# CHAPTER 3 GEOLOGY OF THE MERRITT BASIN

## INTRODUCTION

In contrast to the areally extensive Eocene rocks exposed at Princeton to Tulameen, Hat Creek and along the Fraser River, the Merritt basin (92I/1 & 92I/2) is preserved in four widely separated fault blocks stretching 50 kilometres from the Fig Lake graben (Thorkelson, 1989) on the southwest to Quilchena Creek in the east (Figure 1.1).

Geological data from Ells (1905a, 1905b), White (1947), Preto (1979), McMillan (1978, 1981), Monger and McMillan (1989), Read (1987a) and numerous assessment reports have been used extensively in the preparation of Map 3.

## STRATIFIED ROCKS

The Merritt basin locally contains erosional remnants of Eocene volcanic rocks that underlie a cover of the Eocene Coldwater Formation that is up to 1200 metres thick and consists of sandstone and pebble conglomerate of unit EPcss, and shale and minor coal of unit EPcp. Northerly trending, normal faults segment the basin into four parts (Figure 3.1): an eastern segment underlying the northern part of Quilchena Valley, a central portion around and east of Merritt, a western part underlying the southern end of Guichon Valley to Lower Nicola and beyond, and in the Fig Lake graben exposed along the Coldwater River near Kingsvale south of the mapped area.

### *PRINCETON GROUP*

Cockfield (1948), Ewing (1981b), Monger and McMillan (1984) and Thorkelson (1989) included the Eocene volcanic and sedimentary rocks of the Merritt basin with the Kamloops Group. Later, Monger and McMillan (1989) correlated the volcanic rocks of the basin with the Princeton Group. Based on similarities in the lithology of the volcanic and overlying sedimentary rocks of the Merritt basin with the stratified rocks in the Princeton basin, Read (1988d) correlated the volcanic rocks of the Merritt basin with the Cedar Formation of the Princeton Group and the sediments of the Coldwater Formation with those of the Allenby Formation. Hills (1965, p.28) provided the data for the correlation of the sediments with those of the Princeton basin when he noted that:

> (a) the sandstones at Princeton, Merritt, Nicola-Mamit (Guichon Creek) and Quilchena are arkosic, and at all locations, except Coalmont, the arkoses are very pure with more than 90% of the detritus being of granitic origin.
>
> (b) the sediments of the Coldwater Formation in the Merritt basin belong to the uppermost and possibly the upper part of the middle of three palynological zones present in the Princeton and Tulameen basins, whereas the tuffaceous sediments of the Tranquille Formation of the Kamloops Group belong to only the lower zone which is not represented in the Merritt basin.

Correlation of the Eocene rocks of the Merritt basin with those of the Princeton Group is strongly supported by lithology and palynology; Cockfield's (1948), Ewing's (1981b), and Thorkelson's (1989) suggested correlation with the Kamloops Group is not.

Controversy exists as to whether the Eocene volcanic rocks in the Merritt basin overlie or underlie the Eocene sedimentary rocks. Cockfield (1948) stated, and Monger and McMillan (1984, 1989) implied, that the volcanics overlie the sediments. This conclusion was based on the presumed relationships between the Eocene volcanics and sediments southwest of Merritt. Detailed drilling (Sumicol Consultants Co. Ltd., 1970; Gilmar, 1980) and surface mapping (Read, 1988d) indicated that the last defined fold immediately northeast of the Eocene volcanics is a northwesterly trending syncline. As a result, the Eocene volcanics probably underlie the sediments on the southwest limb of this structure. This is the stratigraphic order of the Eocene stratigraphy exposed in the Fig Lake graben (Thorkelson, 1989).

#### CEDAR FORMATION (Units EPvd, EPvr and EPv)

Southwest of Merritt, medium grey, aphanitic dacite flows (EPvd) and rhyolite lapilli tuff and flows (Epvr) rest unconformably on maroon-grey plagiphyric andesite flows and pyroclastic rocks of the Nicola Group (uTav). At 810 metres (2650 feet) elevation southwest of Merritt, exploration trenches and pits show that Eocene shale and coal immediately overlie the rhyolite at UTM coordinates FL0656480 mE and FL5551360 mN (OF 1988-15).

At the south end of Guichon Creek, radiometrically dated felsic to intermediate flows and volcanic breccias (EPv) nonconformably overlie the Guichon Creek batholith and the Nicola Group, and underlie the Eocene sediments which extend northward up Guichon Valley. Farther south in the Fig Lake graben, radiometrically dated hornblende-phyric dacite flows and pyroclastic rocks are up to 500 metres thick, underlie Eocene sediments and form the basal unit of the graben fill.

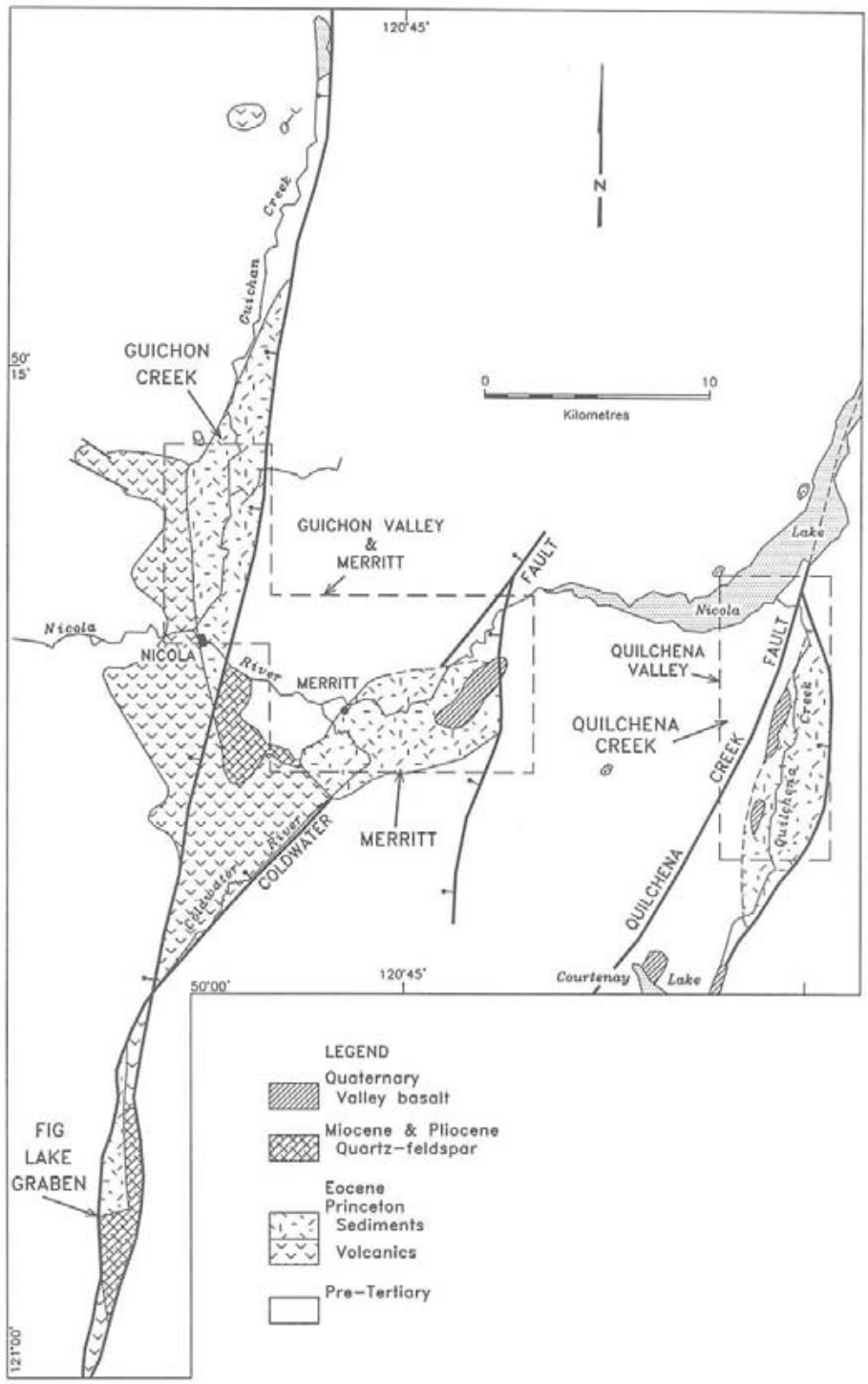


Figure 3.1. Simplified geological map of Merritt basin showing the Fig Lake graben, Guichon Creek, Merrit and Quilchena Creek segments of the basin, the bounding normal faults and the outlines of mapped areas.

**COLDWATER FORMATION (Units EPcss, EPcp and EPc)**

In Quilchena Valley, sandstone and pebble conglomerate, minor shale and rare coal and bentonite seams form a gentle easterly dipping wedge of Eocene sediments that lie unconformably upon the Nicola volcanics and Triassic or Jurassic intrusions. The sediments attain a minimum thickness of 1100 metres before truncation on the east along the Triangle Ranch fault (Section E-F, OF 1988-15).

Near Merritt, folded sandstone and shale with minor, but formerly productive coal seams, unconformably overlie the Nicola Group and locally the Eocene volcanics. Several thin shale-coal intervals of unit EPcp) are present in the

dominant arkosic sandstone and grit host (EPcss). Southwest of Merritt, drilling indicates that the preserved sediments are only 300 metres thick. In Hamilton Creek, where deformation is less intense, bore hole X#1 penetrated 387 metres of gently dipping Eocene sediments.

In Guichon Valley, a gentle northeasterly dipping sequence of sandstone and shale with rare coal and bentonite seams, possibly totalling 1200 metres in thickness (Section A-B, OF 1988-15), apparently overlies Eocene volcanic rocks. A few outcrops and bulldozer trenches several kilometres north of Lower Nicola show that the sandstone (EPcss) and shale-siltstone (EPcp) units are of subequal thickness.

Farther south in the Fig Lake graben, polymictic conglomerate and sandstone attain a total thickness in excess of 2000 metres (Thorkelson, 1989). The conglomerate contains well-rounded to subrounded pebbles and cobbles of mainly volcanic and granitic detritus, and Eocene hornblende-phyric dacite clasts are also present. The sediments were deposited by northward-flowing currents.

The Middle Eocene age of the Coldwater Formation is based on palynology, macroflora and insect collections from 15 localities (Appendix A, Table A2).

### *"VALLEY BASALT" (UNIT PRvb)*

Fresh, vesicular olivine basalt flows (PRvb) of Pleistocene age form remnants along the Nicola and Quilchena valleys. Elevations of the bases of the remnants decrease from 1070 metres (3500 feet) north of Courtney Lake to 640 metres (2100 feet) in the Nicola Valley northeast of Hamilton Creek. The flows probably originated north of Courtney Lake and flowed down the Quilchena Valley into the Nicola Valley.

## STRUCTURE

### *FAULTS*

Northerly trending, normal faults segment the basin into four parts. From east to west, the faults are: in the Quilchena Valley, the Triangle Ranch fault on the east and the Quilchena Creek fault on the west bound a downfaulted block that preserves 1100 metres of easterly dipping Eocene sediments; near Merritt, the Normandale fault forms the eastern limit of folded Eocene sediments; along and south of the Guichon Valley, the Guichon Creek fault forms the eastern limit of an easterly tilted Eocene succession that is more than 1500 metres thick; and in the southwest, the Fig and Kingsvale faults form the western and eastern limits respectively of the north-trending Fig Lake graben which is filled with 2500 metres of Eocene rocks (Thorkelson, 1989). The thicknesses of Eocene rocks preserved in the downfaulted blocks indicate large normal components of fault movement which range from a maximum of at least 4.5 kilometres in the Fig Lake graben (Thorkelson, 1989) to about 2.5 kilometres for the Guichon Creek fault (Section A-B, OF 1988-15), approximately 1.5 kilometres for the Triangle Ranch fault on the east side of the Quilchena Valley (Section E-F, OF 1988-15), to a low of a kilometre for the Normandale fault on the east side of Merritt (Section C-D, OF 1988-15). Although fault movement indicators are lacking and the dip of the faults is unknown, the gentle eastward dip of Eocene rocks in Guichon and Quilchena valleys suggests that the Guichon Creek and Triangle Ranch faults are west-dipping, listric and normal.

The Coldwater fault is a southwesterly striking splay of the Clapperton fault system (Moore and Pettipas, 1990) that bounds the northwest side of the Nicola horst north of Nicola Lake. Contradictory senses of fault movement have been proposed or implied for the Coldwater fault. Monger (1985) depicted the fault as normal with the northwest side down, and Moore and Pettipas (1990) showed it as a splay from the Eocene Clapperton fault system that is estimated to have several kilometres of Eocene or younger normal displacement with the northwest side down, but Thorkelson (1989) suggested that it is a left-lateral strike-slip fault. Within the loose contraints imposed by the lack of Eocene sedimentary outcrops near Merritt, the distribution of the Coldwater Formation indicates that the Coldwater fault may not truncate the formation. A majority of K-Ar radiometric ages for biotite and hornblende from the plutonic rocks of the Nicola horst yield a Paleocene to Early Eocene cooling age for the Nicola batholith (Monger 1989b). These cooling ages would allow normal displacement along the Coldwater fault to precede deposition of the Coldwater Formation.

### *FOLDS*

As Ells (1905a), White (1947) and Cockfield (1948) observed, the Eocene sediments form southeasterly trending, open to tight folds south of Merritt. Later diamond drilling by Sumicol Consultants Co. Ltd. (1970) and Crows Nest Resources Ltd. (Gilmar and Sharman, 1981) substantiates this orientation and extends the affected area. Southwest of Merritt, the folds are probably doubly plunging and preserve the Coldwater Formation in fold depressions. The tight folding has obscured the stratigraphic relationship between the Eocene volcanic and sedimentary rocks. However, an interpretation of the drilling indicates that the southwesternmost Eocene sediments southwest of Merritt occupy the core of a northeasterly overturned syncline, which is flanked farther to the southwest by stratigraphically lower Eocene volcanic rocks.

In the Fig Lake graben, Guichon and Quilchena valleys, Eocene rocks are unfolded but dip gently to moderately eastward as a result of displacement along west-dipping, listric normal faults.