Susan West reports from Washington at the annual meeting of the American Geophysical Union

Alaskan quake potential

A further look at the Gulf of Alaska seismic gap, where a 7.7 magnitude quake occurred Feb. 28 about 100 miles east of Valdez (SN: 3/24/79, p. 185), reveals that it is primed for a magnitude 8 or larger quake in the next 20 to 40 years.

According to William McCann, Klaus Jacob, Omar J. Perez and Lynn R. Sykes of Lamont-Doherty Geological Observatory, the Feb. 28 St. Elias quake, which "filled" an eastern portion of the gap, provided one of the final pieces in a tell-tale pattern of precursory earthquake activity. The seismic gap theory holds that great earthquakes can be forecast by identifying places of stress accumulation along plate boundaries where great quakes have not occurred for the past 30 years.

Though very large quakes — the Good Friday 1964 magnitude 8.5 quake and a 1958 magnitude 7.9 quake — have broken the North America-Pacific plate boundary on either side of the Yakataga Gap (so named for Cape Yakataga), no major activity has occurred along the 175-kilometer stretch since 1899. And McCann and co-workers estimate that, because the plates move at about 6 centimeters per year, about 5 meters of slip needs to be released. Moreover, the Feb. 28 quake seems to fit another precursory pattern, a ring of increasing seismological activity known as a Mogi doughnut that surrounds the quiescent zone. K. Mogi, a Japanese seismologist, found that tremors of magnitude 6 or more occur in a doughnut-shaped pattern 10 to 20 years before a magnitude 8 or larger quake finally ruptures within the doughnut. Before the St. Elias quake, McCann and co-workers had re-examined the seismic history of the area. They identified an increasing number of moderate-sized quakes to the south, and the St. Elias quake occurred on the edge of the ring — "just where you would expect before a big quake."

"These [patterns] indicate that a quake may occur in about 20 years. But, in fact, it may be much longer," said McCann. "It could be another 20 to 40 years. But we'd be not at all surprised if it were tomorrow." In order to gather more information, the U.S. Geological Survey, which McCann says has about 20 stations set up in the gap, plans to add tiltmeters, strainmeters and other equipment to its network.

Wandering New England

The Canadian Maritime and New England region has never seemed to be quite the same, geologically speaking, as the rest of North America. The fossils, the types of rocks and the ages, as determined by radioactive dating, of the two regions differ significantly. Because of these discrepancies, various models have been proposed as to how the two pieces became one.

Now, results from paleomagnetic dating of samples from the Catskills may put those models in sharper focus. While other dating methods can reveal the age of rocks, only paleomagnetic dating — because it measures the direction of magnetization of a rock, which is preserved at the time the rock is formed — can give the ancient position of a land mass relative to the pole.

According to Dennis V. Kent and Neil D. Opdyke of Lamont-Doherty Geological Observatory, the coastal Maritime-New England region, including eastern Massachusetts, Rhode Island, southeastern Maine, coastal New Brunswick, and possibly eastern Newfoundland, existed 15° of latitude south of its present position during the Devonian period. That means that Maine was somewhere around Georgia between 350 million and 400 million years ago. During the Late Carboniferous period, between 280 million and 310 million years ago, continental North America and New England began to share a common polar wander path — meaning that they became joined and oriented in the same direction. Kent and Opdyke estimate the landmass moved about 1,500 kilometers at a rate of 7 centimeters per year.

Tiny bubbles

Crystal-ringed spheres found in basalt samples may be the first example of two materials of the same chemical composition showing different physical properties due solely to a contrast in temperature, according to D. Walker of Harvard University, S.E. De Long of State University of New York in Albany and T. Shibata of Okayama University in Japan. They discovered perfectly circular, 1-millimeter-diameter rings of crystals scattered throughout dredge samples taken during the early 1970s from the North Central Atlantic Ocean bottom northwest of the Azores. Unlike gas-filled vesicles, which are commonly found in basalts, these "spherical microstructures" are filled with the same material as the surrounding volcanic rock. After ruling out the possibility that the structures are simply filled vesicles, Walker and co-workers proposed that they are droplets of colder lava that are mixed in and swept along with hotter magma flows. Because of the thermal contrast, De Long told Science News, the droplets remain in balls, and "like a ball of modeling clay rolling along, picking up confetti on a table," they pick up individual crystals. The droplets and the surrounding lava eventually reach the same temperature and further crystal growth seals the rings. The formation of a ring — or meniscus — often occurs between a solid and liquid or because of contrasts in other physical properties, De Long noted, but "this is the first instance — that we know of — of a meniscus-type structure between two liquids due to temperature alone."

Biblical quakes

The collapse of the walls of Jericho and the miraculous halt of the Jordan River that allowed Joshua and his troops to pass, the destruction of Qumran where the Dead Sea Scrolls were found, even the fall of Sodom and Gomorrah were all caused by recurring earthquakes along the same fault — according to a paper presented by Amos Nur of Stanford University.

The Dead Sea Rift, which cuts through the Jordan Valley where these biblical events took place, is a landward continuation of the boundary between the African and Arabic plates. The type of motion along the fault had been inferred from geologic evidence, but, according to Nur, no seismological record had been analyzed that would pin down the frequency and style of slippage. Nur and Ze'ev Reches of the Weizmann Institute in Rehovot, Israel, have now examined the records from a 6.5 quake that occurred on July 11, 1927, 5 kilometers east of Jericho. They confirmed that the east side (Arabic plate) is slipping north relative to the west side (African plate) at a rate of about .5 meters per quake. Comparing the type of strike-slip motion that they found in the 1927 quake with well-known historical and archaeological records (geologists have long attributed the fall of Jericho and other biblical events to earthquakes), they conclude that quakes measuring 6 to 7 on the Richter scale occur, on the average, every 200 years along the fault.

In addition, they discovered that the Jordan River has a habit of damming up for one to two days because of quake-caused mudslides. In recent history, the researchers say, the river stopped flowing following quakes in 1834, 1906 and 1927. It is likely, they claim, that the miracle that enabled Joshua and his men to cross the dry bed of the Jordan River was, in reality, an earthquake.

And apparently, says Nur, the mode of slippage has remained the same during the fault's recorded history. The Book of Zechariah says "the Mount of Olives shall cleave in the midst thereof toward the east and toward the west, and there shall be a very great valley; and half of the mountain shall remove toward the north, and half of it toward the south." Says Nur, "It is amazing that Zechariah chose to describe strike-slip motion."