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RESEARCH TOPICS FROM JAMS

Rainbow Scoria: Brilliance from a Sub-Micron Texture

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Scoria, a common volcanic ejecta during basaltic to andesitic explosive eruptions, is typically vesicular and black in appearance (FIG. 1A); however, some scoria clasts exhibit shiny blue, yellow, and pink coloration on their surfaces. What mechanism produces this rainbow brilliance? We examined the surface microtextures of scoria from the 1986 Izu-Oshima eruption (B-fissure vents), to explore the physical and volcanological mechanisms that cause rainbow brilliance in volcanic rocks (Matsumoto and Kawasaki 2025).

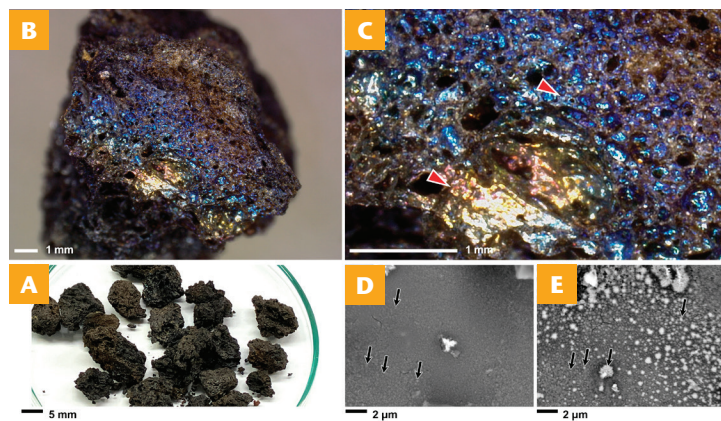


FIGURE 1 (A) Scoria clasts from the B-fissure vents of the 1986 eruption at Izu-Oshima Volcano. (B, C) Focus-composite images of an observed rainbow scoria from the B-fissure vents taken by a digital microscope. Red arrows indicate observation areas for scanning electron microscope (D, E). (D, E) Back scattered electron images of the areas showing (D) blue and transparent, and (E) yellow-to-red and opaque colors. Countless numbers of spherulites cover all these areas. Black arrows indicate typical spherulites.

On the surface of the observed brilliant scoria, distinct areas of blue (transparent), yellow (opaque), and red (opaque) occur from the outermost layer toward the interior of the grain (FIG. 1B, 1C). These colors remain consistent regardless of the observation angle. Scanning electron microscopy revealed that clusters of “kompeito,” sugar-candy-like spherulites, were observed in these areas (FIG. 1D, 1E). Their sizes

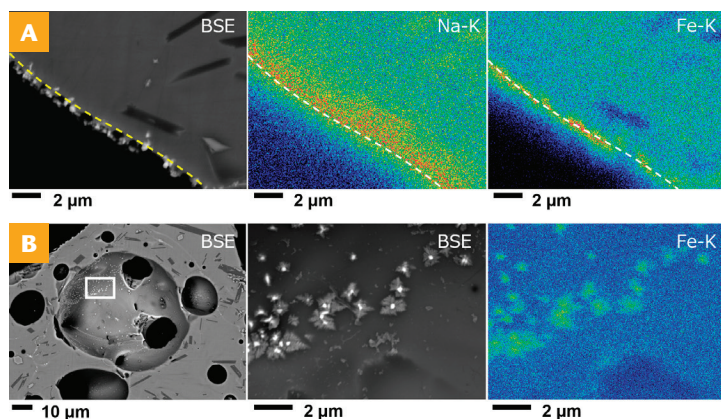


FIGURE 2 (A) Back scattered electron (BSE) images and X-ray intensity maps of the cross-section of scoria. Dotted lines indicate the boundary of scoria surface. (B) BSE images and X-ray intensity maps of polygonal and dendritic precipitates on the wall of a bubble. White square indicates the analysis area on the right panels.

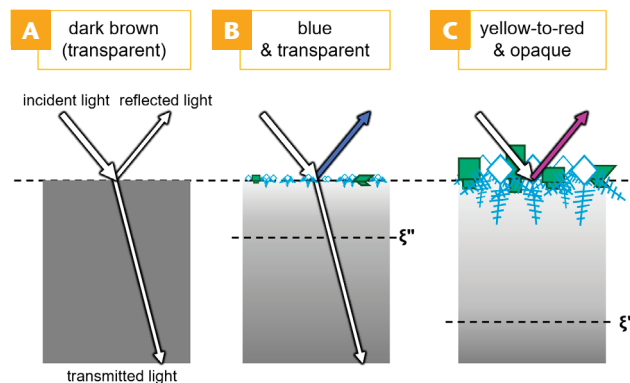


FIGURE 3 Schematic illustration of the brilliance produced by the surface microtexture. Glass without microtexture (A) and that with spherulite clusters that crystallized along the interface between silicate glass and the grain exterior (B, C). The reflected light interferes with colors depending on the thickness of the precipitates. The oxidation front (ξ) advances towards the deeper part as oxidation proceeds.

ranged from comparable with to slightly smaller than the visible-light wavelength (400–800 nm), gradually becoming larger with a shift from blue to yellow to red areas. X-ray elemental mapping indicated that the spherulites are a composite mainly of polygonal Fe-oxide(s), dendritic Fe-silicate(s), and Mg-Ca-bearing mineral(s), distributed along the interface between silicate glass and the grain exterior (FIG. 2). The silicate glass beneath the spherulites was enriched mainly in Na, Ca, and Mg.

The complex textural and compositional characteristics can be explained by an oxidation process of basaltic glass at a high temperature in an SO_2 -bearing gas (Cooper et al. 1996; Cook and Cooper 2000) and the subsequent cooling: when ferrous iron (Fe^{2+}) in a scoria glass is oxidized, ferric iron (Fe^{3+}) becomes a network former, charge-balanced by sodium (Na^+). Divalent cations (Mg^{2+} , Ca^{2+} , Fe^{2+}) are released and enable diffusion toward the surface of the scoria glass, resulting in the counter-diffusion of electron holes and diffusion of Na^+ from the deeper part of the glass for charge balancing. These processes form Fe-oxide(s), Fe-silicate(s), and Mg-Ca-bearing mineral(s) on the surface and the Na-rich oxidized (Fe^{3+} -bearing) glass beneath the surface. In terms of eruption conditions, these processes can be attributed to the environment within an eruption plume.

The presence of the same mineral phases among variably colored areas suggests that the colors are not intrinsic mineral properties, but rather physical interactions of visible light with a microstructure. The monochrome color, regardless of the observation angle, indicates a “non-iridescent structural color” (Kawamura et al. 2016), derived from randomly arranged components, suggesting that the colors are produced by the clusters of spherulites with sizes comparable to visible light wavelengths. The color difference is likely caused by the spherulite size or space between spherulites (FIG. 3).

Scoria formation during volcanic eruption resembles the process of firing ceramics. Our analysis of structural colors was inspired by a scientific study of the Japanese national treasure “Yohen Tenmoku” tea bowls (Nagae and Fukushima 2011; Ebizuka and Okamoto 2023). The colors of rainbow scoria not only capture people’s imagination, but also reflect the dynamics of past volcanic eruptions, and are therefore truly brilliant samples for both science communication and research.

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F. W. Clarke Award



Melisa Diaz, Provost's Early Career Scholar and Assistant Professor at the Ohio State University (USA), will receive the 2026 F. W. Clarke Award this July. The Clarke Award honors a single outstanding contribution to geochemistry or cosmochemistry by an early career scientist. Prof. Diaz is recognized for her work in understanding the geochemical signatures that link the distribution of organisms in Transantarctic Mountains soils to the dynamics

of past glacier movement. She used geochemical and isotopic tools to determine the impact of soil age on biogeography and habitat suitability.

Frank Wigglesworth Clarke (1847–1931) was a chemist who determined the composition of the Earth's crust. He taught chemistry and physics at the University of Cincinnati and served in the U.S. Geological Survey for many years. He also collaborated with the Smithsonian Institution on atomic weight research. The society established the award in his name in 1972.

John Hayes Award



Francien Peterse, associate professor at Universiteit Utrecht (the Netherlands) will receive the 2026 John Hayes Award. The award is given to a mid-career scientist for outstanding accomplishments that draw together multiple fields of investigation to advance biogeochemical science. It was created in 2017 by the Organic Geochemistry Division and a group of friends, colleagues, and students of John Hayes. Dr. Peterse is recognized

for work that has significantly advanced the field of organic geochemistry by developing and applying biomarker proxies for continental climate reconstructions.

Alfred Treibs Award



Steven Rowland, professor emeritus at the University of Plymouth (UK), will receive the 2026 Alfred Treibs Award. Presented by the society's Organic Geochemistry Division, the award is given for major achievements, over a period of years, in organic geochemistry. Prof. Rowland's research has made a substantial impact across several fields of organic geochemistry, ranging from biomarker discovery, structural elucidation and synthesis, and

molecular proxy development for paleoclimate reconstruction, to environmental organic geochemistry of petroleum hydrocarbons and microplastics.

GS-EAG 2025–2026 Outreach Lecture Series: Julio Sepúlveda

University of Colorado, Boulder, USA

The GS-EAG Outreach Program aims to develop geochemistry outreach activities for underrepresented regions of the world. In 2025, Julio Sepúlveda, associate professor at the University of Colorado, Boulder, USA, visited the University of Antofagasta, Chile, and the Technological University of Panama, Panama, to give seminars and facilitate activities focused on organic geochemistry and oceanography.

At both universities, Prof. Sepúlveda offered introductory lectures focused on organic geochemistry and its applications in chemical and biological oceanography, as well as seminars on biogeochemical studies in the Humboldt Current System. These activities were supported by



Undergraduate students from the University of Antofagasta learning about oceanographic research onboard the *R/V Sonne* with Captain Oliver Meyer. PHOTO: JULIO SEPÚLVEDA.



Students at the Technological University of Panama who participated in introductory lectures in organic geochemistry.

postdoctoral fellow Dr. Edgart Flores (University of Colorado, Boulder). While at the University of Antofagasta, he facilitated a tour of the German deep ocean research vessel *R/V Sonne* for 20 undergraduate students. Students learned about life onboard, oceanographic instrumentation, and how scientists perform geochemical work.

In 2026, Prof. Sepúlveda plans to visit universities and institutes in Colombia, Perú, and Chile. For more information, see: geochemsoc.org/programs/outreach-programs.

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