

Patterns in the compositions of minerals I: carbonates and sulfates

This is the first of a series of pages presenting the chemistry of minerals in the context of part of the Earth Scientist's Periodic Table of the Elements and Their Ions. The point of these pages will be that there are patterns and predictability in the compositions of minerals.

Minerals are defined as naturally occurring substances and thus must be sufficiently stable to survive and be recognized in nature. One way to explain the

stability of some substances and instability of others is through the concept of ionic potential or charge density, which is quantified as ionic charge divided by ionic radius (z/r). The principal application of that concept here will be that cations have sufficient density of charge that repulsions between them can make substances unstable, and thus that minerals must be substances in which cations of great charge density must be shielded from

each other.

We can begin with the panel for carbonate minerals. In the blue field, simple carbonates like CaCO_3 consist of cations whose positive ionic potential is sufficiently low that they are not repulsed by the high positive ionic potential of C^{4+} in the carbonate group. Cations of higher ionic potential, such as Y^{3+} , Al^{3+} , and Ti^{4+} , must be shielded by H_2O (in the green field) or have their

