Yōtarō Seki and Sakiko Kuriyagawa*: Notes on Rock-forming Minerals (25) Optical Properties of Pumpellyites in Metabasaltic and Gabbroic Rocks of the Labrador Trough, Canada

Introduction
Recently Seki published a paper on pumpellyite in low-grade metamorphism (Seki, 1961). In this paper, he wrote that pumpellyite has not been found in non-glaucophanitic regional metamorphic terrains. Shortly after the publication of the paper Dr. W. R. A. Baragar of the Geological Survey of Canada kindly sent a letter to Seki, informing that pumpellyite does occur on the low-temperature side of a non-glaucophanitic regional metamorphic belt in the Labrador Trough region in northern Quebec, Canada (Baragar, 1961). At the same time, he also made an offer of six fresh samples of his pumpellyite-bearing basalt and gabbroic rocks to Seki.

We examined thin sections made from these samples and measured some optical properties of pumpellyite. In the present paper, we intend to briefly describe the optical properties of the Labrador pumpellyites with Dr. Baragar’s permission. We wish to express our greatest thanks to Dr. W. R. A. Baragar for his invaluable suggestions and kind informations on the modes of occurrence of the pumpellyites and his permission of the publication of this paper.

Modes of occurrence:
According to Baragar’s paper (1960) and his private communications, the regional metamorphic terrains of the Labrador Trough can be clearly divided into the following three zones in the descending order of metamorphic grade: almandine-amphibolite facies, green-schist facies and lower-grade facies. The almandine-amphibolite zone contains staurolite and kyanite as stable minerals and so this regional metamorphism appears to be the kyanite-sillimanite type or high pressure intermediate group according to Miyashiro (1961). Pumpellyite occurs only in

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metamorphosed mafic extrusive and intrusive rocks of his lower-grade facies.

**Mineral assemblage**

Baragar has already described the mineral assemblage of pumpellyite-bearing mafic metamorphic rocks in the Labrador Trough district (Baragar, 1960) in detail: Pyroxene basalts and gabbroic rocks in the lowest grade part of this metamorphic terrain were generally transformed into the assemblage of pumpellyite-prehnite-chlorite-sodic plagioclase. Actinolite, epidote and zeolite have not or very rarely been formed in these pumpellyite-bearing rocks*. On the other hand, in the greenschist zone mafic rocks were usually altered into the assemblage of epidote-actinolite-chlorite-sodic plagioclase.

**Optical properties of pumpellyites:**

Pumpellyites in samples given us by Dr. Baragar always show strong pleochroism from pale yellowish green to green. Optical dispersion $(\gamma<\delta)$ is very strong. The refractive index $\beta$, optical axial angles and extinction angles measured are as follows.

<table>
<thead>
<tr>
<th>Sample</th>
<th>$\beta$</th>
<th>$2V$</th>
<th>$\alpha\wedge\chi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 66</td>
<td>1.694</td>
<td>(+) 40$^\circ$</td>
<td>24.5$^\circ$</td>
</tr>
<tr>
<td>R 105</td>
<td>1.703</td>
<td>(+) 44$^\circ$</td>
<td>26$^\circ$</td>
</tr>
<tr>
<td>R 108</td>
<td>1.703</td>
<td>(+) 9$^\circ$ to 27$^\circ$</td>
<td>20.5$^\circ$</td>
</tr>
<tr>
<td>B L 9-20</td>
<td>1.705</td>
<td>n. d.</td>
<td>19.5$^\circ$</td>
</tr>
<tr>
<td>B L 9-34</td>
<td>1.705</td>
<td>(+) 36$^\circ$ to 43$^\circ$</td>
<td>24$^\circ$</td>
</tr>
<tr>
<td>B L 26</td>
<td>1.705</td>
<td>n. d.</td>
<td>25$^\circ$</td>
</tr>
</tbody>
</table>

These optical properties were measured by the immersion method and with the universal stage for Na-light.

**Discussion**

Seki has noted in his paper mentioned above that pumpellyite in glaucophanitic regional metamorphic terrains (jadeite-glaucophane type after Miyashiro (1961)) such as Sanbagawa and Kamui-kotan of Japan and Californian Coast Ranges has a relatively low index of refraction (Seki, 1961): $\beta$ of the pumpellyite in glaucophanitic regional metamorphic terrains is usually lower than 1.691. He also wrote in the same paper that pumpellyite which is rich in Fe$^{+3}$ and has a relatively high index of refraction may be stable only when the solid pressure is relatively low. It must be noted here that, as have been described above, the pumpellyite first discovered by W. R. A. Baragar from the lowest grade part of the regional metamorphic terrain of kyanite-sillimanite type or high pressure intermediate group has a relatively high index of refraction ($\beta=1.694$ to 1.705).

**References**


* Dr. W. R. A. Baragar has recently sent us a letter in which he states as follows.

"Mainly as a result of my subsequent work in surrounding areas, my description should be slightly altered. The entire zone in which pumpellyite is found seems to me to be one of incomplete greenschist-type of metamorphism. In a few places gabbros and basalts are almost completely composed of epidote minerals and actinolite; in most places they are only partly transformed and are composed of plagioclase and ferromagnesian minerals altered in varying degree to fine-grained epidote and/or pumpellyite and prehnite- and actinolite or chlorite; in some places they are completely unaltered."