Earth Science

Richard Monastersky reports from San Diego at the annual meeting of the Geological Society of America

Historical clues from the San Andreas

The Loma Prieta earthquake of 1989 caused major damage in the San Francisco Bay area, but its force paled in comparison with the great 1906 shock in that region. Geologists have now uncovered signs that a comparable megashock struck the Bay area around 1650. The finding may help scientists predict when the next great quake will shake this segment of the San Andreas fault.

Trenches dug across the San Andreas fault in the Santa Cruz mountains reveal evidence of two earthquakes in this region: the 1906 event and one from the mid-1600s, reports David Schwartz of the U.S. Geological Survey in Menlo Park, Calif. A trenching study conducted at Point Arena, several hundred kilometers to the north, also shows signs of two quakes from the same periods. At both sites, scientists used carbon-dating techniques. The evidence from these two widely separated sites suggests that the entire length of the fault between the Santa Cruz mountains and Point Arena may have broken at once in a great earthquake around 1650, Schwartz says.

When this long stretch of the San Andreas ruptured in 1906, the resulting earthquake reached an estimated magnitude of more than 8.0. But scientists have never before found geologic evidence of an earlier great quake along the same section. The new work suggests that such megashocks may recur every 250 years or so — a figure that agrees with mathematical calculations of the time between large shocks in this region

The evidence does not prove that a large earthquake ruptured this entire stretch at once, Schwartz cautions. Carbon dating is not precise, so different sections of the fault may have ruptured separately. If so, the Santa Cruz segment may have slipped in a strong—but not "great"—quake in 1650, followed 20 years later by another strong quake near Point Arena.

Diamonds from continental garbage

Gem collectors reject diamonds marred by little black inclusions of foreign minerals. To some scientists, however, these flaws hold more value than the treasured rocks of romance themselves. New studies of diamond inclusions are now revealing how plate-tectonic activity pushes pieces of the continents into the interior of the planet.

Diamonds get their start deep in Earth's mantle, where pressures are high enough to force carbon atoms into a more densely packed crystal structure. The stones reach the surface when explosive volcanic eruptions propel them upward. Scientists originally thought diamonds grew from carbon supplied by the mantle. But in recent years they have found signs that one class of diamonds contains material from the ocean crust, which sinks down into the mantle at subduction zones around the world.

C. Stewart Eldridge of the Australian National University in Canberra and his colleagues now report that diamonds of this class also contain material from continental rocks. The evidence comes from an extremely sensitive machine called an ion microprobe, which the researchers used to analyze the ratios of sulfur and lead isotopes in the diamond inclusions.

The isotopic evidence provides clues to how the motion of Earth's tectonic plates mixes material from one layer of the planet into another. The researchers suggest that sediments — essentially the refuse washed off the continents — get pulled into the mantle through subduction. Because the continental material becomes incorporated into diamonds, it must reach the significant depths where the gems grow, Eldridge says.

Park blazes didn't harm groundwater

When wildfires ripped through Yellowstone National Park in the summer of 1988, some people feared that the tremendous amount of newly created ash might alter groundwater chemistry, lowering water quality in the area. Not so, reports Mary A. Siders of the University of Colorado at Boulder.

Siders collected postfire water samples over several years at four sites in the park and compared them with samples taken before the fires. Matching sites that hadn't burned with sites that burned moderately or severely, she found no dramatic, fire-related changes in the concentrations of various chemicals in the groundwater. Yellowstone is normally a nutrient-poor environment, so the addition of nitrates and other chemicals from blazes could fertilize dangerous algal blooms if the chemicals reached the groundwater.

Trees with a thirst for fog

Fog may be the unsung hero of certain forests While common sense might dictate that rain or snow supplies the water used by vegetation, a study conducted on California's Point Reyes peninsula suggests that some trees also depend on fog water.

Neil Ingraham of the Desert Research Institute in Las Vegas and his colleagues at the University of California, Davis, analyzed water from the interior of trees at three locations on the peninsula — an area bathed in fog during summer and moistened by rain in winter. Because fog water and rain have different ratios of hydrogen and oxygen isotopes, the scientists were able to determine which kind of water the trees had absorbed. At one location, trees used rainwater during the rainy season and fog water during a foggy season. At another site, trees seemed to use fog water year-round, while trees at the third spot used only rainwater. This is the first study to document the uptake of fog water by trees, Ingraham says.

Trees don't absorb fog moisture directly out of the air, but instead use their leaves as a sort of collecting net. As the fog blows in, water droplets collide with the leaf surface. Coalescing into larger droplets, they drip to the ground and then soak into tree roots. Ingraham says his group's findings suggest it may be impossible to regenerate certain forests that have been cleared. If the trees depend on fog water, then cutting the forest will remove the fog-collecting system, and sprouts or young trees may not be able to catch enough fog water to sustain themselves, he says.

Ancient splash in the Atlantic

A drilling project along the Virginia coast has uncovered signs that a meteorite slammed into the Atlantic Ocean 40 million years ago, letting loose a huge wave perhaps more than 100 feet high. The tsunami apparently gouged out of the seafloor a region about the size of Connecticut, reports C. Wylie Poag of the U.S. Geological Survey in Woods Hole, Mass.

Poag and his colleagues devised their wave theory to explain a 200-foot-thick layer of boulders they have found in three locations, buried under 1,200 feet of sediment. Within the boulder layer lie glassy rocks called tektites and mineral grains bearing shock features — indications that a meteorite hit nearby. Poag suggests the meteorite crashed into the submerged continental shelf, creating a wave that ripped the seafloor into 3-foot boulders near present-day Virginia.

The scientists first discovered signs of this impact eight years ago when a deep-sea drilling project off the coast of Atlantic City, N.J., pulled up tektites and shocked mineral grains some 40 million years old. The new findings substantiate the earlier impact evidence and suggest that the crash occurred off the Mid-Atlantic Coast.

Many scientists attribute the mass extinction of 65 million years ago to a large meteorite or comet that walloped Earth at that time. Poag's proposed meteorite was not large enough to cause a mass extinction 40 million years ago.