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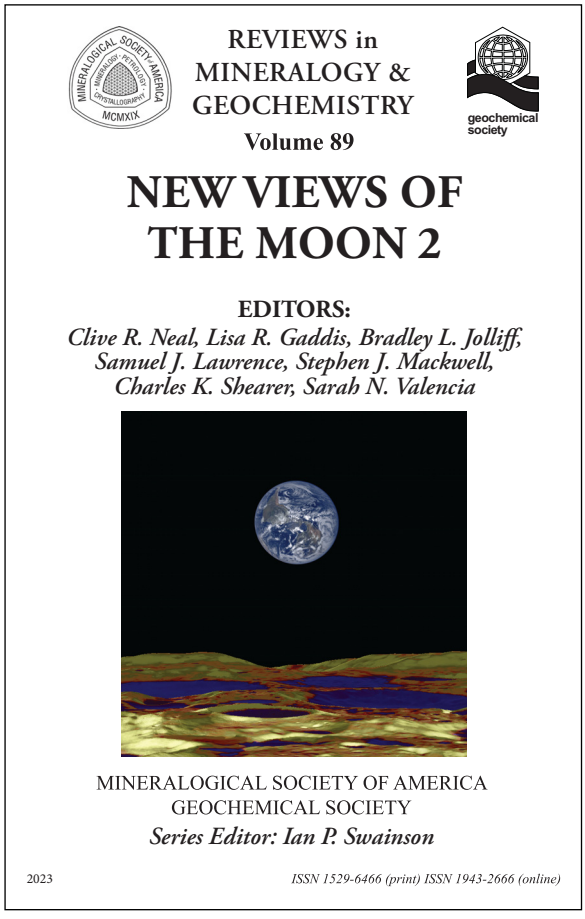
Book Review

Book Review: RIMG Volume 89: New Views of the Moon 2
(2023) By Clive R. Neal, Lisa R. Gaddis, Bradley L. Jolliff, Samuel J. Lawrence, Stephen J. Mackwell, Charles K. Shearer, Sarah N. Valencia, editors. Mineralogical Society of America/Geochemical Society, i-xix + 1088 pages. ISBN 978-1-946850-11-9.



New Views of the Moon 2 emerges as a vital update to lunar science, tracing the monumental strides made since its predecessor in 2006 as volume 60 of the Mineralogical Society of America Reviews in Mineralogy and Geochemistry series. In a span of seventeen years, lunar exploration has exploded with over fifteen new missions, reshaping our understanding of Earth's enigmatic satellite. This comprehensive volume meticulously documents these advancements across nineteen chapters.

The 2023 sequel delves into diverse facets of lunar research, ordering the chapters from ancient lunar evolution and crustal dynamics to the state of knowledge of minerals and materials observed at the surface and, finally, to resources and their potential use in sustainable exploration. This book revisits the impact theory, proposing that the Moon formed from debris ejected by a colossal collision between Earth and a Mars-sized protoplanet. This foundational theory is bolstered by new insights gleaned from recent lunar missions and analyses of lunar samples brought back by the Apollo missions and subsequent lunar meteorites, reshaping and expanding our understanding of planetary formation.

Moving forward, *New Views of the Moon 2* delves into the Moon's complex crustal evolution. Recent missions and sophisticated analytical techniques have provided new insights into the composition of lunar samples, revealing isotopic signatures that align closely with Earth's mantle. This comparison supports the notion that the Moon originated from Earth's material, substantiating the giant impact hypothesis as a pivotal event in the early history of the solar system. Detailed analyses of lunar rocks and minerals have uncovered a diverse array of geological formations, shedding light on the processes that have shaped the lunar surface over billions of years. From basaltic plains to rugged highlands and ancient brecciated terrains to KREEP (K – potassium, REE – rare earth elements, P – phosphorous) basalt distributions, each region offers clues to the Moon's volcanic past and the intensity of past meteoroid bombardment.

This book also offers chapters on lunar interior structure and evolution that integrate recent NASA GRAIL (Gravity Recovery and Interior Laboratory) mission insights with historical Apollo seismic data, illuminating surprising revelations about the Moon's core and past magnetic field dynamics.

Lunar meteorites, discovered on Earth's surface, provide an invaluable window into the Moon's geological history. These samples, originating from impacts that ejected lunar material into space, offer unique insights into the diversity of lunar lithologies not represented in the limited samples returned by the Apollo and Luna missions. It highlights the discovery of new mineralogy, which provides windows into ancient volcanic activity and impact processes.

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A comprehensive section on impact cratering chronicles the Moon's tumultuous history of cosmic collisions, offering a detailed chronology of crater formation and its role in shaping the lunar surface. The section delves into the mechanics of impact processes, from crater formation to the excavation and distribution of ejecta, enriching our understanding of lunar surface dynamics.

The exploration of lunar landforms and tectonics reveals a changing landscape marked by rifts, faults, and volcanic features. High-resolution imaging from modern missions, such as the Lunar Reconnaissance Orbiter (LRO), has revolutionized our ability to map and interpret the Moon's surface features with unprecedented detail.

The final chapters of *New Views of the Moon 2* explore the Moon's surface chemistry and its implications for future lunar exploration and resource utilization. This section investigates how dynamic solar and cosmic particle radiation reshapes the Moon (an airless body with no atmosphere and magnetosphere for protection like that of Earth). Space weathering and irradiation on the lunar surface is a much-needed area of research to reach sustainability endeavors on the Moon. Understanding the irradiative properties of the lunar regolith and the dynamics of lunar dust in plasma and electrostatic conditions are vital to dust mitigation strategies and technologies for future exploration efforts.

Water, detected in permanently shadowed regions and neutron suppression zones, offers exciting prospects for sustaining a human presence on the Moon. The identification of volatile compounds, including hydrogen, helium-3, and other precious elements, underscores the Moon's potential as a strategic resource base for future space missions and scientific endeavors.

Recent advancements in remote sensing and analytical techniques have facilitated detailed investigations into lunar resources, paving the way for innovative approaches to resource extraction and utilization. Proposals for lunar mining operations, *in situ* resource utilization (ISRU), and sustainable habitats propel technological advancements and lunar mission objectives toward an eventual cislunar economy and extended human exploration beyond Earth.

New Views of the Moon 2 captures the present drive of lunar exploration aims and sets the stage for future missions and discoveries, making this volume essential reading for both seasoned researchers and newcomers to lunar science.

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