Geoscience converges under pressure

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The contents of the deep Earth affect the planet as a whole, including life at its surface, but scientists must find unusual ways to "see" it. Only recently have researchers been able to produce the extreme temperatures and pressures found inside our planet to understand how it is forming and evolving.

A special online edition of the *Proceedings of the National Academy of Sciences* (PNAS), released May 21-25, explores the exotic world of high pressures as a window to understand a broad range of problems in Earth and planetary science.

The papers originated from a May 2006 workshop entitled "Synergy of 21st Century High-Pressure Science and Technology," sponsored by the Carnegie/DOE Alliance Center and organized by Carnegie's Geophysical Laboratory scientists Ho-kwang (Dave) Mao and Russell J. Hemley. As the 2005 Balzan Prizewinners, the duo also discussed the subject at the Balzan Distinguished Lecture on May 16, 2007, at the Institut de Physique du Globe, Paris.

"There is a rich history surrounding certain fundamental questions, such as how materials deep within the Earth rise as plumes, and what happens happened to plates as they push against each other and dive below others to great depths," explained Hemley. "But it's just recently that we've been able both to produce the ultrahigh pressures found in the deep Earth and to harness tools that can measure the changes in matter in this extreme environment."

The articles in this issue of PNAS detail some of the profound alterations of earth and planetary materials under these extreme conditions, as well as new findings in seismology and geodynamics that require these new data for their interpretation. The articles provide insights into the inner workings of the planet, and explain new high-pressure techniques that are moving this research forward apace. "It's a new era for both Earth and planetary sciences," Hemley added.

The special edition of the PNAS features 15 articles on high-pressure geoscience. The subjects include what causes deep earthquakes, as well as how tiny, micro- to nanometer-size minerals can reveal physical and chemical process of the deep Earth. Surprising findings about an elusive zone nearly 1,800 miles below the surface near the planet's core, called the D'' layer, are also described. Additionally, observations in seismology are compared with mineral data from the laboratory and first-principles theory. There are also details of techniques that can potentially be used to study the even higher pressures and temperature of the interiors of giant planets, such as Jupiter.

Although the special edition focuses on the Earth and planetary sciences, the broad future of high-pressure was reflected in the workshop. The studies are creating new classes of materials, contributing to our understanding of the planets outside our solar system, and revealing how life may have originated.

Source: Carnegie Institution