When it comes to unravelling the history of past environments the best evidence can sometimes be provided by the smallest fossils as **Ian Wilkinson** and **James Riding** explain.

Clues from microfossils

Microscopic fossils (those less than a millimetre in size) have applications in mapping, hydrocarbons investigations, civil engineering and environmental modelling as well as understanding biodiversity and evolution in the geological past. As different organisms lived in different ecological niches, microfossils are also important tools in determining the environment of deposition in which the enveloping sediments formed.

Diapirs and mud flows

Dinoflagellates are a group of single-celled phytoplankton, some of which form organic-walled cysts, 20–150 micrometres across. They may be found with silicoflagellates (unicellular marine flagellates with a siliceous skeleton generally 20–50 micrometres long) and diatoms (unicellular algae with an opaline siliceous shell, or frustule, comprising two valves). They have been found in sediments associated with the intrusion and doming of sedimentary sequences (diapiric processes) and in glacigenic debris flows between the Faroe–Shetland Channel and the Norwegian–Greenland Sea, in water depths between 1800 and 1450 m. Early to mid Miocene dinoflagellate cysts and silicoflagellates have been found in deep-water mudstone. Above an unconformity, soft muds yield an impoverished Palaeogene dinoflagellate cyst assemblage and reworked Carboniferous spores; Palaeogene to early Miocene silicoflagellates; early Miocene diatoms and abundant Pleistocene foraminifera from arctic environments.

The pre-Pleistocene microfossils are considered to have been originated elsewhere, reworked by processes associated with rise of the diapiric intrusion. The diapirs may be dated by the microfaunas in the mudstone as post-mid Miocene. Pliocene–Pleistocene sediments of glacial origin and other clastic sediments of the North Sea Fan, accumulated on top of the weaker Miocene and older sediments, resulting in movements and gravity-driven mass-flow processes.

Alocopocythere kendengensis, *an ostracod from Holocene shelf deposits off Lantau, Hong Kong.*

Marginal marine environments

Ostracods are small crustaceans that live in all aquatic environments from the deep sea to shallow temporary ponds. These small animals are particularly useful in determining the environment of deposition, including temperature, salinity and changes in sea level. Ostracods and dinoflagellate cysts were found in boreholes off Lantau Island, Hong Kong. They determined how the mudstones and sandstones were deposited in an investigation on their engineering properties. The ostracods and dinoflagellate cysts found were Pleistocene and Holocene, marine and brackish water forms that lived on the continental shelf and in the mouth of estuaries. They give a better understanding of the position of the Pleistocene/Holocene boundary, how the Pearl River influenced the area and how marine conditions were replaced by mangrove swamps and erosive phases, before the shallow sea returned again.

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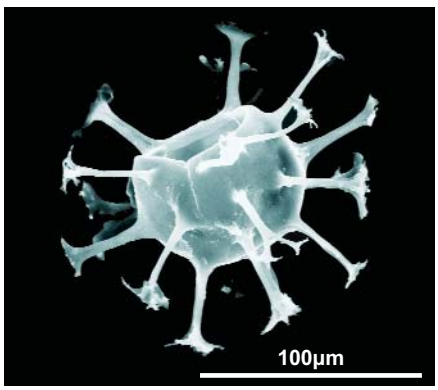

Cordosphaeridium gracile, *a large dinoflagellate cyst from the Palaeogene.*