**Supplemental Item S1. Discussion of unit nomenclature in the Kulutingwak Fiord region**

Rocks currently denoted as the “Kulutingwak Formation” of Trettin (1998) were first described in detail by H.P. Trettin and T. Frisch in their 1987 Geological Survey of Canada report, “Bedrock Geology, Yelverton Inlet Map Area, Northern Ellesmere Island, Interim Report and Map.” In this report, Trettin and Frisch informally named rocks from the Petersen Bay, Kulutingwak Fiord, and Emma Fiord fault zones separately from one another based on lithology and age correlations from the tectonostratigraphic framework outlined in Trettin (1987).

“Kulutingwak Formation” rocks of the Petersen Bay fault zone (PBFZ) were first described as the Petersen Bay assemblage, an “intensely deformed unit of heterogeneous metamorphic rocks that flanks the Mitchell Point Belt on the southeast, being separated from it by the Petersen Bay Fault.” These rocks were divided into map units, 1Pzp and 1PzPBc. Unit 1PzPBc was identified as distinct carbonate units that were mappable from air photographs, while unit 1Pzp consisted of all other lithologies within the PBFZ, including amphibolite, amphibole-rich schists, kyanite and staurolite-bearing pelitic schists, and mica schists. Also described are plagioclase-free, amphibole-bearing rocks with euhedral garnets that were suspected by the mappers to have a mafic/ultramafic origin.

“Kulutingwak Formation” rocks of the Kulutingwak Fiord fault zone (KFFZ) were described as the Kulutingwak Belt and correlated with Succession II of the Pearya terrane. These rocks were divided into four mapped units:

spcqv – argillaceous sediments metamorphosed to schist and phyllite and lesser marble, volcanic rocks, and quartzite

p – dark grey pyritic slate

c – marble and minor dolomitic schist

x – unsorted, matrix-supported conglomerate, with clasts consisting of dolostone, quartzite, recrystallized chert, and siliceous volcanic rocks

These designations in the KFFZ did not include detrital serpentinite-bearing lithologies, which were mapped as a separate unit altogether: um. Serpentinite-bearing rocks are found in the KFFZ in the core of the Kulutingwak anticline and were classified into 3 types: 1) massive serpentinite, 2) poorly-sorted fragments 1-30 cm in a matrix of serpentinite, and 3) size-sorted, thin-bedded serpentinite-bearing sedimentary rocks.

Rocks of the Emma Fiord fault zone (EFFZ) were informally described as the Kulutingwak Fiord assemblage of Trettin et al. (1987), or unit SK, consisting of volcanic rocks and carbonates.

This nomenclature of the Petersen Bay assemblage in the PBFZ, the Kulutingwak belt of Succession II in the KFFZ, and the Kulutingwak Fiord assemblage in the EFFZ was entirely revised by Trettin (1998). In this volume, outcrops and lithologies described above from the KFFZ were included in the Kulutingwak Formation, or map units OK, OK1, and OK2. The lithologies described above from the PBFZ, schists and carbonates, were mapped as units OKs and OKc respectively. Trettin (1998) did not explicitly include PBFZ rocks in the Kulutingwak Formation, but rather stated that their location, structural setting, and lithology warranted correlation with the formal section he described to the south. Rocks of the EFFZ were assigned map unit OSv and correlated with the upper Hazen Formation (see Trettin, 1998 for description) based on assignment of conodonts in the limestone to the early Llandovery to Late Ordovician. This fossil call was tentative, and the age of the volcanic rocks in the EFFZ were unknown at the time.

Importantly, the serpentinite-bearing unit, um, of Trettin and Frisch (1987) was reclassified as the Silurian Phillips Inlet Formation (map units SP, SP1, and SP2) by Trettin (1998). This unit is described in four structural lenses within the KFFZ. Designation of the Phillips Inlet Formation as Silurian was made purely on regional lithological comparisons, largely with the Fire Bay assemblage (formerly the Fire Bay Formation; see Koch et al., 2022) to the southwest, which contains minor serpentinite and chromite. At the time, the Fire Bay assemblage was thought to be a Silurian package of arc-related lithologies, but recent U-Pb zircon data have established an Ordovician age for the volcanic rocks therein.

Cohesive discussion of these enigmatic rocks is made challenging by historical revision of nomenclature and correlation with different units as new data is obtained. New zircon U-Pb-Hf isotopic data in this study may suggest that additional nomenclature revisions should be made. However, revision of the existing tectono-stratigraphic framework and nomenclature of Ellesmere Island is not the focus of this study; instead, we are interested in the tectonic processes recorded by rocks contained within and in proximity to the PBFZ, KFFZ, and EFFZ. As such, we retain the nomenclature of Trettin (1998) with a few exceptions:

1. We refer to the rocks correlated with the Kulutingwak Formation along the PBFZ as the Petersen Bay assemblage (nomenclature of Trettin and Frisch, 1987), following suit from Kośmińska et al. (2022), who distinguished these rocks from other Kulutingwak Formation units based on their amphibolite facies metamorphic overprint.
2. We suggest that the age designation of the Silurian Phillips Inlet Formation should be revised to the Ordovician, as the Silurian age call was made on the basis of correlation with the Fire Bay Formation of Trettin (1998), which was thought to be Silurian. The Fire Bay Formation (now, Fire Bay assemblage) was recently dated to ca. 460-480 Ma (Koch et al., 2022). As there are no currently described Silurian arc-related rocks currently described on Ellesmere Island and Phillips Inlet Formation serpentinite-bearing lithologies are found in fault zones with Ordovician arc-related units, this age designation should be revised.

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|  | *Trettin & Frisch (1987)* | *Trettin (1998)* | *This study* |
| **PBFZ** | Petersen Bay assemblage (1Pzp and 1PzPBc) | OKs and OKc, correlated with Kulutingwak Formation | OKs, or Petersen Bay assemblage (PBA) |
| **KFFZ** | Kulutingwak Belt of Succession II of the Pearya terrane (spcqv, x, c, p) and serpentinite-bearing rocks (um) | OK, OK1, and OK2, Kulutingwak Formation and SP, SP1, and SP2, Phillips Inlet Formation | Kulutingwak Formation (OK) and Phillips Inlet Formation (OPI) |
| **EFFZ** | Kulutingwak Fiord assemblage (SK) | OSv, correlated with Hazen Formation | OSv, correlative with the Fire Bay assemblage |