Sand is everywhere, and sandy deposits belong to the oldest sediments preserved in Earth’s geological record. With the formation of the first continental crust, the first shorelines were created, tidal currents had the first opportunity to rework loose grains, and shallow shelves were the result of first transgressions. It is here, in sands, where life found one of its earliest habitats. And despite all evolutionary changes that took place in the worlds of Earth during its travel through time – the shorelines and the moving waters remained the same for at least 3 billion years.

Benthic prokaryotes, sea floor inhabiting bacterial microbes, are known as the constructors of the famous stromatolites, reef-like boulder heads that constitute the most valuable witnesses of the dawn of life. In recent years, research has wrenched opened a new window that allows hopeful glances back in time. Stromatolites are beautiful geological features, laminated, branched, and full of preserved energy. It seemed therefore an odd idea that Robert Riding and I had in spring of 1993, when discussing in the stair well of the Geological-Paleontological Institute of the University of Tuebingen in Germany: to focus my future work on sandy deposits and prokaryotic build-ups therein. As student of Dolf Seilacher it was logical consequence to search for traces and trace fossils in sand and sandstones. Traces made by microorganisms.

Following Robert Riding’s advice, I scratched my last savings together and participated the “Mini Mat Meeting MMM” in Oldenburg 1993. This meeting was organized by Wolfie Krumbein, and a short introduction by Robert opened the doors to a new approach. Working with Gisela Gerdes, pioneer in sandy microbial mat structures, I learned to understand modern shorelines and the study of cyanobacteria. The following two years were devoted to gather information for the ultimate goal: to have handy modern models that serve to explore Earth’s most antique worlds. I investigated the famous tidal flats of the North Sea, detected MISS in Tunisia, and worked in Egypt.

My first postdoctoral research at the University in Frankfurt/Main let me back to my master thesis study area, the 480 Ma Ordovician of the Montagne Noire, France. After 4 days of looking for something I did not know what it would look like, the late afternoon sun illuminated wrinkled sandstone beds of a fossil tidal flat and shelf in the Gres et Schistes de la Cluse de l’Orb. Suddenly the structures seemed to pop out everywhere in the outcrop recording ancient microbial mats.

Like for so many successful young scientists in Germany, the doors for a continuing career in academia remained closed also for me. My note to Andy Knoll, however, was answered warmly. With Andy Knoll and John Grotzinger I had the opportunity to study 550 Ma Neoproterozoic tidal and shelf successions in Namibia. Containing the same
paleoenvironments like the Ordovician tidal flats and shelves, the Neoproterozoic Nama Group allowed the continuation of my walk into older Earth’s history.

A year later, in 2001, as starting professor at Old Dominion University, I had funds for a ten day field trip to South Africa, the desperate task ahead of me to detect something as tiny as a bacterial fossil in an area as big as half of the country. In the afternoon of the last day (it was a very hot and dusty day) my already discouraged colleagues RC Kidd and Noah Nhleko and myself stumbled along a last road cut, when the light of the already sinking sun shone on a characteristically crinkled sandstone surface – a fossil microbial mat. Like the much younger sandstone successions I studied before, also the 2.9 Ga Mesoarchean Pongola and Witwatersrand Supergroups contained tidal flats and shelves, and showed the same facies-related distribution of photoautotrophic microbial mats. It was not a surprise to find the same situation two years later in the 3.2 Ga Paleoarchean Moodies Group, likewise in South Africa. The star of all study sites, however, was the Nhlazatse Section, a close to 3 Ga old tidal flat spotted with the most beautifully preserved MISS in Earth’s record known so far.

It is this journey of mine through the career of a scientist, the migration from one continent to another, and from present times to most antique ones, which inspired me to summarize this book. This first text on MISS cannot be perfect and many issues will be resolved only in the future. I encourage the reader to contact me with suggestions, corrections and comments that may serve to improve this text for the future editions.

I am deeply grateful to my families on both sides of the Atlantic Ocean for their endurance to cope with my long absences, to my friends in Boston, Washington, and Norfolk for their warm welcome in the States, my colleagues all over the world for their support through my metamorphosis from a fossil-collecting kid to a scholar. I owe major thanks to Kurt Risser, who in long and persistent hours transformed the one or other Germanism in the manuscript into proper English. In stratigraphic order, most of the research on which this text is based has been supported by the Deutsche Forschungsgemeinschaft DFG, the Leopoldina Deutsche Akademie der Wissenschaften, the Sedimentary Geology and Paleobiology Program of the National Science Foundation NSF, and NASA’s Exobiology and Mars Exploration Programs.

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