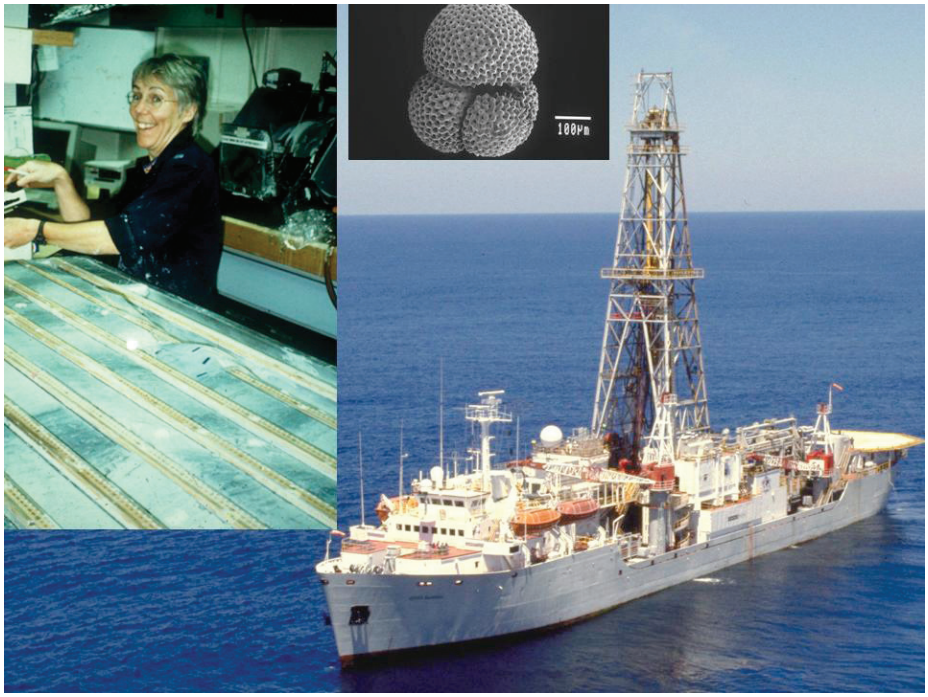

Images: A stripy core from Ceara Rise being sampled by Kate Moran. Inset – a typical foram.

Time machine

The Stratigraphy Commission has the ideal stocking-filler for the Christmas Season.

The immensity of geological time is almost beyond the reach of human imagination. Yet it is becoming ever more urgent that this context be widely accessible and understood - not least because the collective actions of humanity seem set, now, to change the course of our planet's history. The single most striking demonstration of the passage of geological time is surely the sediment that has been accumulating, undisturbed, on the deep ocean floors for up to 200 million years (on the oldest un-subducted ocean crust).

Deposited at a rate of a few centimetres per millennium, deep sea oozes - 'eternal abyssal snowfalls' , to borrow Rachel Carson's metaphor - are still accumulating. Over the last 40 years or so, these deposits have been systematically drilled and studied through the Integrated Ocean Drilling Program (IODP) and its precursors the Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP).

The results have amounted to a revolution of our understanding akin to plate tectonics. If the stratal record used to be seen as a book with most of the pages torn out, here are volumes with virtually all the pages intact. We now have a picture of continually changing - and interlinked - life, environment and climate that underpins our attempts to decipher the controls on the Earth system. Ocean drilling has not, however, achieved a high public profile. It has been an invisible revolution.

We propose that the most powerful, achievable symbol of the passage of geological time would be to place on public display a single, continuous IODP core of deep ocean sediments that extend from the present back to the Cretaceous-Tertiary boundary (64Ma) in an unbroken run, with no significant time gaps.

Core blimey

As a potential example, ODP Site 925 (drilled on a submarine ridge in the western tropical Atlantic off Brazil known as the Ceara Rise) extends to ca 45Ma (mid-Eocene), and is about 1km thick[1]. This site is a key reference section for much of the Cenozoic. No hiatus has been recognised, despite intensive study of the foraminifera and nannofossils and it could undoubtedly be drilled further to the KT boundary. Judging from seismic and other well data, it is very probably continuous all the way; the core would end up over 1.5km long. Sedimentation rates typically vary from 15-30m/Ma.

Much of the succession at Site 925 is characterised by visible cyclic sedimentation caused by Milankovitch cycles. The site is vitally important for Cenozoic astrochronology and isotope stratigraphy. The only drawback, in a stratigraphical sense, is the lack of palaeomagnetic data; but this could probably now be remedied, providing subsidiary scientific justification for a return to Site 925.

On this scale, the last 10,000 years in which civilisation developed, is about 30cm thick, with the pyramids at 15cm and the time since the Industrial Revolution - ten human generations or so - represented by just a few millimetres of sediment. One could walk 50 metres along the core to the start of the Quaternary Ice Age, and a good deal further to the Oligocene expansion of the Antarctic ice sheet, each pace more or less marking one Milankovitch oscillation.

Key moments in evolution could be described, such as the appearance of the first whales, bats and hominids. The evolution of the micro-fossils themselves can be clearly demonstrated, with new forms arising and occasional extinctions occurring in a great evolutionary relay. The average species of foraminifer or nannofossil persists for 5-10 million years (50-100m). Not a single species survives the entire length. Some species show gradual changes in their shape through time, witnessing the stately pace of evolution in the oceans.

Several episodes of rapid change punctuate the record, including the early Oligocene two-step growth

of ice on Antarctica, in which the world jumped from a greenhouse to an icehouse climate state. This corresponds to just a few metres of core more than 700m along the time-line. There are several thermal events/ocean acidification events including the Paleocene/Eocene thermal maximum, in which large amounts of greenhouse gases were injected into the atmosphere and which may bear some similarities to the current atmospheric crisis. This event, at about 1200m, has an ecological and geochemical recovery time of several metres, dwarfing our human timeframe (which visitors, for reference, could carry in the form of a small ruler).

Finally there is the K/T boundary itself, representing the end of one era and the beginning of another. Judging from other Atlantic cores in the approximate vicinity of Chicxulub, it is probably represented by a bed several centimetres thick of glass beads and shocked mineral grains. At the base of the core a signpost would point to the formation of the Earth, 100km away, and the origin of the universe at 300km.

Site 925 does not, however, reach the KT boundary, which is a natural end-point of interest to aim for. A more imaginative (and entirely feasible) venture would be to re-drill at an appropriate site, either on Ceara Rise or elsewhere, to recover the first complete sediment record of the last 65 million years. Such a project would also be of significant scientific value in itself, especially if palaeomagnetic data could be obtained.

As we leave the Society's Bicentennial year, we enter the UN International Year of Planet Earth. The British Geological Survey, British Antarctic Survey and the Natural History Museum could provide stratigraphic and outreach expertise, while oil companies (much of whose source commodity is obtained via marine drilling) might be tempted to help with funding. It would be a major public relations and educational coup for IODP, and take no more than two or three weeks of valuable ship time, including transit. Scheduling an IODP mini-leg could also mean a TV documentary, a schools programme, and the wider science media, magnifying our outreach a thousand fold.

This would be a project comparable in scale to the UK National Space Centre and the Eden Project. There could be no better antidote to young-Earth creationism, and it would be the perfect way to demonstrate the magnificence of the ocean floor sequences, and of Earth history itself.

Jan Zalasiewicz and Paul Pearson, with fellow members of the Stratigraphy Commission (Colin Waters, John Gregory; Tiffany Barry, Paul Bown, Pat Brenchley, David Cantrill, Angela Coe, John Cope, Andrew Gale, Philip Gibbard, Mark Hounslow, Andrew Kerr, Robert Knox, John Marshall, Michael Oates, John Powell, Peter Rawson, Alan Smith & Philip Stone)

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