Thematic Topics in 2008

Volume 4, Number 1 (February 2008)

SUPERVOLCANOES

GUEST EDITORS: **David A. Wark** (Rensselaer Polytechnic Institute and GE Global Research) and **Calvin F. Miller** (Vanderbilt University)

View of Long Valley Caldera from Mammoth Mountain, California. The collapse caldera, about 15 by 30 km in size, is the remnant of a supervolcano that produced the 600 km^3 Bishop Tuff during a super-eruption 760,000 years ago. PHOTO BY C. WILSON

Explosive super-eruptions from large-volume, shallow magma systems lead to enormous and devastating pyroclastic flows, the formation of gigantic collapse calderas, and deposition of volcanic ash over continent-sized areas. Recognition that future eruptions from these "supervolcanoes" will undoubtedly have severe impacts on society—and perhaps on life itself—has led to recent public and media interest. Should we be concerned about an imminent super-eruption? The answer to this question requires an understanding of past eruption events. In this issue, geoscientists investigating ancient supervolcanoes provide insight into the processes and the time required to generate large volumes of eruptible magma, the monitoring of a youthful system, and super-eruption processes and consequences.

Supervolcanoes and their explosive super-eruptions – Calvin F. Miller (Vanderbilt University) and David A. Wark (Rensselaer Polytechnic Institute and GE Global Research)

The magma reservoirs that feed super-eruptions – Olivier Bachmann and George Bergantz (University of Washington)

How long does it take to supersize an eruption? – Mary R. Reid (Northern Arizona University)

Super-eruptions and supervolcanoes: Processes and products – Colin J.N. Wilson (University of Auckland)

Monitoring a supervolcano in repose: Heat and volatile flux at the Yellowstone caldera – Jacob B. Lowenstern and Shaul Hurwitz (U.S. Geological Survey)

Consequences of explosive super-eruptions – Stephen Self and Stephen Blake (The Open University)

Supervolcanoes and metallic ore deposits – David A. John (U.S. Geological Survey)

Volume 4, Number 2 (April 2008)

PHOSPHATES AND GLOBAL SUSTAINABILITY

GUEST EDITORS: **Eugenia Valsami-Jones** (The Natural History Museum) and **Eric H. Oelkers** (LMTG-Université de Toulouse)

Phosphorus is a unique element: it is essential to the existence of all living forms, and as such controls biological productivity in many terrestrial and marine environments; but when in excess, it leads to uncontrollable biological growth and water-quality problems. This has become a common environmental issue, resulting from our careless use of phosphorus in agriculture, yet phosphate ore deposits, from which fertilizers are produced, are a finite natural resource. Understanding the properties of phosphate minerals may hold the key to protecting the future of this resource. Phosphate minerals are also of extreme importance in biomineralization and could be the future hosts of nuclear waste. Despite all this, mineralogists and geochemists have invested little time understanding phosphate mineral stability, reactivity, and transformations, and this issue attempts to bring phosphates to the forefront of our scientific endeavors.

Eutrophication of the Verdouble River in southern France. PHOTO BY TERESA RONCAL-HERRERO

The global phosphorus cycle: Past, present, and future – Gabriel M. Filippelli (Indiana University Purdue University)

Bone and tooth mineralization: Why apatite? – Jill D. Pasteris, Brigitte Wopenka (Washington University) and Eugenia Valsami-Jones (The Natural History Museum)

Phosphate minerals, environmental pollution, and sustainable agriculture – David A.C. Manning (Newcastle University)

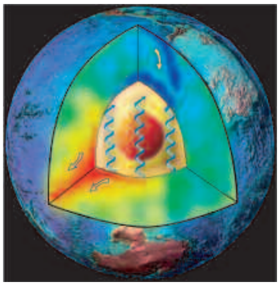
Phosphorus removal and recovery from municipal wastewaters – Simon A. Parsons and Jennifer Smith (Cranfield University)

Phosphate minerals and glasses as potential nuclear waste storage hosts – Eric H. Oelkers and Jean-Marc Montel (LMTG-Université de Toulouse)

Volume 4, Number 3 (June 2008)

DEEP EARTH: RECENT DEVELOPMENTS IN MINERAL PHYSICS

GUEST EDITORS: **Jay D. Bass** (University of Illinois) and **John B. Parise** (Stony Brook University)



Interior of the Earth. IMAGE COURTESY OF THORNE LAY

The field of high-pressure mineral physics is central to our understanding of the Earth's interior and its evolution. It is also a field that is rapidly advancing. Recent major discoveries, such as the post-perovskite phase transition that may explain some of the properties of the core–mantle boundary, speak to the continued importance of high-pressure mineral physics experiments. The results from experimental mineral physics along with seismological data are used to construct compositional and thermal models of the Earth and its heterogeneity, including inferences of deep geochemical reservoirs. These results are also key to understanding all planetary bodies in the solar system. This issue of *Elements* will highlight several key areas of high-pressure mineral physics in a form that is accessible to a broad mineralogical audience.

Elastic properties of minerals: A key for understanding the composition and temperature of Earth's interior – Jay D. Bass (University of Illinois), Stanislav V. Sinogeikin (Carnegie Institution of Washington), and Baosheng Li (Stony Brook University)

Studies of the rheological properties of mantle materials – Shun-ichiro Karato (Yale University) and Donald J. Weidner (Stony Brook University)

The upper mantle and transition zone – Daniel J. Frost (Bayerisches Geoinstitut)

The Earth's lower mantle and core – Guillaume Fiquet, François Guyot, and James Badro (Institut de Physique du Globe de Paris, Université Pierre et Marie Curie)

Discovery of post-perovskite and new views of the core–mantle boundary region – Kei Hirose (Tokyo Institute of Technology) and Thorne Lay (University of California, Santa Cruz)

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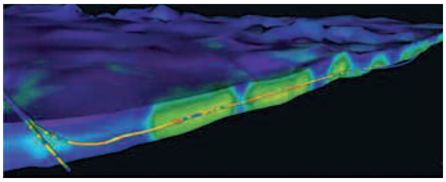
GEOLOGICAL SEQUESTRATION OF CARBON DIOXIDE

GUEST EDITORS: **David R. Cole** (Oak Ridge National Laboratory) and **Eric H. Oelkers** ((LMTG-Université de Toulouse)



Simulation of injection of CO_2 into a reservoir at the Kretchba field, Algeria. PHOTO COURTESY OF STATOIL AND BP (SEE *ELEMENTS* 3: 179-184)

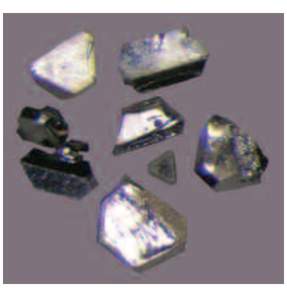
Storage of carbon in the subsurface involves introduction of supercritical CO_2 into rock formations beneath the surface of the Earth, typically at depths of 1000 to 4000 meters. Although CO_2 is a relatively benign substance, the volume being considered is large. If developed to its envisaged potential, geologic sequestration will entail the pumping of CO_2 into the ground at roughly the rate we are extracting petroleum today. To have the desired impact on the atmospheric carbon budget, CO_2 must be efficiently retained underground for hundreds of years. Any underground storage system will have to account for the natural characteristics of subsurface formations; some are advantageous for storage while others are not. When foreign materials are emplaced in subsurface rock formations, they change the chemical and physical environment. Understanding and predicting these changes are essential for determining how the subsurface will perform as a storage container. The specific scientific issues that underlie sequestration technology involve the effects of fluid flow combined with chemical, thermal, mechanical, and biological interactions between fluids and surrounding geologic formations. Complex and coupled interactions occur both *rapidly* as the stored material is emplaced underground, and *gradually* over hundreds to thousands of years. The long sequestration times needed for effective storage and the intrinsic spatial variability of subsurface formations provide challenges to both geoscientists and engineers. A fundamental understanding of mineralogical and geochemical processes is integral to this success.

Titles and authors to be announced

Volume 4, Number 5 (October 2008)

PLATINUM-GROUP ELEMENTS: PRECIOUS TRACERS OF EARTH AND SOLAR SYSTEM EVOLUTION

GUEST EDITORS: **James E. Mungall** and **James M. Brenan** (University of Toronto)



Optical image of synthetic crystals of platinum-rhodium alloy grown by high-temperature vapor deposition (bottom-centre crystal is ~1 mm in diameter). PHOTO COURTESY JAMES M. BRENAN

The geoscientific and economic significance of the PGE is immense. Due to their extreme siderophile and chalcophile behaviour, the PGE are highly sensitive tracers of geological processses involving metal and sulfide phases. Furthermore, there are two radioactive decay series involving PGE, which combine both lithophile and chalcophile characteristics in various parent or daughter elements. PGE consequently offer insight into a wide range of geological processes that no other group of elements can provide. The PGE are also very important economically, primarily due to their "noble" character in common applications such as jewelry, electrodes, catalysts, and fuel cell technology. Unfortunately, the PGE are also bioavailable as potential toxins to organisms in the natural environment. Their widespread use, particularly in automotive catalytic converters, makes their environmental behavior a matter of increasing concern. This issue of *Elements* will provide an overview of our current understanding of the distribution of PGE and their isotopes in the Earth and solar system, and what this knowledge tells us about the workings of our planet, about extraction of PGE resources, and about the environmental risks attendant on their use.

Geochemistry and mineralogy of the platinum-group elements – James E. Mungall and James M. Brenan (University of Toronto)

Chemistry of the PGE – Herbert Palme (Universität zu Köln)

Distribution of the PGE in the Earth and extraterrestrial materials – Jean-Pierre Lorand (Museum National de l'Histoire Naturelle), Ambre Luguet (Université du Québec à Chicoutimi), and Olivier Alard (Université de Montpellier)

PGE ore deposits – James E. Mungall and Anthony J. Naldrett (University of Toronto)

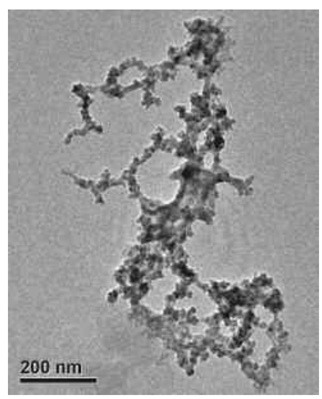
Radiogenic isotope systems involving the PGE – Richard W. Carlson and Steve Shirey (Carnegie Institution of Washington)

PGE in the environment – Sebastien Rauch and Greg Morrison (Chalmers University of Technology)

Volume 4, Number 6 (December 2008)

NANOGEOSCIENCE

GUEST EDITOR: **Michael F. Hochella Jr.**



HR-TEM image of nanoparticulate Fe-oxides found in drinking water in the Washington area. From Wigginton NS, Haus KL, Hochella MF Jr (2007) *Journal of Environmental Monitoring* 9: 1306-1316, DOI: 10.1039/b712709j – Reproduced by permission of The Royal Society of Chemistry

At first glance, nano and Earth seem about as far apart as one can imagine. Nanogeoscience seems to be a word connecting opposites. More specifically, a nanometer relative to a meter is the same as a marble relative to the size of this planet. But to a growing number of Earth scientists, the term nanogeoscience makes perfect sense. Nanomaterials can be manufactured, but they are also naturally occurring. In fact, we now think that nanomaterials are essentially ubiquitous in nature. Importantly, nanomaterials often have dramatically different properties from those of the same material with larger grain size. By understanding these property changes as a function of size and shape in the nanorange, we will acquire another perspective from which to view Earth chemistry.

This issue of *Elements* will explore our current knowledge of nanogeoscience using numerous examples from the "critical zone" of the Earth, as well as from the oceans and the atmosphere. Important insights into local, regional, and even global phenomena await our understanding of processes that are relevant at the smallest scales of Earth science studies. Nanogeoscience is at a relatively early stage of development. Therefore, large gaps in our knowledge in this area exist, making the next few years and decades an exciting time of new realizations, discovery, and change. This issue of *Elements* will help promote and energize this field in its early adolescence.

Titles and authors to be announced