

THE GEOLOGY OF MIDDLE-EARTH

Tolkien's detailed account of the natural features of Middle-Earth, which he regards as the outcome of a long sequence of historical and prehistoric events, makes speculation about the geology of Middle-Earth possible. There are hints of a pre-history of Middle-Earth, that is to say of events occurring before the beginning of the very long historical and legendary records of Numenor and the elves, in the memory of the oldest living creatures. Treebeard and Galadriel, when they speak of lands they visited long ago "that lie beneath the waves" (IV.259). In addition, Tolkien writes of landscapes with an appreciation that they are the products of a long history of geological events, and the detail with which he describes scenery makes it possible to work out the nature of the bed-rocks below the surface. On this basis, in turn, a scheme may be drawn up for the geological history of Middle-Earth, usually by arguing by analogy with the geology of Europe, though with occasional ideas based on the geology of North America. In this task of imaginative reconstruction, the topographical maps of Middle-Earth which accompany the stories are an indispensable aid, and I have used them to prepare the geological sketch-map which accompanies this article.

However, before I give an account of some of the conclusions of this study, I must deal with the suggestion, strongly hinted at by Tolkien in the introduction to both "The Hobbit" and "The Lord of the Rings" (I.11-12), and discussed at some length by Paul Kocher in his book "Master of Middle-Earth" (3-9), that Middle-Earth is Europe and North Africa at a time in the remote past since when "the lands and seas have changed". It is not possible to take this extension of the traditional story-teller's "Once upon a time" very far. The processes forming and eroding away great mountain chains such as the Misty Mountains are too slow for them to have become obliterated by the present day, and for the east-west trending Alpine chain to have come into existence instead. There is evidence that the Alps were already a considerable range of peaks 50 million years ago, long before the fauna and flora of Europe resembled those of today as closely as do those of Middle-Earth. To regard Middle-Earth, with its foxes, eagles, men, "pipe-weed" and willow trees as contemporary with a period before the Alps were formed is as violently anachronistic as the popular fiction portraying stone-age men alongside dinosaurs. Tolkien was too good a student of natural history to commit such a blunder.

A more significant problem arises over the astronomy of Middle-Earth. This is described in detail on several occasions (e.g. I,91) and appears to be that seen at the present day in England. But the "fixed" stars of our familiar constellations have slow relative movements, and it is unlikely that Orion or the Plough would have been recognisable as such 10 or 20 thousand years ago. His careful description of stars shows that Tolkien had a sound knowledge of naked-eye astronomy, and it is likely that he was aware of this well-known fact. The idea that Middle-Earth is Europe, perhaps during an intermission in the Pleistocene ice-age (Kocher, 5) cannot be sustained for the purposes of scientific study. I suspect that the same is true of linguistic or anthropological studies of Middle-Earth. It seems preferable to think of Middle-Earth as an "alternative world", an idea familiar to readers of Science Fiction, resembling ours in its natural history except where Tolkien indicates otherwise. This approach has the merit of agreeing with Tolkien's concept of "Secondary Belief", which he elaborates in his essay "On Fairy Stories" reprinted in "Tree and Leaf".

It might seem illogical of me, having gone to some length to demonstrate that Middle-Earth is not "our"Earth, to use the names for eras of geological time which are employed by geologists on our Earth. On other planetary bodies, for example the Moon, geologists have given different names to the divisions of geological time recognised there, and it might be thought appropriate to do the same for Middle-Earth. I have not done so because of the very close resemblance in geology between Middle-Earth and Europe. Tolkien often refers to "Chalk" forming the Barrow Downs and other hills in and around the Shire, and it seems correct to me to assume that this chalk, like that of southern Britain and northern France, was laid down in the "Cretaceous" (i.e. "chalk-forming") era. By extension, I have also used terms such as "Tertiary", "Mesozoic" and "Palaeozoic" to describe the time of formation of rocks which seem from Tolkien's description of the local landscape, to correspond with rocks of that age seen in Europe or North America.

The Geology of the Shire

The scenery of the Shire is described in particular detail, and permits quite an accurate idea of the geological strata and their structure to be built up. The geological similarity between the Shire and southern England is clear. It is possible to work out which way the escarpments of the Green Hills and the Barrow Downs slope, giving a direction for the dip of the strata. This shows that the Shire lies in a basin structure ("syncline") like the London Basin of SE England. Tertiary sands and clays overlie a basin of chalk, and the hobbits excavated the unconsolidated or weakly cemented sands for their holes. A close analogy to the Hill at Hobbiton, on this view of the geology of the Shire, would be London's Hampstead Heath! The clays form the fertile lower ground, the Brandywine River running over the Middle-Earth equivalent of the London Clay, and the Old Forest lying in a similar geological setting to Epping Forest. Having arrived at this interpretation of the geology of the Shire, I was very encouraged to discover in 1973 that the same conclusion had been reached independently by Mr. P. Palmer of the British Museum (Natural History), and elaborated in a most interesting and amusing unpublished manuscript entitled "The Geology of the North-Western Region of Middle-Earth - the Eriador Syncline" which, as far as I know, is the first account of the geology of part of Middle-Earth.

The Emyn Muil

This group of bare rocky hills in the central region of Middle-Earth, presents a number of problems for the geologist. The landscape is described in considerable detail, and the dip of strata can be determined as in the Shire. Tolkien states specifically that the rapids of Sarn Gebir, north of the Emyn Muil, occur where the river Anduin passes through a barrier of limestone (II.407) and it is tempting to think that the falls of Rauros, like those of Niagara, fall over a great escarpment of Palaeozoic limestone. But how can this view that the Emyn Muil are hills of comparatively ancient rocks be fitted in with the plains of Rohan, which appear to be underlain by comparatively young rocks, like the prairies of North America or the Hungarian plain of central Europe? Fortunately, Tolkien helps with this difficulty (III.25) :-

"The ridge on which the companions stood went down steeply before their feet. Below it twenty fathoms or more, there was a wide and rugged shelf which ended suddenly in the brink of a sheer cliff: the East Wall of Rohan. So ended the Emyn Muil and the green plains of Rohan stretched away before them to the edge of sight".

The East Wall of Rohan is clearly a fault scarp, that is a line of cliffs marking a great fracture in the Earth's crust, where the rocks of the Emyn Muil have been raised many thousands of metres compared with those lying below the plain of Rohan.

The Misty Mountains

The size and continuity of the Misty Mountain chain must mean that it is a comparatively recently-formed fold-mountain chain, like the Alps or the Himalayas. "Caradhras" translates directly the common Alpine peak name "Rothorn" and Tolkien confirms that, like most Alpine Rothorns, it is a granite peak (II. 313-314) because granite frequently weathers to a red colour, a British example being seen in the Red Hills of the Isle of Skye. On the other hand, the abundant underground passages inhabited by Orcs on the passes east of Rivendell described in "The Hobbit" (55-56) suggest that parts of the Misty Mountains chain are formed of limestone. The underground chamber where Gollum lived, for example, seems to be a natural cavern not an abandoned mine. I have, therefore, divided the Misty Mountains into two belts, one of granite and crystalline metamorphic rocks, the other of sedimentary rocks, mainly limestone, following in this the very general structure of the Alpine chain of Europe. The presence of the caves of Aglarond and the name "White Mountains" suggest that this part of the chain is mainly formed of limestone.

I have done little more here than indicate the kinds of arguments which sustain the accompanying geological map. I have not discussed many interesting aspects of the study, for example the location and character of the mines of Middle-Earth in relation to the geological structure. Each re-reading of "The Lord of the Rings" has produced improved versions of the geological map over the first crude version made for a meeting of the Greenough Club of University College, London in 1970. Discussion with other geologists has also strongly modified my ideas, and I am especially grateful to the members of the Greenough Club, the De La Beche Club of Imperial College, London and the Geology Club of Luton Polytechnic for lively and enlightening discussion at their meetings.

Geological study of Middle-Earth is a pastime open to anyone with an enthusiasm for Tolkien's works and the Earth Sciences, and the ideas outlined here are little more than a beginning. I would be most interested to hear from Tolkien enthusiasts who have come to their own conclusions about the geology of Middle-Earth.

Bibliography

Page references are to the following editions of Tolkien's works :-

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