Density and hardness I: a first look

The index minerals of the Mohs system of hardness present an interesting pattern: hardness is roughly correlative with density. In addition, several pairs of polymorphs show the same trend: the more dense mineral is the harder mineral. This relationship makes some sense, in that closer packing of atoms would give greater density and would allow shorter bond lengths, which allows greater hardness.

With that said, the relationship shown on this plot is hardly an exact one, with a relatively low correlation coefficient. One reason is that density of a mineral, as we’ve seen, depends on many factors. One factor is the atomic weight of the mineral’s atoms. Two minerals on the plot exemplify this: diamond consists of the light element carbon and thus inevitably falls to the left (the low-density side) of the correlation line. Zircon, on the other hand, contains the heavy element zirconium and thus falls to the right (the high-density side) of the correlation line. It’s thus no wonder that the correlation is a sloppy one. A better approach would be to normalize a mineral’s density for its formula weight, as we’ll see in Part II of this series.