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RESEARCH HIGHLIGHTS

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Fish 'gut-rocks' solve ocean puzzle

For decades marine scientists have been perplexed by the increase in alkalinity with depth in the top 1000 m of the ocean surface when chemistry suggests this should only take place lower down. But now, a team from the UK, US and Canada reckons excretion of a highly soluble form of carbonate from fish intestines could go some way to solving the mystery.

"Our most conservative estimates suggest three to 15% of the oceans' carbonates come from fish, but this range could be up to three times higher," said Rod Wilson of the University of Exeter, UK.

Previously scientists believed that calcium carbonate in the ocean came almost exclusively from shelled plankton such as coccolithophores and foraminifera. Frank Millero of the University of Miami heard Rod Wilson give a seminar about production of calcium carbonate by fish and realized this may be the key to the puzzle.

"The total alkalinity (sum of all the bases in seawater, mostly HCO_3^- and CO_3^{2-}) increases in the deep oceans due to the dissolution of $CaCO_3$," Frank Millero of the University of Miami told **environmentalresearchweb**. "This dissolution occurs because the mineral is more soluble in deep waters. The increase in waters near the surface should not occur since the waters are super saturated."

Bony fish drink seawater continuously because otherwise their bodies tend to lose water by the process of osmosis (in which water transfers across a semipermeable membrane into a more concentrated solution). The fish later excrete the calcium they gain from the seawater as carbonates, either in the form of mucous-coated tubes or pellets (known as gut-rocks) or along with their faeces.

"We also know that fish carbonates differ considerably from those produced by plankton," said Wilson. "Together these findings may help answer a long-standing puzzle facing marine chemists, but they also reveal limitations to our current understanding of the marine carbon cycle."

The carbonate the fish excrete is high in magnesium and more soluble than the forms of carbonate produced by plankton. As a result it can dissolve at higher levels of the ocean.

Together with colleagues from the University of Miami, University of Ottawa in Canada, University of British Columbia, Canada, and the University of East Anglia, UK, Wilson estimated

the total biomass of bony fish in the world's oceans as between 812 million and 2050 million tonnes, leading to a total carbonate production of around 110 million tonnes.

It's likely that the rising ocean temperatures of the future will cause fish to produce even more calcium carbonate by speeding up their metabolism. And increasing carbon dioxide concentrations are likely to boost levels of carbon dioxide in the blood, again increasing carbonate production.

"Given current concerns about the acidification of our seas through global carbon dioxide emissions, it is more important than ever that we understand how the pH balance of the sea is normally maintained," said Wilson. "Because of the impact of global climate change, fish are likely to have an even bigger influence on the chemistry of our oceans in future. So it is vitally important that we build on this research to help fully understand these processes and how this will affect some of our most precious marine ecosystems."

The researchers reported their work in **Science**.

About the author

Liz Kalaugher is editor of **environmentalresearchweb**.