

## 2022 IMA MEDAL OF EXCELLENCE TO PATRICIA M. DOVE

The IMA is delighted to present its 2022 Medal of Excellence to Patricia M. Dove, Distinguished Professor and C.P. Miles Professor of Science at Virginia Polytechnic Institute and State University, USA. She has been praised as a “world leader in the field of mineral reactivity and biomineralogy” and a pioneer who “has combined key advances and development of new techniques at the atomic level with major insight into large-scale processes including the long-term evolution of biomineral systems.”

Patricia completed her BSc and MSc studies at Virginia Tech, USA (1981 and 1984, respectively), and earned her doctoral degree from Princeton, USA, in 1991. In the past 30 years, she has built an impressively successful research career at the crossroads of mineralogy, aqueous geochemistry, biochemistry, surface physics, and environmental science—first at Georgia Tech and, since 2000, at Virginia Tech. Recognizing the critical role of interaction between rocks and biota in the critical zone, Professor Dove embarked on studying some of the least-understood aspects of that interaction, including the atomic-scale kinetics and molecular dynamics of dissolution and precipitation at mineral surfaces, and focused her research efforts on biologically relevant systems (quartz, amorphous silica, calcite, and amorphous  $\text{CaCO}_3$ ). She pioneered the use of atomic force microscopy (AFM) for in situ molecular imaging to observe crystal growth and resorption under carefully controlled conditions (Dove and Hochella 1993; Dove and Platt 1996). The parameters of these experiments ranged from ambient temperature and pressure to methodologically challenging simulated environments, which required ingenious experimental apparatuses—e.g., a hydrothermal mixed-flow reactor for direct measurements of reaction rates at steady-state conditions (Dove and Crerar 1990) and fluid-tapping AFM for studying microbial interactions with minerals (Grantham and Dove 1996). This work was foundational to constraining the effects of physicochemical parameters on the kinetics of crystal growth and dissolution and to the development of quantitative molecular models describing these processes in surficial, hydrothermal, and bio-mediated environments (e.g., Dove 2010; Dove et al. 2008, 2019). Another important outcome of Professor Dove’s research was the collaborative discovery of crystallization by particle attachment (De Yoreo et al. 2015). This “non-classical” crystallization mechanism has since been documented increasingly in synthetic and natural systems, yielding over 170 citations of the original publication annually! These papers have far-reaching implications not only for our understanding of how minerals form and dissolve, but also for the interpretation of rock textures, paleoclimate reconstructions, evolutionary biology, and such practically important areas as nanotechnology and crystal design. Professor Dove’s outstanding contribution



to science has been recognized through many awards and honors, including the F.W. Clarke Medal from the Geochemical Society (1996); Dana Medal from the Mineralogical Society of America (2014); fellowships in the Mineralogical Society of America (2000), American Geophysical Union (2008), and Geochemical Society (2010); and the US Department of Energy Best University Research Award (1999 and 2005).

Professor Dove is an award-winning educator and promoter of science, who has shared her passion for biomineralogy with hundreds of university and school students through National Science Foundation programs, Virginia Tech’s CurVinci Living Learning Communities, Kids Tech, and other outreach platforms. At Georgia Tech and Virginia Tech, she has developed and taught an impressive spectrum of courses, from *Resources of the Earth* to *Oceanography* and *Biomimetic Materials and Design*.

We congratulate Professor Dove on this prestigious award and look forward to reading about her new exciting discoveries in biomineralogy and beyond!

### REFERENCES

- De Yoreo JJ and 14 coauthors (2015) Crystal growth. Crystallization by particle attachment in synthetic, biogenic, and geologic environments. *Science* 349: aaa6760, doi: 10.1126/science.aaa6760
- Dove PM (2010) The rise of skeletal biominerals. *Elements* 6: 37-42, doi: 10.2113/gselements.6.1.37
- Dove PM, Crerar DA (1990) Kinetics of quartz dissolution in electrolyte solutions using a hydrothermal mixed flow reactor. *Geochimica et Cosmochimica Acta* 54: 955-969, doi: 10.1016/0016-7037(90)90431-J
- Dove PM, Han N, Wallace AF (2019) Systematic dependence of kinetic and thermodynamic barriers to homogeneous silica nucleation on NaCl and amino acids. *Journal of Materials Research* 34: 442-455, doi: 10.1557/jmr.2018.474
- Dove PM, Han N, Wallace AF, De Yoreo JJ (2008) Kinetics of amorphous silica dissolution and the paradox of the silica polymorphs. *Proceedings of the National Academy of Sciences* 105: 9903-9908, doi: 10.1073/pnas.0803798105
- Dove PM and Hochella MF Jr (1993) Calcite precipitation mechanisms and inhibition by orthophosphate: in situ observations by scanning force microscopy. *Geochimica et Cosmochimica Acta* 57: 705-714, doi: 10.1016/0016-7037(93)90381-6
- Dove PM and Platt FM (1996) Compatible real-time reaction rates of mineral dissolution by atomic force microscopy (AFM). *Chemical Geology* 127: 331-338, doi: 10.1016/0009-2541(95)00127-1
- Grantham ME and Dove PM (1996) Investigation of bacterial-mineral surface interactions using Fluid Tapping Mode™ Atomic Force Microscopy. *Geochimica et Cosmochimica Acta* 60: 2473-2480, doi: 10.1016/0016-7037(96)00155-X



# International Mineralogical Association

[www.ima-mineralogy.org](http://www.ima-mineralogy.org)

The “Mineral of the Year” is an IMA initiative launched in 2014 that awards the best new mineral described in a given Solar year, no matter the year in which that mineral was found and approved. For 2022, the “Mineral of the Year” award has been assigned to **lazaraskeite**. This mineral was discovered in Oro Valley, north of Tucson, Pima County, Arizona, USA. Lazaraskeite was found and fully characterized by a research team led by Hexiong Yang from the Department of Geosciences, at the University of Arizona, USA.



**FIGURE 1** Greenish-blue prismatic crystals of lazaraskeite (polytype  $M_1$ ). Field of view: 3 mm. PHOTO: RON GIBBS.

More precisely, lazaraskeite was found on the western end of Pusch Ridge at the high elevation (975 m) of the Santa Catalina Mountains, where it occurs as individual crystals of up to  $0.2 \times 0.2 \times 0.8 \text{ mm}^3$  or as aggregates. Crystals have a greenish blue color and are transparent (FIGS. 1 and 2). Associated minerals are chrysocolla, malachite, wulfenite, mimetite, hydroxylpyromorphite, hematite, microcline, muscovite, and quartz.

**FIGURE 2** Greenish-blue prismatic crystals of lazaraskeite (polytype  $M_2$ ), associated with chrysocolla, muscovite, orthoclase, calcite, and quartz. PHOTO: WARREN G. LAZAR.



The ideal chemical formula of lazaraskeite is  $\text{Cu}(\text{C}_2\text{H}_3\text{O}_3)_2$ . Therefore, it represents the first known example of an organic mineral containing glycolate. Shortly thereafter, three other glycolate minerals from the same locality were discovered and described: stanvevansite, jimkriegite, and lianbinite.

Lazaraskeite is monoclinic. Two distinct polytypes occur that exhibit the same space group,  $P2_1/n$ , but different yet related structures. Lazaraskeite- $M_1$  has unit cell parameters of  $a = 5.1049(2) \text{ \AA}$ ,  $b = 8.6742(4) \text{ \AA}$ ,  $c = 7.7566(3) \text{ \AA}$ , and  $\beta = 106.834(2)^\circ$ , whereas those of lazaraskeite- $M_2$  are  $a = 5.1977(3) \text{ \AA}$ ,  $b = 7.4338(4) \text{ \AA}$ ,  $c = 8.8091(4) \text{ \AA}$ , and  $\beta = 101.418(2)^\circ$ . The crystal structures of both polytypes have been refined from single-crystal X-ray diffraction data to  $R = 2.6\%$  ( $M_1$ ) and  $2.4\%$  ( $M_2$ ). The structure of lazaraskeite in both its variants is new among minerals, whereas synthetic  $\text{Cu}(\text{C}_2\text{H}_3\text{O}_3)_2$  is known to have the same structure of polytype  $M_1$ .

The mineral name is a composite of the names of the two mineral collectors who found it, Warren G. Lazar and Beverly Raskin.

The state of Arizona is confirmed as the seat of beautiful and interesting crystals, as another mineral from Arizona was awarded “Mineral of the Year” in 2017: rowleyite, after the Rowley mine in Maricopa County.

The full description of the new mineral has been published in the *American Mineralogist* [Yang, H., Gu, X., Gibbs, R., Evans, S., Downs, R.T., Jibrin, Z. (2022): Lazaraskeite,  $\text{Cu}(\text{C}_2\text{H}_3\text{O}_3)_2$ , the first organic mineral containing glycolate, from the Santa Catalina Mountains, Tucson, Arizona, U.S.A. *American Mineralogist*, 107, 509-516].



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## 2023 MEDAL OF EXCELLENCE IN MINERALOGICAL SCIENCES TO PROFESSOR TETSUO IRIFUNE

The IMA is honored to present its 2023 Medal of Excellence in Mineralogical Sciences to Prof. Tetsuo Irifune. Distinguished Professor at Ehime University in Japan, Prof. Irifune is Director of the Geodynamics Research Center (GRC) at the same University, as well as Principal Investigator of the Earth-Life Science Institute (ELSI) of Tokyo Institute of Technology, Japan.

As a major contributor to the development of high-pressure techniques and their applications to Earth sciences and materials science, Prof. Irifune has reached the highest level of scientific excellence and eminence within the international mineral physics community. He has set new standards in the performance of high-pressure experiments with applications to deep-Earth processes, and to materials science. His outstanding contributions to the mineral sciences have had a profound impact on high-pressure mineralogy, as attested by his tremendous publication list.

Prof. Irifune completed his BSc and MSc studies at Kyoto University, Japan (1978) and Nagoya University, Japan (1980), respectively, and earned his PhD from Hokkaido University, Japan (1984). After a Postdoctoral Fellowship at the Japan Society of Promotion of Science (1984) and at the Research School of Earth Sciences, Australian National University (1984–1987), Prof. Irifune joined the Department of Geological Mineralogy of Hokkaido University, Japan, as an assistant professor (1987–1989) and later at Ehime University, where he worked as an associate professor (1989–1995), professor (1995–2001), professor and director of the GRC (since 2001), and distinguished professor (since 2012).

Throughout his career, Prof. Irifune's research has spanned over a wide range of research fields, from the study of the phase relations of mantle rocks by the quench method, to the determination of phase transitions using in-situ X-ray diffraction, sound velocity measurement of mantle minerals in their stability fields, and synthesis of nano-polycrystalline diamond and ceramics. Among his many scientific achievements are the exquisite experimental determination of phase relations involving ringwoodite, majorite, davemaoite, and bridgmanite; and the seismic sharpness of the upper-lower mantle boundary. Prof. Irifune has also developed multi-anvil facilities, including multi-anvil synchrotron beamlines, for the synthesis of ultra-hard materials and the deformation of transition-zone minerals. He is recognized for his contribution to the coordination of high-pressure mineralogy research in East Asia, and for helping colleagues around the world to set up multi-anvil laboratories.

Prof. Irifune has also demonstrated high dedication and commitment to serve the scientific community by sitting on several committees, commissions, and boards; as well as his excellent leadership capabilities, which brought him to conceive and establish the *Geodynamics Research Center*, which he has brilliantly coordinated for over two decades, making it an undisputed reference center not only for the high-pressure experimental petrology, but also for related fields, like mineral physics and geodynamics. He also founded The Asian Network for Deep Earth Mineralogy (<http://www.grc.ehime-u.ac.jp/legacy/g-coe-shinpo1-tandemgaiyou-h20.pdf>), and served as the President of International Association for the Advancement of High Pressure Science and Technology (AIRAPT).

Prof. Irifune's high international reputation has been recognized through many prestigious honors and awards, including the Mineralogical Society of Japan (MSJ) Award, 1998; Ishikawa Carbon



Prize, 2004; Alexander von Humboldt Research Award, 2007; Fellow of American Geophysical Union (AGU), 2008; Japan Society of Powder and Powder Metallurgy, Innovatory Research Award, 2008; Japan Society of High Pressure Science and Technology (JSHPST) Award, 2009; Geological Society of Australia (GSA), A. E. Ringwood Medal, 2014; Medal with Purple Ribbon, Government of Japan, 2015; European Geoscience Union (EGU) R. W. Bunsen Medal, 2016; Fellow of Japan Geoscience Union (JpGU), 2017; Japan Association of Mineralogical Sciences (JAMS), Applied Mineralogy Award, 2020; International Association for the Advancement of High Pressure Science and Technology (AIRAPT), P. W. Bridgman Award, 2021.

We heartily congratulate Prof. Irifune on this prestigious award. Prof. Irifune represents today's international mineralogy at its best, both as a scientist and a citizen of the community. He continues to be an active and creative scientist, and we look forward to his new discoveries and achievements.

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