

contract and crack in places. Indeed, the floor of the Pacific Ocean is littered with thousands of volcanic seamounts, rifts, and faults, in various orientations and alignments.² And other volcanoes, such as ones in the islands of western Samoa, are thought to form from a flexed plate, though in a different tectonic context, and display chemical signatures similar to those found in lavas sampled off the Japanese coast. Some theorists argue that lithospheric flexing may even explain a periodicity in the spacing of volcanic islands.

Models support the idea that the lower part of the plate stretches, but Brown University's Donald Forsyth questions whether the stresses created several hundred kilometers from the subduction zone are indeed large enough to fracture the rock. Why an eruption should occur on a plate whose upper regions are compressed is also puzzling. Magma can, however, force its way to the surface by forming and expanding its own crack, especially if the magma is volatile-rich, as it appears

to be here. Still, Forsyth and other researchers agree that the newly found seamounts, small as they are, offer a compelling example of volcanism in part of Earth that is not one of the usual volcanic suspects—a mid-ocean ridge, an upwelling plume, or an island arc.

Together, however, the mechanisms of depressurization and the flux of volatiles may not be enough to explain the eruptions. Based on the geochemistry of the lavas, Hirano argues that the seamounts tap a region of the mantle that contains preexisting small but widely distributed pockets of partial melt. Thermodynamically, that's a reasonable viewpoint, at least in regions where conditions are hot enough for liquid and solid to coexist, says Caltech's David Stevenson. And it may prompt researchers to revisit their interpretation of the seismic low-velocity zone, commonly observed below ocean basins, where signals travel significantly more slowly than they do in surrounding regions of the mantle.

Last year, researchers explained the

low-velocity zone as possibly due to the rheology of olivine—the upper mantle's most prevalent mineral.³ But the presence of small amounts of molten material could also contribute to slow seismic velocities. Minerals in the asthenosphere are unlikely to be perfectly mixed, and the region may well experience thermal gradients and melting anomalies. The implications for volcanism are fascinating: A through-going crack or leaky fault would support volcanism just about anywhere on Earth. Judging from the Japanese seamounts, though, the eruptions might be meager.

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References

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2. See J. H. Natland, E. L. Winterer, in *Plates, Plumes, and Paradigms*, G. R. Foulger et al., eds., Geological Society of America, Boulder, CO (2005), p. 687.
3. U. H. Faul, I. Jackson, *Earth Planet. Sci. Lett.* **234**, 119 (2005).

the typical 10^{-21} seconds for nuclear reactions. In tetrahedral nuclei, up to four nucleons of the same kind (neutrons or protons) could share a single energy level instead of the customary one or two nucleons permitted by classic nuclear theory. That rule-of-four would inhibit the normally observed decay modes by which nonspherical nuclei throw off energy, usually by emitting gamma rays. The inhibition would explain the puzzling results of earlier experiments. Dudek says that gadolinium-156 and ytterbium-160 are good candidate nuclei for stable pyramidal configurations, and the physicists found tentative evidence for tetrahedral ^{156}Gd . The researchers plan to test their ideas in upcoming experiments. (J. Dudek et al., *Phys. Rev. Lett.* **97**, 072501, 2006.)

—PFS

Methane from the deep could be a significant feedback mechanism in climate change. As oil and gas companies well know, many hydrocarbon deposits lie beneath the sea floor. Over geologic time scales, some oil and gas (primarily methane, CH_4) deposits can slowly seep through cracks in the sedimentary rock and reach the ocean floor, where buoyancy takes over. The ensuing natural oil slick on the ocean's surface then degrades through both bacterial action and evaporation of the volatile chemicals. What's left is a tar residue that sinks back to the ocean floor. This chain of events inspired a team of Earth scientists to examine sea-floor cores, drilled off the coast of California, for deposits of tarry sand as a proxy for CH_4 release. They found several episodes of enhanced CH_4 emission in Earth's history, notably from 16 000 to 14 000 years ago and from 11 000 to 10 000 years ago. Those two eras correspond to periods of globally melting glaciers and rising atmospheric temperatures. The researchers also note that hydrates—semisolid CH_4 agglomerates that can exist in the cold, high-pressure sea-floor environment—are common near hydrocarbon seeps. According to team leader Tessa Hill (University of California, Davis), a possible scenario is that the

hydrates first become unstable due to a warmer ocean bottom at higher pressure from rising sea levels; the roused hydrates then perturb the sea floor to enhance hydrocarbon seepage and CH_4 emission. Because CH_4 is a potent greenhouse gas, global warming increases and brings about further sea-floor instabilities. The natural process is slow to start, but it gathers steam in a positive feedback loop. (T. M. Hill et al., *Proc. Natl. Acad. Sci. USA* **103**, 13570, 2006.)

—SGB

A Google-like approach to mammograms. Knowledge-based computer-assisted detection (KB-CAD) systems, which are increasingly being used in clinical settings, compare a mammogram image with images in a database of known cases of breast cancer. The results of the comparison are then used by a radiologist to aid in the diagnosis. Although they are diagnostically accurate, detailed comparisons become increasingly inefficient as image databases grow. At the recent meeting of the American Association of Physicists in Medicine (AAPM), held in Orlando, Florida, Georgia Tourassi (Duke University) presented a way to speed up the process using the information-theoretic idea of image entropy. An image that is all black or all white has zero entropy; a complex image with a more uniform distribution of different pixel intensity levels has higher entropy. Image entropy can be easily and quickly determined, and that's what the Duke system does first. In a way similar to an internet search engine, the new KB-CAD system first returns a list of database images whose entropies are similar to that of the one under study, then does a detailed comparison on only that subset of images. The database of Tourassi and her colleagues uses images of both normal and cancerous tissue for comparisons. In their tests, a database of 2318 images was quickly whittled down to only 600, and achieved the same performance as the standard KB-CAD method in one-fourth the time. The researchers expect to follow up their pilot study with a larger clinical investigation. (AAPM Meeting Paper TU-D-330A-8.)

—BPS ■