The Future of Mineralogy

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In the face of continuing human population pressures and the fact that atmospheric, soil, groundwater, and biosystem resources are approaching, or have already crossed, decline thresholds, mineralogy holds a central position in understanding how to achieve a sustainable state for Earth (Hochella, 2002). This fact forms and assures the long-term health and technical future of the science of mineralogy. It is well known that most physical, chemical and biological processes on Earth are either influenced to some degree or fully driven by the properties of minerals. But with only approximately 4500 mineral species presently described – not many relative to millions of prokaryotic and eukaryotic species combined – their diversity and range of influence may seem, by comparison, relatively modest. Yet minerals exert their influence by constituting the bulk of this Earth system and having a wide range of composition and structure that is expressed in a remarkable diversity of physical and chemical properties. Further, minerals are more complex than previously thought because of the discovery that their chemical properties vary as a function of particle size when smaller than a few to perhaps as much as several tens of nanometers in at least one dimension (Hochella et al., 2008). These variations are most likely due, at least in part, to differences in surface and near-surface atomic structure, as well as crystal shape and surface topography as a function of size in this smallest of size regimes. It has now been established that these variations may make a difference in important geochemical and biogeochemical reactions and kinetics (Hochella et al., 2008). This recognition is broadening and enriching our view of how minerals influence the hydrosphere, pedosphere, biosphere, and atmosphere.

Mineralogy is as important to Earth sustainability issues as most other branches of science. But as has become apparent, it is the combination of mineralogy with other sciences, such as hydrology and aqueous geochemistry, microbiology, atmospheric science, nanoscience and the medical sciences that makes it so powerful. Starting with the advent of re strikers, minerals have made vital contributions to the human endeavour for at least tens of thousands of years, if not for hundreds of thousands of years. Direct contributions, in terms of the extraction of mineral resources, will continue indenitely. However for the future, it is the interaction of minerals with the human-impacted hydrosphere, atmosphere and biosphere that will play a big role in dictating the sustainability, or if not, the failed sustainability, of planet Earth.

References

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