PHYSICS UPDATE

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NEWFOUND ROCKS MAY BE PROGENY OF PRIMORDIAL CRUST

Within the first few hundred million years of our planet's formation, during the so-called Hadean eon, Earth's first rocks had frozen out of the molten surface to form a primordial crust. Chemical fractionation endowed those rocks with overabundances of the lighter rare-earth elements; they were richer in neodymium-144, for instance, than they were in heavier samarium-146. As a result, the few remaining rocks from that time carry a distinct isotopic signature: They are depleted in ^{142}Nd—the radioactive decay product of ^{146}Sm—relative to ^{144}Nd. Seemingly as a rule, rocks younger than about 3.3 billion years don't exhibit that depletion; the repeated cycling of material between the mantle and crust washed out the primordial ^{142}Nd signature.

Now Jonathan O'Neil (University of Ottawa) and Richard Carlson (Carnegie Institution for Science) have discovered more than a dozen counterexamples to that unwritten rule. Near the Nuvvuagittuq belt on the eastern shoreline of Canada's Hudson Bay, the researchers found 15 granitic rocks that exhibit Hadean-like ^{142}Nd deficits despite being just 2.7 billion years old. Based on the samples' isotopic profiles, O'Neil and Carlson effectively ruled out every possible explanation except one: Somehow, Hadean material survived for more than 1 billion years—many times a rock's life expectancy—before being recycled to form the granitic rocks. The discovery may help researchers pinpoint elusive events in the planet's geological time line, such as the emergence of tectonics and the formation of oceans. (J. O'Neil, R. W. Carlson, *Science* **355**, 1199, 2017.) —AGS

SEA TURTLES DON'T JUST GO WITH THE FLOW

When foraging, sea turtles presumably give little thought to the physics of ocean vortices. But scientists who study the reptiles want to know how mesoscale eddies, vortices 50–100 km in radius that transfer heat in the oceans, influence the distribution of turtle populations.

Now Peter Gaube at the University of Washington and colleagues have found that loggerhead sea turtles (*Caretta caretta*) modify their behavior to position themselves inside eddies. Colleagues from Uruguay and Brazil fixed satellite transmitters to juvenile turtles that journeyed to the confluence zone of the Brazil and Malvinas currents in the southwestern Atlantic Ocean. For five years the team tracked the turtles' positions and those of untethered buoys known as drifters that are administered by the National Oceanic and Atmospheric Administration. The researchers used satellite observations of sea-surface height to identify and track eddies.

The data showed that turtles avoided the peripheries of anticyclonic eddies. They were 83% more likely to be found in the interior of the eddies than in the outermost regions, whereas the buoys were scattered about all regions. Once the turtles found the sweet spot of an eddy, they seemed to try to stay there: Relative to the local current, they swam more slowly in the interior (~17 cm/s) than they did when caught in the periphery (~29 cm/s). Gaube proposes that the turtles were seeking the gelatinous gastropods that favor the anomalously low chlorophyll concentrations and warm water in the interior. That hypothesis is bolstered by the fact that the turtles did not target the colder waters at the center of cyclonic eddies.

The study establishes a methodology for investigating how aquatic organisms make use of ocean currents, for identifying critical habitat in the open ocean, and for protecting endangered species. Such research is becoming increasingly important as ocean conditions change due to natural and anthropogenic factors. (P. Gaube et al., *PLOS ONE* **12**, e0172839, 2017.) —RB

A STEP TOWARD DECIPHERING AURORAS

Auroras have long dazzled sky watchers but befuddled physicists. Via a mechanism that remains unclear, electrons get yanked away from the magnetosphere and slammed into the ionosphere, where their collisions with atoms and molecules engender green, red, and blue light. (See the Quick Study by Bob Strangeway, PHYSICS TODAY, July 2008, page 68.) The leading culprits for scooping up and accelerating auroral electrons are Alfvén waves, oscillations of the ions in a plasma that propagate along magnetic field lines. The oscillations can be triggered by magnetic storms, which often portend auroral displays. And at least in theory, the waves should be able to propel electrons in their path.

Now, for the first time, scientists have confirmed that Alfvén waves can move electrons, an important first step toward linking the waves to auroras. Rather than probing plasmas at auroral altitudes, Jim Schroeder at the University of Iowa and his colleagues created Alfvén waves in the lab. Using a copper antenna placed inside the Large Plasma Device at UCLA, the researchers launched waves through a roughly 15-m-long column of magnet-

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