Antoine Peak Conservation Area Field Study: An Undergraduate Service-Learning Research Project

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INTRODUCTION

Antoine Peak Conservation Area (APCA) is 1,296 acres of mountainous terrain between Forker and Campbell roads north of Spokane Valley. The goals of the project are as follows:

- Map and describe the local bedrock units;
- Create hiking trail geology maps;
- Submit a field study report to the Antoine Peak Conservation Area section of the Spokane County Conservation Futures website (**Figure 1)**.
- We studied outcrops adjacent to marked trails only, following hiking etiquette. Lineation directions and strike and dip measurements were taken using a Brunton compass (**Figure 2**). We described hand samples from representative sites using a standard optical microscope. Thin sections taken from three rock types, Newman Lake Gneiss, Hauser Lake Gneiss and Rathdrum Granite, were analyzed for mineral content using a petrographic microscope.

https://www.spokanecounty.org/DocumentCenter/View/49680/Geology-Of-Antoine-Peak--Conservation-Area-A-Limited-Field-Study

GEOLOGY OF ANTOINE PEAK CONSERVATION AREA
A LIMITED FIELD STUDY

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Figure 1. Field Study Report.

LOCATION

APCA is structurally within the four-kilometer- thick Spokane dome mylonite zone (Doughty et al., 2016) in the southern portion of the Priest River Complex, a metamorphic core complex (**Figure 3**). All APCA rock types exhibit various degrees of deformation, mylonitization, and high-grade metamorphism evidencing its location in the "shear zone" of the complex.

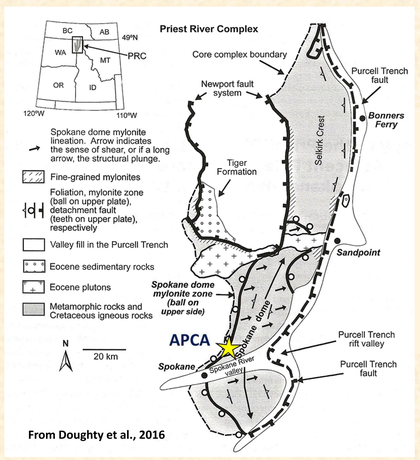

Figure 3. Schematic of the Priest River complex, from Doughty et al., 2016.

BEDROCK GEOLOGY

Four rock types make up the bedrock geology at APCA: two metamorphic rocks and two younger igneous rocks intruding the metamorphic rocks. Each rock type shows varying degrees of deformation.

- Newman Lake Gneiss is an orthogneiss whose protolith is granodiorite (Weiss, 1968). The mineral assemblage observed at APCA is quartz, orthoclase, plagioclase, and biotite. Its defining characteristic is large blocky feldspar megacrysts (**Figure 4**).
- Hauser Lake Gneiss, (**Figure 5**), is a paragneiss whose protolith is the Prichard Formation (Doughty et al., 1998). Its mineral assemblage at APCA consists of quartz, plagioclase, orthoclase, biotite, muscovite, and sillimanite indicating amphibolite facies conditions (**Figure 6**). Based on visual observations, possible migmatitic Hauser Lake Gneiss in the southern section of APCA is inferred. (**Figure 7**).
- Rathdrum Mountain Granite is a felsic igneous rock comprised of quartz, orthoclase, plagioclase, biotite, and minor muscovite. It is fine to medium-grained with equigranular crystals weathering pinkish to yellowish brown. At APCA it displays mild foliation indicated by the alignment of quartz and feldspar crystals (**Figure 8**). At APCA it occurs only as narrow intrusions into the metamorphic rocks.
- Clusters of felsic granitic pegmatite float were observed throughout APCA. This rock unit is composed of quartz, orthoclase feldspar, plagioclase feldspar, muscovite, and small amounts of biotite. Because we limited observations only to outcrops on marked trails, in situ pegmatite was not found (**Figure 9**).

Figure 2. Measuring strike & dip.

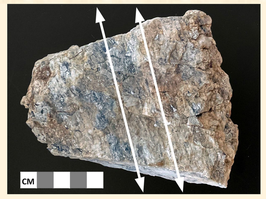

Figure 9. Lineated pegmatite float from near site EN-14

Figure 5. Folded Hauser Lake Gneiss at site TW-7.

Figure 7. Boudins consisting of quartz and feldspar within foliated Hauser Lake Gneiss. In this area of the park, several outcrops appear to show partial melting of the Hauser Lake Gneiss. Silicate-rich quartzo-feldspathic bodies are concordant to the foliation of the host Hauser Lake Gneiss. From site TW-3 on the left and site TW-11 on the right.

TEXTURES, FABRICS, & STRUCTURE

The combination of well-developed foliation and lineation, folding, existence of boudins, and mylonitic fabric indicates that the rocks at APCA have undergone significant deformation from being subjected to intense stresses, probably during multiple geologic events (Doughty et al., 1998, Stevens et al. 2016). The lineated and mylonitic fabric seen here is typical of rocks from other parts of the Spokane dome mylonite zone of the Priest River complex. The direction of lineation in fixed outcrops consistently trend west at approximately 250°, like other studies done from other parts of the Spokane dome mylonite zone and the Priest River complex in general (Doughty et al., 2016).

Figure 4. Newman Lake Gneiss: (A) Site EN-13. Several large outcrops are along the southwestern side of the Emerald Necklace Trail; (B) 2-3 cm megacrysts characterize this rock. (C) ultramylonite texture indicated by minerals of reduced crystal size stretched into distinct bands. Small lens-shaped porphyroclasts are surrounded by crushed and stretched quartz and feldspar grains. This sample from site CG-17 is from a high strain shear zone near the contact with Hauser Lake Gneiss.

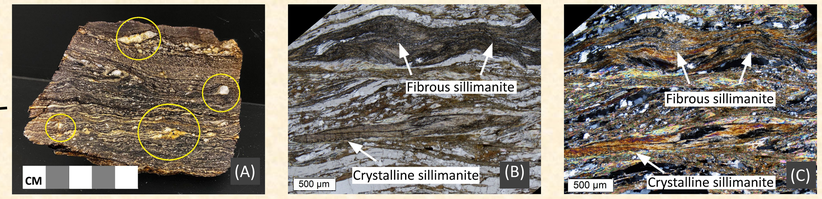

Figure 6. Hauser Lake Gneiss: (A) ultramylonite demonstrated by elongated, wavy minerals of biotite, quartz, feldspar, and sillimanite with porphyroclasts (circled). (B, C) thin sections in plane and polarized light showing folded and deformed sillimanite, a defining mineral in Hauser Lake Gneiss. From site CG-4.

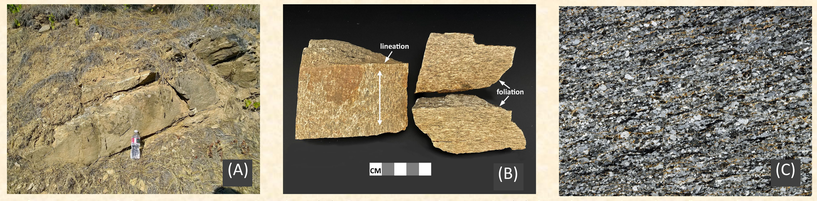

Figure 8. Rathdrum Mountain Granite: (A) Outcrop at site EN-8; (B) hand sample taken from site EN-8, showing lineated and foliated textures. (C) thin section indicating mild foliation. Taken together, (B) and (C) provide evidence that the rock likely intruded late during the unroofing of the Priest River complex.

CONCLUSIONS

The geologic history of a region profoundly affects the composition, texture, and microstructures of the rocks there. The textures and fabrics of APCA rocks affirm the following sequence of events:

1. Deposition of Belt Supergroup sediments forming the Prichard Formation 1.47 Ga. (Doughty et al., 2016).
2. Intrusion of Newman Lake granodiorite 65 Ma (Buddington, et al, 2019).
3. Deep burial, peak metamorphism and formation of Hauser Lake Gneiss from the Prichard protolith 68-64 Ma. (Stevens et al., 2016).
4. Unroofing of the Priest River complex 60-48 Ma. (Stevens, et al., 2016)
5. Intrusion of Rathdrum Mountain granite 49-46 Ma. (Stevens et al., 2016).
6. Intrusion and placement of leucocratic pegmatite dikes, timing uncertain.

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