NEWS

Pleistocene Forests Preserved in Oregon Coast Sediments

PAGES 2–3

Erosion on the Oregon coast has exposed several paleosols (ancient soil deposits) containing well-preserved tree trunks. Some trunks are of Holocene age [*Hart and Peterson*, 1997], while others are much older. These macrofossil deposits contain clues to tectonic activity, paleovegetation patterns, coastal erosion, and climate evolution.

This article describes a paleosol located near Cape Perpetua, Oregon, containing trunks dated at prior to 50,000 B.P. The forest appears to have been buried during a catastrophic debris flow and preserved due to anoxia.

The exposure is located at 124.108°W, 44.298°N, about 1 km south of the town of Yachats. A 10-m-high bank forms the north slope of a creek mouth that empties into a small embayment of the Pacific Ocean. The bank is composed of a homogeneous mixture of sand and angular clasts with diameters up to ~10 cm. Underlying the bank is the Yachats Basalt bedrock. Enclosed within the bank, about 1 m above the bedrock, is a layer of horizontally-oriented tree trunks (Figure 1).

Fig. 1. Macrofossil stratum and overlying sediments. Coast Highway 101 runs atop the bank. The white vertical line at the lower left is 1 m in length.

The largest trunks have diameters near 40 cm, and the maximum thickness of the wood layer is about 1 m. The layer extends for about 20 m along the bank. Thick, ruddy bark suggests that the trees are spruce, a common species on the modern Oregon coast. Above the paleosol is an 8- to 10-m-thick layer of sediment atop which runs the coast highway.

The horizontal orientation of the largest trunks as well as the homogeneity of the overlying sediments suggest that the forest was buried in a landslide. Such events may occur in association with the subduction zone earthquakes that happen every few hundred years on the Oregon coast [e.g., *Darienzo and Peterson*, 1995]. The other potential source of horizontally-oriented logs is driftwood [e.g., *Komar*, 1998, Figure 2.5], but the ubiquitous presence of thick bark appears to rule out this possibility.

The macrofossil stratum overlays the southern edge of a wave-cut platform formed around 80,000 B.P. during a previous interglacial high stand [*Lund*, 1972]. Two wood samples have been radiocarbon dated at the Center for Accelerator Mass Spectrometry at the U.S. Department of Energy's Lawrence Livermore National Laboratory. Each sample was dated twice.

The first sample gave an initial date of 44,690 ± 1100 B.P. After dissection to reduce possible contamination by modern rootlets, a second run yielded > 49,900 B.P. As this is within two standard deviations of the background measurement, it is considered a lower bound [*Stuiver and Polach*, 1977].

The second sample was taken from a higher elevation in the wood layer but gave an earlier date, suggesting that some modern contamination remained in the first sample. Two measurements of the second sample yielded > 55,500 and > 54,750 B.P., which are again considered lower bounds. These results suggest that the forest lived at least 50,000 years ago.

Work is under way to compare the Yachats paleosol with other similar features on the Oregon coast. One such exposure, located a few miles south of Yachats at Devil's Churn, has been dated at > 55,500 B.P. The forest layer at Devil's Churn is overlain by Pleistocene low stand dune deposits.

Splits from a trunk in a paleosol at the base of the Capes landslide in Tillamook County (123.964°W, 45.558°N) have yielded radiocarbon ages of 38,900 ± 680 and >47,070 B.P. [*Allan and Priest*, 2001]. Trees in colluvium associated with a landslide north of Lincoln City (124.009°W, 45.023°N) have been dated at >47,330 and >45,410 B.P. [*Priest and Allan*, 2004].

The results so far suggest that a period of forest growth and landsliding occurred on the Oregon coast after the cutting of shore platforms during the 80,000 B.P. high stand. The forests were supplanted by dune fields and later exposed by wave erosion some time after the rise of sea level in the Holocene.

Acknowledgments

We are grateful for the assistance of Laura Brophy, Chris Goldfinger, Barbara Smyth, and Carol Wille. A portion of this work was performed under the auspices of the U.S. Department of Energy by the University of

California, Lawrence Livermore National Laboratory under contract W-7405-Eng-48.

References

Allan, J. C., and G. R. Priest (2001), Evaluation of coastal erosion hazard zones along dune and bluff backed shorelines in Tillamook County, Oregon: Cascade Head to Cape Falcon, *Open File Rep. 0-01-03,* 126 pp., Oreg. Dep. of Geol. and Miner. Ind., Portland.

Darienzo, M. E., and C.D. Peterson (1995), Magnitude and frequency of subduction-zone earthquakes along the northern Oregon coast in the past 3,000 years, *Oreg. Geol., 57,* 3–12.

Hart, R., and C. Peterson (1997), Episodically buried forest in the Oregon surf zone, *Oreg. Geol., 59,* 131–144.

Komar, P. (1998), *The Pacific Northwest Coast*, Duke Univ. Press, Durham, N.C.

Lund, E. H. (1972), Coastal landforms between Yachats and Newport, Oregon, *Oregon Geology* (formerly known as *The Ore Bin*), *34*(5), 73–91.

Priest, G. R., and J. C. Allan (2004), Evaluation of coastal erosion hazard zones along dune and bluff backed shorelines in Lincoln County, Oregon: Cascade Head to Seal Rock-Technical Report to Lincoln County, *Open File Rep. 0-04-09*, Oreg. Dep. of Geol. and Miner. Ind., Portland.

Stuiver, M., and H. A. Polach (1977), Discussion: Reporting of 14C data, *Radiocarbon, 19*(3), 355–363.

—William D. Smyth, Oregon State University, Corvallis; Roger A. Hart, Oregon Department of Geology and Mineral Industries, Coastal Field Office, Newport; Paula J. Reimer, Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, Calif. (current address: 14CHRONO, Queen's University of Belfast, U.K.)

Sumatran Earthquake Spawns Devastating Tsunami

PAGE 3

The devastating tsunami that followed the *M*9.0 earthquake off the west coast of northern Sumatra, Indonesia on 26 December "to our knowledge is the first global tsunami," according to Eddie Bernard, director of the U.S. National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory.

Bernard, past chairman of the U.S. National Tsunami Hazard Mitigation Program and of the International Union of Geodesy and Geophysics' Tsunami Commission, said he received reports on 28 December that the tsunami had been recorded on tide gages as far away as Kamchatka, Russia. He anticipates that it also may have been recorded in the Atlantic Ocean.

Measurements of the tsunami so far from its source provide an indication of the amount of energy that the earthquake and likely subsequent underwater landslides placed into the ocean, he said.

"The tsunami community is in awe of the magnitude of this event. This very small and highly specialized community needs the brain power of the entire Earth science community to help understand and tackle this problem so that we can avert these colossal disturbances to our societies," he said.

Bernard noted that the National Tsunami Hazard Mitigation Program has developed the ability to detect small tsunamis in the open ocean, transmit that information in real time back to warning centers, and feed the data into numerical models for forecasting tsunamis. He said the accuracy of detection is on the order of one-half centimeter, and that the numerical models have about an 80% accuracy.

However, Bernard cautioned that while small tsunamis are fairly linear and well-behaved, colossal tsunamis may not be so easy to predict.

He said the direct, deep ocean measurement of tsunamis would advance tsunami science "faster than anything else we can do," and it would also help to provide the public with vital hazard warning information.

The World Conference on Disaster Reduction, on 18–22 January 2005 in Kobe, Japan, will include a special session on tsunami warnings, and Bernard is involved with drafting a U.S. position statement on the subject.

Sálvano Briceño, director of the secretariat on the United Nations International Strategy for Disaster Reduction, said that he wants to see that every country around South Asia and Southeast Asia has "at least a basic but effective tsunami warning system" in place within a year.

Kenji Satake, deputy director of the Active Fault Research Center at Japan's National Institute of Advanced Industrial Science and Technology, noted that an international tsunami warning system exists in the Pacific. He added that if a similar system had already been in place for the Indian Ocean, it may have saved some lives by providing sufficient warning between the time of the earthquake and the arrive of the tsunami several hours or longer afterwards.

The earthquake was the first instrumentally-recorded *M*9 earthquake in the Indian Ocean, according to Satake.

He noted that a detailed analysis of the Sumatra earthquake source process could help to prepare for earthquakes in other subduction zones.

He also noted that the earthquake is providing a good opportunity for scientists to study the Earth's interior, because the seismic waves from the quake have traveled through and around the globe many times. Satake noted that the 1960 *M*9 earthquake in Chile significantly advanced the understanding of the Earth's free oscillation.

—Randy Showstack, Staff Writer