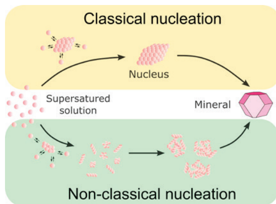
2025 THEMATIC PREVIEW

Volume 21, Number 1 (February)

THE BIRTH AND GROWTH OF MINERALS FROM AQUEOUS SOLUTIONS

GUEST EDITORS: **Alejandro Fernandez Martinez** (ISTerre, France) and **Alexander E.S. Van Driessche** (IACT, Spain)



The birth and growth of minerals from aqueous solutions is a ubiquitous process in both natural and engineered environments. This research field has recently experienced a paradigm shift due to the discovery of non-classical nucleation and growth processes. These insights have helped us to understand better the natural world and significantly impact various industrial and environmental applications, such as the development of more sustainable building materials, mineral processing, CO2 storage, and water treatment. Consequently, detailed knowledge of the mechanisms and kinetics underlying mineral nucleation and growth is vital in these areas. This issue provides a comprehensive overview of mineral formation by reviewing classical mechanisms and supplementing them with recent insights about the nucleation and growth of minerals, particularly those concerning non-classical crystallization pathways.

- **We Live in a Mineral World** Alejandro Fernandez Martinez (ISTerre, France) and Alexander E.S. Van Driessche (IACT, Spain)
- **Early Stages of Mineral Formation in Water: From Ion Pairs to Crystals** Mariette Wolthers, (Utrecht Univ., The Netherlands), Denis Gebauer (Leibniz Univ., Germany), and Raffaella Demichelis (Curtin Univ., Australia)
- **The Birth of Minerals: From Single-Step to Multiple-Step Mechanisms** Tomasz Stawski (Federal Inst. for Materials Research and Testing, Germany), Matteo Salvalaglio Univ. College London, UK), Adam Wallace (Univ. Delaware, USA), and Jim DeYoreo (Pacific Northwest Nat'l. Laboratory, USA)
- **How Minerals Grow: From Monomer-By-Monomer to Particle-Mediated Pathways** Jeffrey D. Rimer (Univ. Houston, USA), R. Lee Penn (Univ. Minnesota, USA), and Christine V. Putnis (Univ. Münster, Germany)
- **Pathways for Nucleation and Growth in Confined Spaces and at Interfaces** Ben Legg (Pacific Northwest Nat'l. Laboratory, USA), Yandi Hu (Peking Univ., China), Ayumi Koishi (Lawrence Berkeley Nat'l. Laboratory, USA), and Michael L. Whittaker (Lawrence Berkeley Nat'l. Laboratory, USA)
- **Natural Wonders of Mineral Nucleation and Growth** Electra Kotopoulou (Univ. Aix en Provence, France), Silvia Frisia (Unversity of Newcastle, Australia), and Alexander E.S. Van Driessche (IACT, Spain)

Volume 21, Number 2 (April)

LOW-TEMPERATURE PROXY SYSTEMS: PAST CLIMATES AND A WINDOW INTO BIOMINERALIZATION

GUEST EDITORS: **David Evans** (University of Southampton, UK), **Gavin Foster** (University of Southampton, UK), and **Rosalind Rickaby** (University of Oxford, UK)

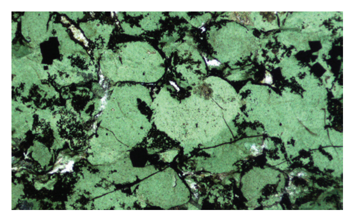
Quantitative paleoclimate reconstructions are chiefly based on the empirical calibration of trace element and isotopic 'proxy' systems in marine biominerals, especially those formed by calcite- and aragonite-producing organisms (e.g., foraminifera, corals, molluscs). Owing to the biological nature of host minerals, these proxy carriers are distributed throughout a diverse range of marine environments and across geological time, and can provide continuous palaeoclimate records over hundreds to millions of years, even though biomineralisation processes imprint on these proxy systems and can complicate palaeo-reconstructions. This information can be leveraged, as biologically rooted geochemical fractionations can be simultaneously used to understand various physiological aspects, including the organism's biomineralisation process. Low-temperature proxy systems, thus, offer insight into both paleoenvironmental change as well as the mechanistic processes involved in biomineral formation.

- **Geochemical Proxy Systems in Marine CaCO3 Biominerals Record Environmental Changes and Biomineralisation Processes** David Evans (Univ. Southampton, UK), Rosalind Rickaby (Univ. Oxford, UK), and Gavin Foster (Univ. Southampton, UK)
- **The Biogeochemistry of Polymorph Control and the Coevolution of Biomineralisation and Seawater Chemistry** Jaroslaw Stolarski (Polish Acad. of Sciences, Poland), Inge van Dijk (Univ. Angers, France), and Liane Benning (GFZ Potsdam, Germany)
- **Boron Proxies: From Calcification Site pH to Phanerozoic CO_2** Claire Rollion-Bard (IPGP, France) and Thomas Chalk (CEREGE, CNRS, France)
- **Biomineralisation Processes Inferred from Trace Element Partitioning** Oscar Branson (Univ. Cambridge, UK) and Lennart de Nooijer (NIOZ, The Netherlands)
- **The Use of Oxygen and Carbon Isotopes in Identifying Disequilibrium Processes During the Formation of Marine Carbonates** Sang Chen (Shanghai Jiao Tong Univ., China) and James Watkins (Univ. Massachusetts, USA)
- **Amorphous Precursor Phases: A Major Component of the 'Vital Effect'?** Anne Jantschke (Univ. Mainz, Germany) and Denis Scholz (Univ. Mainz, Germany)

Volume 21, Number 3 (June)

GREENALITE – A TINY CRYSTAL WITH A BIG STORY

GUEST EDITORS: **Birger Rasmussen** (University of Western Australia, Australia), **Janet R. Muhling** (University of Western Australia, Australia), and **Nicholas J. Tosca** (University of Cambridge, UK)



Greenalite [$Fe_3Si_2O_5(OH)_4$] is an Fe(II)-serpentine mineral that was first identified in Lake Superior iron formations over 100 years ago, but its true extent is only now being recognized with the advent of in-situ nanoscale techniques. In the last decade, nanoparticulate greenalite has emerged as a prime candidate in the deposition of early Precambrian banded iron formations (BIFs). Together with experiments and modeling, new light is being shed on greenalite-forming conditions and environments, challenging long-held models that argue that BIFs were deposited from seawater as biologically oxidized phases of Fe. Greenalite–hisingerite minerals also occur as alteration products in meteorites, and recent in-situ and orbital data imply that Fe-serpentines are major products of serpentinization systems on early Mars, potentially recording widespread H_2 production.

- **Greenalite: An Introduction** Birger Rasmussen (Univ. Western Australia), Janet R. Muhling (Univ. Western Australia), and Nicholas J. Tosca (Univ. Cambridge, UK)
- **Ordered but Disordered: The Peculiar Crystal Structure of Greenalite** Huifang Xu (Univ. Wisconsin-Madison, USA), Yiping Yang (Guangzhou Inst. of Geochemistry, China), and Stephen Guggenheim (Univ. Illinois Chicago, USA)
- **Serpentine Solid Solutions and Hydrogen Production on Early Earth and Mars** Benjamin M. Tutolo (Univ. Calgary, Canada) and James A. Leong (Lamont-Doherty Earth Observatory, USA)
- **Greenalite: Cryptic Mineral of Ancient Ferruginous Oceans** Janet R. Muhling (Univ. Western Australia, Australia), Latisha A. Brengman (Univ. Minnesota Duluth, USA), and Jena E. Johnson (Univ. Michigan, USA)
- **The Precambrian Greenalite Factory** Nicholas J. Tosca (Univ. Cambridge, UK), Clancy Z. Jiang (Univ. Cambridge, England), and Benjamin M. Tutolo (Univ. Calgary, Canada)
- **Greenalite: A Template Fit for Life?** Birger Rasmussen (Univ. Western Australia, Australia), Woodward W. Fischer (California Inst. of Technology, USA), and Daniel Duzdevich (Univ. Chicago, USA)

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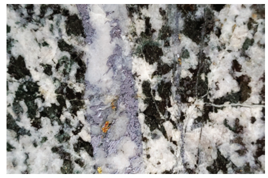
RE-OS – CLOCK WITH CLOUT



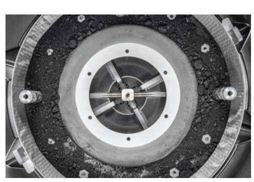
GUEST EDITORS: **Holly Stein** (AIRIE, Applied Isotope Research for Industry and the Environment, USA; University of Oslo, Norway) and **Laurie Reisberg** (University of Lorraine, France)

The Re-Os isotope system features two of silicate Earth's rarest elements. This couple's unique combination of siderophile, chalcophile, and organophile properties allows it to play an outsized role both as a geochronometer and as a source tracer, helping answer questions that cannot be addressed by other radiometric systems. Successive analytical breakthroughs have led to increasingly challenging applications that will be reviewed in this issue of *Elements*. The Re-Os system tells us about Earth's accretion and the chemical evolution of the convecting and lithospheric mantle over time. Novel applications to the Earth's crust include dating molybdenite and a host of other sulfides and oxides, deducing paleoenvironment and paleoclimate from organic material in shales, reconstructing complex petroleum systems, and balancing continental versus oceanic-hydrothermal and meteoritic inputs to seawater.

- **The Re-Os Revolution: Mighty Messages from Two of Earth's Rarest Elements** Laurie Reisberg (Univ. Lorraine, France) and Holly Stein (AIRIE, USA; Univ. Oslo, Norway)
- **Sulfides and Their Little Darling, Molybdenite** Holly Stein (AIRIE, USA), Aaron Zimmerman (AIRIE, USA ; Univ. Oslo, Norway), Gang Yang (AIRIE, USA; Univ. Oslo, Norway), Rob Creaser (Univ. Alberta, Canada), and Katsuhiko Suzuki (JAMSTEC, Japan)
- **Reel-to-Reel Re-Os Records—Earth System Transactions Preserved in Sediments** Brian Kendall (Univ. Waterloo, Canada), Rob Creaser (Univ. Alberta, Canada), Judith Hannah (AIRIE, USA), Vineet Goswami (PRL, Physical Research Laboratory, India), and Gyana Tripathy (Indian Inst. of Science, Education and Research, India)
- **Oil and Water – Intimate Conversations** Svetoslav Georgiev (Bulgarian Acad. of Sciences, Bulgaria) and Nicole Hurtig (New Mexico Tech, USA)
- **Osmium and Tungsten Isotopes Reveal Earth's Youthful Exuberance** Igor Puchtel (Univ. Maryland, USA), Richard Walker (Univ. Maryland, USA), Sonja Aulbach (Goethe Univ., Germany), and Vickie Bennett (Australian National Univ., Australia)
- **Os Isotopes—Tracing the Dynamics of Post-Archean to Modern Mantle** Ambre Luguet (Univ. Bonn, Germany), Jingao Liu (Inst. of Earth Science, China Univ. Geosciences, China), and Elisabeth Widom (Miami Univ., USA)

Volume 21, Number 5 (October)

SAMPLE RETURN THROUGHOUT THE AGES



GUEST EDITORS: **Jemma Davidson** (ARES, NASA Johnson Space Center, USA) and **Jessica Barnes** (University of Arizona, USA)

This thematic issue of *Elements* will provide an overview of the mineralogical, petrological, and geochemical information learned about different planetary bodies through the study of extraterrestrial samples retrieved by both crewed and robotic missions. Sample return missions provide unique insights into the geological and chemical histories of a wide variety of celestial bodies, from the Sun and Moon to asteroids and planets. Each article—themed to a specific planetary body (e.g., the Moon, Mars) or series of bodies (e.g., asteroids, comets)—summarizes a previous mission or series of missions and their sample collection(s), and relevant current/future missions, and mission concepts. This issue focuses on the scientific benefits and discoveries gained or promised by sample return missions.

- **To See a World in a Grain of Sand** Jessica Barnes (Univ. Arizona, USA) and Jemma Davidson (ARES, NASA Johnson Space Center, USA)
- **It's Not Just a Phase: Over 50 Years of Lunar Sample Science** Katherine Joy (Univ. Manchester, UK), Xiaochao Che (Chinese Acad. of Geological Sciences, China), Bradley Jolliff (Washington Univ., USA), and Jessica Barnes (Univ. Arizona, USA)
- **Seeing Red: Retrieving Rocks from Mars and Phobos** Arya Udry (Univ. Nevada Las Vegas, USA), Tomohiro Usui (JAXA, Japan), and Amanda Ostwald (Smithsonian Inst., USA)
- **One's Trash is Another's Treasure: Cosmic Rubble Piles** Hikaru Yabuta (Hiroshima Univ., Japan), Conel Alexander (Carnegie Inst. of Washington, USA), and Timothy McCoy (Smithsonian Inst., USA)
- **Ice to Meet You: Sampling Cold Bodies** Perry Gerakines (Goddard Space Flight Center, USA), Penny Wozniakiewicz (Univ. Kent, UK), and Stefanie Milam (Goddard Space Flight Center, USA).
- **Space Weathering: Clear with a Chance of Solar Wind and Micrometeoroid Showers** Michelle Thompson (Purdue Univ., USA), Amy Jurewicz (Arizona State Univ., USA), and Takaaki Noguchi (Kyoto Univ., Japan)

Volume 21, Number 6 (December)

THE VARISCAN OROGENY IN EUROPE – UNDERSTANDING SUPERCONTINENT FORMATION

GUEST EDITORS: **Urs Schaltegger** (University of Geneva, Switzerland) and **Karel Schulmann** (University of Strasbourg, France; Czech Geological Survey, Czech Republic)

The Variscan orogen formed between 380 and 300 million years ago through several accretionary and collisional cycles, culminating with the construction of the Pangea supercontinent. This process occurred via sequential opening and closure of oceanic basins, synchronous detachment of Gondwana derived continental ribbons, and their outboard amalgamation onto the Laurussia margin. The Variscan orogen is rather unique compared with other orogenic belts on Earth: its overthickened and dominantly magmatic crust in the central belt, surprisingly minor mantle involvement in the magmatic and geodynamic processes, coherent and pulsed magmatism along the collision suture, and its complex accretionary history. Because its final product, Pangea, is the youngest and best-understood supercontinent on Earth, the Variscan orogeny offers clues for understanding the mechanisms of supercontinent formation.

- **The Specific Nature of the Variscan Lithosphere** Karel Schulmann (Univ. Strasbourg, France; Czech Geological Survey, Czech Republic), Urs Schaltegger (Univ. Geneva, Switzerland), and José-Ramón Martínez-Catalán (Univ. Salamanca, Spain)
- **Granites and the Anatomy of the Variscan Lithosphere** Jean-François Moyen (Univ. Clermont-Auvergne, France), Patrizia Fiannacca (Univ. Catania, Italy), Alexandra Guy (Czech Geological Survey, Czech Republic), Vojtech Janousek (Charles Univ. and Czech Geological Survey, Czech Republic), María Puy-Ayarza (Univ. Salamanca, Spain), and Carlos Villaseca (Univ. Complutense of Madrid, Spain)
- **A Look into the Past: Role and Extent of Cratonic Lithosphere in the Variscan Orogeny** Stanislaw Mazur (Polish Acad. of Science, Kraków, Poland), Oscar Laurent (Univ. Toulouse, France), Imma Palomeras (Univ. Salamanca, Spain), and Christian Schiffer (Univ. Uppsala, Sweden)
- **A Mantle Perspective on Variscan Lithosphere Evolution from Mountain Building to Collapse and Rifting** Jacek Puziewicz (Univ. Wrocław, Poland), Sonja Aulbach (Goethe Univ., Germany), Olivier Vanderhaeghe (Paul Sabatier Univ., France), and Małgorzata Ziobro-Mikrut (Jagiellonian Univ., Poland)
- **The Laurussia-Gondwana Supercollision: Geodynamic Implications of the Architecture of the Colliding Margins** Brendan Murphy (St. Francis Xavier Univ., Canada), Damian Nance (Ohio Univ. and Yale Univ., USA), Karel Schumann (Univ. Strasbourg, France; Czech Geological Survey, Czech Republic), and Yvette D. Kuiper (Colorado School of Mines, USA)
- **Modeling the Variscan Orogeny** Taras Gerya (ETH Zürich, Switzerland) and Petra Maierová (Czech Geological Survey, Czech Republic)