Network Analysis Applications: Exploring Geosphere and Biosphere Co-evolution with Big Data Techniques

S.M. MORRISON1, A. ELEISH1,2, C. LIU1, D.R. HUMMER1,3, D. GIOVANNELLI4,5, M.B. MEYER1, P. FOX2, R.T. DOWNS6, J.J. GOLDEN6, A. PIRES6, G. HYSTAD7, J. RALPH6 and R.M. HAZEN1

1Carnegie Institution, Washington DC USA #Email: smorrison@ciw.edu; 2Earth & Environmental Sci, RPI, Troy NY USA; 3Dept. Geology, Southern Illinois Univ., Carbondale IL USA; 4Earth Ocean Atmospheric Sci., Rutgers Univ., New Brunswick NJ USA; 5ELSI Institute, Tokyo JP; 6Dept. Geosciences, Univ. Arizona, Tucson AZ USA; 7Dept. Math., Purdue Univ. NW, Hammond IN USA; 8Mindat.org, Surrey UK.

We employ data analysis to explore, visualize, and quantify complex, multi-dimensional systems. Recent mineral ecology studies1,2 have applied network analysis3 to mineralogical systems to characterize the diversity and distribution of Earth’s near-surface minerals. Here we use network analysis visualization and statistical techniques to explore the relationships among minerals, geological and geochemical environments, and microbial communities.

Bipartite networks illustrate relationships between two parameters, such as localities and minerals or microbial communities. Each parameter can be represented with multiple characteristics, such as chemistry, age, or temperature by correspondence to node color, shape, or size. This flexibility allows us to display multi-dimensional data in ways that reveal previously unrecognized trends.

Figure: Bipartite Cu mineral network. Colored nodes = Cu mineral species; black nodes = Cu mineral localities.