Linear and nonlinear analysis of pattern formation in porous tidal sediments

K. Bube, T. Klenke and U. Feudel

Institut für Chemie und Biologie des Meeres, Universität Oldenburg, Carl-von-Ossietzky
Straße 9-11, 26111 Oldenburg, Germany (bube@icbm.de / Phone: +49-551-7983778)

Sediments in tidal flats are complex geosystems. Highly inhomogeneous distributions
of chemical compounds and populations of microorganisms are a typical phenomenon
of these sediments. The interplay of various physical, chemical and biological pro-
cesses mediate the pattern formation. We study the properties of these patterns in order
to measure them in terms of their complexity and to relate them to genetic processes.

We analyze thin sections of modern sediments of the Wadden Sea (southern North
Sea). Patterns of the spatial concentration of carbon, calcium, silicon and oxygen are
gathered by the means of a scanning electron microscope equipped with an energy
disperse x-ray spectrometer. The patterns are used to extract distribution functions
and topological measures within sedimentary profiles. We apply methods of linear
and nonlinear data analysis to characterize the patterns and to discriminate different
kinds of structures. With this information we identify classes of processes leading to
pattern formation. Although most of the processes involved are of stochastic nature,
the result which manifests in the sediment is not. Complicated patterns which range
over several spatial scales are observed.