PUMPellyite GROUP
Ca$_2$XY$_2$(SiO$_4$)(Si$_2$O$_7$)(OH)$_2$ • H$_2$O

Closely related to the epidote group, the pumpellyite group comprises a series of mineral species defined by specific cations occupying structural sites represented by x and Y in the formula given above. Because multiple cations are involved, and because the same cation may occupy either site, it is impossible to say which species of pumpellyite is present without complete chemical and structural data. Based on the available analyses, most Michigan pumpellyites appear to be magnesium-dominant, intermediate solid solution series between pumpellyite-(Mg), pumpellyite-(Fe$^{2+}$) and pumpellyite-(Fe$^{3+}$).

Figure 109: A 0.8 mm aggregate of green pumpellyite crystals from the Cliff mine, Keweenaw County. Dan Behnke specimen and photograph.

Pumpellyite group minerals are widespread in low-grade metamorphic rocks (particularly in glaucophane schists), and also occur in hydrothermally altered mafic igneous rocks (e.g., basalts and diabases). Originally the mineral was described under the name “lotrite” from the southern Carpathian Mountains (Murgoci, 1901). Charles H. Palache, who in 1920 made the first systematic study of the secondary minerals in the altered copper lodes for the Calumet and Hecla Copper Mining Company, noted a green mineral which he believed to be a new mineral closely related to the zoisite-epidote family. Unaware of Murgoci’s earlier work, he submitted a manuscript to Calumet and Hecla describing the “new” mineral, proposing to call it “kearsargeite.” B. S. Butler didn’t like the name, and Palache changed the manuscript by crossing out “kearsargeite” and penciling in “pumpellyite,” in honor of Raphael Pumpelly, the noted 19th century U.S. Geological Survey geologist who made many contributions to the knowledge and understanding of copper minerals and the copper deposits of the Keweenaw Peninsula.

“Chlorastrolite,” the State’s official gemstone (Figure 21), was first verified as a variety of pumpellyite at the University of Michigan in the late 1940s (W. B. Griffiths, personal communication). “Chlorastrolite” is found chiefly as small rounded beach pebbles showing a finely radiating or stellate pattern of slender green crystals. The pebbles are derived from vesicle fillings in the amygdaloidal basalts of the Copper Country, and were formerly found in relative abundance, particularly on Isle Royale beaches. Chlorastrolite was named the “official state gem” by the Seventy-sixth Legislature (Act 56, PA 1972, effective March 30, 1973). It is also called “greenstone” and “Isle Royale greenstone.” “Zonochlorite” is an obsolete name for impure pumpellyite-Mg, originally described by Foote (1873) from an amygdaloidal basalt from Nipigon Bay, Ontario, but to which Hawes (1875) subsequently referred as “chlorastrolite.” It is probably a mixture of pumpellyite-Mg and chlorite.

In general, pumpellyite is abundant in all amygdaloidal lodes and fissures. It is also present but not abundant in the conglomerate lodes and felsites. It forms in vugs, and, with quartz, has replaced large volumes of the host rocks. It may occur in amygdules by itself, as needles in quartz, or associated with chlorite or epidote, from which it is not easily distinguished. Much of the pumpellyite is bluish-green in contrast to the epidote, which is yellow-green. Its most common occurrence is as a replacement of rock in flow tops, yielding a hard, dense, greenish-gray to bluish-green lode material that makes up a large part of the amygdaloid lode mined at the Isle Royale mine (Butler and Burbank, 1929; Stoiber and Davidson, 1959).

Keweenawan pumpellyite has the following habits: 1) radial stout prismatic, euhedral crystals usually enclosed by quartz; in fragmental amygdaloidal flows and in veins, 2) radial groups of needle-like crystals, either alone or with chlorite as amygdule fillings in “foody zones” of flows, 3) felt-like masses of cryptocrystalline grains replacing parts of...
flow tops and ashy layers, with primary igneous textures preserved. Livnat (1983) recognized a number of parageneses. Northern Peninsula.
