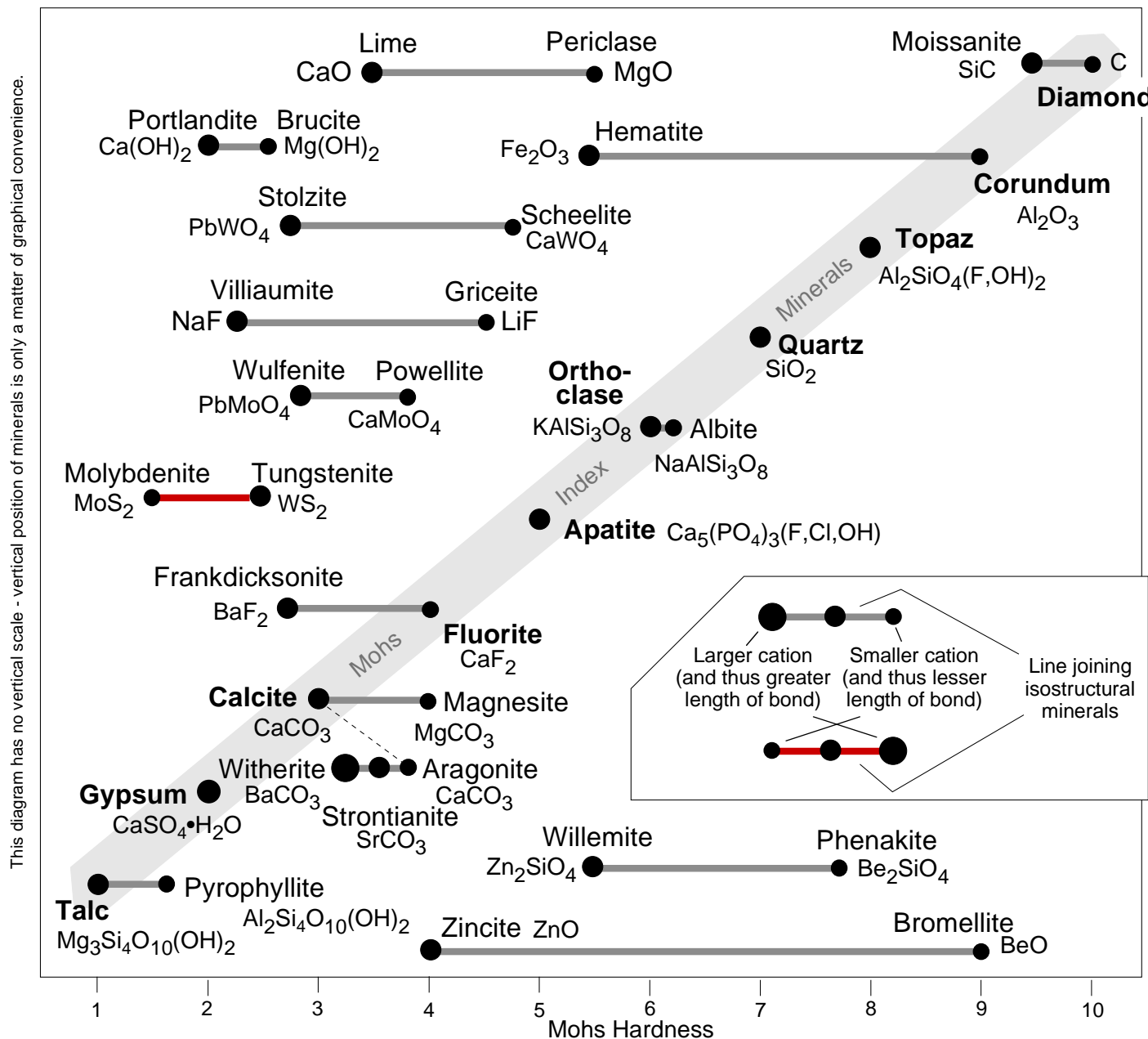


Hardness of minerals IVa: variation with bond length and cation size



One control on hardness of a mineral is the length of bonds within that mineral. To illustrate this point, this diagram shows pairs or sets of isostructural minerals. In almost all of the examples shown on this diagram, minerals with larger cations, and thus greater bond lengths, are softer than their counterparts with smaller cations and thus shorter bonds. Much the same point can be made with regard to anion size, as is shown in Part IVb of this series.

One pair of isostructural minerals shown here, the one joined by a red line, has hardnesses opposite the pattern described above. Those minerals are molybdenite and tungstenite, the sulfides of the relatively soft cations Mo^{4+} and W^{4+} . Bonding in these two minerals may be sufficiently covalent, and bonding in tungstenite more covalent, that the more covalent bond causes greater hardness of tungstenite. The same sort of trend can be seen with regard to Ag^+ and Pb^{2+} minerals in Part IVb of this series.

Hardness data are from Nickel, E.H., and Nichols, M.C., 1991, *Mineral Reference Manual*: New York, Van Nostrand Reinhold, 250 p.