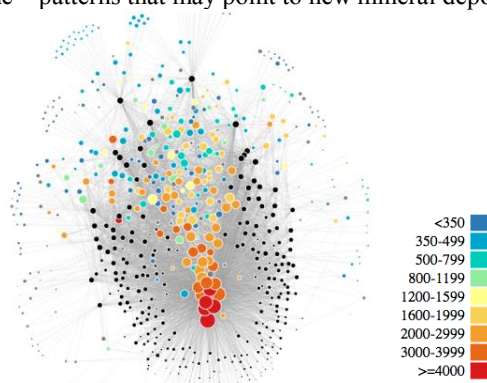


Carbon Mineral Network Analysis: A Big Data Geobiology Study

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We exploit large and growing “big data” resources (rruff.info/ima, mindat.org, and paleobiodb.org) and powerful data analysis and visualization methods to explore the diversity, distribution, and biological contexts of >400 minerals that incorporate carbon as an essential element [1]. Key findings include: (1) the distribution of carbon minerals conforms to a Large Number of Rare Event model, which may be a planetary biosignature; (2) the majority of carbon minerals are biologically mediated; (3) we predict that ~145 carbon-bearing minerals occur on Earth but have yet to be discovered and described; (4) carbon minerals display features of mineral evolution owing to physical, chemical, and notably biological processes; and (5) network analysis reveals previously hidden symmetries in mineral diversity and distribution through deep time—patterns that may point to new mineral deposits.



A bipartite carbon mineral diversity and distribution network; colored nodes indicate minerals and their maximum ages (in Ma). Black nodes indicate C mineral localities.

[1] R.M. Hazen et al. (2016) *Am. Mineral.* **101**, 889-906.

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