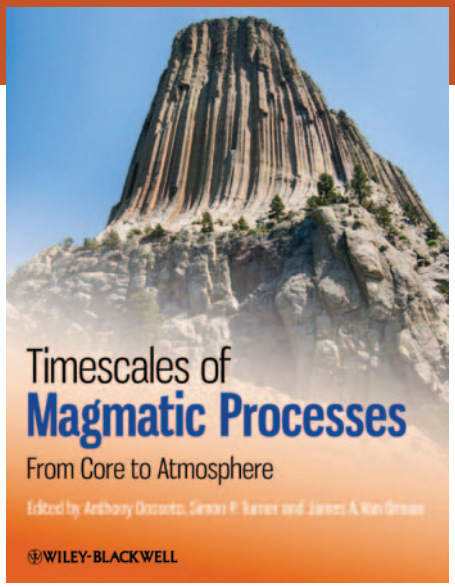
TIMESCALES OF MAGMATIC PROCESSES FROM CORE TO ATMOSPHERE[1]



To say that this book is very timely would appear to be a cheap pun. But actually, timescales have been one of the most important focuses of research in the last 10 to 20 years for those working on magmatic rocks, as a brief survey of the AGU Volcanology, Geochemistry, Petrology (VGP) section sessions will confirm.

Four and a half billion years of geological time is the unique canvas that underlies our discipline and distinguishes it from other sciences. In the last 10 to 20 years though, technological advances – better spatial resolution for low-abundance elements, better measurements of diffusivities, and better determinations of low-abundance isotopes such as uranium, thorium, and radon – have allowed us to access the shorter timescales. *Timescales of Magmatic Processes* serves as a benchmark in the field. Nevertheless, it is not a definitive summary but more a progress report, because I suspect that such an active topic has a great deal more fruit to bear.

The ambition of this book, to cover timescales from the Earth's core to its atmosphere, is encapsulated in the title. The chapters have been written by an international spectrum of recognized experts in their field, and as such the book is admirably authoritative. At the same time, collating chapters from such diverse contributors has led to variability in approach and level. The reader should probably see this book as a compendium of summary chapters to be read or referenced as needed, rather than as a cover-to-cover read that will provide complete enlightenment on the issues of magmatic timescales.

The book is logically organised, from inside the Earth (core and mantle) outward to the atmosphere. The focus on the main theme of timescales varies in intensity. There are, for instance, useful chapters on simulating magma ascent and the geochemistry of melting – arguably essential for understanding the context of magmatic processes and, implicitly, their characteristic timescales. But such chapters are not effectively woven into the timescales theme. A disadvantage of the "collection of contributions" approach is that connectivity is not deliberately imposed and there are no integrating chapters. The chapter topics and their contents are therefore probably not those which would be chosen by an individual or team of authors. The compromise is that the individual chapters are written by recognised experts in their respective fields. There is an implicit assumption that the reader has an adequate background in geology, chemistry and physics, because the introductions to radioactive decay, element distribution, the principles of diffusion and plate tectonics, for instance, are limited.

Although both physical and chemical tools are considered throughout the book, there is a leaning towards the latter. The introductory chapter by the editorial team of Dosseto, Turner, and Van Orman, as well as Costa, lays out the groundwork and makes clear the systematics of the U-series isotopes and the subsidiary theme of diffusion; these are the main tools of the magmatic geochronologist and are referred to throughout much of the book. Early planetary magmatic processes are covered in the next chapter, by Caro and Kleine. This contribution seems slightly out of place among the other chapters but serves well as a stand-alone introduction to a challenging topic. There are two complementary chapters on mantle melting. Bourdon and Elliott summarise interpretations based on U-series isotope data, while Van Orman and Saal show how diffusion may influence trace element and isotope systematics. In the same vein there are three complementary chapters on magma ascent. O'Neill and Spiegelman summarise the physics controlling ascent mechanisms and thereby ascent rates, Turner and Bourdon show how interpretations of U-series data can constrain ascent, and O'Reilly and Griffin present a brief analysis of ascent rates derived from xenolith-settling criteria. The chapter by Costa and Morgan is a particularly elegant summary of the many recent advances in in situ techniques for teasing out timescales of processes in magmas from their crystal cargoes. Replete with a detailed tabulation of diffusivities in the major minerals, this chapter is likely to be highly cited and appreciated. It too is complemented by subsequent chapters. Dosseto and Turner outline the application of U-series data to magmatic differentiation. Rushmer and Knesel summarise the experimental contributions to understanding the consequences and timescales of crustal melting. And Bachman focusses on the timescales required to develop large silicic bodies – an area to which much interest and attention has been devoted over the past decade. Berlo and others close the book with an analysis of magmatic degassing timescales and the geochemical consequences. The complementarity of chapters on similar themes – melting, ascent and differentiation – is apparently accidental but provides useful variations in perspective.

Are there any gaps in the coverage? Very few really. Perhaps some mention of observed natural and experimentally determined crystal growth rates and their relation to textures (through crystal size distributions) could have been included. Despite the slightly quirky mix of chapters, there is probably no other volume which brings together the various perspectives on the topic of magmatic timescales as thoroughly and credibly as this one.

A definite "plus" is that the book is laid out simply and cleanly – the diagrams, in particular, are commendably simple and easy to read. Equations are there where needed but not used unnecessarily. Many of the chapters, laced as they are with key references, are ideal for graduate students or senior undergraduates to use as an introduction to the current state of the art in our understanding of magmatic timescales. *Timescales of Magmatic Processes* is more than a textbook though. It will certainly be a useful reference work for academics, even those of us working with, and familiar with, the timescales of magmatic processes. Furthermore it's a handy mid-sized paperback, easy to toss into a carry-on and dip into en route to the next conference or workshop.

A minor quibble concerns the collection of colour figures bound into the centre of the book (and not even between two chapters). These are all simply colour versions of figures already in the text. It is not clear on what basis they were chosen, and the addition of colour does little to enhance most of them, other than the photomicrographs. One hopes that the colour plates have not substantially inflated Wiley's list price of £80 ($130).

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1 Dosseto A, Turner SP, Van Orman JA (eds) (2010) Timescales of Magmatic Processes from Core to Atmosphere. Wiley-Blackwell, Hoboken, New Jersey, ISBN: 978-1-4443-3260-5, 272 pages