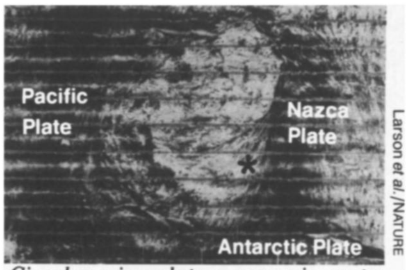
Earth Science

Spinning spectacle under the Pacific

Mapping of the Pacific floor has revealed that an Ohio-size patch of the ocean bottom is performing the geological equivalent of a pirouette. The region, a so-called microplate, has spun 90 degrees in the geologically short time of 4 million years, reports a group of scientists from the United States, England and Canada.



Circular microplate appears in center of sonar image. Star shows location of spoke-like ridges that indicate rotation.

Like a cracked eggshell, the Earth's outer skin is broken into a dozen large pieces called plates that roam around the world, crashing together in some places and moving apart in others. Much smaller blocks, or microplates, sometimes appear at the junction between two or three plates.

In the late 1980s, oceanographers discovered that the Easter microplate, near Easter Island, has rotated nearly a quarter turn in 3 million to 4 million years. Now, mapping of a microplate farther south reveals a similar phenomenon, suggesting that most microplates behave the same way, even if they form for very different reasons, says Roger L. Larson of the University of Rhode Island in Narragansett. He and his colleagues report their results in the April 16 NATURE.

The Juan Fernandez microplate sits at 110°W and 33°S, the junction between the Antarctic, Pacific and Nazca plates. Seafloor spreading along the border between the plates is adding new ocean crust onto their edges, causing the plates to diverge like three people walking away from each other. Using sonar to map the ocean bottom's topography, the oceanographers discovered ridges along the southeast edge of the microplate that fan out like the spokes of a bicycle wheel. The same spoke pattern appears on a map of seafloor magnetic measurements, which reveals the history of seafloor spreading in the area. Such agreement between both maps indicates that the spoke-like ridges formed as the microplate rotated in a clockwise direction. The scientists suggest that the various seafloor-spreading ridges in the area exerted a torque on the microplate, causing it to spin.

The turning has slowed in the last million years as the microplate has expanded. Oceanographers cannot tell whether the microplate will grow into a true plate or remain small and bond onto an already established plate. If it keeps growing, it may face an impressive future. Some oceanographers have posited that the huge Pacific plate started as a tiny microplate some 190 million years ago.

Rare quake rocks central Europe

A strong earthquake struck the border between the Netherlands, Germany and Belgium last month, causing damage to a region that had not experienced such a strong shock for generations.

The Richter magnitude, based on surface seismic waves, measured 6.1, making this the largest earthquake in this part of Europe since 1756, says Dieter Seidl, director of Germany's Seismological Central Observatory in Erlangen. The U.S. Geological Survey, which collects information on seismic waves that pass through the Earth, reported a magnitude of 5.3.

The earthquake's epicenter lay near the city of Roermond in the Netherlands. The stresses that caused the jolt may arise from the ongoing collision between the African plate and the Eurasian plate, Seidl suggests.

Physics

Ivars Peterson reports from Washington, D.C., at an American Physical Society meeting

Radioactivity on the spot

As a by-product of a painstaking search for an extremely rare type of radioactivity, researchers have detected the step-by-step transformation of a single atomic nucleus through four stages. Starting as a radioactive isotope of radon, this particular nucleus eventually ended up as an isotope of polonium.

"This may be the first time anyone has seen four successive decays of the same nucleus," says Michael K. Moe of the University of California, Irvine.

Moe and his colleagues have spent the last few years looking for a form of radioactivity known as neutrinoless double-beta decay, characterized by the simultaneous emission of two beta particles, or electrons. Using an apparatus called a "projection time chamber," the researchers trace the paths of the two electrons released during a decay event and compute their energies.

However, several other processes produce remarkably similar tracks. For example, the trace contaminant bismuth-214 decays into polonium-214 by emitting a single beta particle, but the process sometimes dumps enough energy into the bismuth atom to force the ejection of one of the atom's orbital electrons. Such tracks are difficult to distinguish from those left by legitimate double-beta decays. Luckily, the resulting polonium-214 nucleus decays almost immediately by emitting a telltale alpha particle (helium nucleus). But sometimes the emitted alpha particle gets trapped and doesn't show up.

About eight years ago, Luis W. Alvarez of the University of California, Berkeley, suggested the possibility of eliminating bismuth-214 events by looking back in time for the recorded trails left by alpha particles or electrons created during the decay of radioactive isotopes in the chain leading to bismuth-214. Citing the large number of extraneous events normally detected in his apparatus, Moe dismissed the idea as impractical. He would have to sort through too many recorded events to be sure he had found the right tracks.

Since then, however, Moe has moved his apparatus into one of the deep tunnels serving Hoover Dam near Boulder City, Nev., where the surrounding rock helps shield the equipment from the effects of cosmic rays (SN: 9/17/88, p.188). "As the chamber got quieter, we were able to do what Alvarez proposed," Moe says.

The researchers started with a suspect two-electron event. Going back 57 minutes in their records, they noticed the twin trails of a beta particle and an emitted orbital electron coming from the same spot. The track of an alpha particle appeared in the same location 70 minutes earlier, and still another showed up 72 minutes before that. These observations represented a sequence of decays in a single nucleus, going from radon-222 to polonium-218 to lead-214 to bismuth-214 to polonium-214.

Moe and his colleagues may not be the only ones who have actually traced such a chain of events. Researchers now attempting to detect solar neutrinos at the Gran Sasso underground laboratory in Italy have had to scrutinize and characterize similar sequences of decays to eliminate false signals.

Highs and lows of heavy neutrinos

Experiments hinting at the existence of a type of neutrino with a mass of 17 kiloelectron-volts – significantly greater than most theorists had anticipated – have prompted a great deal of additional experimental work and much theoretical speculation (SN: 4/27/91, p.260). But evidence to date – with many other experiments in progress – remains equivocal.

"We have the very uncomfortable situation that both the positive and the negative experiments are getting better," comments David O. Caldwell of the University of California, Santa Barbara. "It's a great mystery at this point."

Stay tuned.