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Correlation of symmetry indices and mineral properties

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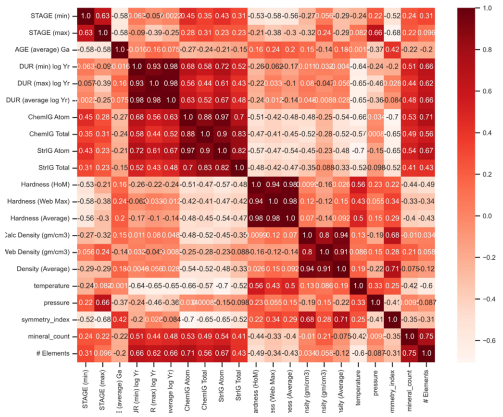

The Dolivo – Dobrovol'sky symmetry index calculation provides a useful way to quantify the statistical trends in the symmetry of a set of minerals [1]. These symmetry data can be used to better interpret the role of paragenetic modes on mineral stability, as well as the distribution of symmetry through mineral evolution.

To better understand these trends, symmetry indices of minerals were correlated with several evolutionary, physical, and chemical properties of minerals. The correlation matrix for these properties (Figure 1) takes into account the stage of mineral evolution in which the minerals appear, average age of the mineralogical record, duration of mineral formation, chemical and structural complexity of minerals, hardness, density, temperature and pressure of formation, symmetry index, mineral count, and number of essential elements in the structural formula.

Some of the resulting correlations warrant a more detailed investigation. There is a significant correlation between the average age of mineral formation and symmetry index, which is also shown in the steady decline in symmetry index through stages of mineral evolution [1]. Furthermore, there is an even higher positive correlation between density of minerals and their symmetry index. Also, interestingly, the symmetry index shows strong negative Pearson correlation with chemical and structural complexity of minerals. As the complexity of minerals grows through time, this leads to lower average symmetry of the minerals present on Earth's surface.

Other correlations may point to unexplored evolutionary processes. For example, a significant correlation exists between the number of minerals present in each paragenetic mode and the number of essential elements. Also, the pressure of formation seems to be strongly correlated with the latest stage of mineral evolution in which the mineral has formed. These correlations will be further explored for their potential uses in interpreting the geologic record as well as their causal relationships.

Figure 1. Pearson pairwise correlation matrix for selected attributes.

References

[1] Bermanec, Marko; Vidović, Noa; Gavryliv, Liubomyr; Morrison, Shaunna M.; Hazen, Robert M. (2022): Evolution of symmetry index in minerals. *Geoscience Data Journal*, 00, 1–17. DOI: 10.1002/gdj3.177.