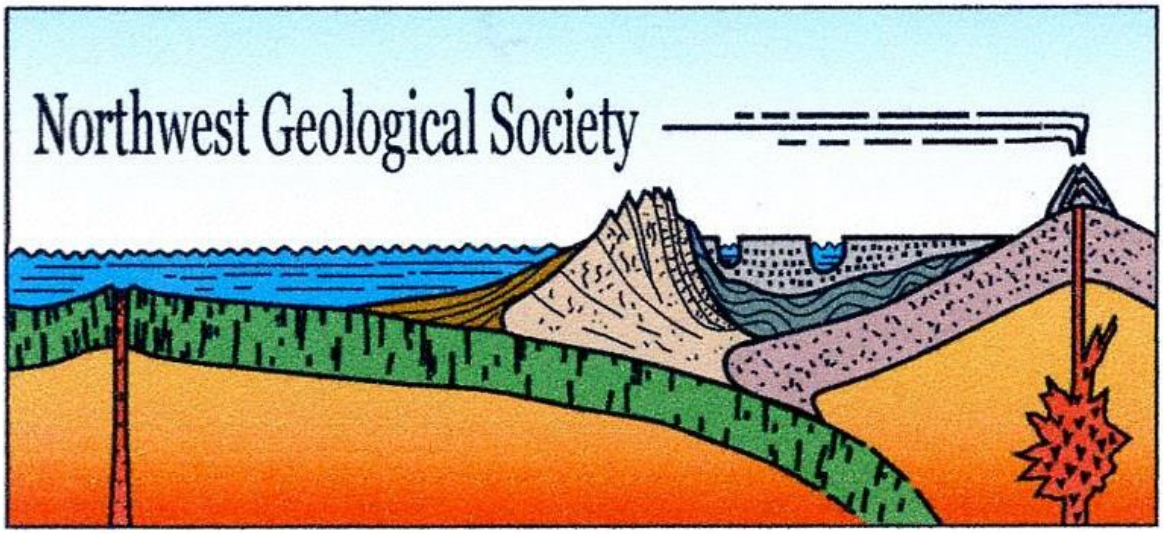

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FIELD TRIP GUIDEBOOK #051

THE GEOLOGY OF THE SANPOIL SYNCLINE AND THE OKANOGAN METAMORPHIC CORE COMPLEX, NORTH-CENTRAL WASHINGTON

May 5-7, 2017

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NWGS FIELD TRIP GUIDEBOOK SERIES

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THE GEOLOGY OF THE SANPOIL SYNCLINE AND THE OKANOGAN METAMORPHIC CORE COMPLEX, NORTH-CENTRAL WASHINGTON

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I. ABSTRACT

The dominant structures in north-central WA are the southerly plunging Sanpoil syncline and the antiformal Okanogan and Kettle metamorphic core complexes (MCCs) west and east of it, respectively. These structures deform rocks as young as middle Eocene.

In the Republic area, the Carboniferous to Jurassic greenschist facies rocks of the Quesnel terrane, the oldest and easternmost of the accreted terranes in WA, are restricted to the syncline. In this terrane, the regional and folded Chesaw thrust puts Permian to Carboniferous ophiolitic rocks of the Knob Hill Group over the Jurassic Rossland Group, the Triassic Brooklyn Formation, and the Permian to Carboniferous pelitic and carbonate rocks of the Attwood Group.

Unmetamorphosed Eocene sedimentary and volcanic rocks of the Eocene Challis sequence are unconformable on the Quesnellian rocks. In the Republic area, strata of the Challis sequence are confined to the Sanpoil syncline; however, remnants of this sequence extend discontinuously across and beyond WA.

The MCCs rose in the middle Eocene. Rocks within the MCCs consist of amphibolite facies Precambrian rocks, Mesozoic orthogneisses, and Eocene granitic plutons. Middle Eocene low angle normal faults (known as detachment faults) bound the MCCs. The crystalline rocks of the MCCs are below the faults; the Quenellian and Challis rocks are restricted to hanging wall blocks.

The Sanpoil syncline occurs between the two antiformal MCCs. Formerly the Sanpoil syncline was regarded as the Republic graben.

The Sanpoil syncline, of which the Republic district is a part, has been the largest gold producer in WA. Volcanogenic massive sulfide/magnetite deposits in the Quesnel terrane have yielded about half of the gold. The other half came from epithermal (paleo-hot spring) vein-type deposits in the Challis sequence.

II. INTRODUCTION

Components of This Field Guide

The guide for this field trip consists of three items:

1) Cheney (2014a) describes the regional geology. This review article should be read immediately after reading this introduction. The review adequately describes the rocks and structures of the area, and it is purposely not repeat4ed elsewhere in this field guide.

2) Cheney (2014b), describes the field trip in the Quesnellian rocks that we will take on Day Two, and

3) The present guide, describes the portion of the field trip in Eocene rocks in Republic, a trip across the

Okanogan MCC on Day Three, and other topics not covered in Cheney 2014a, b), The present guide across the Okanogan MCC purposely does not include descriptions of the lithologies at each stop because the general descriptions in Cheney (2014a) are adequate. So reread Cheney (2014a) before the trip across the Okanogan MCC. Likewise, this guide does not have many references because Cheney (20i4a, b) do.

Location

Figure 1 of Cheney (2014a) shows the geography of north-central WA.

Itinerary

On Day 1 we will drive from Seattle to Republic without making any "official" field stops. However on Day 3 we will examine quite a few stops between Republic and Omak on this route. We will spend Friday and Saturday nights in motels in Republic. The motels do provide continental breakfasts. At least one of the restaurants (on the west side of the main street (Clarke Avenue) is likely to be open for breakfast on Saturday and Sunday.

Lunch food can be purchased at the grocery store on the west side of Clarke Avenue. Make your purchases for Days 2 and 3 the evening before (so that we can maximize our time in the field).

At 8:03 AM of Day 2 we will depart the motels for Curlew to the north (see Cheney, 2014a, fig.1). Bring lunch and drink. Commercial and toilet facilities are limited today. Having first read Cheney (2014a) about the general geology, we will use Cheney (2014b) as a guide to examine Quesnellian rocks and structure between Curlew and the International Border. We will not cross the International Border. **Figure 1** of this guide was inexplicably omitted from the explanation of Figure 2 of Cheney (2014b): you may wish to insert it in your copy of Cheney (2014b). This portion of the trip involves a 1.5 km hike along an abandoned railroad grade. South of Curlew, we will examine (and map) Quesnellian rocks near the former Lamefoot mine. We will return to Republic in the mid-afternoon for a walking tour of the Challis rocks in the town (see a later section of the present guide).

On Day Three we will again depart the motels at 8:03 AM. Bring lunch and drink. We will traverse westward across he Okanogan MCC to Tonasket and then southward to Omak (see Cheney 2014a, fig. 1). The guide for this portion of the trip is a section of the present guide; this guide is purposely skeletal; it assumes that the participants have read the section on MCCs in Cheney (2014a, p 1 -4). We expect to return to Seattle shortly after 6 PM.

Other Guide Books

The present guide is one in a series across northeastern WA. The series includes:

1) Cheney and Buddington (2014) on Laurentia, which is pre-Jurassic (ancestral) North America. Laurentia underlies the northeastern corner of the State (east of the area of the present guide and east of the Kettle MCC),

2) the metamorphic core complexes of eastern Washington (Cheney et al. 1982: Doughty et al., 2006),

3) the Sanpoil syncline and the Okanogan MCC (Cheney, 2014a. b),

4) the area between Chelan and Quincy (Cheney, 2009), and

5) the area between Leavenworth and Cle Elum (Cheney, 2012, 2014).

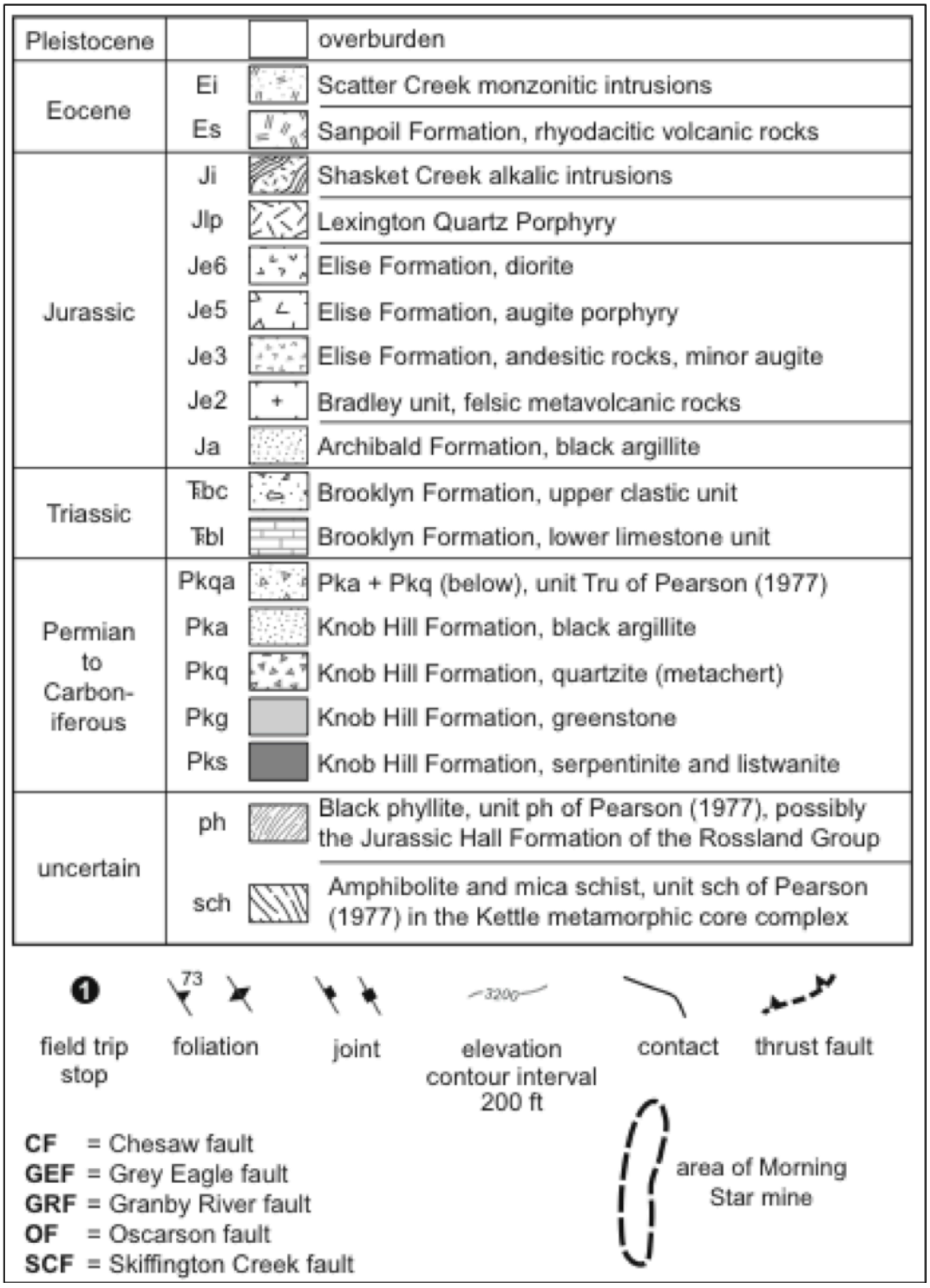

Figure 1. *Stratigraphy near the Morning Star mine, Danville, WA. This part of the explanation was omitted from Figure 2 of Cheney (2014b).*

III. REGIONAL GEOLOGIC SETTING

Cheney (2014a), which accompanies this guide, provides details on the regional geology that are not in the above abstract.

IV. ROAD GUIDE

DAY 1: FRIDAY, MAY 5: TRAVEL TO REPUBLIC

Drive from Seattle to Republic without any "official" stops. Overnight in Republic.

DAY 2: SATURDAY, MAY 6: GUIDE TO ROCKS IN REPUBLIC

Large road cuts occur along SR 20 immediately west of Republic. The Eureka fault juxtaposes the O'Brien Creek Formation of arkosic rocks (see Cheney, 2014a, p, 6) on the west against the rhyodacitic Sanpoil Volcanics (see Cheney, 2014a, p. 6 to 7).

STOP 2-1
Drive to the top of the hill on SR 20 west of town, which is at the western end of a large road cut. The white weathering rocks here are arkosic sandstones of the O'Brien Creek Formation of the Challis sequence. The color and the somewhat chalky texture of the sandstones probably are due to regional zeolitization of the original feldspar grains (Cheney, 2014a, p 6). A distinctive feature of O'Brien Creek sandstones is mm- to cm-scale clasts of black argillite, presumably derived from Quesnellian formations. Also present are a few more rounded pebbles of felsic volcanic rocks.

The O'Brien Creeks rocks are intruded by dikes of Scatter Creek rhyodacite, which probably are hypabyssal equivalents of the Sanpoil Volcanics. Typical features of the Scatter Creek rhyodacite are phenocrysts of plagioclase (a few up to 1 cm), biotite, and hornblende, along with min- or cm-scale ovoid clasts of microdiorite.

STOP 2-2
Walk eastward from Stop 2-1 down the highway to the outcrop on the opposite side of Eureka Creek. The creek marks the northerly trending Eureka fault; this fault is the major structure in and near which most of epithermal gold mineralization occurs at Republic. Note the pervasive supergene argillic alteration in the coarse volcaniclastic rocks here. To determine whether the argillic alteration is derived from acidic water from gold deposits upstream or directly from the weathering of these rocks, examine these rocks for pyrite and chloritically altered mafic minerals (so called propylitic hydrothermal alteration). Since 2014 the Hecla Mining Company has invested significantly in mitigating acidic drainage from former mines in the district.
The clastic volcanic rocks in the road cut were formerly included in the Tom Thumb Tuff Member of the Klondike Mountain Formation**,** but they are mineralogically similar to the Sanpoil Volcanics and are conformable on them (see Cheney, 2014a, p. 6 to 7). Thus, the Tom Thumb Tuff is the upper part of the Sanpoil Volcanics. Note the size of the clasts here. Continue uphill past the eastern end of the road cut and take the first left (Kauffman Street on the north side of SR 20) to the parking lot for condominia.

STOP 2-3
Compared to the rocks at Stop 2-2, the rocks here are finer-grained, weakly bedded, less weathered, and less altered). 1-2 km to the northeast above and beyond the parking lot is a road, on the far side of the gully. The

Stonerose fossil quarry is on thus upper road. Walk or drive along Kaufman Street to the quarry.

STOP 2-4
The Stonerose fossil quarry is in the upper lacustrine part of the Tom Thumb Tuff. Compared to the rocks at Stop 2-3, these rocks are finer grained, variably bedded, and are not argillically altered. From Stop 2-2 we have ascended through a homoclinal, upward-fining section. The tuff has very well preserved fossils (see Cheney, 2014b, p. 6). You must pay to dig for the fossils. The tuff in the quarry and its stratigraphic relationship to gold mineralization at Republic are noted in Cheney (2014a, p. 6 to 8); specifically, the 50 Ma gold mineralization tops out at the unconformity above the tuff.

STOP 2-5
Continue on the road 100 m northwest from the quarry. Note that this rubbly rock is stratigraphically below the tuff in the quarry. Also note the clast of aphanitic sinter in the rubble. The sinter indicates that epithermal mineralization was contemporaneous with sedimentation of the Tom Thumb Tuff portion of the Sanpoil Volcanics.

STOP 2-6
A small park on the west side of the main street (Clarke Ave.) south of the motels has two monuments that commemorate the gold production of various mines in the area. The cube represents production by the Hecla Ming Company from epithermal deposits north of town. The obelisk represents production by Kinross Gold Corporation (and its predecessor, Echo Bay) mostly from Quesnellian rocks. The Buckhorn mine was active until 2016 (after the obelisk was emplaced).

DAY 3: SUNDAY, MAY 7: GUIDE ACROSS THE OKANOGAN MCC

This trip proceeds westward on SR 20 from Republic to Tonasket and then southward on US 97 to Omak. In the interest of brevity, only thumbnail descriptions of the stops are included here. Therefore, participants are encouraged to read a general reference of the MCCs, such as Cheney (2014a, p. 1- 4). MP is the abbreviation for mileposts along the highways.

STOP 3-1
A rock avalanche deposit of probable Herron Creek granitic rock is in the Klondike Mountain Formation on SR 20, 9.7 miles west of Republic and 1.2 miles west of USFS Sweat Creek Campground.

STOP 3-2
This abrupt metamorphic discontinuity marks the Myers Creek detachment fault on the north side of SR 20, 0.3 miles west of Wauconda Summit.

STOP 3-3
3) Granitic rock of the Colville batholith at MP 286.2 is on the south side of SR 20.

STOP 3-4
Mildly mylonitic Tonasket Gneiss at MP 270.2 is on the north side of SR 20.

STOP 3-5
Classic ultramylonite is in the Tonasket Gneiss at the end of 7th Street and its extension, Mill Drive, south of downtown Tonasket (and south of SR 20 in Bonaparte Creek).

STOP 3-6
The Tertiary stratigraphy of Whitestone Mountain is visible from a curve in State Street north of downtown Tonasket).

STOP 3-7
A recumbent fold occurs in carbonate rocks of the Quesnel terrane at MP 302 in the cliffs west of US 97 (and north of Riverside, WA).

STOP 3-8
Very mylonitic hogbacks of the Okanogan MCC can be photographed from the parking lot of the church above the junction at MP 305 of US 97 and the Riverside Cutoff Road, Riverside, WA.

STOP 3-9
Photographically spectacular mylonitic fabrics occur in Eocene megacrystic granitic rock in a quarry on a dirt road on the north side of SR 155, 2.0 miles east of the junction with US 97 in Omak.

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