Crystalinity and mineral stability I

Minerals are inevitably defined as "crystalline" solids. Crystalinity refers to a repeating geometric arrangement of atoms, such that the locations of just a few atoms allow prediction of the locations of the vast number of atoms in a single crystal. A correlative of this statement is that crystal structures consist of planes of atoms.

If one asks “why are stable solids crystalline?”, the answer is apparent in the figure below. In a hypothetical solid in which positions of ions were completely random, repulsions would force cations apart (A) . The structure would fall apart or rearrange itself to a configuration with fewer repulsions. Iterative rearrangement would ultimately lead to a stable configuration in which repulsions were minimized and attractions maximized (B). Repetition of that configuration through space leads to the regularity of structure that we call “cystallinity”.

With that said, one should appreciate that order does not necessarily convey stability. Example C at left is as ordered as is Example B, but its order establishes repulsions that would constitute a very unstable structure. Order that maxmimizes attractions (bonding) and minimizes repulsions is order that promotes stability.

The figure at left shows a very simple notion of crystal structure. One difference from reality is that in reality cation and anion are rarely of the same size: anions are almost always larger than the cations with which they form minerals. For a more realistic model, see "Crystallinity and mineral stability II".

A. Disorder and instability
B. Order and stability
C. Order and instability

Repulsion between ions of like charge

Attraction between ions of opposite charge