

Eelco Rohling

The Oceans: A Deep History

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They cover over two thirds of the planet and yet ‘we know more about the surface of the moon than we do about the oceans’ ... or do we? Eelco Rohling, Professor of Ocean and Climate Change at the Australian National University and the University of Southampton, embarks on his journey into the history of our oceans with an apology, an admittance that he and fellow colleagues have somewhat let us down – we actually know a great deal about the oceans – and this comprehensive and timely introduction to palaeoceanography begins to set the record straight.

Although the author concedes that ‘some technical terminology is unavoidable’, and indeed the somewhat academic language may only attract the most eager lay reader, those who persevere are rewarded with a wealth of knowledge, interesting tidbits and at times humour. The book is well suited to students new to the field as well as those more experienced. It provides an excellent overview and often invites readers to delve deeper into the research themselves: where certain topics go beyond the scope of the book, the bibliography of ‘key sources’ for each chapter is extremely useful.

Rohling starts with an introduction that does not hold back in its message that ‘the world ocean is vast but finite’. By the end of the book, the reader will be left in no doubt that immediate action is needed for a sustainable future, but that this cannot be done without an understanding of how the oceans have changed in the past.

The story begins with a summary of Earth’s history and the emergence of the oceans a staggering 4 billion years ago. Plate tectonics, basic ocean circulation, ocean chemistry (with a particular focus on carbon) and biology are all discussed in detail in the second chapter, as well as the still unknown and much-debated of origins cellular life: ‘a game of molecular cat and mouse’.

The third chapter gives a summary of the important controls on the climate system through time: ultimately a product of the Earth’s energy balance. This touches upon the bio-, cyro-, litho- and hydrosphere, creatively putting into perspective the relative influence of the latter, stating that each year, the modern estimated energy loss from the oceans via evaporation (latent heat) is equivalent to ‘the energy contained in about one million trillion [Mars bars]’. The orbital and solar influences underlying Earth’s natural climate variability are also explained alongside plate tectonics and notable volcanic events.

These climate controlling factors lead on nicely to chapter four, helping to explain the ever-interesting Snowball Earth episodes which ‘represent the planet’s closest shave with uninhabitable conditions’. The ‘explosions of life’ after each of these extreme events are shown clearly to be evidence of the complex feedbacks within the Earth system that have helped to ensure the planet is the habitable and productive place it is today.

The carbon cycle and complex ocean carbonate chemistry are tackled in the fifth chapter aptly titled 'Oceans on acid'. Some stark facts are presented here about our modern carbon emissions and associated ocean acidification; the 0.1 drop in pH from 8.2 to 8.1 since the industrial revolution represents a 25% increase in ocean acidity, the rate of which is significantly faster than even the most extreme acidification event recorded in history. Rohling pulls no punches here, explaining that this past acidification event (the end-Permian, 252.3 million years ago) was a significant factor in what he describes as 'the mother of all extinctions' and we must take action 'lest we inadvertently slide down the slippery slope into a similar mess in the near future'.

A brief tour of the Mesozoic greenhouse world is given in the next chapter, focusing on the dominance of reptiles for around 200 million years. Here, Rohling firmly puts us (*Homo sapiens*) in our place, remarking that our appearance 'a trifling' 200,000 years ago, means 'we've got quite a while to go yet before we could even consider claiming that we're more adapted or successful than giant reptiles'. He goes on to discuss the dangerous and sometimes catastrophic anoxic ocean events through time using the Mediterranean as a modern analogue of these past conditions to explore the controlling processes involved.

'Winter is coming' is the penultimate chapter of the book, detailing the last 66 million years or so, the steady glaciation of the poles and the coming of the ice age seesaw around 2.5 million years ago. The vital role of the oceans in these seesaws, namely in heat distribution around the planet and carbon storage, leads to the final chapter on the modern oceans and what we may expect in the future.

Within this final chapter and the epilogue, Rohling makes even clearer his true motivation for the book and the message he has conveyed throughout – that we simply cannot continue emitting carbon at our current rate. He passionately reiterates the need for immediate action in the form of emissions reduction and carbon storage via reforestation. He shares his frustration at short-term political time-scales, which are 'delaying essential action through endless debate, negotiation, and senseless attempts at sowing doubt against a veritable tide of evidence'.

This timely volume is more than just a history of our oceans, it's an important and sobering reminder 'of what happens when Mother Nature gets really cross'. The message, loud and clear, is: 'we have had our wild party, emitted the carbon, and enjoyed the benefits. Now it's time to clean up our mess.' I could not have said it better myself.

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