A team of geologists led by Yaakov Weiss of Columbia’s Lamont-Doherty Earth Observatory have developed a new way to date and chemically profile diamonds, a breakthrough that could help scientists answer fundamental questions about our planet’s early history, the creation of the continents, and geological processes that continue to unfold today.

Diamonds, which form one hundred miles or so below ground and are then brought to the surface by volcanic activity, have long been scrutinized by scientists for clues about what lies below us deep in the earth. But they hold their secrets tightly. Crystals cannot be dated using radioactive-decay techniques, because they are
made of pure carbon, which is chemically inert. Scientists have therefore resorted to
dating tiny flecks of more reactive minerals, like garnet or zircon, which are
sometimes encased within diamonds. But this strategy is imperfect, because
scientists have no way of knowing if the baked-in minerals formed long before the
diamonds did.

So Weiss and his colleagues devised a better method: they extract and analyze
small droplets of liquid preserved within lesser-quality diamonds. “Diamonds form
when liquefied elements crystallize, and some diamonds still have little pockets of
that same fluid trapped inside of them,” Weiss says. “The fluid is the matter out of
which the crystal formed. So it’s a perfect time capsule, providing a window directly
into the diamond’s origins.”

In a recent issue of the journal *Nature Communications*, Weiss and his collaborators
report the results of their analysis of fluid droplets drawn from ten diamonds found
in mines in and around Kimberley, South Africa. The researchers say that they were
able not only to determine the diamonds’ ages — the samples ranged from
85 million to 2.6 billion years old — but also to glean valuable insights into the
geological processes that were occurring underground when they formed. For
example, by assessing the relative amounts of carbonate, silica, and saline present
in fluid from individual diamonds, the authors conclude that some of them formed
when a giant slab of oceanic crust smashed into, and then dove underneath, the
edge of the African continent some hundred million years ago. The study thus
provides evidence for an idea that was once considered improbable but which has
been gaining currency among scientists: that diamonds may contain carbon recycled
from the earth’s surface.

Weiss says that his team’s techniques could be useful to geologists working in other
diamond-rich areas of the world, including Australia, Brazil, northern Canada, and
northern Russia. They could help disentangle the deep histories of those regions and
give a better understanding of our planet’s ongoing evolution. Studying diamonds,
he says, could shed light on how geological phenomena on the earth’s surface — the
barely perceptible movements of continents, oceans, and mountains, for example —
are influenced by turbulence deep underground. “These are really big questions, and
it’s going to take people a long time to get at them,” says Weiss. “But hopefully
we’ve provided new tools and ideas for figuring out how these things work.”