Article Title:
3D Maps Reveal a Lead-Laced Ocean
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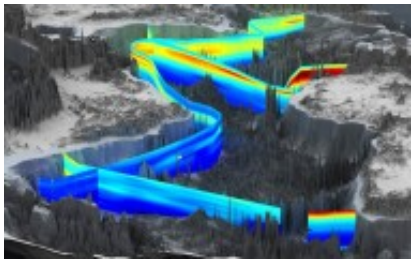

3D graphics by Steven van Heuven, courtesy Hein de Baar, Rob Middag, Abigail Noble, and Christian Schlosser

Tracking pollution. Red and yellow areas on a cross-sectional map of the Atlantic Ocean, and in a rotating 3D animation (*below*), highlight areas with relatively high traces of lead.

HONOLULU—About 1000 meters down in a remote part of the Atlantic Ocean sits an unusual legacy of humanity's love affair with the automobile. It's a huge mass of seawater infused with traces of the toxic metal lead, a pollutant once widely emitted by cars burning leaded gasoline. Decades ago, the United States and Europe banned leaded gas and many other uses of the metal, but the pollutant's fingerprint lingers on—as shown by remarkably detailed new maps released here this week at the 2014 Ocean Sciences Meeting [1].

The 3D maps and animations [2] are the early results of an unprecedented $300 million international collaboration to document the presence of trace metals and other chemicals in the world's oceans. The substances, which often occur in minute quantities, can provide important clues to understanding the ocean's past—such as how seawater masses have moved around over centuries—and its future, such as how climate change might shift key biochemical processes. Over about 30 cruises in the past few years, researchers have collected nearly 30,000 water samples at 787 study sites. Then, using painstaking techniques —including wearing "moon suits" and working in clean rooms to prevent contamination— they've measured elements like iron, nickel, and zinc. The effort, known as GEOTRACES [3], "is a huge improvement over what we were able to do in the past," says ocean chemist Hein de Baar of the Royal Netherlands Institute for Sea Research in Texel.

GEOTRACES is tracking some 200 elements and other substances, but the lead maps released this week tell an especially sobering story of past pollution—and continuing contamination. In the central Atlantic, for example, the maps show a huge slug of subsurface seawater with lead levels higher than those in surface or deeper waters. That tainted water was once at the surface, where it collected airborne lead particles, explains chemical oceanographer Abigail Noble of the Massachusetts Institute of Technology (MIT) in Cambridge. But the surface water slowly sank into the deep ocean, essentially becoming a time capsule recording "the incredible impact that we have had on the oceans in the past, and how it changes over time."

Although the elevated lead levels stand out as red and yellow blotches on the GEOTRACES

maps, the concentrations are too low to pose a major threat to humans or wildlife, says MIT ocean scientist Edward Boyle. “You probably aren’t going to see stupid fish or whales swimming around,” he says, alluding to the brain damage that can be caused by lead exposure. The lead concentrations are roughly equivalent to what you’d get if you dissolved a small spoonful of frozen orange juice in 200 Olympic-sized swimming pools, Noble estimates. And lead levels in much of the Atlantic have dropped dramatically over the past few decades, Noble and Boyle note, mostly thanks to the lead phaseout in the United States and Europe.

Still, the maps show there are places where lead contamination is a continuing problem. Off the southern tip of Africa, surface waters with relatively high traces of lead are flowing into the South Atlantic from the Indian Ocean. That’s probably due to the continuing use of leaded gasoline in parts of Africa and Asia and perhaps to some heavy industry there, says chemical oceanographer Christian Schlosser of the University of Southampton in the United Kingdom.

Another hot spot, the maps show, is where the Mediterranean Sea empties into the eastern Atlantic. The lead concentrations there “are some of the highest we saw anywhere” in the Atlantic, says chemical oceanographer Rob Middag of the University of Otago, Dunedin, in New Zealand. That may be because the Mediterranean is a relatively enclosed body of water with heavily settled shores and has been collecting pollution for centuries.

The maps will be expanded in coming years as new cruises are completed. But other researchers are already beginning to mine them for insights into trace elements such as iron, which can fertilize plankton blooms and could be a major player in how the oceans respond to climate change. Scientists are also tracking atomic isotopes that can help map the worldwide movements of seawater and help pinpoint the original sources of lead and other trace metals. The unusually detailed GEOTRACES data, Noble says, is letting researchers “see things that we couldn’t see before.”

Links:
[1] http://www.sgmeet.com/osm2014/default.asp
[2] http://www.egeotraces.org/
[3] http://www.geotraces.org/