X-I1

Fluxes Across Continental Margins : Comparison of the SEEP and ECOMARGE Experiments

Pierre BISCAYE* and André MONACO**

*Lamont-Doherty Geological Observatory of Columbia University, Palisades New York 10964 (U.S.A.)
**Laboratoire de Sédimentologie et Géochimie Marines, Université de Perpignan, 66025 Perpignan (France)

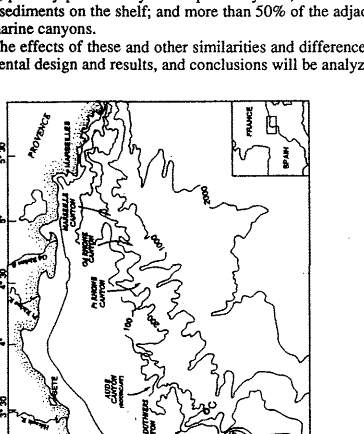
The first comprehensive, multi-disciplinary, multi-institutional experiments to address the problem of fluxes across the marine boundaries of continental margins have been the SEEP program in the USA and the ECOMARGE program in France, both having begun in the early 1980s and continuing to the present. Major aspects of the first stages of both experiments have been published in dedicated volumes of *Continental Shelf Research* in both of which introductory papers give overviews and, to some degree, syntheses of the projects (Walsh et al., 1988; Monaco et al., 1990). SEEP (Shelf-Edge Exchange Processes) has been funded primarily by the US Dept. of Energy, and ECOMARGE (ECOsystemes de MARGEs continentales) by INSU of the French CNRS.

The scientific objectives of the two programs are very similar, as are some of the hypotheses on which the two experiments are based, as well as numerous aspects of the physical characteristics of the study areas yielding, therefore, some similarities in experimental design. Several other aspects of the study areas, however, are dissimilar, yielding differences in experimental strategy, and therefore in the results of the two experiments.

Both experiments have been sited on arcuate portions of continental margin on which the width of the continental shelf decreases in the downstream direction of the general advective drift of both shelf and slope waters (Figs. 1 & 2); exchange of water and suspended particulate matter (SPM) by "diffusive" processes across the shelf/slope break is relatively less than by advective transport toward and across the break at the downstream end of the system; "diffusive" exchange is related to meteorologic forcing with both seasonal and shorter-term components, and is strongly "event" driven.

Other aspects of the study areas and experiments differ strongly from each other. In the Middle Atlantic Bight of the SEEP experiment: there is a significant tidal dynamic component; riverine influx of SPM is low to possibly negative; primary productivity is reltively high; there is little storage of fine particles on the shelf; and the adjacent continental slope is incised by occasional submarine canyons. In the Gulf of Lions ECOMARGE experiment: there is no tidal mixing; riverine input of SPM is significant although seasonally variable; primary productivity is comparitively low; there are significant depositis of fine-grained sediments on the shelf; and more than 50% of the adjacent continental slope is incised by submarine canyons.

The effects of these and other similarities and differences on hypotheses, on experimental design and results, and conclusions will be analyzed as quantitatively as possible.



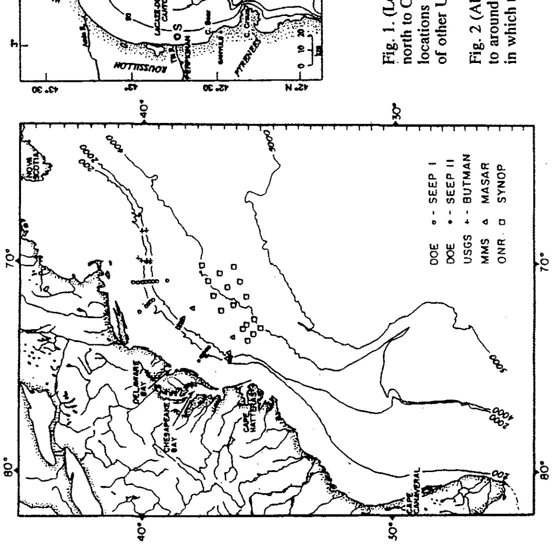


Fig. 1. (Left) The Middle Atlantic Bight (Cape Hatteras north to Cape Cod) of the USA east coast, showing the locations of the SEEP-I and -II experiments in the context of other US experiments during the 1980s.

Fig. 2 (Above) The Gulf of Lions (Cape Creus northeast to around Maresilles) of the French Mediterranean coast in which the first ECOMARGE experiment took place.

REFERENCES

Monaco, A., P. Biscaye, J. Soyer, R. Pocklington and S. Heussner, 1990, Particle fluxes and edosystem response on a continental margin: the 1985-1988 Mediterranean ECOMARGE experiment. Cont. Shelf Res. (in press).

Walsh, J.J., P.E. Biscaye and G.T. Csanady, 1988, The 1983-1984 Shelf Edge Exchange Processes (SEEP)-I experiment: hypotheses and highlights. Cont. Shelf Res., 8, 435-456.

X-I2

Vertical Fluxes and Food Web Interactions

Rolf PEINERT

I.A.E.A., International Laboratory of Marine Radioactivity, 19, Av. des Castellans, MC 98000 (Monaco)

Although pelagic systems are potentially capable of retaining and recycling all autochtonous organic material, losses due to sinking particles inevitably do occur. The upper limit for the annual pelagic export in terms of essential biogenic elements is set by the availability of new nutrients and hence controlled by physical transport. The time pattern, composition and origin of settling particles, however, is under biological control by pelagic food web interactions. Sediment trap deployments revealed significant spatial and temporal variations of vertical fluxes that reflect imbalances of pelagic particle formation and degradation. Seasonal patterns, often consisting of flux maxima during spring and reduced losses thereafter during summer are the best documented ones. In the concept of new and regenerated production the spring vertical flux maximum is commonly regarded as characteristic for temperate to polar latitudes. Trap deployments have since shown, however, that seasonal patterns may substantially deviate from this paradigm and considerable interannual variations have come to light as well. This holds true in particular for different types of settling particles (various types of faeces, aggregates of varying origin, different organisms).

The presentation highlights the impact of selected planktonic organisms and their seasonal food web interactions on pelagic sedimentation. It concludes that further differentiations beyond the categories of new and regenerated production are needed for understanding observed vertical flux patterns. Herbivores with different feeding and life cycle strategies (including copepods, euphausiids, salps, pteropods) are grouped according to their role of either accelerating losses or counterworking sedimentation. The possible roles of copepods and pteropods are discussed in particular.

Based on sediment trap and water column data from the northern Northeast Atlantic, copepod grazing is proposed as a general retaining mechanism for suspended matter. For the spring period it is concluded that the timing between the onset of phytoplankton growth and copepod grazing controls the vertical flux. The coastal (fjords) and shelf systems (Norwegian Coastal Current, Barents Sea) as well as the marginal ice zones are characterized by spring blooms prior to the onset of intense copepod grazing. Thus, they have in common a spring sedimentation maximum of autotrophic origin that is triggered by the exhaustion of winter accumulated new nutrients. In the Norwegian Atlantic Current, however, that houses large overwintering copepod populations, a closer coupling of spring autotrophs and copepods is typical. The retention efficiency for essential elements in the pelagic food web therefore is more efficient and seems to be related to copepod population dynamics (with coprorhexy and coprophagy as important processes).

In the Norwegian Atlantic Current the seasonal vertical flux maximum accordingly is shifted towards late summer/autumn and consists of matter with heterotrophic origin. Omnivorous pteropods play a major role during this period and their abundance is highest after copepod hibernation has commenced. Their abandoned feeding webs and discharged pseudofaeces of pteropods scavenge smaller particles into aggregates. Discarded pteropod webs provide microhabitats and serve as transport vehicles accelerating the vertical export of particles. Their shells, in addition, contribute significantly to the carbonate flux during autumn in the Norwegian Sea. Little is known about the factors triggering pteropod mass sedimentation in autumn, be it may be starvation or old age mortality. The impact of the succession from copepods to pteropods as important grazers on the pelagic food web and on sedimentation can as yet only be speculated upon.

Other plankters such as salps and euphausiids can entirely dominate the vertical flux regionally and temporarily due to their rapidly sinking faeces. Krill faeces dominate trap collections during summer on the Norwegian Shelf and have been found of paramount importance in antarctic waters. Being rapidly exported from the layers of production, however, they are commonly not collected by deep moored traps, indicative of their easy fragmentation and, hence, deceleration. Salps, notoriously unpredictable in appearance and being patchily distributed, could contribute significantly to the interannual vertical flux variability at a given place.

Knowledge of the propagation, seasonal appearance and regulatory mechanisms of the biomass of all these plankters, as well as their specific functions in the pelagic food web, is of paramount importance in understanding the biological control of vertical fluxes in the oceans.

X