

Third Report from the IMA Mineral Informatics Working Group September 2024

The IMA Mineral Informatics Working Group has been tasked with exploring needs and opportunities in the exciting direction of data science applied to mineralogy. We have identified three principal scientific tasks:

- 1) Create and expand robust open-access mineral data resources, including complete lists of IMA-approved mineral species and their attributes; comprehensive lists of mineral crystal structures and compositions for numerous samples; systematic tabulations of mineral physical and chemical properties; and information on mineral localities, the associated minerals, their modes of formation, age, geological context, and other attributes; similar lists for other planets and moons.
- 2) Development and application of powerful open-access data analytical and visualization methods related to fundamental problems in mineralogy, for example cluster analysis and community detection to identify distinct kinds or groups of minerals; network analysis, chord analysis, and other methods to explore and illustrate relationships among populations of minerals; and association analysis to predict the occurrences of as yet undiscovered mineral resources and new mineral species.
- 3) Development of machine learning and artificial intelligent algorithms, including mineralogical foundation models to identify large-scale, multi-dimensional patterns in mineralogical data.

Layered on these scientific ambitions are organizational tasks related to community building; the dissemination of informatics methods and other resources; fostering mineral informatics publications and conference sessions; and the engagement, training, and promotion of early-career scholars. The past year has seen a significant increase in the numbers of mineral informatics publications in both mineralogical and data science periodicals, as well as the inauguration of new geoscience data journals. Also of note is the increase in size and frequency of special mineral/geoscience materials informatics sessions at major conferences, including the International Geoscience Congress (Busan, South Korea; August 2024), the European Mineralogical Conference (Dublin, Ireland; August 2024), the Geological Society of America Annual Meeting (Anaheim, CA; September 2024), the American Geophysical Union Annual Meeting (Washington, DC; December 2024), the European Geosciences Union Annual Meeting (Vienna, Austria; April 2025), the Mineralogical Association of Canada Annual Meeting (Ottawa, Canada; May 2025), and the Goldschmidt Conference (Prague, Cechia, July 2025).

Looking forward, mineral informatics will be a significant theme at the August 2026 IMA meeting in Nanjing, China, with additional sessions at AGU, EMC, Goldschmidt, and other conferences.

In the coming years we propose to expand the leadership of the IMA Working Group on Mineral Informatics to engage early-career scientists to become the next generation of leaders in this organizational effort.

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