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234-7 - CHARACTERIZING CARBON MINERALOGY AND FORMATIONAL ENVIRONMENTS THROUGH DEEP TIME WITH ADVANCED ANALYTICS AND VISUALIZATION

  	 Wednesday, 25 September 2019
	 8:30 AM - 8:45 AM
	 <i>Phoenix Convention Center - Room 125AB, North Building</i>

Abstract

The key to answering many compelling and complex questions in Earth, planetary, and life science lies in breaking down the barriers between scientific fields and harnessing the integrated, multi-disciplinary power of their respective data resources.

Recent years have seen a dramatic increase in the volume of mineralogical and geochemical data available for study. These large and expanding data resources have created an opportunity to characterize changes in near-surface mineralogy through deep time and to relate these findings to the geologic and biologic evolution of our planet over the past 4.5 billion years [1-2]. Using databases such as the RRUFF Project, the Mineral Evolution Database, mindat, and EarthChem, we explore the spatial and temporal distribution of minerals on Earth’s surface while considering the multidimensional relationships between composition, oxidation state, structural complexity, and paragenetic mode.

These studies, driven by advanced analytical and visualization techniques such as mineral ecology [3-4], network analysis [5], affinity analysis, and natural kind clustering [6] allow us to begin tackling big questions in Earth, planetary, and biosciences. These questions relate to understanding the relationships of mineral formation and preservation with large-scale geologic processes. We can also investigate the abundance and likely species of as-yet undiscovered mineral, as well as estimate the probability of finding a mineral or mineral assemblage at any locality on Earth or another planetary body. Given the spatial and temporal distribution of minerals on Earth, which was heavily influenced by life, we can explore the possibility that Earth’s mineral diversity and distribution is a biosignature that can be used for future planetary evaluation and exploration. With natural kind clustering, we can predict the formational environment of mineral samples. These geologic resources also facilitate integration across disciplines and allow us to explore ideas that one field alone cannot fully characterize, such as how the geochemical makeup of our planet affected the emergence and evolution of life, and, likewise, how life influenced chemical composition and geological processes throughout Earth history.

[1] Hazen et al. (2008) *Am. Mineral.* 93, 1693-1720

[2] Liu et al. (2017) *Nat. Comm.* 8:1950

[3] Hazen et al. (2015) *Can. Min.* 53(2):295-324

[4] Hystad et al. (2019). *Math. Geosci.* 51, 401–417.

[5] Morrison et al. (2017) *Am. Mineral.* 102, 1588-1596.

[6] Hazen, R. M. (2019) *Am. Mineral.* 104, 810–816.

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Authors

M Shaunna Morrison Carnegie Institution for Scien	E Ahmed Eleish Rensselaer Polytechnic Institute
P Anirudh Prabhu Rensselaer Polytechnic Institute Tetherless World Constellation	N Shweta Narkar Rensselaer Polytechnic Institute
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  	 Wednesday, 25 September 2019
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