Ocean iron affects biological productivity: study

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(PhysOrg.com) -- A team of researchers has just published a new paper, lead authored by Boston University Professor of Earth Sciences Richard W. Murray, that provides compelling evidence from marine sediment that supports the theory that iron in the Earth's oceans has a direct impact on biological productivity, potentially affecting the amount of carbon dioxide in the atmosphere and, in turn, atmospheric temperature. These findings have been published in the March 11, 2012 online edition of the journal *Nature Geoscience.*

The oceans are the world's largest inventory of reactive carbon. Over time, oceanic carbon exchanges with the atmospheric reservoir of carbon in the form of carbon dioxide (CO_2). Much of the carbon present in the surface oceans is taken up by the growth of marine plants (primarily by phytoplankton) through photosynthesis. Consequently, marine biological productivity is recognized as a factor in determining the amount of atmospheric carbon dioxide at various times in the Earth's history.

The magnitude of ocean biological productivity depends on the availability of key nutrients, including nitrogen, phosphorous and metals such as iron. In fact, previous research has established that biological productivity in the equatorial Pacific and the oceans around Antarctica is limited by the amount of iron, a micro-nutrient, more than by the better-known 'major' nutrients nitrogen and phosphorus.

The link between iron and marine biological productivity first gained attention more than twenty years ago with the publication of a controversial paper by the late John Martin, an oceanographer at the at the Moss Landing Marine Laboratories (California State University). Martin's "Iron Hypothesis" postulates that biological productivity could be stimulated by increasing the amount of iron in the ocean, which in turn would draw down atmospheric carbon dioxide. He further argued that this process contributed to ancient ice ages: When the earth was drier and therefore dustier, more iron was deposited in the oceans, thus stimulating biological productivity, reducing atmospheric carbon dioxide and cooling the earth (the inverse of global warming). This could result in prolonged glacial periods. By closely examining the sedimentary record, Murray and his colleagues have established a clear relationship between plant plankton (diatoms) and the input of iron, exactly as Martin predicted.

Many researchers since Martin have established that the availability of iron in the modern ocean determines the amount of biological production in high-nutrient, low-chlorophyll regions and may be important in lower-nutrient settings as well. By examining the paleo-oceanographic record of iron input and the deposition of diatoms, Murray and his colleagues found that the ancient system is highly consistent with what occurs in the oceans today.

The new publication provides an important sedimentary record from the high-nutrient, low-chlorophyll region of the equatorial Pacific Ocean, and shows strong links between iron input and the export and burial of biogenic silica (opal produced from diatoms) over the past million years. Although the direct relationship to climate remains unclear, data collected by the team demonstrate that iron accumulation is more closely tied to the accumulation of opal than any other biogenic component, and that high iron input closely correlates with substantially increased opal sedimentation. The strong links between iron and opal accumulation in the past are in agreement with the modern biogeochemical behavior of iron and silica, and the response of the diatom community to their mutual availability, all of which supports Martin's postulate of a biological response to iron delivery over long timescales.

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