International Mineralogical Association

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EXPANDING THE VOCABULARY OF MINERALS: HOMOGENEITY, ORIGIN, AND VALIDATION

Minerals constitute the solid part of the Universe. Paraphrasing Anhuai Lu (IMA President, 2020–2022): *if minerals are like words, then learning and applying mineralogical knowledge, particularly through mastering a rich vocabulary of minerals, enables us to write great articles on Earth sciences.* In other words, the more minerals we know, the richer our vocabulary becomes.

According to the definition of Nickel and Grice (1998), a mineral is a homogeneous, solid substance formed through geological processes. Substances of biogenic origin that have not been modified by geological processes are not considered minerals.

A mineral must be homogeneous over a measurable minimum volume to allow reliable identification and characterization. While homogeneity on the scale of millions of unit cells generally ensures that the material is large enough to yield statistically meaningful data, even minor compositional variations at smaller scales can significantly affect its overall properties. Consequently, the smaller the sample, the greater the effort required by the researcher to verify its homogeneity. This leads to an important question: what is the minimum size required for a substance to be classified as a mineral species?

This represents one of several challenges facing the Commission on New Minerals and Mineral Names (CNMNC), alongside the ongoing issue of defining the natural (geological) origin of minerals. Encouraging progress has been made on this front, as evidenced by a recently published guidance paper (Bosi et al. 2025) addressing minerals of uncertain origin. Drawing on the 2024 report of the IMA Mediation Committee, this paper provides key recommendations for submitting mineral proposals to the CNMNC, with the aim of minimizing issues related to contamination, anthropogenic influence, or fraudulent synthesis. In addition, the CNMNC has recently adopted a 75% positive vote threshold for the approval of new mineral species, nomenclature changes, and the establishment of new mineral groups or supergroups. The Chair (or designated officer) also retains the authority to suspend the voting process if serious concerns are raised by Commission members.

The number of known mineral species has increased over time due to the natural evolution of the Earth–Universe system. This number continues to grow year by year, driven by ongoing advances in scientific and analytical techniques that enable the characterization of increasingly smaller volumes of solid matter (Fig. 1).

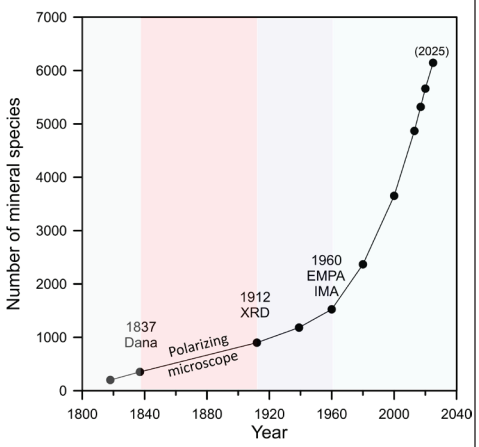

Figure 1 Historical increase in the number of officially recognized mineral species.

Over the past two centuries, the discovery of minerals has grown exponentially. In 70 AD, Pliny the Elder listed approximately 30 minerals in his *Naturalis Historia*. By the early 1800s, the number of known mineral species had increased to around 200 (Ford 1918). In 1837, Dana's seminal book *A System of Mineralogy* documented about 350 scientifically described minerals. By 1912, just before the widespread use of X-ray diffraction (XRD), this number had nearly tripled to approximately 900 (Dana, 1892–1915), driven by advances in chemical analysis and the introduction of the polarizing microscope. Between 1920 and 1959, nearly 600 more minerals were described (Mandarino 1977), aided by XRD and wet chemistry.

A turning point came with the founding of the IMA in 1958, which introduced standardized rules for defining and validating new minerals. At the same time, the introduction of the electron microprobe enabled chemical analyses at the micron scale, further accelerating discoveries. As a result, the number of recognized mineral species rose to ~2,370 by 1980, ~3,650 by 2000, ~5,660 by 2020, and stands at roughly 6,200 today. This remarkable growth reflects both natural processes and the ever-expanding capabilities of modern analytical science.

Note to Journal Editors

In accordance with the *Advice to Editors* by Nickel and Grice (1998), journal editors play a crucial role in supporting the Earth science community by ensuring strict adherence to IMA-CNMNC procedures. Manuscripts involving new minerals, nomenclature questions, or any changes to existing mineral species must be carefully evaluated in agreement with CNMNC guidelines. Authors are required to confirm that all relevant proposals have been submitted to and approved by the Commission. Such manuscripts must be accompanied by a formal *Approval Notification Letter* issued by the CNMNC. This letter serves as official certification of the approval of new minerals, nomenclature revisions, or the establishment of mineral groups and supergroups. It also provides editors and reviewers with access to essential comments from the Commission, facilitating a thorough and informed peer-review process.

Failure to adhere to established procedures can lead to significant confusion, as illustrated by a recent pair of publications by Cabri and McDonald (2025a, 2025b). In addition to several basic errors concerning nomenclature rules, the authors questioned the validity of IMA-CNMNC-approved species (ezochiite and shiranuiite) and re-evaluated the nomenclature of mertieite without submitting the required formal proposals for consideration and approval.

Although scientific debate is encouraged, revisions to the official nomenclature must follow established protocols to ensure transparency, evidence-based assessment, and international consensus. This is the role of the CNMNC, which, through the work of 34 internationally renowned mineralogists and crystallographers, reviews all proposals on a monthly basis to ensure their scientific validity. Publishing articles that contradict CNMNC decisions—without clarification that the expressed views are personal—risks undermining decades of work toward a coherent, authoritative nomenclature system. Editors are therefore strongly urged to clearly distinguish in their journals between unofficial interpretations and the official positions of the IMA-CNMNC.

It is instructive to conclude this note with the words of Williams et al. (2014): "*The key point we want to stress, besides this specific case, is that the IMA guidelines should be followed at all levels – by authors, by referees, and* ***also*** *by editors of scientific journals. These guidelines can be found in: Nickel & Grice (1998), Burke (2008), Hatert & Burke (2008), Mills et al. (2009), Mills (2010), and Hatert et al. (2013). All those involved in scientific research in mineralogy should speak a common language, and the IMA –CNMNC does represent the locus where these issues are discussed and put in the form of general guidelines.*"

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