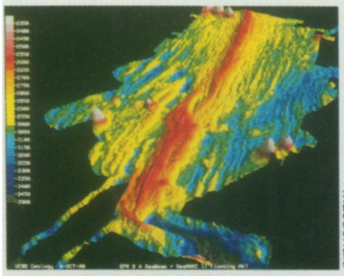
Earth Science

New theory tells how Earth grows skin

Forget the purple mountains' majesty and the fruited plains. In terms of sheer surface area, they can't compare to deep-sea ridges called abyssal hills, which cover 60 to 70 percent of Earth's face. But while these hills are the most pervasive geologic feature on the planet's surface, the secret of their formation has eluded scientists for 40 years.

Recent dives to the seafloor in the ALVIN submersible have now yielded an explanation of how the hills form in the Pacific Ocean, report Ken Macdonald and Russell Alexander of the University of California, Santa Barbara, and Paul J. Fox of the University of Rhode Island in Narragansett.



Macdonald

Abyssal hills flank the East Pacific Rise.

In January, the scientists studied a section of the East Pacific Rise 1,000 kilometers southwest of Acapulco, Mexico. This midocean ridge – part of a worldwide system – represents the border where two of Earth's surface plates spread apart. Moving about as fast as a fingernail grows, the plates slowly creep away in opposite directions, opening up cracks through which molten rock can rise to the surface and then harden to form new ocean floor.

Some theories about abyssal hills suggest that they develop through eruptions along the midocean ridges. Others argue that the hills form by fracturing of the crust. Evidence from the dives this year now suggests a combined theory, the scientists reported at a recent meeting of the American Geophysical Union (AGU) in Baltimore, Md.

As the newly formed crust moves away from the center of the ridge, it stretches, causing the rock to crack. Some blocks of crust drop to form valleys, while other parts remain elevated as steep-sided hills. Later, lava erupting from the midocean ridge pours over some of the fractures, coating portions of the hills with fresh volcanic rock. This two-step process explains how abyssal hills form in the Pacific and other spots where the plates spread apart at their quickest rate, according to the scientists. Other places, where the ridges spread more slowly, may create abyssal hills differently, Macdonald says.

High clouds may soon light U.S. sunsets

Since the late 1800s, residents of the far northern latitudes have witnessed a strange type of cloud appearing high in the sky during the twilight of summer days. These so-called noctilucent ice clouds may become visible as far south as Philadelphia in the next century because of greenhouse gases accumulating in Earth's atmosphere, according to calculations by Gary Thomas of the University of Colorado at Boulder and his colleagues. They reported their work at the AGU meeting.

Noctilucent clouds develop in the mesosphere at an altitude of 85 kilometers. Prior to the Industrial Revolution, the air in this region was too dry to form clouds. But rising concentrations of methane added water vapor to the mesosphere, prompting clouds to form in the coldest latitudes.

Greenhouse gases will enhance noctilucent clouds in two ways. The addition of more methane to the atmosphere will further increase water vapor concentrations in the dry mesosphere. Furthermore, rising carbon dioxide concentrations tend to cool the mesosphere, even as they warm Earth's surface. The temperature drop will prompt noctilucent clouds to extend farther from the poles, according to the team. Although beautiful, the clouds provide a reminder that humans are changing the natural state of the atmosphere, Thomas says.

Astronomy

Ron Cowen reports from Minneapolis at a meeting of the American Astronomical Society

Are gamma-ray bursts standard candles?

Astronomers often liken gamma-ray bursts to cosmic flashbulbs – brief outpourings of high-energy radiation in the sky. A new analysis suggests that the mysterious bursts might resemble flashbulbs in more ways than one.

A trio of astrophysicists began by examining 260 gamma-ray bursts detected by NASA's Compton Gamma Ray Observatory (GRO) and charting them on the basis of their intensity. If the bursts are distributed uniformly throughout the cosmos, one might expect to find a much larger number of dim flashes than bright ones – just as there exist many more faint, distant stars than bright, nearby ones.

However, cosmology confounds this simplistic model. As the expanding universe moves galaxies farther apart, photons emitted by distant sources lose energy, shifting to redder wavelengths. Some of the photons drop to an energy level below what the GRO detectors can record. The expansion lengthens the amount of time it takes photons from distant bursts to reach Earth, also reducing the number of dim bursts recorded by GRO.

Gordon Emslie of the University of Alabama in Huntsville and his colleagues John M. Horack and Charles A. Meegan of NASA's Marshall Space Flight Center in Huntsville, Ala., were well aware of these cosmological influences when they conducted their graphical analysis. They still expected to find an increase in the number of dim bursts, but at a more gradual rate. Instead, they saw an abrupt slowing of the increase midway between the brightest and dimmest flashes.

Two possible explanations, both of which have startling consequences, can account for his team's results, Emslie notes. A universe that expands at an accelerated rather than a uniform rate could account for the abrupt change in the number of bursts. But an accelerating cosmos would require a repulsive force to counteract gravity. This force, which pushes two masses farther apart, would have to grow stronger, not weaker, at larger distances. In mathematical terms, it would require a cosmological constant to modify the accepted theory of gravitation. Other observations don't seem to support this.

Alternatively, he says, gamma-ray bursts may resemble a group of light bulbs, very few of which exceed a certain wattage. If the bursts have a relatively uniform intensity, then the standard model of an expanding universe would account for the new findings, Emslie says. This model would require that the bursts have a narrower range of luminosity than any known group of celestial objects.

The notion that gamma-ray bursts are some type of "standard candle" may provide a new clue for discovering the sources that generate them, he adds. If bursts are standard candles, they might also yield another estimate of the age and size of the universe.

New views of a neighbor

It took only 3 nights of telescope time to get the data, but it required nearly a year of work to assemble a seamless, 3-foot by 7-foot, high-resolution image of the Andromeda galaxy. The new near-infrared image of our nearest spiral neighbor will provide astronomers with a new tool to study a galaxy similar to our own, says Somak Raychaudhury of the Harvard-Smithsonian Center for Astrophysics. Other astronomers produced a similar image of Andromeda in visible light.

Raychaudhury et al.

False-color, 41-image mosaic of the Andromeda galaxy.