas and Bermuda. Over the past 15,000 years, the volcano kept erupting under water, building back up from the Atlantic sea bed three miles below the water surface to its present height, which is now more than a mile above the Atlantic. Its last two eruptions were 1971 and 1949.

During the 1949 eruption, the western side of the island slipped 16 feet downward towards the sea and opened up a 2-kilometer-long fracture which is visible today. It is believed that this process was driven by the pressure caused by the rising magma heating and vaporizing water trapped within the structure of the island. Now geologists think that western side of the volcano is unstable. During another future eruption, as much as *500 cubic kilometers* of that western side could collapse into the Atlantic waters. If that happened - as incredible as it sounds - computer models indicate the tsunami at the collapse site could be more than a kilometer high. That would be *more than half a mile of water rise* at La Palma after all the estimated 500 billion tons of rock fell rapidly and displaced an equivalent amount of water.

Computer models show that as the water moves out at 500 mph across the Atlantic Ocean, by the time it reaches the East Coast of North America and as far south as Brazil some 8 to 12 hours later, the tsunami could be *as high as 165 feet* when it hits shorelines in northern Brazil. That's a 15-story-building!

A scientist who began studying the Cumbre Vieja volcano in the mid-1990s and the possible consequences of such a mega-tsunami on the east coast of North America and Brazil is British geologist, Simon Day, Ph.D. Dr. Day is now Visiting Associate Researcher from University College, London, in the Department of Earth Sciences, University of California - Santa Cruz, California. Recently I asked him about the potential tsunami danger of the volcano and if he had confidence in the accuracy of the computer modeling projections which some other geologists dispute.



Cumbre Vieja volcano today on Island of La Palma, Canary Islands, (Spain).

Interview:

Simon Day, Ph.D., Visiting Associate Research Geologist from University College, London, now in the Department of Earth Sciences, University of California - Santa Cruz, California: "At some stage in the future, La Palma might do the same. After a series of eruptions in each of which it moves a little bit, it could eventually collapse catastrophically and produce a landslide of a few hundred cubic kilometers, taking away the whole side of the volcano and dumping it into the ocean as a landslide. That's what would then generate the giant tsunami waves.

Cumbre Vieja Volcano Collapse Could Produce Mega-Tsunamis
20 to 55 Yards High On North and South American East Coasts

YOUR COMPUTER MODELING SHOWS THAT THE TSUNAMI COULD BE AS HIGH AS 55 YARDS (165 feet) IN BRAZIL.

You have to remember that the tsunami will be very much larger near the source and will then as it spreads out from a few very large waves into a series of smaller waves, it will diminish in height as it crosses the ocean. Then, of course, as tsunamis do, it will build up again on the other side. But the sorts of heights that the computer model is predicting for the Eastern seaboard in the United States, Canada and the Caribbean and for northern Brazil are in that sort of range several tens of meters high as a maximum value.

IF SOMETHING WERE 55 YARDS, WHICH IS OVER 150 FEET, THAT WOULD BE AT LEAST A 15-STORY BUILDING.

Yeah, it's that sort of size. Following events in the Indian Ocean, we'll now have a comparison which is the tsunamis there the La Palma collapse would produce a tsunami at least a few times larger in terms of wave heights than the tsunami in the Indian Ocean was. (Those very high waves) would be very close to source, but what we're talking about is the height of the wave as it reaches the other side of the Atlantic Ocean. So, along a much greater length of seaboard.

WE'RE TALKING ABOUT NEW YORK, BOSTON, WASHINGTON, D. C. WE'RE TALKING ABOUT ONE OF THE LARGEST POPULATION CORRIDORS IN THE UNITED STATES.

That's correct. I think one of the lessons from the Indian Ocean tsunami is just how much damage a tsunami can do when it strikes a densely populated coast line and particularly, those cities on the eastern seaboard that face the ocean directly. They would potentially be under very considerable threat from such a wave.

HAS THERE BEEN ANY 15-STORY-HIGH TSUNAMI ON RECORD FROM ANYTHING HAPPENING IN THE CANARY ISLANDS OR THAT AREA IN THE

PAST?

Not in human historical record, because the last collapse of this type that occurred in the Canary Islands occurred at least 15,000 years ago, and perhaps much longer than that. But in terms of the geologic record, there have been a number of these volcanic collapses in the Canaries and also into other island groups in the Atlantic, like the Cape Verde Islands which are further south than the Canaries. So, in terms of the geologic record, these things are not unprecedented at all.

THE ASSUMPTION IS THAT EVEN IF IT WERE 15,000 YEARS AGO THAT BIG SWAMPING TSUNAMI FLOODS DID HIT THE EAST COAST OF NORTH AMERICA?

That's right. And the one 15,000 years ago, sea level would have been significantly lower than present and the coast line would have been much further out. So, we don't have direct records of that. But there are a number of deposits on, for example, the Bahamas and in Bermuda that have been tentatively linked to tsunamis that might have been produced by previous volcano collapses in the Canaries.

WHAT DO THOSE DEPOSITS CONSIST OF?

Very, very large boulders, great chunks of the reef weighing as much as a couple of thousand tons that have been ripped off the edge of the reef and are carried inland by the waves.

SO THE EDUCATED GUESS IS THAT FOR THAT KIND OF FORCE TO LIFT THAT SIZE OF ISLAND CHUNKS INLAND, IT WOULD HAVE TO BE LARGE WATER?

That's right. If it was a tsunami wave in one of these very rapid floods, very turbulent floods similar to those that we've seen in the video footage from the Indian Ocean, we'd be looking at waves at least a few tens of meters high. So, pretty high thirty yards plus (at least 90 feet high) necessary to move boulders of that size over great distances.

What is important is the question whether or not at some stage in the near future, one of these eruptions is going to give enough push to the flank of the island to cause it to collapse? That's the big question.

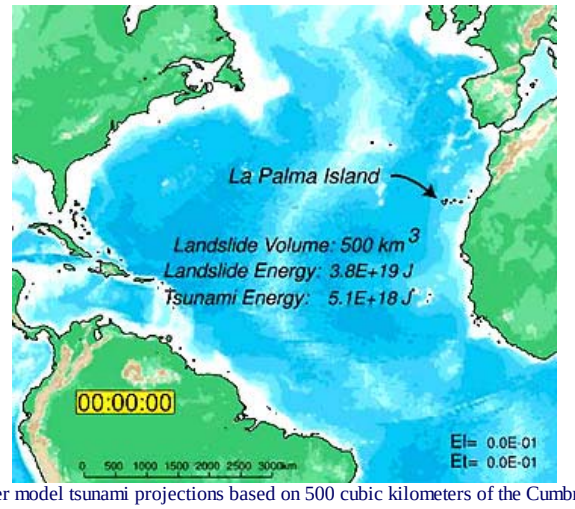
CAUSE COLLAPSE IN THE VULNERABLE SIDE OF THE VOLCANO.

That's right, on that vulnerable western side of the volcano.

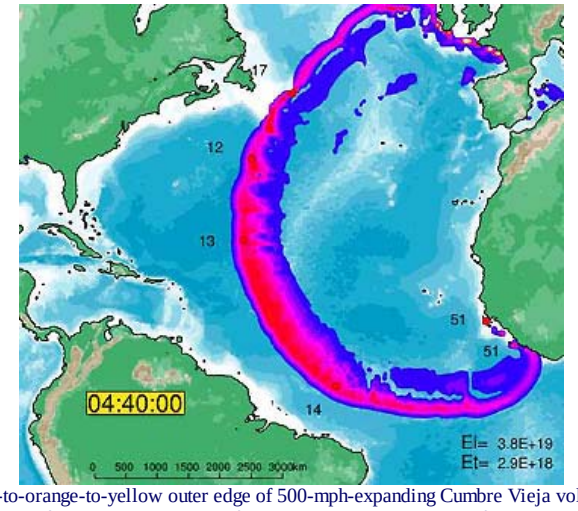
What Would A Mega-Tsunami Do To American East Coast? Compare to Krakatoa Volcano Explosion in 1883

[Editor's Note: When Krakatoa erupted on August 26, 1883, the entire northern portion of the island was blown away. The blast has been estimated to have had the power of *100 megatons of TNT*. That explosion was heard over 4,800 kilometers (2,983 miles) away on the island of Rodrigues. The pressure waves in the atmosphere circled the earth seven and a half times before fading away. For two and a half days, the whole region was clouded in darkness. The estimated amount of material ejected into the atmosphere was 11 cubic miles, 21 cubic kilometers. Only one-third of the volcanic caldera remained above sea level.

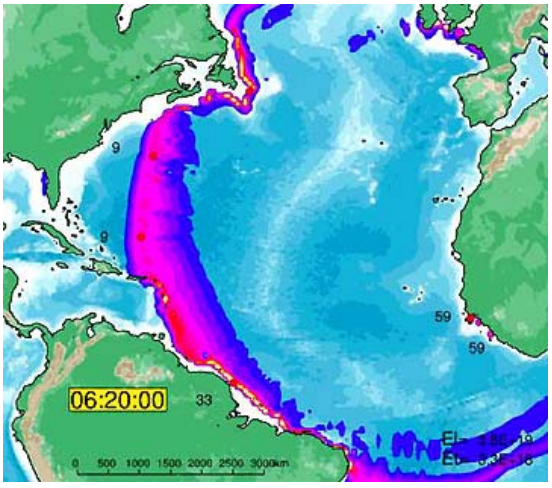
Tsunamis from Krakatoa: A series of large tsunami waves generated by the main explosion, some reaching a height of nearly 40 meters (more than 120 feet) above sea level, killed some 37,000 people in the coastal towns and villages along the Sunda Strait on Java and Sumatra islands. Tsunami waves were recorded or observed throughout the Indian Ocean, the Pacific Ocean, the American West Coast, South America, and even as far away as the English Channel. Krakatoa is located between the Indonesian Islands of Java and Sumatra and lies in a small group of islands, known as the Sunda Straight.]



Computer model tsunami projections based on 500 cubic kilometers of the Cumbre Vieja volcano on the (arrow) La Palma Island, Canary Islands, sliding rapidly into the Atlantic Ocean.



Red-to-orange-to-yellow outer edge of 500-mph-expanding Cumbre Vieja volcano "mega-tsunami," after potential collapse of 500 cubic kilometer section of volcano. Such a tsunami would be as high as 55 yards high in computer models upon impact at North and South American shorelines. Frames from computer simulation © 2004 by Steve Ward, Ph.D., U.C. Santa Cruz.



Mega-Tsunami Travel Time to North and South America: 8 to 11 Hours

IF THE CUMBRE VIEJA VOLCANO DID COLLAPSE, HOW MUCH TIME WOULD THERE BE BETWEEN THAT MOMENT AND THE TSUNAMI REACHING NEW YORK AND THE EAST COAST?

According to Steve Ward's computer models and I think other computer models would agree on the travel time indicate between 8 to 10 or 11 hours for different parts of the North and South American coasts. So, there would be a certain amount of warning between the collapse and the arrival of the waves. The big question is: would that be

sufficient to evacuate coastal areas? Or would it be necessary to start an evacuation earlier? For example, on the basis that the flank of the volcano was moving very fast and perhaps was accelerating, might suggest that it was about to collapse catastrophically. In which case, the goal might be to try to predict a collapse, maybe two or three days in advance, and say provide two or three days in which evacuation could be carried out.

WHAT KIND OF DEVASTATION WOULD OCCUR? ASSUMING YOU COULD GET PEOPLE OUT, WHAT WOULD HAPPEN TO THE CITY ITSELF?

We can get an idea from the Indian Ocean tsunami and also from the 30-yard-high waves that were produced locally by the Krakatoa eruption in 1883. I suppose the nearest analogy we have in our experience are the very strong stone lighthouses. Around Krakatoa, those were completely destroyed when they were struck by tsunami waves with 20-meter-plus heights.

SO THE STONE LIGHTHOUSES WERE LITERALLY PHYSICALLY DESTROYED AND THE WATER REDUCED THEM TO LIKE THESE MOONSCAPES LIKE WE HAVE SEEN IN SUMATRA AND THAILAND?

Absolutely. There are photographs taken soon after the Krakatoa tsunamis in photographs and they look exactly like the very worst damaged areas in Sumatra and Thailand. But there, they had only 10-meter-high tsunamis which are very much less destructive than the 20-meter-plus higher waves.

WHAT DO YOU THINK THE LIKELIHOOD OF THIS OCCURRING THIS CENTURY COULD BE?

That really is the question, isn't it? The probability of an eruption of this volcano occurring in this century is pretty high. In fact, I think it's almost certain. The problem is: Is that eruption the one that is going to trigger the collapse? Or is it just going to cause the fault to move another few yards or tens of yards and then the thing stops again? And that we really don't know. It's really going to be important to monitor the volcano during its next eruption, or few eruptions. Then at that stage, we'll really be in a much better position to say this is going to occur next on the volcano or not. Or isn't going to occur for the next several eruptions in which case, it becomes a more distant prospect.

But, of course, the thing is in geological terms, this is going to happen very soon in terms of the geological time scale. And so, you have to consider it as a real possibility every time the volcano erupts. As I said, it's almost certain that the volcano is going to erupt at least once probably twice in the next century.

WITH REALLY DIRE CONSEQUENCES FOR THE EASTERN SIDE OF NORTH AMERICA IF THAT VOLCANO COLLAPSES.

That's right. The key question is: how many more eruptions are going to occur before it collapses. It might be ten or twenty eruptions in which case the collapse might not occur for a couple of thousand years. But at some stage in the very near geologic future, something like this is going to happen.

AND IT COULD HAPPEN IN THIS CENTURY?

It could. The probability is pretty low, but it's something that has to be considered as a possibility every time the volcano erupts."

How Accurate Is the UC-Santa Cruz Cumbre Vieja Collapse Computer Model by Steve Ward?

Dr. Day and his UC-Santa Cruz colleague and computer modeling expert, Steve Ward, checked the accuracy of their model against what happened on Ritter Island in Papua, New Guinea, in 1888, after a volcanic landslide produced tsunamis back then. Dr. Day and Dr. Ward went to Ritter Island to map the landslide distribution and studied eyewitness accounts. When Dr. Ward ran his computer model with Ritter Island data, it described the collapse, dispersion and tsunamis quite accurately.

Websites:

Steve Ward's Computer Models, UC-Santa Cruz: **http://es.ucsc.edu/~ward/**

Steve Ward's Computer Model Moving Video File: **http://es.ucsc.edu/~ward/LP_tsu_Atlantic_small.mov**

Credits

www.earthfiles.com
earthfiles@earthfiles.com