Avalanches

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Bioturbation From Square Millimeter to Global Scales

Bioturbation: An Update on Darwin's Last Idea; Renesse, Netherlands, 23–27 August 2008

Marine sediments occupy about 70% of the Earth's surface and represent one of the most important interfaces in the Earth system, because they regulate the transfer of carbon from the biosphere to the geosphere. A crucial control on carbon processing is exerted by the animals inhabiting the ocean floor, which extensively rework and oxygenate sediments while feeding and moving, a process referred to as bioturbation.

The significance of bioturbation was first realized by Charles Darwin, who devoted his final book to the subject. Recently, the second international meeting on bioturbation was organized in the Netherlands, following upon the success of the first meeting, in France (Marseille), in 2004. The purpose of this meeting was to provide a multidisciplinary update on the importance of bioturbation in sediment biogeochemistry, ecosystem functioning, and global biogeochemical cycles. Sixty scientists from 16 countries came together to address the physics, chemistry, geology, and biology of bioturbation in sediments and soils, in both the present and the past.

Talks addressed the impact of bioturbation from square millimeter to global scales, on land, in lakes, and in the ocean. Results from novel observation technologies were shown, particularly featuring planar optodes, which use chemical transducers to optically measure properties of specific substances This enables the real-time observation of two-dimensional dissolved oxygen, acidity, dissolved iron, the presence of hydrogen sulfide, and carbon dioxide distributions in sediments, thus allowing an unprecedented characterization of submillimeter-scale heterogeneity. These novel observation tools are complemented with a variety of modeling techniques, including those based on continuous time random walks and individual-based computer simulations.

Sediments are composite media comprising not only particles of various size and water-filled pores, but also many organisms of variable size (from microbes to large animals). The mechanical properties are largely unknown, and novel insights were presented at the meeting on how bioturbating worms crack sediments and how organisms generate pressure waves while ventilating their burrow structures.

Finally, bioturbation research has traditionally been executed independent of biodiversity studies. This is unfortunate, and some talks highlighted how biodiversity links to bioturbation and to organic matter mineralization in sediments. This new line of research will need further development because the biodiversity loss of organisms near the ocean floor (e.g., due to increasing coastal hypoxia) will have major consequences for bioturbation and sediment biogeochemistry. Several talks and posters presented at the meeting illustrated that burrow construction by large animals can result in new niches for smaller animals and microbes, emphasizing the strong link between bioturbation-induced heterogeneity and biodiversity maintenance, and the need for further targeted studies on this topic.

The meeting was organized by Bob Aller (Marine Sciences Research Center, State University of New York at Stony Brook), Erik Kristensen (Institute of Biology, University of Southern Denmark, Odense), Frank Gilbert (Laboratoire d'Ecologie des Hydrosystèmes, Université Paul Sabatier (Toulouse III), France), Jack Middelburg (Netherlands Institute of Ecology, Yerseke), and Filip Meysman (Earth System Science Group at Vrije Universiteit Brussel, Belgium) under the umbrella of Nereis Park, the Internet portal of an international association of bioturbation researchers (http://www.nereispark.org/). The meeting was financially supported by the Darwin Center for Biogeology, the Marine Biodiversity and Ecosystem Functioning (MarBEF) Network of Excellence, and personal career awards to Filip Meysman (Research Foundation–Flanders) and Jack Middelburg (Netherlands Organisation for Scientific Research).

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