# Earth History and Palaeogeography

Palaeogeography is the challenging yet fascinating study of changing geography and geomorphology through deep time, in response to tectonic plate movements. This full-colour volume presents our latest knowledge of the Earth's dynamic evolution over the last 540 million years, making it an invaluable reference for researchers, graduate students, professional geoscientists, and anyone interested in the geological history of the Earth.

Using full-colour palaeogeographical maps from the Cambrian to the present, this interdisciplinary volume explains how plate motions and surface volcanism are linked to processes in the Earth's mantle, and to climate change and the evolution of the Earth's biota. These new and very detailed maps provide a complete and integrated Phanerozoic story of palaeogeography. They illustrate the development of all the major mountain-building orogenies, both those that have ended (such as the Caledonide and Variscan) and those continuing (such as the Andean and Himalayan). Old lands, seas, ice caps, volcanic regions, reefs, and coal beds are highlighted on the maps, as well as faunal and floral provinces. Many other original diagrams show sections from the Earth's core, through the mantle, and up to the lithosphere, and how large igneous provinces (LIPs) are generated, helping to understand how plates have appeared, moved, and vanished through time.

Supplementary resources are available online, including software, data files, operating instructions, and extended descriptions of continental plates and terranes, enabling readers to make their own reconstructions at any given time over the past 540 million years.

**Trond H. Torsvik** is the Founding Director of the Centre for Earth Evolution and Dynamics (CEED), University of Oslo, Norway, and Honorary Professor at Wits University, Johannesburg. He is a Member of the Norwegian Academy, and was awarded the prestigious Arthur Holmes Medal (European Union of Geosciences) in 2016 and the Leopold von Buch Medal (German Geological Society) in 2015 for outstanding achievements in the geosciences, among various other awards and prizes. He has written over 200 publications in refereed journals and books.

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For Stephanie and Elaine

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# Preface

Although Trond and Robin had met previously, our first significant interaction was at the Europrobe meeting at St Petersburg in 1999, with the result that Robin was invited by Trond to the Norwegian Geological Winter Meeting at Trondheim in 2000, after which our collaboration into unravelling global palaeogeography began in earnest. Some years and many joint papers later, we thought that a summary and extension of our work would be timely, and this book is the result. Our specialities are complementary: Trond is a geophysicist specialising in palaeomagnetism and mantle dynamics, whilst Robin specialises in Palaeozoic stratigraphy and faunas. However, both of us had previously published on global and regional palaeogeography, alone and with other colleagues, and we both have first degrees in geology, which has formed the essential common language for appropriate discussion, which has been both challenging and fun. In addition and most importantly, Trond has developed the software to generate flat maps from a spherical Earth, and which can move the lithospheric units through time with kinematic objectivity, as explained in Chapter 2. That means that he has constructed virtually all the diagrams in this book, whilst Robin has written slightly more of the words. Nevertheless, we are under no illusions that this book is a final summary of the Earth's changing geography; merely a progress report.

# Acknowledgements

We are indebted to a host of friends, colleagues, and acquaintances from around the world, with whom we have separately and together interacted over many years. It is impossible to name them all here, but we particularly thank (in alphabetical order) Lew Ashwal, Kevin Burke, Mat Domeier, Pavel Doubrovine, Richard Fortey, Carmen Gaina, Morgan Jones, Paul Kenrick, the late Stuart McKerrow, Adrian Rushton, Grace Shephard, Bernhard Steinberger, the late Brian Sturt, Henrik Svensen, Rob Van der Voo, and Douwe van Hinsbergen.