Table 2. Mineral assemblages found in Glamorgan township.

Rock type	Characteristic mineral assemblage
Basic igneous	Hornblende-plagioclase-augite (± biotite, ± scapolite, ± calcite) Hornblende-scapolite-augite-calcite
Granitic (including granitic bands in migmatite)	Quartz-microcline-plagioclase-biotite-magnetite (± muscovite in some late stage veins) Quartz-microcline-plagioclase-biotite-hornblende-magnetite Quartz-microcline-plagioclase-magnetite
Non-granitic bands in migmatite	Quartz-plagioclase-biotite-hornblende-microcline-magnetite (± sillimanite)
Paragneiss	Quartz-plagioclase-biotite (± magnetite) Quartz-plagioclase-biotite-hornblende-microcline-magnetite Quartz-plagioclase-biotite-microcline-almandine (± epidote, ± cordierite)
Pelitic	Sillimanite-almandine-biotite-quartz-plagioclase (± hornblende ± staurolite)
Marble and skarn	Calcite-diopside-tremolite Calcite-diopside-scapolite Calcite-diopside-phlogopite Calcite-diopside-spinel Calcite-diopside-hornblende Calcite-diopside-grossularite Calcite-diopside-grossularite-plagioclase-epidote
Calc-silicate rock	Diopside-tremolite Diopside-tremolite-scapolite Diopside-scapolite

as the authors recognized, it is 'believed to have formed at lower pressures' (p. 545). In other words (and to use Miyashiro's, 1961, term), two distinct *facies series* are here placed together, all under the umbrella of the almandine-amphibolite facies.

Miyashiro (1961) in fact, was one of the first petrologists to dispute the idea that the almandine-amphibolite facies had any universal applicability. He recognized that low pressure environments (for example, Abukuma) gave rise to a set of mineral assemblages of amphibolite facies type, distinctly different from amphibolite facies assemblages found in higher pressure series such as the Barrovian.

Miyashiro's work suggests that it may be possible to divide the amphibolite facies into subfacies by means of pressure-dependent mineralogical changes, and relations between the Al_2SiO_5 polymorphs could be particularly useful in this respect. For example, the amphibolite facies defined by Eskola (1939) as that one in which plagioclase and hornblende coexist, could be divided into andalusite- sillimanite-, and kyanite-subfacies in a sequence from low to high pressure. One obvious shortcoming of a simplistic scheme of this kind arises from the fact that transitions between the Al_2SiO_5

polymorphs are not simply pressure-dependent so that further mineralogical information is necessary to label say, the sillimanite-subfacies as being formed at a *higher pressure* (and not just a higher temperature) than the andalusite-subfacies. In this respect, Miyashiro's (1961) recognition that staurolite characterizes certain Barrovian rocks whereas cordierite is found at Abukuma, is particularly useful.

It is possible to put tentative values on pressures of formation of the amphibolite facies rocks from the Scottish Highlands and the Abukuma plateau, by taking the mineralogical assemblages from these two areas (Fig. 2) and superimposing them on Hess's (1969) grid. Hess himself concluded that the Abukuma rocks must have formed at total pressures below 3 kilobars to place them outside the field of stability of staurolite. Similarly the assemblages of the Barrovian amphibolite facies can be placed on Hess's grid at total pressures above 6.5 kilobars. This leads to the schematic arrangement shown in Fig. 2, a framework that will prove useful in discussing the metamorphism of the Haliburton area.

Mineral facies in Glamorgan township

The mineral assemblages found in this part of the Haliburton Highlands are shown in Table 2. Those assemblages that can be plotted on the usual ACF and AKF diagrams are shown in Fig. 3. A comparison of Fig. 3 with Fig. 2 indicates the obvious similarities that exist between the Glamorgan rocks and both Barrovian and Abukuma assemblages. For example, staurolite *and* cordierite are found in Glamorgan township. In fact these two minerals are observed in other parts of the Grenville province in Ontario (e.g. Lal & Moorhouse 1969, Shaw 1962).

A reasonable inference from the similarity of Glamorgan rocks with what Miyashiro (1961) calls andalusite-sillimanite, and kyanite-sillimanite types of metamorphism, is that the Canadian occurrence forms part of a low pressure intermediate facies series. Added support for this conclusion is provided by the fact that andalusite (Lumbers 1967) as well as sillimanite and kyanite (Best 1966) occur in adjacent parts of the Grenville province, and Miyashiro (1961) has suggested that the occurrence of all three Al_2SiO_5 polymorphs is diagnostic of low pressure intermediate type metamorphism.

Physical conditions of metamorphism

In order to place limits on conditions of formation of the Glamorgan rocks, the following field observations prove useful.

(a) Sillimanite occurs in the scarce pelitic rocks of the region, and also in some of the non-granitic bands in migmatite.
(b) Staurolite occurs in some of the pelitic rocks.
(c) Cordierite is found in some of the paragneisses.