THEMATIC TOPICS IN 2021

Volume 17, Number 1 (February)

SHEDDING LIGHT ON THE EUROPEAN ALPS

GUEST EDITORS: **Anders McCarthy** (University of Bristol, UK and University of Tasmania, Australia) and **Othmar Müntener** (University of Lausanne, Switzerland)

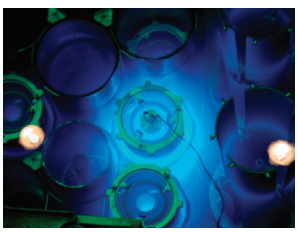
The European Alps are one of the most studied orogens in the world. Research over last 30 years is forcing us to rethink our understanding of Alpine evolution: new concepts have emerged that question long-established paradigms. We will provide a petrological, geochemical, and tectonic overview of the Alpine Orogeny, from rifting and spreading to subduction and collision and, finally, to postcollisional uplift and erosion. In this issue, we shed light on the current debates regarding the origins of (ultra-)high-pressure metamorphism, the origins of syncollisional magmatism, and the evolution of rifting and ocean spreading. We also examine the consequences of the new interpretations on the dynamics of subduction and collision.

- **Ocean Subduction Dynamics in the Alps** Philippe Agard (Sorbonne University, France) and Mark Handy (Free University of Berlin, Germany)
- **Climate, Uplift and Erosion Shaping the European Alps** Pierre Valla (Grenoble Alpes University, France), Pietro Sternai (University of Milano–Bicocca, Italy), and Matthew Fox (University College London, UK)
- **The Heterogeneous Tethyan Oceanic Lithosphere of the Alpine Ophiolites** Elisabetta Rampone (DISTAV, University of Genoa, Italy) and Alessio Sanfilippo (University of Padua and CNR, Italy)
- **Amagmatic Convergence Controlled by Rift Inheritance** Anders McCarthy (University of Bristol, UK and University of Tasmania, Australia), Julie Tugend (Sorbonne University, France), and Geoffroy Mohn (University of Cergy-Pontoise, France)
- **Under Pressure: High-Pressure Metamorphism in the Alps** Lucie Tajčmanová, (Heidelberg University, Germany), Paola Manzotti (Stockholm University, Sweden), and Matteo Alvaro (University of Pavia, Italy)
- **Superhydrous Arc Magmas in the Alpine Context** Othmar Müntener (University of Lausanne, Switzerland), Peter Ulmer (ETH Zurich, Switzerland), and Jon Blundy (University of Oxford, UK)

Volume 17, Number 2 (April)

EXPLORING EARTH AND PLANETARY MATERIALS WITH NEUTRONS

GUEST EDITORS: **David R. Cole** (Ohio State University, USA) and **Nancy L. Ross** (Virginia Tech, USA)



For over half a century, the structural details and the dynamics of atomic arrangements in materials have been determined using neutron-based scattering and absorption measurements. Neutron scattering experiments have contributed valuable information on geological materials and how these interact with fluids. In situ studies of transformations and fundamental properties can emulate diverse environments, from Earth's surface to its deep interior. Potential growth of the "neutron community" is being realized with the development of new and improved neutron sources. This issue of *Elements* will familiarize the reader with the basic concepts of neutron scattering, the methods that are available to Earth scientists, provide a summary of facilities around the world, and give key applications of the technique.

- **Neutron Scattering: A Beginners' Guide for Earth Scientists** Nancy L. Ross (Virginia Tech, USA) and David R. Cole (Ohio State University, USA)
- **Where is the Hydrogen?** G. Diego Gatta (University of Milan, Italy), Klaudia Hradil (Vienna University of Technology, Austria), and Martin Meven (RWTH Aachen University, Germany)
- **Phase Transitions and Magnetism in Minerals** Bryan C. Chakoumakos (Oak Ridge National Laboratory, USA) and John B. Parise (Stony Brook University, New York, USA)
- **Probing the Structure of Melts, Glasses, and Amorphous Materials** Chris J. Benmore (Argonne National Laboratory, USA) and Martin C. Wilding (Sheffield Hallam University, UK)
- **Nanoscale Structure and Dynamics in Geochemical Systems** Andrew G. Stack (Oak Ridge National Laboratory, USA), Hsiu-Wen Wang (Oak Ridge National Laboratory, USA), and David R. Cole (Ohio State University, USA)
- **Imaging with Neutrons** Gilberto Artioli (University of Padua, Italy) and Daniel S. Hussey (National Institute of Standards and Technology, USA)

Volume 17, Number 3 (June)

SPELEOTHEMS

GUEST EDITORS: **Joshua M. Feinberg** (University of Minnesota, USA) and **Kathleen R. Johnson** (University of California, Irvine, USA)

Growing slowly drip by drip through the millennia, stalagmites, stalactites, and flowstone—collectively known as speleothems—are some of the most fantastic mineral features in nature. Speleothems are also critical archives of past environments, and their study incorporates expertise from groundwater hydrogeology and geochemistry, atmospheric chemistry, climate science, geobiology, and even geophysics. Research on speleothem trace element and isotopic geochemistry, constituent organic compounds, noncarbonate minerals, and morphology can help illuminate paleoenvironmental conditions and document historical anthropogenic land-use changes. This issue of *Elements* will introduce the many ways that speleothems are used within the geoscience community to learn about natural Earth processes and our role in modifying them.

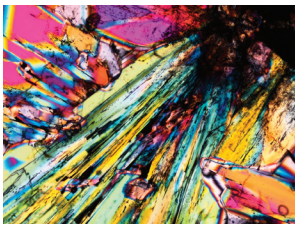
- **The Origins of Caves and Speleothems** Joshua M. Feinberg (University of Minnesota, USA) and Kathleen R. Johnson (University of California, Irvine, USA)
- **Uranium-Series Geochronology of Speleothems** Katee Wendt (University of Minnesota, USA), R. Lawrence Edwards (University of Minnesota, USA), and Xianglei Li (Xi'an Jiaotong University, China)
- **Reconstructing Past Hydroclimates from Speleothems** Kathleen R. Johnson (University of California, Irvine, USA)
- **Speleothem Paleothermometry** Nele Meckler (University of Bergen, Germany) and Hubert Vonhof (Max Planck Institute for Chemistry, Germany)
- **Cave Decorating with Microbes: Geomicrobiology of Caves** Daniel S. Jones (New Mexico Institute of Mining and Technology, USA) and Diana E. Northup (University of New Mexico, USA)
- **Mineral Magnetism of Cave Deposits** Joshua M. Feinberg (University of Minnesota, USA), Plinio Jaqueto (University of São Paulo, Brazil), and Ron Shaar (Hebrew University of Jerusalem, Israel)

THEMATIC TOPICS IN 2021

Volume 17, Number 4 (August)

GEOSCIENCE BEYOND THE SOLAR SYSTEM

GUEST EDITORS: **Oliver Shorttle** (University of Cambridge, UK), **Natalie R. Hinkel** (Southwest Research Institute, USA), **Cayman Unterborn** (Arizona State University, USA), and **Claire Cousins** (University of St Andrews, UK)



A revolution in astronomical observation has expanded the horizon of geological processes out from the handful of rocky and icy bodies in our solar system to the now thousands of planets detected around other stars ("exoplanets"). A major result from this burgeoning field is that rocky planets are the most abundant. A remarkable ~11% of Sun-like stars host planets similar in their size and incident flux to Earth, whilst many more planets may exist in states relevant to past periods of terrestrial evolution, either trapped as perpetual magma oceans or locked into a snowball climate. This issue will highlight the myriad opportunities exoplanets represent for investigating fundamental geological processes and the opportunities for the geosciences to contribute to this exciting young field.

- **Why the Geosciences and Exoplanetary Sciences Need Each Other** Oliver Shorttle (University of Cambridge, UK), Natalie R. Hinkel (Southwest Research Institute, Texas, USA), Cayman Unterborn (Arizona State University, USA), and Claire R. Cousins (University of St. Andrews, UK).
- **Compositional Diversity of Rocky Exoplanets** Keith D. Putirka (California State University, Fresno, USA), Caroline Dorn (University of Zurich, Switzerland), Natalie R. Hinkel (Southwest Research Institute, USA), and Cayman Unterborn (Arizona State University, USA)
- **Exogeology: Insights from Dead Stars** Siyi Xu (Gemini Observatory, USA) and Amy Bonsor (University of Cambridge, UK)
- **The Diversity of Exoplanet Interior Dynamics and their Surface Expressions** Maxim D. Ballmer (University College London, UK and the Tokyo Institute of Technology, Japan) and Lena Noack (Free University of Berlin, Germany)
- **Leveraging Models to Constrain the Climates of Rocky Exoplanets** Thaddeus D. Komacek (University of Chicago, USA), Wanying Kang (Massachusetts Institute of Technology, USA), Jacob Lustig-Yaeger (John Hopkins University, USA), and Stephanie L. Olson (Purdue University, USA)
- **The Air Over There: Exploring Exoplanet Atmospheres** Laura K. Shaefer (Stanford University, USA) and Vivien Parmentier (University of Oxford, UK)
- **Starting and Finding Life on Rocky Planets** Paul B. Rimmer (University of Cambridge, UK), Sukrit Ranjan (Massachusetts Institute of Technology, USA), and Sarah Rugheimer (University of Oxford, UK)

Volume 17, Number 5 (October)

CARBONATITES

GUEST EDITORS: **Gregory M. Yaxley** (Australian National University), **Michael Anenburg** (Australian National University), and **Suzette Timmerman** (University of Alberta, Canada)

Carbonatites are rare, but important, igneous rocks in the Earth's crust. They are composed dominantly of the Ca, Mg and Fe carbonates, along with many other minor and trace components. The popularity of high-tech devices—smart phones, electric motors for zero-emission vehicles, wind turbines for renewable energy—has led to a renewed focus on these enigmatic carbonatite magmas, because to make these devices requires rare earth elements and the majority of the world's rare earth elements are associated with carbonatites. In this issue, we explore the current models for how carbonatites form and evolve in the mantle or crust, the temporal and tectonic controls on their formation, why they are so enriched in rare earth elements, and what are their economically significant minerals.

- **Carbonatites: Are They the Product of Simplicity or Diversity?** Vadim S. Kamenetsky (University of Tasmania, Australia), Anatoly N. Zaitsev (St Petersberg State University, Russia), Anna G. Doroshkevich (Sobolev Institute of Geology and Mineralogy, Russia), and Holly A.L. Elliott (University of Southampton, UK)
- **Upper Mantle to Crustal Evolution of Carbonatite Magmas** Gregory M. Yaxley (Australian National University), A. Lynton Jacques (Australian National University), and Bruce A. Kjarsgaard (Geological Survey of Canada)
- **Carbonatites and their Role in Diamond Formation in the Deep Earth** Suzette Timmerman (University of Alberta, Canada), Anna V. Spivak (Russian Academy of Sciences), and Adrian P. Jones (University College London, UK)
- **Rare Earth Deposits in Carbonatites** Michael Anenburg (Australian National University), Sam Broom-Fendley (University of Exeter, UK), and Wei Chen (China University of Geosciences)
- **The Distinctive Mineralogy of Carbonatites** Andrew G. Christy (Queensland Museum, Australia), Igor V. Pekov (Lomonosov Moscow State University, Russia), and Sergey V. Krivovichev (St. Petersburg State University, Russia)
- **Carbonatites and Global Tectonics Through Geological Time** Emma R. Humphreys-Williams (Natural History Museum, London, UK) and Sabin Zahirovic (University of Sydney, Australia)

Volume 17, Number 6 (December)

HEAVY STABLE ISOTOPES: FROM CRYSTALS TO PLANETS

GUEST EDITORS: **François L. H. Tissot** (California Institute of Technology, USA) and **Mauricio Ibañez-Mejia** (University of Arizona, USA)

Since their discovery in 1913, stable isotopes have become formidable tracers of physicochemical processes at all scales. Steady advances in mass spectrometry have allowed isotopic inquiries to move from the so-called "traditional" systems (i.e., H, C, N, O, and S) to heavier "non-traditional" systems (e.g., Fe, Mo, Ti, Zr, U) whose diverse geochemical characteristics are providing novel and complementary insights. Moving from micron-size systems (single crystals) to planetary-size bodies, the articles in this issue will explore the enormous range of temporal and physical scales over which heavy stable isotopes have provided paradigm-shifting insights into the evolution of our planet and solar system. We will also highlight new frontiers where novel stable isotope systematics appear particularly promising for unraveling long-standing questions.

- **Reading the Isotope Code: Lessons from Emerging Isotope Systems** Mauricio Ibañez-Mejia (University of Arizona, USA) and François L. H. Tissot (California Institute of Technology, USA)
- **Breaking the Equilibrium Paradigm: Kinetic Isotope Fractionation in High-Temperature Environments** James M. Watkins (University of Oregon, USA)
- **Unlocking the Single-Crystal Record** François L. H. Tissot (California Institute of Technology, USA) and Mauricio Ibañez-Mejia (University of Arizona, USA)
- **Planetary Genealogy** Christoph Burkhardt (University of Münster, Germany)
- **Planetary Mantles: The Iron Conundrum** Paolo A. Sossi (ETH Zurich, Switzerland) and Anat Shahar (Carnegie Institution for Science, USA)
- **The Icing on the Cake: Forming Earth's Crust** Sarah M. Aarons (University of California, San Diego, USA), Aleisha Johnson (University of Chicago, USA) and Shelby Rader (Indiana University, USA)
- **Planetary Evaporation: Atmospheric Boundaries** Haolan Tang (University of California, Los Angeles, USA) and Edward D. Young (University of California, Los Angeles, USA)