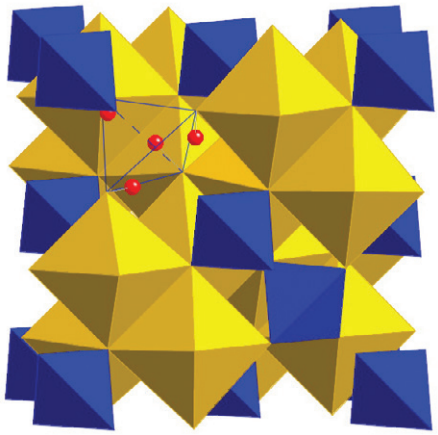

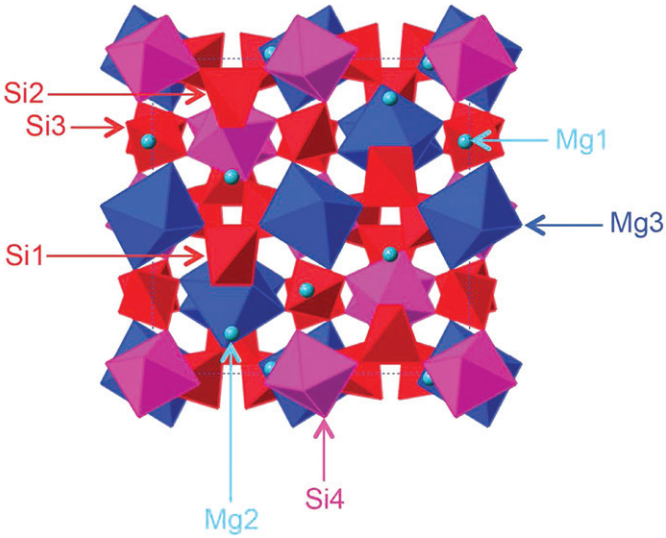

Mineral Reservoirs

Panero group concludes earth's mantle holds vast amounts of water

Water, water everywhere, but it's all locked underground.

Wendy Panero, Ph.D., and The Ohio State University Mineral Physics Research Group have found that minerals within the earth's mantle hold a vast amount of water. The group is using Ohio Supercomputer Center resources to discover where and how much of this water could exist.

Panero's team focuses on the hypothesis that the earth created its own water. Hydrogen atoms are locked within solid minerals in the earth's mantle. Chemical reactions allow these hydrogen atoms to bond with oxygen, creating water molecules. Panero's team is using supercomputers to model the structure of these minerals and the energy cost of incorporating hydrogen atoms. They can then calculate how much hydrogen likely exists in a mineral as a function of pressure and temperature.

Researchers predict that the mass of water stored in the earth's mantle is approximately 50 percent greater than that on earth's surface.

"It's a lot of water," Panero said. "And it's completely inaccessible to humans—the earth has to give us the water from that depth through plate tectonics."

Many minerals undergo structural changes between 410 and 660 kilometers deep due to heat and pressure. If they contain more water than the new minerals can store, the rocks should melt at these depths, Panero said.

"What is kind of enchanting to think about, yet really difficult to look at in detail, is that those minerals that are stable between that 410 and 660 kilometer depth range can take on a huge amount of water," Panero said.

Panero's group has found that the minerals garnet and the lesser-known ringwoodite have the greatest potential to store water in the earth's mantle at 660 kilometers deep. Ringwoodite is the dominant mineral in the mantle at these depths and, luckily, can be synthesized in the lab. Garnet is of interest due to its stability in the earth's mantle down to 750 kilometers.

"The amount of water that garnet holds at that depth is going to be what tells us exactly how much water is in the earth because new data show us that the earth's mantle might be melting at 750 kilometers depth," Panero said.

The implications of this study extend out of this world. If hydrogen is a key ingredient for Earth, it could exist within the interior of other planets. Studies have suggested that water existed on the surface of Mars, but there is no explanation of its origins. Perhaps, trapped deep beneath the surface, the key to life exists. •

(Above) Atomic structure of ringwoodite calculations done with the Ohio Supercomputer Center. The red balls are hydrogen atoms surrounding the site of a missing silicone atom. The blue polyhedra are SiO4 atoms and MgO6 atoms are yellow polyhedra.

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