EARTH SCIENCE

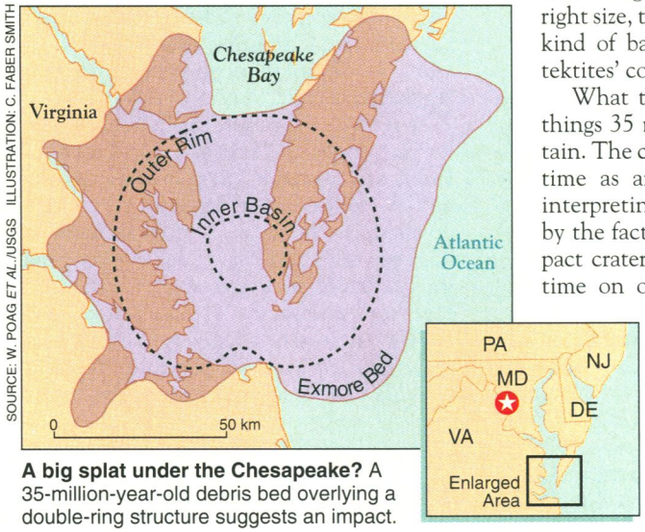
Making an Impact Under the Chesapeake

Giant impacts seem to be in season. Just as Jupiter starts to recover from its pummeling by kilometer-size comet pieces, the scar of a similar impact may have turned up much closer to home. If a group of U.S. Geological Survey (USGS) geologists is right, the east coast of North America was blasted by a meteorite a few kilometers across some 35 million years ago. Besides leaving an 85-kilometer-wide crater—the seventh largest ever identified on Earth—the impact could have strewn debris as far as South America, triggered the formation of Chesapeake Bay, and driven some marine plankton to extinction.

"Your first reaction when you hear about something like this is to doubt it," says oceanographer Kenneth Miller of Rutgers University. But after reading the paper by Wylie Poag of the USGS in Woods Hole and his colleagues, which appears in the August issue of *Geology*, Miller was intrigued. A layer of chaotic debris buried beneath lower Chesapeake Bay certainly implies some violent event, Miller says. And Poag's claim that images of the bay, made by bouncing seismic waves off buried sediment layers, reveal a large impact crater is "reasonable," if not completely convincing, says Miller.

The first hints of something unusual beneath the Chesapeake came in the 1950s, when USGS geologists studying ground water drilled through some curious sediments beneath the Virginia shore of the Bay. Sediments are normally found in neat, separate layers, but drilling samples of this particular sediment bed hinted at a jumble of different sediment types. In the mid-1980s, USGS drillers recovered complete cores from this 60-meter-thick layer, dubbed the Exmore bed, which revealed a hodgepodge of pebble-, cobble-, and boulder-size chunks of sediment up to 2 meters in diameter. Microfossils in the chunks showed that the original sediments were laid down anywhere from 100 million years ago to 35 million years ago, when the bed was formed. It was as if whole sections of sea floor were scooped into a giant mixer, churned up, and spewed out. By 1991, Poag and his colleagues had found clues to the identity of that mixer: traces of minerals in the bed that had been altered by the extreme pressures of a shock wave, presumably generated by an impact.

Now Poag and his colleagues think they can see the buried crater itself. Examining seismic soundings of the sediments made by both a company exploring the lower Chesapeake for oil and gas and the USGS, the researchers spotted three places where undisturbed, horizontal layers of sediment are broken off at nearly vertical faults—the remnants, they think, of the crater rim. Well within the outer rim, the group sees a concentric inner "peak-ring," where the basement rock rises, then drops into a central depression. Such bull's eye structures are known from other craters, says Poag, such as the Ries crater of southern Germany.



SOURCE: W. POAG *ET AL.*/USGS ILLUSTRATION: C. FABER SMITH

A big splat under the Chesapeake? A 35-million-year-old debris bed overlying a double-ring structure suggests an impact.

Over time, Poag thinks, the low spot left by the impact might have become the focus of the network of river valleys that was ultimately drowned to form the Chesapeake Bay. Another legacy of the impact may be the glassy spherules, called tektites, that are strewn in a thin layer over 9 million square kilometers of the southeastern United States, the Gulf of Mexico, and Caribbean Sea. Geologists have assumed that these tektites splashed out of an impact crater as molten rock, but the crater has never been found. Poag thinks the Chesapeake Bay crater might fit the bill: It's about the right size, the right age, and in the right kind of basement rock to match the tektites' composition.

What the impact meant for living things 35 million years ago is less certain. The crater didn't form at the same time as any major extinctions, and interpreting its effects is complicated by the fact that several other large impact craters formed at about the same time on other continents. Still, says tektite specialist Billy P. Glass of the University of Delaware, there are hints that the meteorite did claim some victims: Five species of microplankton seem to have died out just when the tektite field was laid down.

Before researchers search too hard for distant effects of the impact, though, they want to confirm it. After all, says Miller, interpreting seismic data "can sometimes be something of an art." Lubomir Jansa of the Geological Survey of Canada in Dartmouth, Nova Scotia, who has discovered his own impact crater on the sea floor, adds that "if [Poag] wants to prove it, he has to drill in the center," where the most abundant shocked minerals and even melted rock should be. That is exactly what Poag wants to do, but he needs money to do it. So the scientist is looking for a deep-pocketed partner with an interest in deep sediments.

–Richard A. Kerr

ASTROPHYSICS

Are Quasar Twins an Optical Illusion?

Searching for a missing lens can be exasperating, as any contact wearer knows. That's all the more true when the lens is somewhere in the far reaches of the universe. For more than a decade, astronomers have been looking for something very much like a lens in front of a pair of apparently identical quasars, or distant starlike objects. Since most quasars are sparsely distributed across the sky, these close twins seemed likely to be an optical illusion. The blaze of a single quasar, astronomers guessed, was being split into two images by the light-bending gravity of a galaxy or cluster of galaxies between the quasar and the observer. One problem: no one could find this gravitational lens.

Now, by merging pictures from telescopes in Hawaii, Arizona, and Chile to produce an exposure that is effectively more than 22 hours long, J. Anthony Tyson of AT&T Bell Laboratories and a team of astronomers have uncovered what may be part of the long-sought lens: an extremely dim and distant galaxy hidden in the glare of one of the quasar images. Other scientists, such as Edwin Turner of Princeton University, think the record-breaking photographic feat—reported in the 20 August *Astrophysical Journal Letters*—is strong evidence pointing towards a lensed system. "It's an extraordinary powerful observation, one of the deepest ever made," Turner says.

Not everyone is convinced that Tyson and his colleagues have spotted the missing lens. More than the mass of a single galaxy is needed for the lens, and the group's evidence for an additional cluster near the detected galaxy is tenuous. "I don't think it's proven," says lens expert Chris Kochanek of the Harvard-Smithsonian Center for Astrophysics (CFA). Even if the lens is accepted, it only brings a new puzzle into fo-