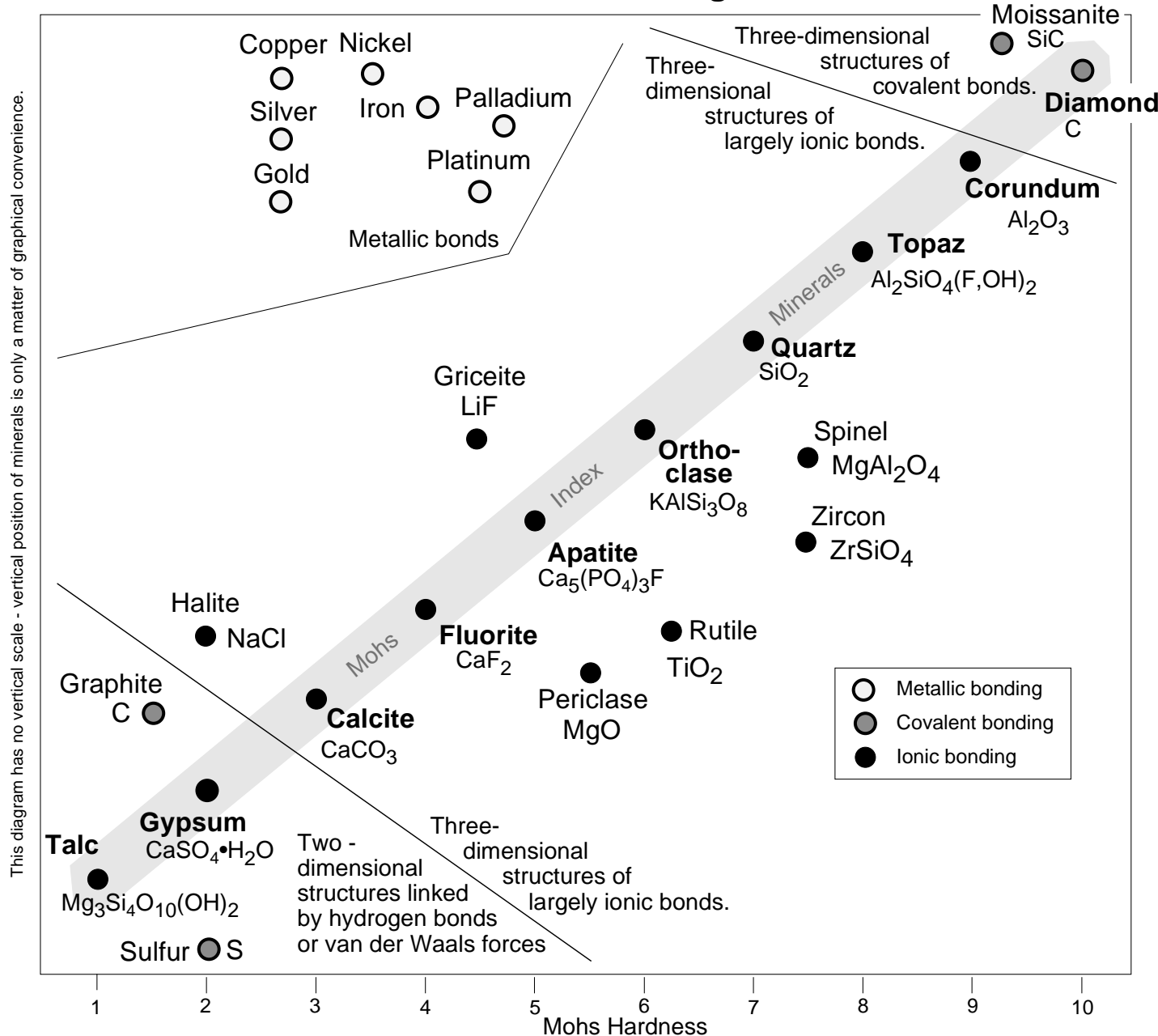


Hardness of minerals II: variation with bonding and structure



One of the most important controls on the hardness of a mineral is the nature of the mineral's chemical bonds. Covalent bonds are stronger than ionic bonds, and so it's not surprising that the hardest minerals, such as diamond and moissanite, are bonded covalently rather than ionically.

A second important control is the overall structure of the mineral. A structure with strong bonds in all three dimensions allows a rigidity at the atomic scale that we recognize as hardness at the macroscopic scale. On the other hand, a two-dimensional structure allows slippage of planes at the atomic scale that is recognized as softness at the macroscopic scale. Thus both graphite and diamond are minerals with covalent bonds, but the three-dimensional framework of covalent bonds in diamond results in spectacular hardness, whereas the two-dimensional framework of graphite allows slippage between monolayers and thus a very soft mineral.

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