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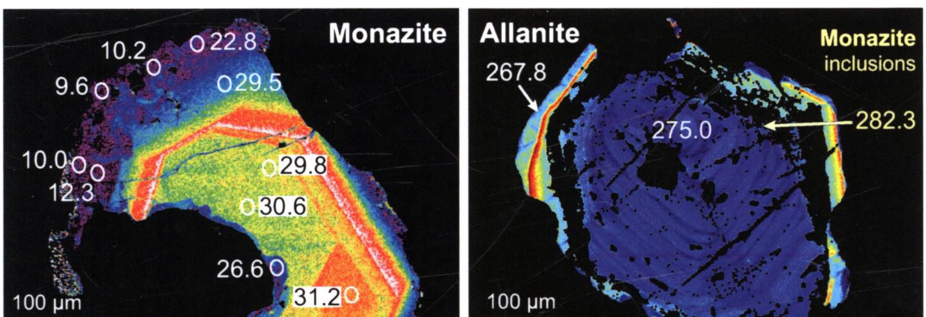
PETROCHRONOLOGY:
METHODS AND APPLICATIONS

EDITORS:
Matthew J. Kohn
Martin Engi & Pierre Lanari



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CONTENTS

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83

PETROCHRONOLOGY

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Petrochronology: Methods and Applications

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Boise State University, USA

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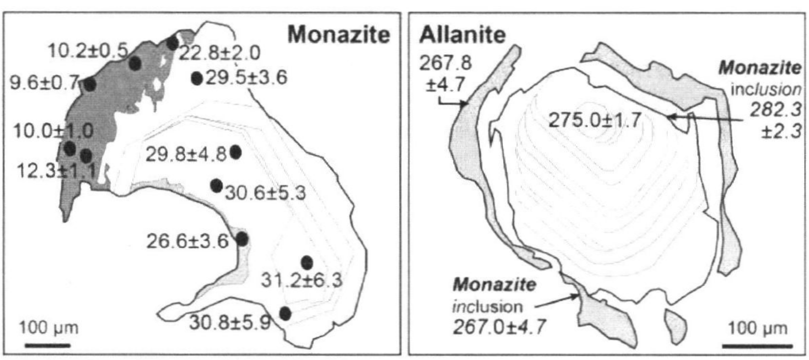

Cover image: Thorium compositional maps of monazite (X-ray counts, cps) and allanite (atoms per formula unit, apfu). ***Left:*** Monazite crystal from a Greater Himalayan Sequence orthogneiss, central Nepal. Ellipses show locations of ion probe Th–Pb analyses. Core shows oscillations, probably formed during igneous crystallization. An age of ca. 27 Ma likely reflects prograde metamorphic overprinting (23 Ma age straddles two chemical domains). An age of 10–11 Ma reflects hydrothermal replacement; based on Corrie and Kohn (2011). ***Right:*** Allanite from the Cima d'Asta pluton, southern Alps (NE Italy). Magmatic allanite core with oscillatory zoning (dated at 275.0 ± 1.7 Ma (2s) by quadrupole LA-ICP-MS) formed by breakdown of early-magmatic monazite, preserved as relics (282.3 ± 2.3 Ma). During hydrothermal alteration Th-rich allanite rim (267.8 ± 4.7 Ma) formed, and its partial breakdown produced a new generation of monazite (267.0 ± 4.7 Ma); based on Burn (2016), compare Chapter 12, this volume.

Series Editor: ***Ian Swainson***

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Petrochonology: Methods and Applications

83 *Reviews in Mineralogy and Geochemistry* **83**

FROM THE SERIES EDITOR

It has been a pleasure working with the volume editors and authors on this 83rd volume of *Reviews in Mineralogy and Geochemistry*. Several chapters have associated supplemental figures and or tables that can be found at the MSA website. Any future errata will also be posted there.

Ian P. Swainson, Series Editor
Vienna, Austria

PREFACE

"Thy friendship makes us fresh"
Charles, King of France, Act III, Scene III
(Henry VI, Part 1, by William Shakespeare)

Friendship does indeed make us fresh—fresh in our enthusiasm, fresh in our creativity, and fresh in our collaborative potential. Indeed, it is the growing friendship between petrology and geochronology that has given rise to the new field of petrochronology. This, in turn, has opened a new array of methods to investigate the history of the geologic processes that are encoded (oh, so tantalizingly close!) in rocks, and to develop a broad new array of questions about those processes.

All friendships have their initiations and growth periods, and the origins and evolution of petrochronology are discussed in some detail in the Introduction. In brief, petrochronology has been practiced for many decades, but was first labeled in 1997. The seeds for this specific volume were planted in 2013, watered in 2015, and (we hope) will thrive as a resource through the coming decades. Indeed, it is hard to envision any future work involving the geochronology of igneous or metamorphic rocks in the context of tectonics and petrogenesis that is not somehow petrochronologic.

Our overall goal in this volume is to capture a high-resolution image of the state of petrochronology during its ascendance, not simply for historical purposes, but rather to provide a solid foundation for the future. We have striven to corral the very best practitioners in the field in hopes that their wisdom can help train new generations of petrochronologists, and inspire them to greater enthusiasm and more diverse research directions. The high quality of each chapter suggests that we might just have succeeded in this endeavor!

We thank all the authors for their immense investment of time and resources to pull off the writing of this book. Similarly, the reviewers worked overtime to temper the sometimes soft metal of each chapter (often on regrettably short notice from the editors…). Ian Swainson rapidly turned around our manuscripts, hardly giving us rest between submission of final versions and editing proofs. We appreciate his remarkable attention to detail and unflagging patience. We also thank our governmental, corporate, society, and university sponsors who helped support the accompanying short courses: the US National Science Foundation, Cameca & Nu Instruments, ESI, Selfrag, the European Association of Geochemistry, The European Geosciences Union, the Geochemical Society, Société Française de Minéralogie et Cristallographie, Boise State University, and the University of Bern. Last, but not least, we thank our families and close friends for somehow managing to put up with us over the long two years that it took to bring about this book.

Matthew J. Kohn, *Boise, Idaho, USA*
Martin Engi, *Bern, Switzerland*
Pierre Lanari, *Bern, Switzerland*
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Petrochronology

83 *Reviews in Mineralogy and Geochemistry* **83**

TABLE OF CONTENTS

1 Significant Ages—An Introduction to Petrochronology

Martin Engi, Pierre Lanari, Matthew J. Kohn

2 Phase Relations, Reaction Sequences and Petrochronology

Chris Yakymchuk, Chris Clark, Richard W. White

3 Local Bulk Composition Effects on Metamorphic Mineral Assemblages

Pierre Lanari, Martin Engi

4 Diffusion: Obstacles and Opportunities in Petrochronology

Matthew J. Kohn, Sarah C. Penniston-Dorland

5 Electron Microprobe Petrochronology

Michael L. Williams, Michael J. Jercinovic, Kevin H. Mahan, Gregory Dumond

6 Petrochronology by Laser-Ablation Inductively Coupled Plasma Mass Spectrometry

Andrew R. C. Kylander-Clark

7 Secondary Ionization Mass Spectrometry Analysis in Petrochronology

Axel K. Schmitt, Jorge A. Vazquez

8 Petrochronology and TIMS

Blair Schoene, Ethan F. Baxter

9 Zircon: The Metamorphic Mineral

Daniela Rubatto

10 Petrochronology of Zircon and Baddeleyite in Igneous Rocks: Reconstructing Magmatic Processes at High Temporal Resolution

Urs Schaltegger, Joshua H.F.L. Davies

11 Hadean Zircon Petrochronology

T. Mark Harrison, Elizabeth A. Bell, Patrick Boehnke

12

Petrochronology Based on REE-Minerals: Monazite, Allanite, Xenotime, Apatite

Martin Engi

13 Titanite Petrochronology

Matthew J. Kohn

14 Petrology and Geochronology of Rutile

Thomas Zack, Ellen Kooijman

15 Garnet: A Rock-Forming Mineral Petrochronometer

E.F. Baxter, M.J. Caddick, B. Dragovic

16 Chronometry and Speedometry of Magmatic Processes using Chemical Diffusion in Olivine, Plagioclase and Pyroxenes

Ralf Dohmen, Kathrin Faak, Jon D. Blundy

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