investigating sediment compositions, not volcanism. And each underwater volcano, or seamount, produced less than 1 cubic kilometer of lava, a millionth of the volume that has erupted from the Hawaiian islands. It was only by tracking similarities in sonar data during their recent survey[1] that Hirano and his crew could locate the small seamounts and their lava beds. During their expedition, the researchers used a manned submersible—the *Shinkai* (Japanese for "deep sea")—to sample basalt from the sea floor.

What makes the discovery off Japan intriguing is that volcanism there is unexpected. The seamounts are young, some less than a million years old, and erupt through a cold plate dating from 135 million years ago. Old plate is thick—estimated to reach nearly 100 km in this region of the Pacific Ocean, far from the tectonic boundaries where volcanism typically occurs. High concentrations of a few trace elements in the basalt signaled that only small amounts of melting had occurred at depths greater than 100 km. Rare-gas compositions confirmed that the melting originated in the upper mantle, or asthenosphere.

Current models of Earth hold that minerals found in the asthenosphere at depths around 150 km below the sea floor should remain solid. But the presence of even small concentrations of volatile materials such as carbon dioxide and water lowers the melting temperature of mantle rock. Melting at those depths would then supply the additional magma needed to percolate to the surface through so thick a plate. The morphology of the basalt dredged up by Hirano and company—in particular, the embedded pores and vesicles—bore out the presence of those volatiles. As the melt rose through the lithosphere, dissolved gases in the magma changed phase to form bubbles—much like carbon dioxide bubbles in a newly opened bottle of beer. Further decompression of the gaseous bubbles provided explosive force to the eruption.

To explain the presence of the volcanoes, arranged on the sea floor in rows parallel to the trench off Japan, Hirano and his colleagues propose that a gentle buckling of the lithospheric plate (east of the outer rise) accompanies the severe bend formed as the Pacific plate slides under Japan, as pictured on page 21. The plate's slight upward bulge then depressurizes the mantle underneath to create magma, which squeezes through cracks and stress fractures at the bottom of the plate and drains upward.

Most geophysicists imagine that the melt percolates along microscopic grain boundaries, at least initially. Although buoyant, the melt still has to overcome the friction generated as it flows around rocky grains. The eventual formation of a macroscopic crack appears essential to prevent the melt from losing heat and freezing on its way to the surface. The youngest volcanoes appear farthest from the trench, where stress conditions make the plate ripe for fracture. Older ones appear closer to the trench.

The Pacific plate cools nonuniformly as it ages, so it's no surprise that it might

physics update

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Flexible, large-area sensors and microphones made with thin sheets of packaging foam may be possible. Via a simple charging process, the foam can be turned into a ferroelectret, a material that combines the permanently polarized electric dipoles of a ferroelectric substance with a large piezoelectric effect whereby a slight deformation generates a significant voltage. (See the article on ferroelectrets in PHYSICS TODAY, February 2004, page 37.) Physicists at the Johannes Kepler University (Linz, Austria) and at Princeton University have shown that ferroelectret films can muster electric fields big enough to activate a thin-film FET made of amorphous silicon. Combining those two technologies—ferroelectrets and FETs—the researchers have demonstrated working versions of flexible microphones and touch sensors, about a centimeter across and 70 microns thick. Lead investigator Ingrid Graz says that their new form of soft electronics can be scaled up and may be useful for producing items like flexible paper-thin keyboards, flexible microphones for mobile phones, active noise-control devices, toys, hearing aids, and surround-sound systems. Someday it might even be used as prosthetic skin. (I. Graz et al., *Appl. Phys. Lett.* **89**, 073501, 2006.) —PFS

Bloch oscillations measure gravity. In 1929 Felix Bloch predicted that electrons in a periodic crystal potential subjected to a weak electric field would not be linearly accelerated; rather, they would oscillate around their individual positions. Although never seen in actual crystals because of lattice defects, Bloch oscillations are observable with cold atoms in an optical lattice (see PHYSICS TODAY, July 1997, page 30, and August 2004, page 25). Experimenters at the University of Florence (Italy) have set up such a system and measured gravity on the micron scale. To do that, they cooled bosonic strontium-88 atoms—which not only have no angular momentum in the ground state but also enjoy extremely weak atom–atom interactions—to a mere 400 nK and loaded them into a vertically oriented optical lattice. Because the ^{88}Sr atoms formed a nearly ideal gas, the system remained coherent and stable for a remarkably long time, about 7 seconds. For each atom during that time, the physicists observed roughly 4000 oscillations and 8000 photon momenta coherently transferred. In the end, they measured the gravitational acceleration to be 9.80012(5) m/s^2. According to team leader Guglielmo Tino, unlike gravity-measuring experiments that use torsional balances or cantilevers, the Florence approach measures gravity directly and over shorter distances. In addition, the experiment can take place within microns of a surface, enabling future explorations of the Casimir force and deviations from Newtonian gravity. (G. Ferrari et al., *Phys. Rev. Lett.* **97**, 060402, 2006.) —PFS

Pyramid-shaped nuclei. A group of European physicists believe they can solve the mystery behind dozens of nuclear experiments carried out more than a decade ago. The experiments—conducted with various detectors, at various energies, and involving various nuclear species—produced such puzzling results that many of the experimenters turned their attention to the study of other systems. Now, Jerzy Dudek of University Louis Pasteur (Strasbourg, France) and his colleagues at Warsaw University (Poland) and the Autonomous University of Madrid (Spain) think that the old results can be explained by nuclei having tetrahedral symmetry. Just as so-called magic nuclei have the right number of neutrons and protons to readily form stable spherical nuclei, so too can such magic numbers be expected for forming pyramidal nuclei. Stable, in this case, means that the state persists from 10^{12} to 10^{14} times longer than