Water may exist in Earth’s lower mantle: study

Colour image of Earth, taken by NASA's Earth Polychromatic Imaging Camera. | Photo Credit: REUTERS/NASA/Handout via Reuters/File Photo

Water may be more common than expected at extreme depths within Earth’s lower mantle — approaching 640 kilometres and possibly beyond, a study of diamonds from across the world has found.

The oceans have been measured to a maximum depth of 11 kilometres, though water is known to exist well below the oceans. Just how deep this hidden water reaches, and how much of it exists, are the subjects of ongoing research.

The study, published in the journal *Science*, explored microscopic pockets of a trapped form of crystallized water molecules in diamond samples from locations in Africa and China. The tiny traces of crystallised water, trapped in spaces called inclusions that measure just a few microns in length, contain the molecular signature of ice. This crytallised water likely formed from liquid water existing at very high pressures, researchers said

The structure and chemical studies helped the scientists to determine the pressures and temperatures at which the diamonds formed. This allowed the scientists from US Department of Energy’s Lawrence Berkeley National Laboratory (Berkeley Lab)in the US to estimate the depths of their formation.

Many of the studied diamonds from a random sampling seemed to originate from deep inside the Earth, within and even beyond the transition zone sandwiched between Earth’s upper and lower mantles, said Oliver Tschauner, from the University of Nevada in the US. While only about 60 diamonds had previously been confirmed to originate at depths greater than about 300 kilometres, the latest study added several more to this tally. “It seems many diamonds come from greater depths,” Tschauner said.

In the past, people had focused more on larger inclusions, tens of times the size of the ones that were the focus of the new study. “Some of these small inclusions may have been overlooked before,” Tschauner added.

Researchers concluded that some of the inclusions likely were formed from fluid existing at depths of 400 to 540 kilometres beneath Earth’s surface. Others may have formed at depths ranging from 610 to 800 kilometres - possibly within Earth’s “shallow” lower mantle.

“It’s not just a curiosity to have a diamond residing deep in Earth’s mantle — this is direct evidence for aqueous fluid in the deep Earth,” Tschauner said.

The pressures that formed these deeper diamonds are estimated at about 24 to 25 gigapascals, which is about 224 times more pressure than exists at the bottom the ocean’s deepest point in its Mariana Trench. The composition of the fluid that was trapped in the inclusions appears to be complex, with traces of carbonates, oxides, and salt, Tschauner said.

It is not yet possible to estimate how much watery fluid exists in Earth’s transition zone and how it’s distributed, Tschauner said, but more diamond studies should help with the estimates.

Please enter a valid email address.

Perkin discovered the first synthetic dye, known as mauveine.

END