

BOOK REVIEW

PLATES vs PLUMES: A GEOLOGICAL CONTROVERSY by Gillian R. Foulger.
Wiley-Blackwell, Sussex, UK, 328p.

This book is about the most debated issue of plates vs plumes. This is a very timely publication which provides very useful information on this controversy. Most of the magmatic rocks are supposed to be originated either by processes related to plate tectonics or due to plume. Foulger has tried to provide detailed analyses on this interesting topic.

The first chapter presents historical view on the Plate and Plume hypotheses. Wegener's idea of break-up of mother continent Pangaea into many continents has gained popularity after his death. It was Holmes who popularized the idea of continental drifting. Later many have accepted this hypothesis. Simultaneously, plume hypothesis was suggested by Morgan for generation of large amount of mantle melts. This chapter also discusses about how to test Plume and Plate hypotheses.

In the consecutive sections the author has provided detailed information on various features related to plates and plumes such as vertical motions, volcanism, time progressions and relative fixity of melting anomalies, seismology, temperature and heat, petrology and geochemistry and discussed about predictions of the Plume and Plate hypotheses. These sections are very well-presented and explanations are made while discussing different case studies. Each section also provides a comparison of merits and demerits of plates and plumes. Vertical motion is an integrated feature for both Plate and Plume hypotheses. But Foulger points out that in a number of cases, pattern and rate of uplift in and around are found to be inconsistent with the timing, shape and rates predicted. Her main conclusion is that only on the basis of uplift alone noticed in any region cannot be inferred as a Plume effect. There may be other reasons for uplift also. Such constraints are not applied for the plate hypothesis. Similarly volume of melting anomalies is another feature of concern. This has also been discussed in detail.

Plume hypothesis supports fixity of melting anomalies, whereas such restrictions are not necessary for plate hypothesis. Plume hypothesis is challenged in this book by discussing some case studies. She concludes that volcanism is a consequence of lithospheric processes, regardless of the deeper origins of the melt. Seismology may help to

explore melting anomalies and provides useful information about interior of Earth but, sometimes, interpretations based on this are not acceptable to all. Foulger's emphasis is that seismology alone cannot provide any concrete information on any hot bodies exists within the Earth. The next point discussed is temperature and heat. It starts with a question – Are “hot spots” hot? This is an important question to answer because high-temperature mantle source is a vital prediction of the Plume hypothesis. This book addresses that the term “hot spot” is a misnomer. This is because there is no reliable evidence from seismic, petrological, bathymetric or heat-flow. I agree with author that geochemistry *alone* is unlikely to be able to resolve the depth of any melt source deeper than ~200 km. But this is equally true for any hypothesis. Author agrees that high $^3\text{He}/^2\text{He}$ isotope ratios are unambiguous lower-mantle signature but she also has many arguments against this. She rightly mentions that a hypothesis must be falsifiable in order to be scientific, and for it to be meaningful, to question and test it.

This is a well-written book in a view that Plume hypothesis has a number of problems and Plate hypothesis has answers to those problems. In Earth science such arguments are essential because no one is certain what and how actually happened within the Earth. One has to depend on observations. At the end of the book a big table (Table 8.2) is mentioned which compares observations that are problematic or unexplained by the Plume hypothesis but have contrasting explanations in the Plate hypothesis. At the end of each chapter many fundamental questions have been raised. These questions are really important and must be answered. This is a very important contribution as it provokes those who advocate plume hypothesis and I am sure follower of Plate hypothesis will get answers to all the questions raised in this book in due course.

At the end I may say that this is must read book for igneous petrologists and students.

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