CONTACT METAMORPHISM OF LIMESTONE AT OPEN BAY, QUADRA ISLAND

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Supervised by Sandra Johnstone as part of GEOL 300: Igneous and Metamorphic Petrology, SPRING 2018
VIU Create Conference

Introduction

On the East Coast of Quadra Island, BC exposes metasedimentary country rock of Quatsino and/or Parsons Bay Formations intruded by the magmatic front of the Coast Plutonic Complex (CPC). The research conducted in this project aimed to determine the pressure and temperature conditions involved in the metamorphism of the these country rocks in proximity to suspected CPC intrusions. This question was addressed through analysis of petrography and geochemistry to determine mineral assemblages that predictably correlate to metamorphic facies. Through field observations and background research, it was hypothesized that minerals of amphibolite and hornblende-hornfels facies would be identified in samples nearest the plutons. This poster includes geology of Quadra Island, methods of research, geochemical and petrographic analysis, and discussion of results and recommendations for further research.

Background Geology

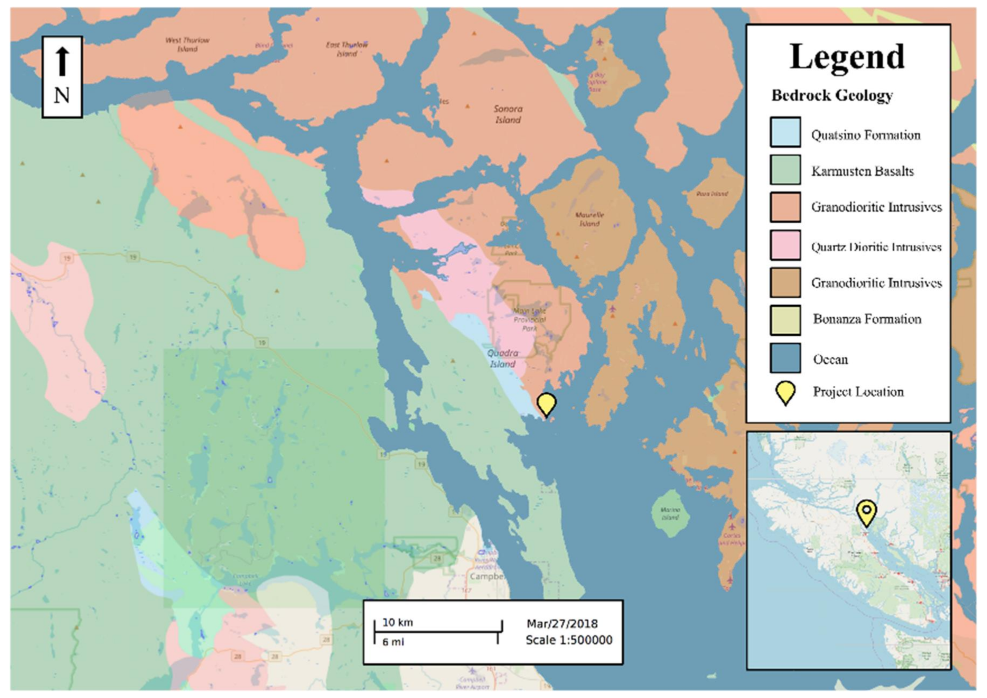


Figure 1. Geologic map of contact area between the Wrangellia and Coast terranes.

Karmutsen Formation (Upper Triassic)
Characterized by tholeiitic, pillowed, oceanic flood basalts[3], as well as a homogenous succession of basaltic lava, comagmatic sills and dykes[4].

Quatsino Formation (Upper Triassic) - Light to medium grey-weathering limestone. The lower member contains 99% calcite and is massive and poorly to thickly bedded. The upper member consists of beds 5 to 30cm thick separated by thin shale laminae[4].

Parsons Bay Formation (Upper Triassic) - A thin unit composed of sequences of thinly interbedded argillite, shale, and limestone, passing upwards into siliceous siltstone or possibly cherty argillite[4]. *Quite often found where Quatsino is exposed.

Coast Plutonic Complex (Cretaceous to Jurassic) - Defined as quartz diorite with peripheral mafic phases. Contacts with the intrusions typically involve up to greenschist and hornblende-hornfels metamorphic facies[1].

Field and Analytical Methods

Field Work:

- Detailed mapping of structures and nature of contacts.
- Representative sample suite collected (fig.1).
- Sample locations mapped and documented.

Lab Work:

- Representative sample was cleaned, cut, and prepared for geochemical analysis and/or thin section preparation
- Samples were sent to the Bureau Veritas Group, in Vancouver for major oxide geochemical analysis.

Study Area

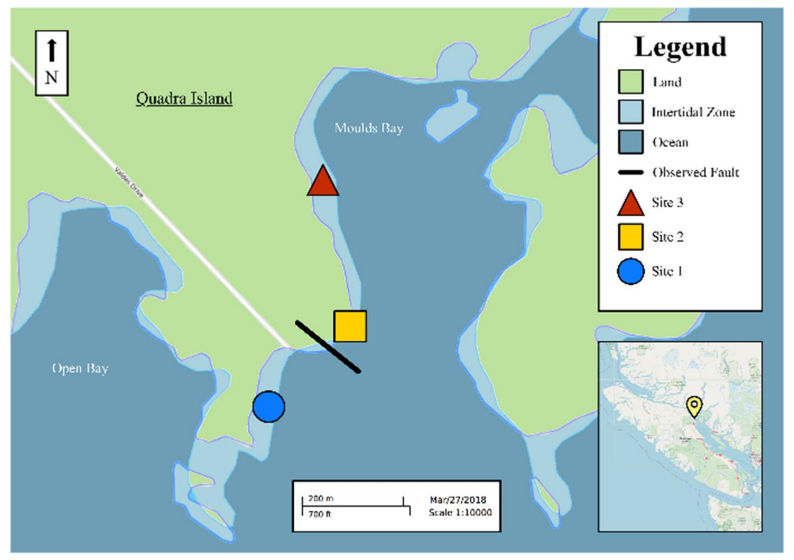
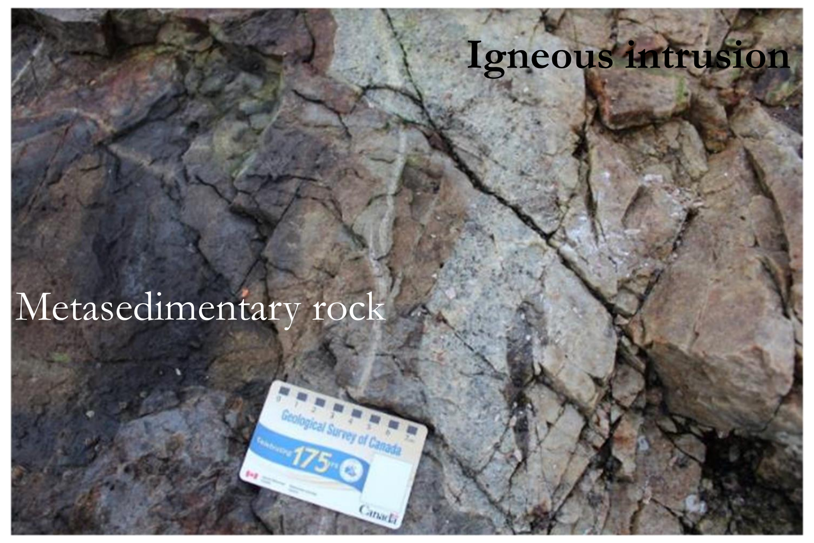


Figure 2. (left) Locations of field sites at Open Bay (left). Mapping and sample extraction took place at three locations, with the pluton at greatest proximity to site 2.

Figure 3. (right) Field photo of igneous intrusion in contact with metasedimentary rock.



Geochemical Results

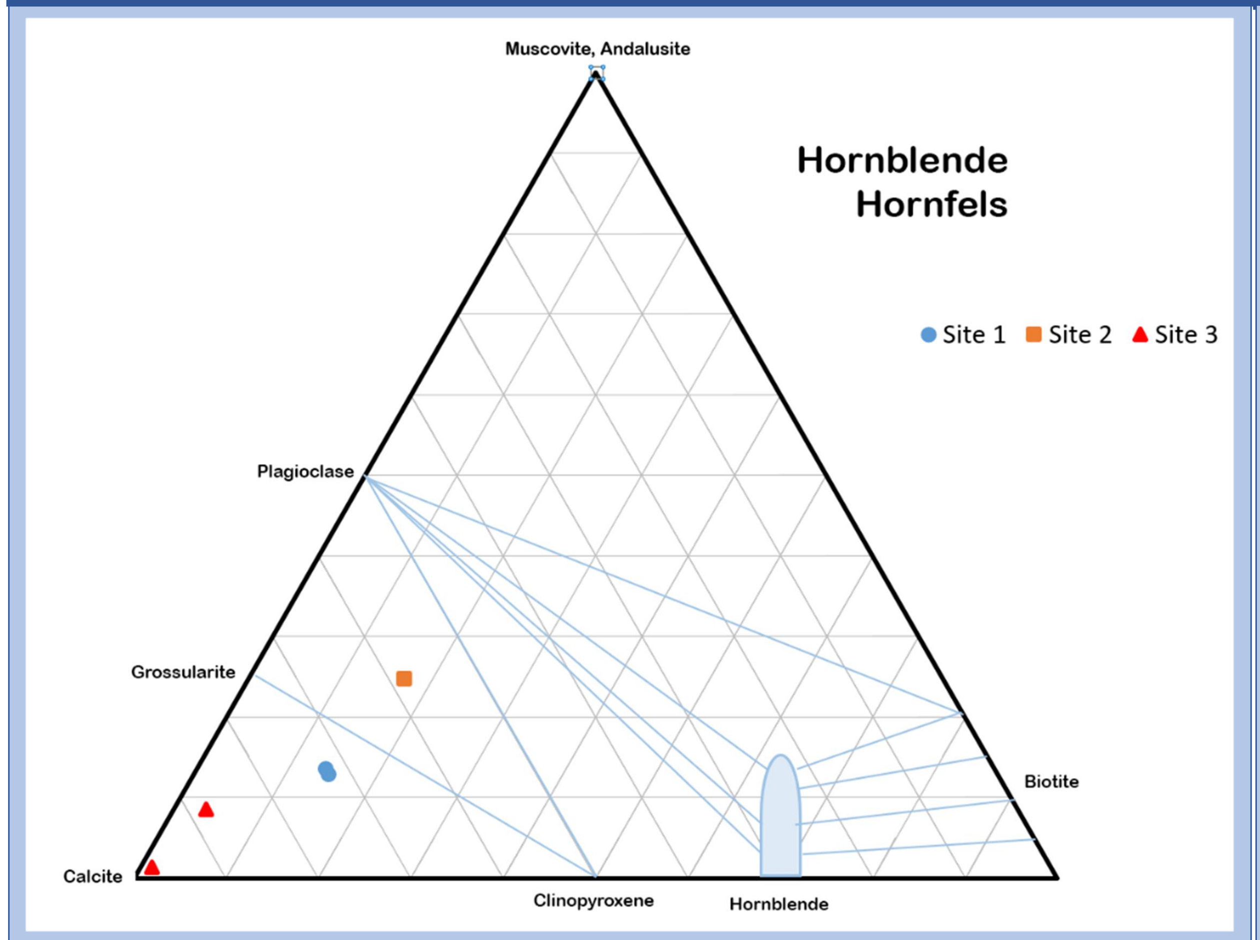


Figure 4. Major Oxide ACF diagram showing distribution of samples across the three sample sites. Site 3, furthest from the pluton showed the least metamorphism as expected. Site 2 exhibits a higher grade of metamorphism than site 1 which is unexpected given the proximity to the pluton.

Metamorphic Facies

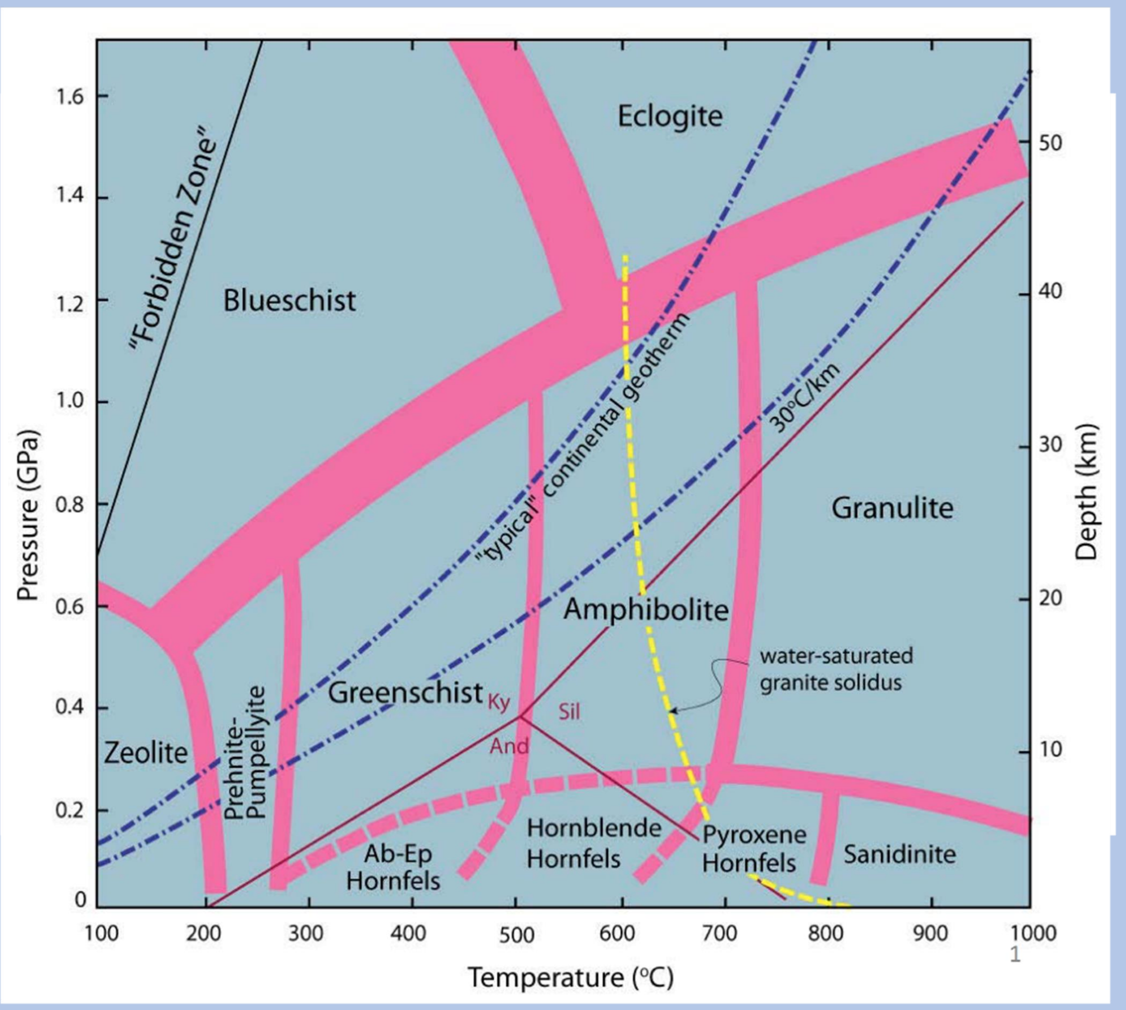


Figure 5. Pressure-temperature conditions of metamorphic facies, indicating pressure increase with depth[6].

Petrographic Analysis

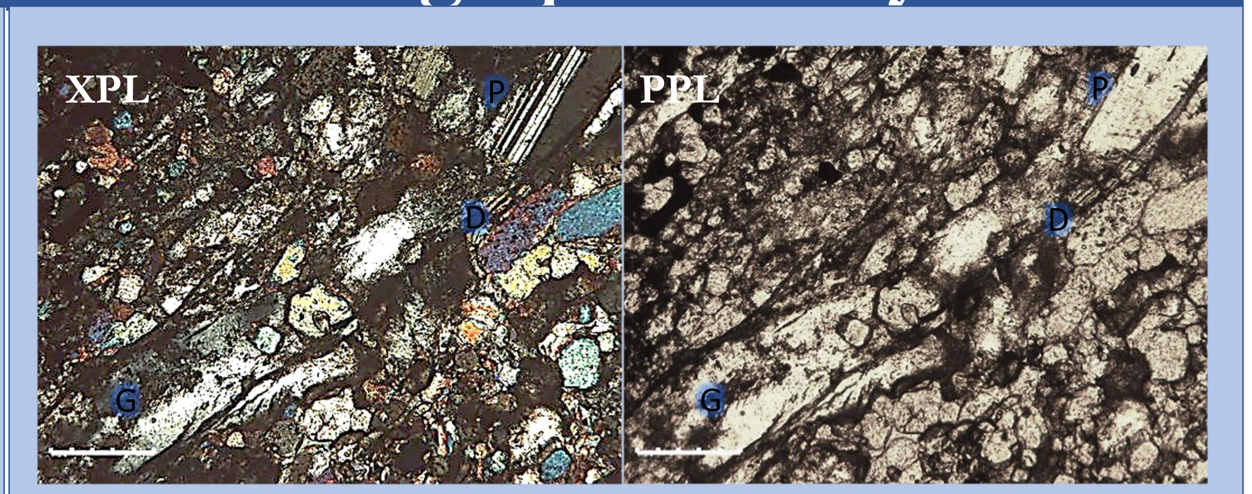


Figure 6. Sample OB-18-48 showing a plagioclase (P)-diopside (D)-grossular (G) mineral assemblage indicating a hornblende-hornefels metamorphic facies (Scale Bar: 200um).

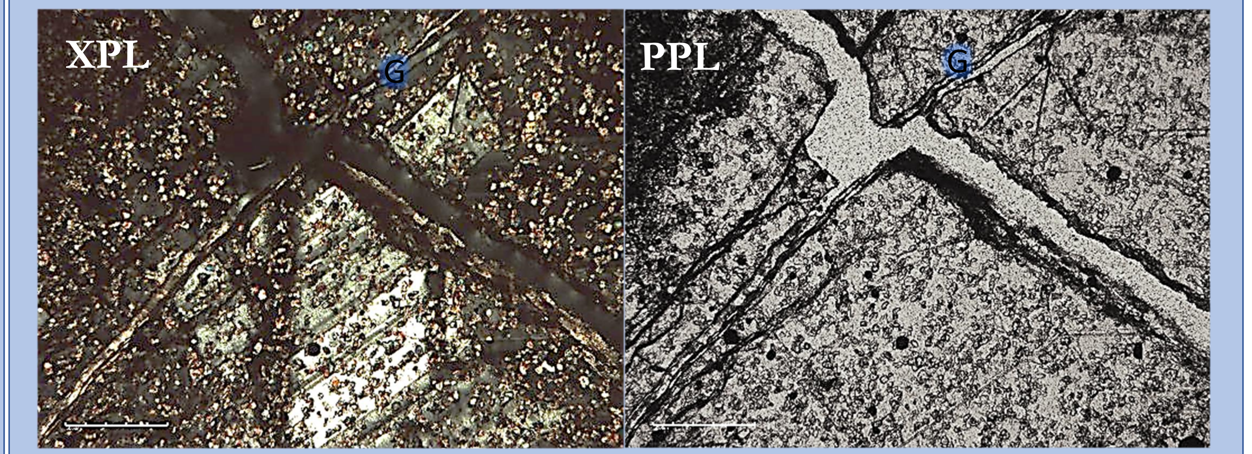


Figure 7. Sample OB-18-36 showing large grossular garnet crystals (G) with inclusions of diopside and sulphide minerals(Scale Bar: 500um).

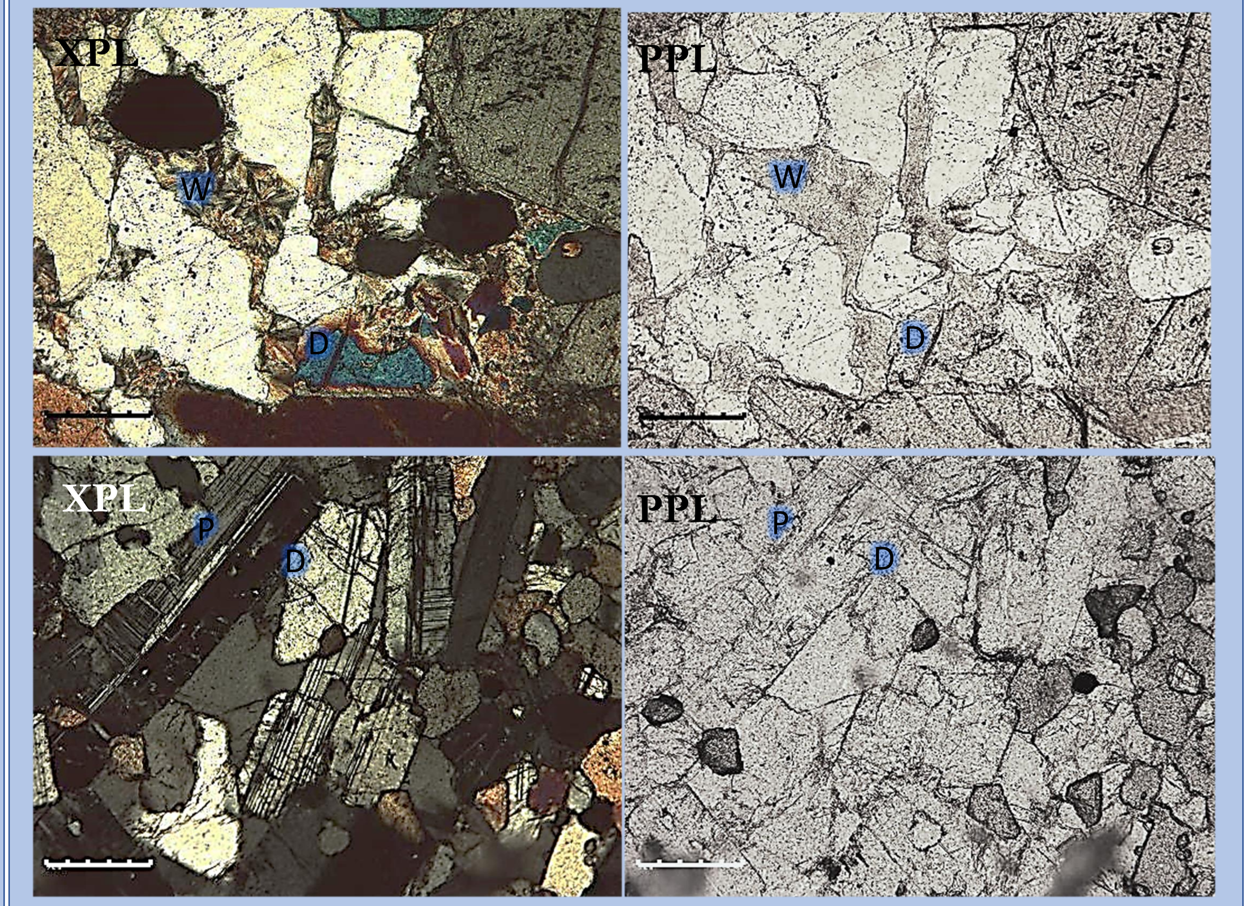


Figure 8. Sample OB-18-51 showing a wollastonite (W) (top)-plagioclase (P) (bottom)- diopside (D) (top and bottom) mineral assemblage indicating sanidine metamorphic facies (Scale Bar: 200um).

Analysis and Discussion

Major oxide concentrations plotted on the ACF diagram (fig. 4) have been overlain with the mineral assemblage of the hornblende-hornfels metamorphic facies. Samples from each site were plotted to anticipate their potential mineral assemblages. Thin section analysis confirmed the presence of minerals correlating to the interpreted assemblages, allowing for the determination of their metamorphic facies.

Sample OB-18-48 (Site 2): ACF plot shows low CaO content in accordance with higher grade metamorphism proximal to the intrusive body. The presence of grossular, plagioclase and diopside plotted on compatibility diagram indicate hornblende-hornfels or amphibolite facies metamorphism (fig. 5). Schluessel et. al (2018) determined an emplacement pressure below amphibolite facies, therefore confirming hornblende-hornfels metamorphic facies (fig. 6).

Sample OB-18-36 (Site 3): A mineral assemblage of grossular, calcite and diopside was found in this sample indicating a hornblende-hornfels metamorphic facies (fig. 5). Anisotropic grossular garnet formed as a result of structural alteration through the presence of hydrothermal fluids and OH groups distributed in a noncubic manner[6](fig. 7). This confirms high temperature, low pressure contact metamorphism.

Sample OB-18-42 (Site 1): Representative sample of the Quatsino Formation. This limestone shows 99% calcite composition with 1% sulfide impurities. Sample may also be metamorphosed within the hornblende-hornfels facies but, the nearly pure calcite composition limits the ability for metamorphism to change the mineral assemblage up to this grade.

Sample OB-18-51 (Site 2): Presence of wollastonite, plagioclase and diopside as well as a lack of grossular garnet represents a mineral assemblage corresponding to the sanidinite metamorphic facies (fig. 5). This represents the highest temperature metamorphism observed, which is interpreted to be in nearly direct contact with the pluton (fig. 8).

Conclusions and Recommendations

Hypothesis	Accepted /rejected	Rationale
Amphibolite facies metamorphism closest to pluton	Rejected	Grossular-diopside-plagioclase/calcite mineral assemblage and maximum pressure below amphibolite facies metamorphism indicates hornblende-hornfels. A localized sample in nearly direct contact with pluton indicated the highest temperature of metamorphism is categorized in sanidinite facies.

Recommendations

- Further sample extraction at sites of varying metamorphic grade, with differentiation between rocks of Quatsino and Parsons Bay protolith.
- Petrographic and geochemical analysis of samples of lower metamorphic grade (I.e. greenschist facies).
- Mapping at smaller scale to determine the extent of varying metamorphic grade and contact aureoles.

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Acknowledgements:
Sandra Johnstone
Bureau Veritas Group
Previous and Current VIU Students
VIU for hosting VIU Create 2018