

JGOFS Final Open Science Conference 5-8 May 2003 ~ Washington, DC USA

"A Sea of Change: JGOFS Accomplishments and the Future of Ocean Biogeochemistry"

Introductory Remarks by Mark Abbott on behalf of the U.S. JGOFS Steering Committee (SC)

On behalf of the JGOFS SC of the United States, I would like to add my welcome to Hugh's. The Final OSC of JGOFS promises to be a landmark event in the study of biogeochemical cycles in the world ocean. Nearly 20 years ago, the ocean research community began to consider the role of the ocean in global change. Programs such as WOCE developed ambitious plans for ocean observations, relying on a broad range of observing platforms and models.

In 1984, the U.S. National Research Council convened a workshop in Woods Hole, MA. From this workshop, the Global Ocean Flux Study was born. Similar planning was occurring in other nations and by 1987 JGOFS was formed as a program of the IGBP.

This week, we will hear many talks and see many posters that are the result of nearly two decades' of JGOFS research. It is no exaggeration to state that JGOFS has resulted in the birth of a new field of study: global ocean biogeochemistry. The presentations will demonstrate how our knowledge of the ocean carbon cycle has evolved, including the role of ecosystem structure and the microbial loop, the importance of iron and zooplankton grazing, and the development of predictive models. We have learned much, but we have much to learn.

JGOFS has not only led to the development of a new field of research, it has also supported the development of a new generation of scientists. Many of our now-prominent researchers were in grade school when JGOFS began. They were probably not worrying about carbon cycling! They may have been worrying about their first car or their first date. Eventually, they entered a field of research that is inherently interdisciplinary in its approach, inherently collaborative in its culture, inherently global in its perspective and inherently international in its approach.

This is a good thing. But it is also useful to remember that the process was messy at times, and it will continue to encounter choppy waters at times. It is the nature of the scientific process. Recall that some of the early discussions of JGOFS focused on the "missing" 2 gigatons of carbon. Observations could not account for all of the anthropogenic releases, and some speculated that the ocean might be taking up more CO₂ than previously estimated. Wally even wrote a paper in GBC warning us not "to hitch our wagon to the greenhouse star!" Controversies continued to flare up. For example, new methods suggested that the DOC content of the ocean was much higher than expected. Although the controversy was eventually resolved at the lower number, I can still recall a modeler enthusing that these new higher estimates made his model work! Some things never change! John Martin had been pursuing the role of trace metals for years, and his team at Moss Landing was the world leader in the clean techniques necessary for measuring iron at its naturally low levels in the ocean. His research eventually led him to propose an iron fertilization experiment, and although it was not an official part of JGOFS, the impact of this research on subsequent studies cannot be overestimated. John was one of the intellectual founders of JGOFS, and I wish he could be with us to share in the events of this week.

We should also remember that the political and economic world has changed substantially in the last 20 years. The USSR and the United States were in the midst of a continuing Cold War, and perestroika had entered our vocabulary. The concept of a unified European currency was only dimly imagined. New countries and new political boundaries have emerged, yet many issues remain. Economic development, the divide between North and South, and other chronic challenges remain. But the globalization of the economy, though painful and controversial has emerged as an important economic and indeed environmental force. Consider the events of 1997. The ability to move enormous amounts of capital rapidly led to the collapse of the Thai bhat, an event which rapidly spread throughout Southeast Asia, significantly affecting economic activity. The unexpected default of Russia on its debt payments exacerbated the currency crisis. I still recall being on the R/V Roger Revelle in late 1997, reading the teletype news reports as the events rippled around the globe. The ability of governments to control their currency and economy had entered a new era. For example, Long-Term Capital

JGOFS May 2003 OSC presentations

Management, a hedge fund, had managed to leverage \$100M in assets to over \$1T in obligations. When it collapsed, only significant intervention by both public and private banks was able to avert a major global economic downturn. The information age had now led to increased connectivity and rapid changes in the global economy. Nonlinear processes were now causing unexpected effects, and new linkages in the global system were emerging.

Changes in technology have affected our science. In 1984, the Internet was largely confined to a few computer science departments and the military. The World Wide Web was several years away. We collected our data on magnetic tape, 8 inch floppy disks, or on paper. My first Sun Microsystems workstation came with 2MB of memory. We shared data by mailing disks or notebooks. Microsoft was still a privately-held company. The first Apple Macintosh had just appeared with 512K of memory. My first Fujitsu Eagle disk drive held 320MB, weighed 60 kg, and cost \$25K!

How things have changed! Many of us now have Internet access in our homes or use wireless connections at the local Starbucks. More and more of us work evenings and weekends, spanning the global time zones. Brian Griffiths at CSIRO Australia asks me questions about bio-optical moorings as he arrives for work in the morning and I am just about ready to call it a day in Oregon. I carry a 256 MB disk drive on my keychain that weighs 25 g and costs \$129. My laptop comes with 1GB of memory, weighs 2 kg, and it doesn't come with a floppy disk drive. We publish and share our data in real time over the Web. Cruises are in nearly continuous contact with researchers on shore. Data reports are produced in real time, and many of our sensors are now linked globally over the Internet. Microsoft stock is now worth over 68 times what it worth when it first became available in 1986. Just think if we had taken \$1M of NSF funds and invested it...On the other hand, companies such as Digital Equipment, Compaq, and Osborne have come and gone.

Our real-time, global data network has enabled more collaboration and more connections to be developed between researchers. There is less emphasis on proprietary data rights, less focus on purely single-discipline issues. The scientific challenges have become inherently multi-disciplinary. And our underlying tools for observations, analysis, and modeling have advanced to meet these challenges. The pressure is now for policy-relevant knowledge, delivered much more rapidly. The centralized model, where a few big institutions dominated the landscape has shifted. Commodity pricing of information technology and even sensing systems, global access to data, flexible scientific teaming, has diminished the importance of geographic place, leading to a highly distributed scientific world. But this shift is painful. We still need enormous amounts of infrastructure such as ships, observatories, satellites, etc. Can these be developed and maintained in a world of highly distributed science teams? Are we structured to take advantage of these changes when infrastructure funding has been based on a more centralized model?

Moreover, our scientific institutions, such as publications, peer review, promotion and tenure, developed in an era of much slower processes. A cruise took place, the data were analyzed over 2-4 years, and publications appeared 2 years after that. Now we are analyzing data in real time, and the complexity of the analyses and data sets require dispersed scientific teams and collaboration. Although the principal investigator is still important, it is much more difficult to attribute scientific progress to a single individual. How do we ensure scientific integrity of the data in such an environment? What do we mean by publishing? A Web site? A PowerPoint presentation?

Lastly, recall that our science of global biogeochemistry is now highly linked to global policies. Economic downturns and upturns affect the amount of air pollution generated in SE Asia, which is then transported across the Pacific to Southern California. But the globalization of markets and industries, along with the ability to move large amounts of capital rapidly across borders, has diminished the abilities of governments in these policy discussions. Do our science investigations need to consider the "policy" needs of global corporations and the global economy? Carbon sequestration is but one example where our community is working directly with the private sector. Sea of Change indeed!

This week we will celebrate the many accomplishments of JGOFS and the fruits of science, technology, and program planning and management that began 20 years ago. We look forward to new endeavors and new accomplishments. The Sea of Change will continue, and the next 20 years will see profound changes in our world. The children of today will inherit a new ocean of knowledge with new challenges.

Thank you for your attendance and enjoy what will certainly be an exciting and successful meeting!