CC/NUMBEB 30
JULY 27, 1992

This Week's Citation Classic ®

Rhoads D C. Organism-sediment relations on the muddy sea floor. *Oceanogr. Mar.* 12:263-300, 1974. [Department of Geology-Geophysics. Yale University, New Haven. CT]

This is a comprehensive review defining the scope of the field for both geologists and biologists. It also laid the foundation for using an organism-sediment model to study applied problems such as the ecological impacts of pollution on the sea floor. These conceptual models are used today in a wide range of pure and applied work. [The *SCI*® indicates that this paper has been cited in more than 290 publications.]

Defining the Scope of an Emerging Field

Donald C. Rhoads
Science Applications International Corporation
Woods Hole, MA 02543

This is my second *Citation Classic* on organism-sediment relationships. The first *Classic* paper, written in 1970, showed how bottom-dwelling organisms (benthos) affect the physical stability of subtidal muds.[1] The 1970 paper showed how biological and geological processes are tightly coupled. This relationship was known for a long time in terms of the formation of coral reefs and other forms of carbonate sediments, but my 1970 paper extended the concept to less obvious environments—clastic sediments in general.

The 1974 paper was a broad review of the rapidly emerging field of organism-sediment relationships. I attempted to define the edges of the field for both sedimentologists and ecolcgists. From the geological perspective, I showed how organisms could control or otherwise modify the geological and geochemical properties of the sea floor, such as grain-size, fabric, water content, porosity, compaction, shear strength, biodeposition, bioadvection (bioturbation), and the critical threshold velocity for erosion. The influence of bioturbation on both vertical particle and fluid transport was pointed out as a first-order process for understanding redox and pH gradients, the distribution of metals and nutrients, and microbial processes that influence geochemistry. From the biological perspective, I attempted to show how the aforementioned biogenic alterations of the sea floor influence the distributions of organisms, nutrient recycling, trophic structure, secondary productivity, plant compensation depth, and functional morphology and physiology.

Both of these *Citation Classics* remain popular today because they have identified interrelationships that remain important research topics. These papers, as well as a newer updated review,[2] contributed, among others, to identifying a new interdisciplinary field called "geobiology." These papers were strong statements for the broad interdisciplinary training of both biologists and geologists.

Once one understands the environmental implications of organism-sediment relationships, they provide a powerful insight into how the benthic system works under normal or ambient conditions versus polluted or "ecologically stressed" conditions. I have subsequently pursued this approach in the study of eutrophication, dredging and submarine disposal, thermal loading, etc. I also developed a remote sensing optical instrument that allows for the efficient identification of organism-sediment relations in situ, for rapid mapping of disturbance or pollution gradients on the sea floor (REMOTS[13]). To make the transition from pure research to applied research, I found it necessary to resign my 21 -year-tenure at Yale and join private industry. This was largely due to the lack of support for my research initiatives by the National Science Foundation. I have not regretted this transition. I value my years at Yale, working with stimulating graduate students, but I equally enjoy the challenges of real-world problem-solving with Science Applications International, which has funded my research through an Industrial Research & Development program.

In retrospect, I see now that both of my *Citation Classics* were at least 10 years ahead of the field. This explains the difficulty I had with funding during the early years. I am most gratified by how this work has set the course for the field and promoted interdisciplinary student training. Many of the observational protocols and conceptual models I proposed in these early works are now being applied routinely to solve real-world problems on a day-to-day basis. This, I suppose, is the ultimate measure of a scientist's impact on society.

1. **Rhoads D C & Young D K.** The influence of deposit-feeding organisms on sediment stability and community trophic siructure. *J Mar. Res.* 28:l50-78, l970 (Cited 320 times.)[See also: **Rhoads D C.** Citation Classic. *Current Contents/ Agriculture. Biology & Environmental Science* 13(49):16, 6 December 1982. Reprinted in: *Contemporary ₜclassics in plant. Animal.. and environmental sciences* . (Barrett J T. comp.) Philadelphia: ISI Press. 1986 p. 153.]
2. **Rice D L & Rhoads D C.** Early diagenesis of organic matter and the nutritional value of sediment. (Lopez G. Taghon G & Levinton J. eds.) *Ecology of marine deposit teeJerK* Neu York: Springer-Verlag. 1989. p. 59-97.
3. **Rhoads D C & Germano J D. I**nterpreting long-term changes in benthic community structure: a new protocol. *Hydrobiologia* 142:291-308,1986.

Received July 7. 1992.