Mineral diversity: beyond 7000 species?

Ulf Hålenius[1], Frédéric Hatert[2], Marco Pasero[3], Stuart Mills[4]

[1]Department of Geosciences, Naturhistoriska Riksmuseet, Stockholm, Sweden, [2]Laboratoire de Minéralogie, Université de Liège, Liège, Belgium, [3]Dipartimneto di Scienze della Terra, Università di Pisa, Pisa, Italy, [4]Geosciences, Museum Victoria, Melbourne, Australia

In 2014 the number of valid mineral species reached 5000 and is now close to 5400. The mean yearly increase during the last decade has been in excess of 100 species. At the present growth rate, which exceeds by far the pre-2008 rates, so far published estimates (e.g., Hazen et al. 2015) of the total mineral diversity will be outscored shortly. The reasons for this are several. Development of refined as well as new techniques for characterization of matter enables analyses at higher spatial resolution and improved precision. In addition, intensified research on material from poorly studied or even previously unknown types of geological regimes reveals unexpected minerals formed under new physical or chemical conditions. Examples include for instance minerals in extraterrestrial bodies, high-pressure mantle xenoliths and volcanic fumaroles.

In addition to technological progress and diversity of study material, the accelerating numbers of new minerals reflect revisions in mineral classification schemes. Increased degree of detail in species recognition by taking into consideration cation and/or anion distributions among similar, but non-equal, structural sites is one important driving force. This anthropogenic "species accelerator" is complemented by results of additional human activities. Recently Hazen et al. (2017) identified more than 200 approved mineral species that are formed, at least partly, in response to human processes. Given the intense, widespread and increasingly diverse nature of human activities it is highly plausible that the number of such minerals will increase drastically in the future.

A plethora of so far unknown minerals are likely to form in response to processes, abiotic or combined abiotic/biotic, at the interface between the lithosphere and the biosphere (e.g. Schindler and Dorn, 2017). With the access to high-resolution analytical techniques there exists a potential to carry out adequate structural and chemical studies of the nanometer-sized mineral grains formed in these environments (e.g. Schindler and Hochella, 2016). Furthermore, a large number of naturally occurring organic substances and layered hydroxides or silicates formed by geological processes have so far been difficult to characterise in sufficient detail. New analytical tools may solve this problem and thus open up a large pool of potentially new minerals.

Consequently, discoveries of new nano-sized compounds in meteorites and in soils as well as other less explored environments have the potential to reveal a mineral diversity far beyond so far published estimates. Several of these potential new minerals will most likely present challenges to existing mineral classification and nomenclature schemes.

References

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