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PROGRESS REPORT: STRATIGRAPHY AND STRUCTURE OF THE SHUSWAP METAMORPHIC COMPLEX IN THE HUNTERS RANGE, EASTERN SHUSWAP HIGHLAND

(82L)

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INTRODUCTION

In the interest of exploring the role of Tertiary extension in the development of metamorphic core complexes in the southern Omineca Belt, fieldwork was undertaken in 1987 to examine the geology of the Eagle River fault in the eastern Shuswap Highland. The Eagle River fault is a west-side-down low-angle normal fault that juxtaposes low to medium-grade metasedimentary and metavolcanic rocks of the Paleozoic Mount Ida Group atop high-grade gneisses of the Shuswap metamorphic complex (Figure 1-4-1 inset).

Regional geology of the Shuswap Highland was first mapped by Jones (1959). He subdivided the metamorphic rocks into two groups of low-grade rocks (Mount Ida and Chapperon), and a group of high-grade rocks (Monashee) that approximately coincides with what commonly is called the Shuswap metamorphic complex (see Okulitch, 1984). Geology of the Shuswap metamorphic complex in the Monashee Mountains north of 51° north latitude was mapped by Wheeler (1965). Fyson (1970) examined the structural geology of the Shuswap Lake – Mara Lake area, where he described four phases of deformation. Nielsen (1982) investigated the stratigraphy, structure and metamorphism of the Mount Ida Group and the Shuswap Complex around Mara Lake. His study supported a report by Okulitch (1974) that rocks of the Mount Ida Group have high-grade equivalents in the Shuswap Complex. Okulitch (1979) proposed that part of the Mount Ida Group (Eagle Bay assemblage) is correlative with North American pericratonic rocks, based on his examination of the stratigraphy, structure, paleontology and geochronology of rocks in the Shuswap Lake area. The Eagle Bay assemblage has been studied in detail by Schiarizza and Preto (1984).

Jones (1959) was the first to recognize that the Mount Ida Group was separated from the high-grade gneisses of the Shuswap metamorphic complex by a fault, but he inferred this fault to dip steeply. Journeay and Brown (1986) noted that the fault, which they named the Eagle River detachment, was a gently dipping, west-side-down normal fault. They inferred it to have formed in response to Tertiary extension, and suggested that it is connected to the Okanagan shear zone (Figure 1-4-1 inset).

Mapping at 1:50 000 scale in 1987 was concentrated in the Hunters Range of the eastern Shuswap Highland (82L/16, 15, 14, 11, 10), focusing on the geology of rocks of the Shuswap metamorphic complex that lie structurally above the Monashee complex (Read and Brown, 1981; Figure 1-4-1 inset) and beneath the Eagle River fault. These rocks are part of an allochthonous sheet (Selkirk allochthon) that was carried eastward over the Monashee complex along the Monashee décollement, a major ductile shear zone related to mainly Mesozoic crustal shortening (Brown *et al.*, 1986).

STRATIGRAPHY

The rocks of the Hunters Range have been subjected to upper amphibolite facies metamorphism, as indicated by sillimanite + potassium-feldspar mineral assemblages in pelitic schists. Generally these minerals appear fresh, except in the notheastern Hunters Range near Mount Griffin, where retrograde muscovite is abundant. Metamorphic rocks throughout the Hunters Range are intruded by pegmatites, which commonly form 50 per cent of the total rock volume. The stratigraphy of each of three subareas is described here; there is not yet sufficient data from intervening areas to demonstrate relationships between them (Figure 1-4-1).

SUBAREA 1: THREE VALLEY GAP – MOUNT GRIFFIN

A long roadcut along the Trans-Canada Highway at Three Valley Gap exposes a southwest-dipping succession of quartzofeldspathic gneiss, semipelite and minor diopsidic quartzite, that contains truck-sized boudins of garnet amphibolite. These rocks structurally overlie a chaotic assemblage that is truncated below by the Monashee décollement (Bosdachin and Harrap, in press). They therefore represent part of the deepest structural level of the Selkirk allochthon in the area of study. The amphibolite boudin-bearing unit is separated from rocks to the west by a vegetated topographic lineament that was mapped by Jones (1959) as a high-angle fault. Because the rocks west of this lineament have no known equivalents at deeper structural levels, they are inferred to have originated from a structurally higher level than the amphibolite boudin-bearing unit. The lineament is therefore interpreted as a high-angle, west-side-down normal fault (Figure 1-4-1). West of this lineament are quartzofeldspathic gneisses with interlayered sillimanite-biotite and muscovite-biotite schists. These are overlain by a thick, monotonous

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succession of hornblende-biotite-quartz-feldspar gneiss which forms Mount Griffin.

SUBAREA 2: RIDGES SOUTH OF YARD CREEK

A generally eastward-dipping succession of quartzofeldspathic gneiss and sillimanite-biotite schist with minor marble, diopsidic calc-silicate gneiss and amphibolite is exposed on ridges south of Yard Creek (Figure 1-4-1). The upper part of this succession consists of hornblende-biotite-quartz-feldspar gneiss with interlayered thin quartzite and marble units.

SUBAREA 3: MOUNT MARA – MARA LAKE

On Mount Mara a distinctive thick, locally diopsidic amphibolite is overlain by psammitic paragneiss, pelitic garnet-sillimanite schist and minor quartzite. These grade into a succession that contains diopsidic calc-silicate gneiss, marble and amphibolite. The latter calcareous assemblage is tenatively correlated with similar rocks exposed in roadcuts on Highway 97A, along the southeast side of Mara Lake.

STRUCTURAL GEOLOGY: DUCTILE STRUCTURES

A strong penetrative foliation is in most places subparallel to compositional layering. The layering is deformed by tight to isoclinal folds with axial surfaces that are parallel to the foliation. Hinges of these folds are subparallel to a strong east-northeast and west-southwest-plunging stretching lineation which is defined by mineral aggregates and by alignment of inequant minerals, such as sillimanite and hornblende, on foliation surfaces. Most folds of this type display southward vergent asymmetry, as was noted by Jones (1959). In the Mount Griffin area the overturned short limbs of some of these folds are about 100 metres long, although they are typically smaller.

A younger set of open, upright to overturned, westward verging folds deforms the early folds, the foliation and the stretching lineation. These folds plunge gently to the north-northwest or south-southeast and have east-northeast-dipping axial surfaces. They increase in scale and abundance from northeast to southwest across the Hunters Range: in the Mount Griffin area they are virtually absent; in the ridges south of Yard Creek they are common, with amplitudes of a few metres; and from Mount Mara to Mara Lake, westerly verging folds with amplitudes of over 100 metres are abundant and closely spaced.

Many of the rocks in the Hunters Range display mylonitic fabrics. Sheared pegmatites and migmatitic pelites in the Three Valley Gap – Mount Griffin area and in the ridges south of Yard Creek display C/S fabrics and rotated feldspar porphyroclasts indicative of easterly directed shear (the sense of shear is here described in terms of relative motion of the upper member of the simple shear couple). South of Yard Creek, such rocks are cut by discrete shear zones within which C/S fabric, rotated porphyroclasts and shear bands indicate westerly directed sense of shear. Westward verging folds at Mount Mara locally are cut by shear zones of this type (Figure 1-4-2). Biotite in the westerly directed shear zones is commonly chloritized, although the other minerals (for example, sillimanite) appear fresh. Westerly directed shear zones are extensively developed in migmatitic pelites along Mara Lake and along the Trans-Canada Highway near Sicamous. In contrast to the shear zones south of Yard Creek, these migmatites display little retrograde chloritization.

BRITTLE STRUCTURES

Steep north-northwest-striking extension fractures, ranging in scale from millimetre-wide cracks to extensive regional lineaments, are developed throughout the area. The thin cracks occur in parallel sets in many of the schists and generally are filled with chlorite. Some of the larger fractures, notably those in ridges south of Yard Creek, are filled with undeformed quartz feldspar porphyry dykes. Several tens of metres of normal or oblique slip have occurred along some of the fractures.

Schists between Three Valley Gap and Mount Griffin contain zones of extensive brittle deformation, expressed

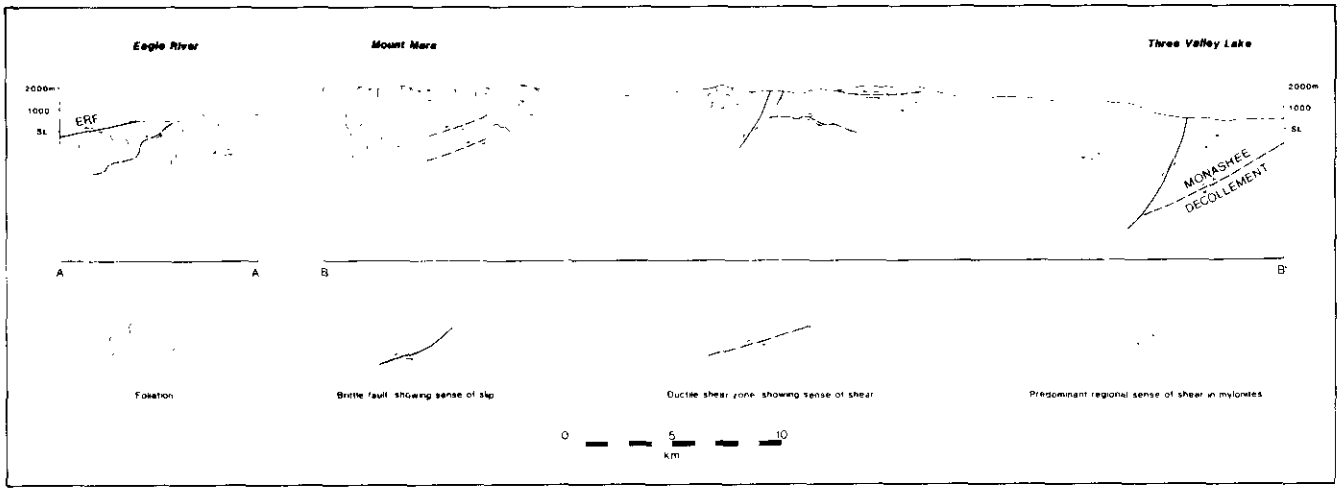

Figure 1-4-2. Schematic structural cross-sections A-A′ and B-B′, showing fold styles and kinematics of shear zones. The composite section A-A′ – B-B′ represents a transect from the hangingwall of the Eagle River fault (ERF) through progressively deeper levels of its footwall. *See* Figure 1-4-1 for locations.

both as discordant fractures and as layer-parallel zones of clay gouge and fault breccia. These zones have a characteristic rusty appearance due to oxidation of iron in biotite and sulphide minerals. The deformation is probably related to the inferred normal fault discussed previously. The amount of displacement on this fault is unknown.

DISCUSSION

Stratigraphic relationships between and within the three subareas are uncertain, but a few preliminary speculations are offered here. The homogeneous texture and hornblendic mineralogy of the gneisses of Mount Griffin (Subarea 1) suggest that they were derived from igneous protoliths. Subarea 2 contains hornblendic gneiss of probable igneous origin and a metasedimentary package that is predominantly siliciclastic but which has a minor calcareous component. Subarea 3 contains a shelf-like assemblage with both siliciclastic and carbonate components. Rocks of Subarea 1 represent the deepest structural level within the study area, and westward verging folds in the central and western parts of the Hunters Range expose progressively higher structural levels to the west. If structural levels correspond to stratigraphic levels, then the overall succession could represent an evolving "passive" continental margin, beginning with a volcanic rift stage (Subarea 1) and evolving through a transitional stage (Subarea 2) into a marine shelf setting (Subarea 3).

The oldest preserved structures are probably related to Mesozoic compression. Synmetamorphic tight to isoclinal folds, with hinges that are subparallel to the stretching lineation related to easterly directed mylonitic fabric, are consistent with the structural style of rocks that overlie the Monashee décollement elsewhere (for example, Journeay, 1986; Bosdachin and Harrap, in press). By analogy with structures described by Journeay (1986), the mylonitic fabric and lineation are presumed to be expressions of Mesozoic easterly directed thrusting, and the folds are inferred to have been formed either before or during the early stages of thrusting.

Westerly directed shear fabrics, which locally overprint the easterly directed fabrics, are most prominent in the western part, and hence the highest structural level, of the study area (Figure 1-4-2). Westerly verging open folds (also most prominent in the west) locally are cut by discrete westerly directed shear zones that contain syntectonic sillimanite, but they deform sillimanite lineations in other westerly directed mylonites. Therefore, the late folds and mylonites apparently are products of the same synmetamorphic, westerly directed shearing event. Because the intensity of this deformation seems to increase up structural section toward the Eagle River fault, it likely is a ductile manifestation of Tertiary extension. A sample of sheared pegmatite was collected from Sicamous so that this hypothesis can be tested against uranium-lead zircon geochronology.

Unless it is a contact metamorphic effect due to the emplacement of swarms of porphyry dykes, the retrograde chloritic overprint that characterizes westerly directed shears in the central part of the Hunters Range implies that these shears were active at higher crustal levels than were the mylonites now exposed near Mara Lake. This could mean that Tertiary extensional deformation propagated eastward as the footwall of the Eagle River fault was uplifted. The extensive brittle deformation west of Three Valley Gap is consistent with this hypothesis.

Fieldwork planned for 1988 will focus on mapping the Eagle River fault north and south of Sicamous, and on more detailed mapping of specific areas within the Hunters Range

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