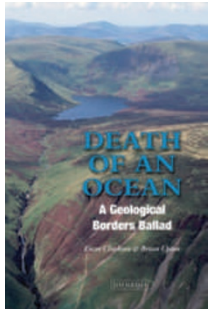


# Ballad of the borders



**Death of an Ocean:  
A Geological  
Borders Ballad**

by Euan Clarkson and  
Brian Upton

DUNEDIN ACADEMIC  
PRESS: 2010. 210 PP.  
£25.00

The Scottish Borders contain key geological evidence that a wide ocean once separated Scotland from England around 420 million years ago. But this evidence is complex, cryptic and obscured by later geological events. In *Death of an Ocean*, Euan Clarkson and Brian Upton bravely explain to the general reader the events that led to the disappearance of this ocean. By decoding the rocks of the Scottish Southern Uplands, they show how the disappearance of an ancient ocean welded Scotland together with England and Wales.

In 1966, Tuzo Wilson proposed that an ocean existed in place of the present-day North Atlantic Ocean over 420 million years ago. This idea marked a radical change in our understanding of the formation and geological history of Britain. This ancient ocean, named the Iapetus Ocean, bisected Ireland and cut through Britain along the border between England and Scotland, explaining why the old rocks of the two countries are very different. Before the closure of the Iapetus Ocean, Scotland was attached to Greenland and North America as

part of the palaeocontinent of Laurentia. And England and Wales belonged with Africa and South America as part of the palaeocontinent of Gondwana. As these ancient continents approached one another, the ocean between them was destroyed, leaving behind the Caledonian–Appalachian mountain belt to mark the join. These tectonic ideas have mostly stood the test of time.

Clarkson and Upton have faced the challenge of explaining, to the non-geologist, generic principles such as plate tectonics, stratigraphy and igneous processes, as well as the specific local details of Scottish geology and landscape. They have met this challenge by writing well-crafted informative text and using well-designed diagrams and photos. They have resisted the natural urge of geological historians simply to allot successive chapters to consecutive time slices. Instead, the history is pieced together more indirectly through a series of topical essays. Several of these chapters are entertainingly biographical; James Hutton famously used the unconformities in his native Scottish borders to deduce the immensity of geological time, and Charles Lapworth refined the use of graptolite fossils for subdividing the Southern Uplands rocks, and thereby early Palaeozoic time in general.

We can forgive Clarkson and Upton some overemphasis of their respective specialisms of fossils and igneous rocks. Such personal enthusiasms bring geology to life. My personal interest in regional tectonics might have promoted further aspects of Scottish geology. Specifically, the deformation that turned the continental margins of the Iapetus Ocean into the Caledonian

mountain belt mostly happened before ocean closure. In Britain, anyway, formation of the Scottish uplands did not involve a climactic continental collision. Clarkson and Upton correctly narrate how the Southern Uplands' sedimentary rocks were scraped off the Iapetus oceanic plate in the 30 million years before ocean closure. They could also have stressed that the strong deformation on the English margin, once attributed to the closure of the Iapetus Ocean, actually occurred a further 30 million years after closure, due to an unrelated cause. Thus the Scottish–English border is one of the few places in Britain where the closure of the Iapetus Ocean can be dated.

My second addition to the book would have been a chapter on the period between the Carboniferous wetlands, about 300 million years ago, and the Quaternary ice age of the past couple of million years. This long period gets only a passing mention by Clarkson and Upton, perhaps quite reasonably, as no depositional rock record of this period exists. However, it would have been interesting to chart how the topographic plateau of the Scottish Southern Uplands survived the Mesozoic crustal rifting that essentially defined the shape of the British Isles, and how the late Cretaceous seas probably lapped over the Scottish Borders.

Around 60 million years ago, and towards the end of this gap in our records, the intrusion of igneous melt into the Scottish crust caused regional uplift, and rejuvenated the upland plateaux of northern and western Britain. The Scottish mountains are too often equated directly with the Caledonian mountain belt that marked the Iapetus Ocean closure. *Death of an Ocean* avoids this implication, but it misses a chance to advertise that the British uplands have a multistage geological origin, and are not simply the result of a continental collision that resulted from the closure of this ancient ocean.

Minor reservations aside, *Death of an Ocean* is an illuminating, entertaining and authoritative read for the non-specialist interested in the ancient geological history of Britain, and in the fundamental act of union between Scotland and England. □

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