

## Variation in C-O and Si-O coordination

Beginning geology students are taught that Si<sup>4+</sup> coordinates with four O<sup>2-</sup>s, in the silica tetrahedron found in all silicate minerals that occur at Earth's surface. Mineralogy students go on to learn that coordination is dictated by the ratio of cation radius to anion radius, so that radius ratios predict coordination. However, Si<sup>4+</sup> actually enters into three-fold, four-fold, six-fold and perhaps eight-fold coordination. This diagram lays out that variation in coordination, and does the same for C<sup>4+</sup> too.

The point of this diagram is that coordination of cations varies with environmental context. Coordination can be low in solution, where repulsion between cations is irrelevant. It is greater in Earth-surface minerals, where cation-cation repulsion necessitates shielding between cations and thus requires greater coordination with anions. Coordination is even greater in minerals expected deep within the Earth or inside larger planets, where pressure allows compression of the "fluffy" anions and thus allows higher coordination of anions around cations.

