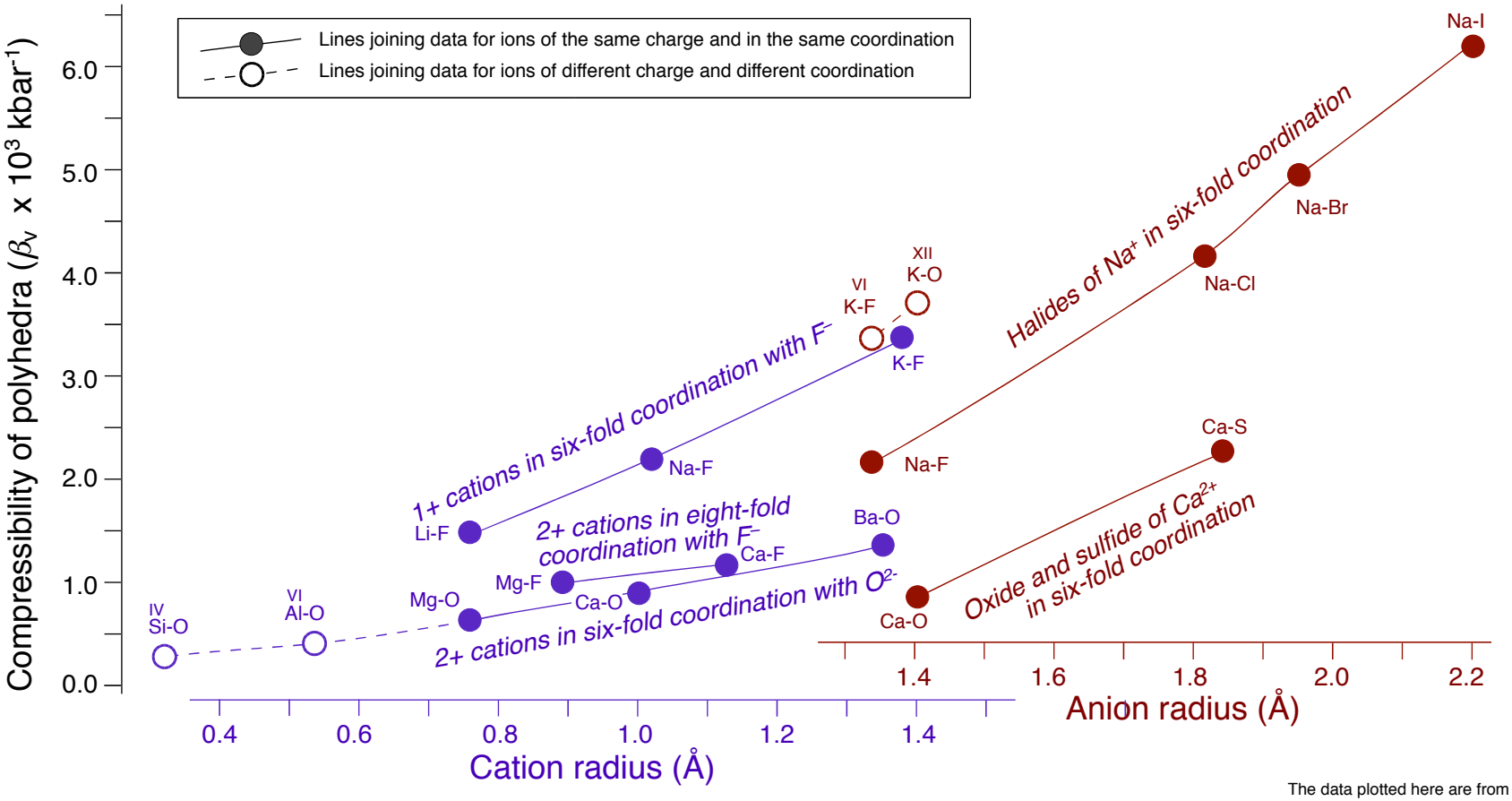
Compressibility of minerals as a function of cation and anion size



Compressibility is a mineral property to which we humans are insensate, but it is an important property with regard to the behavior of minerals in Earth's interior. The plots here show that compressibility increases with increasing size of the ions of which the mineral consists. This comports well with the notion that larger ions lower in the period table are softer, in this case in a very physical sense of being soft and deformable so that a mineral is compressed.

One might plot the data above in terms of bond length, whereby one would add cation radius and anion radius for each pair. Compressibility would increase with bond length. However, that plot would lose one of the key points evident above, which is that the greater part of the range in compressibilty (the vertical extent of this diagram), and greater increase in compressibility within a group (the more steeply sloping lines) have mostly to do with anions rather than cations. That makes some qualitative sense, because anions, as negatively charged atoms, necessarily have extra electrons that further contribute to their size and softness and thus their compressibilty.

The data plotted here are from Table 1 of Hazen, R.M., 1985, Comparative crystal chemistry and the polyhedral approach, in Kieffer, S.W., and Navrotsky, A., eds., Microscopic to Macroscopic – Atomic Environments to Mineral Thermodynamics: Mineralogical Society of America Reviews in Mineralogy Vol. 14. p. 317 ff. The ionic radii used are from Shannon, R.D., 1972, Revised effective ionic radii and systematic studies of interatomic distance in halides and chalcogenides: Acta Crystallographica, v. A32, p. 751-767.