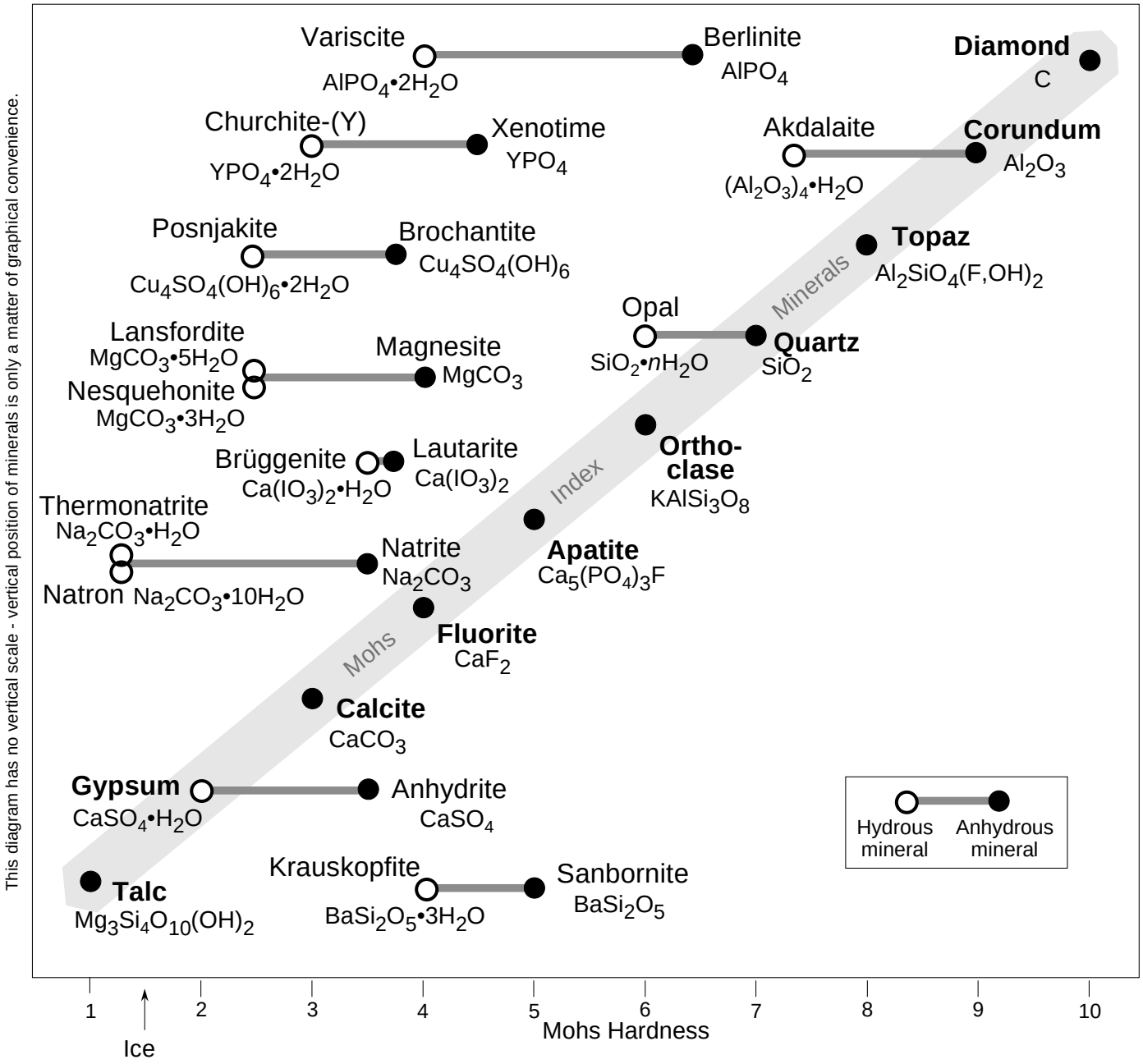
Hardness of minerals III: hydrous vs. anhydrous minerals



One control on the hardness of a mineral is the presence or absence of structural water in the mineral. The plot at left shows the hardness of all pairs of anhydrous and hydrous minerals for which hardness data are available. The plot shows that H_2O-bearing minerals are consistently softer than their anhydrous counterparts. That's because H_2O is generally only held in place by hydrogen bonds, so that it causes a weakness in the mineral structure.

With that said, one should appreciate that a hydrous mineral can be hard, as akdalaite and opal show on this diagram. However, both are hydrous analogs of very hard minerals, corundum and quartz.

On the other hand, the ultimate hydrous mineral, ice, is relatively soft at H = 1.5. It is nonetheless harder than talc, because ice has a rigid three-dimensional framework (if only of hydrogen bonds) rather than the two-dimensional framework joined by van der Waals forces in talc.

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