

Global monsoon drives long-term carbon cycles in the ocean

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Monsoon is a global system, and many arrays of evidence indicate that it drives long-term cyclicity of the carbon reservoir in the global ocean. The new view is introduced in a substantial paper in Issue 7 (April 2009) of *Chinese Science Bulletin*.

For over 300 years, monsoon has been considered as a gigantic land-sea breeze of regional scale, but now it is considered as a global system over all continents but Antarctica. This new development in modern climatology, however, has not yet been responded by paleo-climatology.

Prof. Pinxian Wang from Tongji University, Shanghai, reviews the geological evolution of the global monsoon and its impact, showing that the global monsoon exists through all geological history since at least 600 million years ago. It covaries with various geological cycles including those caused by the geometric changes of the Earth's orbits. The 20,000-year precessional cycle of the global monsoon, for example, is responsible for the collapse of several Asian and African ancient cultures at ~ 4000 years ago. The same cyclicity is seen in the chemical composition of the [air](#), such as methane concentration and isotope composition of air-bubbles captured in ice cores.

Now Wang found that the long-term cycles in the oceanic carbon reservoir also has a global monsoon origin. This 400,000-year cyclicity related to "long eccentricity" of the Earth's orbit, is best seen in carbon isotope compositions of calcite test of foraminifera, a single-cell animal in the ocean. The rhythmic changes in oceanic carbon reservoir were

likened to "heartbeat" of the Earth system. This cyclicity becomes longer since 1.6 million years ago, displaying a kind of "arrhythmia" in the Earth system, probably resulting from the growth of the Arctic ice. Although the mechanism of how monsoon drives oceanic carbon cycle remains unclear, the monsoon-related long-term cyclicity should not be overlooked in carbon-cycle modeling for long-term climate prediction.

"It is an authoritative review", said Prof. Andre Berger, University of Louvain, in his commentary, "and probably also the first in which the monsoon issues are reviewed in a global scale through a so long geological history....I totally agree with Wang's argumentation about paying more attention to the importance of the tropical forcing in modulating the Earth's climate system". The geological evolution of the global monsoon is a new topic attracting growing interest from both modern and paleo-climatologic communities. An international symposium on global monsoon was organized by the PAGES (Past Global Changes) project in Shanghai in 2008, and the next symposium is scheduled in 2010.

More information:

Wang, P., 2009. Global monsoon in a geological perspective. Chinese Science Bulletin, 54(7): 1113-1136

Berger, A., 2009. Monsoon and general circulation system. Chinese Science Bulletin, 54(7): 1111-1112

Wang, P., Tian, J., Cheng, X., et al., 2004. Major Pleistocene stages in a carbon perspective: The South China Sea record and its global comparison. Paleoceanography, 19, PA4005, doi: 10.1029/2003PA000991

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