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TAKLA GROUP VOLCANO-SEDIMENTARY ROCKS, NORTH-CENTRAL BRITISH COLUMBIA: A SUMMARY OF FIELDWORK (94D/9)

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INTRODUCTION

This report summarizes field data collected during two field seasons from Upper Triassic Takla Group rocks of the Canadian Cordillera. The project was undertaken to determine the paleotectonic environment of a well-defined rock package within the allochthonous Intermontane Belt.

Takla Group volcano-sedimentary rocks occur in Quesnellia, a possible arc and subduction complex, which forms part of Terrane 1 of Monger and Price (1979). Terrane 1 was formed by late Triassic time by the amalgamation of four subterranes which are, from east to west; Slide Mountain or Eastern, Quesnellia, Cache Creek and Stikinia. By late Jurassic, Terrane 1 had collided with North America (Monger *et al.*, 1982).

The Pinchi fault is a prominent lineament trending north-northwest through the south-central portion of the Intermontane Belt. It extends from 52° north to 56° north where it joins the Ingenika and Findlay faults. Gabrielse (1985) calculated a pre-Late Cretaceous dextral transcurrent displacement of 100 kilometres for the once continuous Kutcho and Pinchi faults. The Kutcho and Pinchi faults are displaced along the Ingenika and Findlay faults which moved dextrally a distance of 110 kilometres in mid-Cretaceous and possibly more recent times. Rocks assigned to the Takla Group have been identified on both sides of the Pinchi fault. Previous work on Takla rocks in the McConnell Creek map area has been concentrated west of the Pinchi fault and conclusive stratigraphic correlations across the fault have not been made.

The stratigraphy was first defined and mapped by Lord (1948). Subsequent work by Church (1973, 1974) and others focused on the geology near Sustut Peak, where Falconbridge Nickel Mines Limited discovered extensive copper showings in 1971. Monger (1977a) subdivided the volcano-sedimentary rocks of the Takla Group west of the Pinchi fault into Dewar, Savage Mountain and Moosevale formations. East of the Pinchi fault the group remains undifferentiated.

The area of study, approximately 75 square kilometres, is located in the Omineca Mountains east of the Pinchi fault, in the southwestern part of the Ingenika Ranges. It is bounded to the southeast by a fault slice of Lay Range assemblage and to the northeast by the Swannell fault and Proterozoic miogeoclinal rocks of the Ingenika Group. Excellent exposure on prominent ridges is characteristic, although limited road access necessitates helicopter transportation. Preliminary fieldwork was conducted in 1987 and is summarized in Bellefontaine and Minehan (1988).

GENERAL GEOLOGY

Takla Group rocks within the study area are a diverse suite of volcanic, volcaniclastic and sedimentary rocks which were deposited subaqueously. Volcanic and volcaniclastic rocks are plagioclase and pyroxene porphyries of intermediate composition. In Bellefontaine and Minehan (1988) pyroxene was misidentified as amphibole. The strata, which have been metamorphosed to greenschist grade (Monger, 1977a, 1977b), are cut by several major northwest-trending transcurrent faults. The general geology is presented in Figure 1-26-1.

STRATIGRAPHY

The stratigraphic succession, approximately 3400 metres thick, consists predominantly of interlayered volcanogenic breccia, volcanogenic sandstone and volcanogenic siltstone. Volcanic flows and sediments also occur. The fining-upward volcaniclastic sequences described by Bellefontaine and Minehan (1988) have been reinterpreted using a nongenetic classification. The fragmentation process is inferred to have been pyroclastic, based on the presence of vesicular fragments, agglomerate bombs, altered pumice and possible welding textures. Whether they were deposited pyroclastically or epiclastically, however, is not clear. The volcaniclastic units are characterized by volcanic breccia fining upwards through volcanogenic sandstone and siltstone. They range in thickness from several metres to several hundred metres.

Five major northwest-trending transcurrent faults divide the map area into six stratigraphically distinct fault blocks. The stratigraphic relationships found in most fault blocks are broadly consistent with these fining-upward units.

Fault Block A (Figure 1-26-1) is characterized by typical fining-upward units in the lower 1450 metres of the stratigraphic section. In the upper 200 metres, there are at least three simple lava flows and their associated flow-top breccias. With the exception of an interlayered sandstone and rusty siltstone unit 10 metres thick, which occurs near the top of the section, Block B consists of approximately 750 metres of repeating volcaniclastic units. Block C is comprised

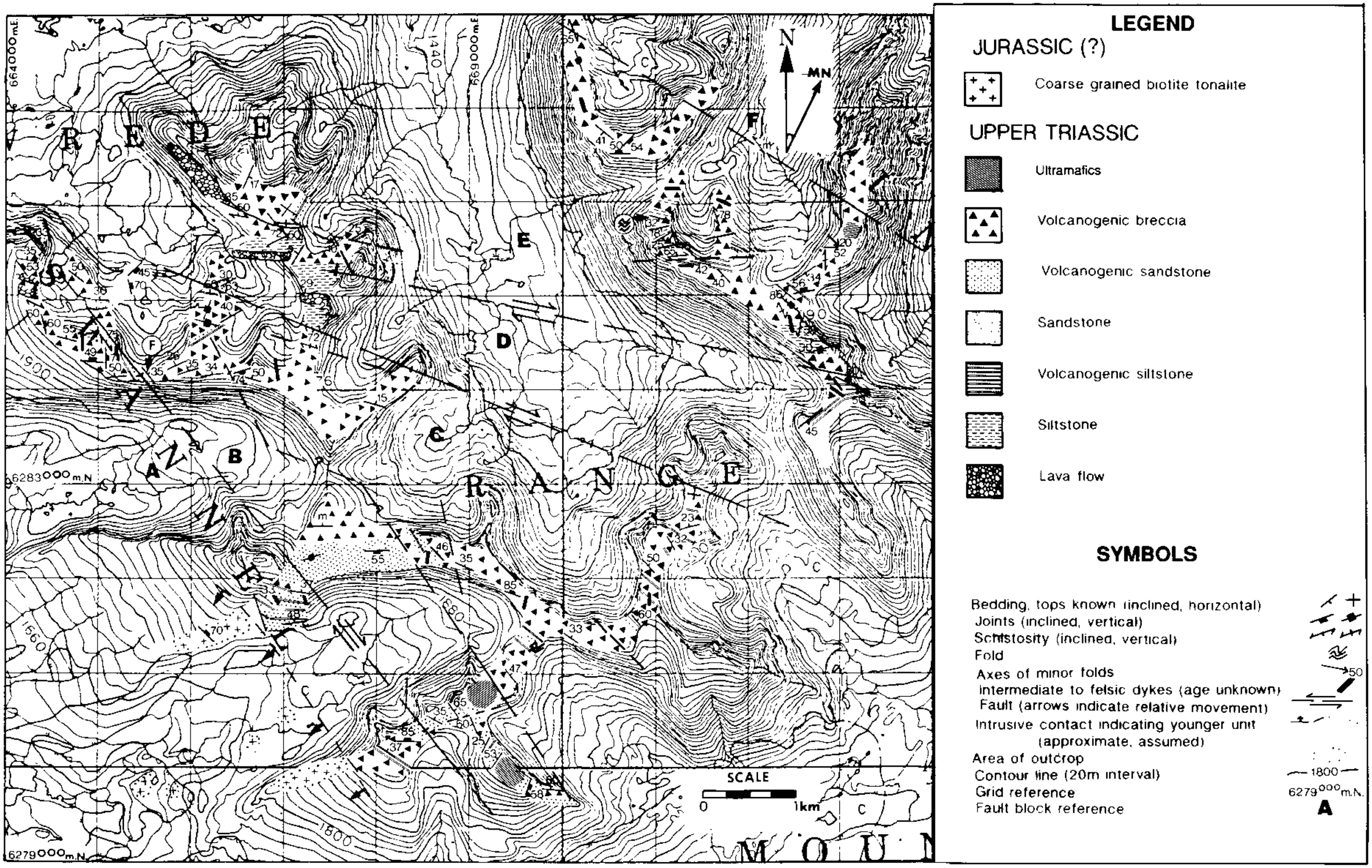

Figure 1-26-1. General geology of Takla Group rocks in the study area, north of Johanson Lake. Adapted from Bellefontaine and Minehan (1988).

Plate 1-26-1. Typical, finely bedded and laminated green-grey volcanogenic siltstone.

Plate 1-26-2. Thin bed of volcanogenic sandstone bounded by fine crystal-rich volcanogenic breccia.

wholly of fining-upwards units with a total thickness of approximately 870 metres. Block D is anomalous in the map area, consisting largely of black, sometimes rusty, sedimentary siltstone, and composite lava flows. Minor breccia is also present. The total thickness is approximately 760 metres. Volcaniclastic units are also dominant in the 800 metres of stratigraphy exposed in Block E, but massive, black pyritic siltstone does occur near the bottom of the section. Block F is comprised of approximately 200 metres of breccia.

Small-scale soft-sediment deformation in the form of convolute folds and irregular laminations occasionally occurs in siltstone and volcanogenic siltstone units. Large-scale soft-sediment folding is found in the south-central part of the map area in an interlayered siltstone and sandstone unit.

Volcanogenic siltstone is differentiated from massive, dark grey, often rusty siltstone by its green-grey colour and close association with crystal-rich volcanogenic sandstone and breccia. It also often exhibits wavy millimetre-scale laminations of alternating dark and pale green colour, presumably reflecting alternating concentrations of plagioclase and pyroxene (Plate 1-26-1). Bed thicknesses range from several millimetres to several centimetres for volcanogenic siltstone, and up to several metres for siltstone.

Green-grey volcanogenic sandstone (Plate 1-26-2) is composed predominantly of plagioclase and pyroxene crystals. It is interlayered with volcanogenic siltstone and fine breccia in beds commonly graded and upward facing, averaging 10 centimetres in thickness, or as massive units attaining thicknesses of 115 metres. Sandstone is not a common rock type in the study area. It is usually carbonaceous and found interlayered with laminated rusty siltstones. In one locality sandstone exhibits oscillation ripple marks characterized by 20-centimetre wavelengths and 4-centimetre amplitudes, indicative of a shallow water environment.

Volcanogenic breccias are divided into two basic groups. The first group occurs at the base of fining-upward sequences and shows evidence of epiclastic processes. The breccias vary in thickness from several centimetres to a maximum of 350 metres. Recessive zones of carbonaceous matrix confined to the top of beds, or occurring as large irregular patches, are characteristic (Plate 1-26-3). The groundmass is always plagioclase and pyroxene porphyritic, and the concentration and morphology of each mineral phase often change within an individual unit. The pyroclasts include cognate lithic (juvenile magmatic) and accidental lithic fragments, and crystals (Plates 1-26-2 and 1-26-4). The phenocrystic shape in the groundmass and in cognate fragments is most commonly rounded wispy plagioclase and euhedral pyroxene. Plagioclase laths and anhedral pyroxene are rare exceptions. Phenocrysts range in size from a few millimetres to 1 centimetre.

Plate 1-26-3. Recessive carbonaceous patch in polymictic volcanogenic breccia.

Plate 1-26-4. Typical, coarse-grained polymictic volcanogenic breccia. Fragments shown are of varied composition and texture.

Polymictic cognate magmatic fragments, although all of roughly intermediate composition, show some variation in composition and texture. Accidental lithic fragments are purple-grey and buff-coloured carbonate and green-grey volcanogenic siltstone. Dark red siltstone fragments, vesiculated magmatic fragments of intermediate composition, altered pumice and agglomerate bombs are rare. Fragment sizes range from a few millimetres up to 45 centimetres with the majority being less than 10 centimetres.

In Block B, four breccia units are comprised solely of euhedral pyroxene crystals in a pale green matrix. Each one is approximately 1 metre in stratigraphic thickness, and bounded by rusty, laminated volcanogenic siltstones. Each is characterized by fine-grained top and bottom margins, and a coarse centre approximately 50 centimetres thick, where crystals are up to 0.5 centimetre in diameter.

The second group, the flow-top breccias, is found closely associated with flow units and contains only monomictic cognate fragments. The fragments are plagioclase and pyroxene porphyries of intermediate composition. Fragments average 10 centimetres in diameter but are larger toward the flow tops where hyaloclastite textures are sometimes recognized. These units attain thicknesses of approximately 1 metre when associated with compound lava flows and up to 25 metres when associated with simple flows.

Lava flows are recognized by unbrecciated igneous material grading upward into a brecciated flow top. Chilled basal contacts are rarely observed. All flows identified are intermediate in composition and plagioclase and pyroxene porphyritic. Anhedral plagioclase and euhedral pyroxene phenocrysts average 2 to 3 millimetres in diameter. In one instance, a compound lava flow, containing abundant purple-grey carbonate fragments up to 50 centimetres in diameter, appears to have disrupted and incorporated a carbonate unit. Flow units, excluding flow-top breccia, average 5 metres in thickness.

INTRUSIVE ROCKS

The layered rocks are cut by abundant intermediate to felsic dykes and sills which commonly change direction drastically over short distances. They average 1 to 3 metres in thickness and usually do not have chilled margins. Green intermediate dykes are plagioclase and pyroxene porphyritic while buff-coloured felsic dykes may contain anhedral biotite, amphibole needles and quartz eyes. Phenocrysts average 0.5 centimetre in diameter but occasionally reach 2 centimetres. Crosscutting relationships between intermediate and felsic dykes demonstrate that intermediate dykes are the youngest.

Massive mafic igneous rocks outcrop in several locations. These units are dark green in colour and contain small amphibole and plagioclase phenocrysts. Grain size increases from fine to medium away from the inferred contacts, which are faulted in several cases. Although intrusive relationships are not apparent, there is no evidence for flow origin. It is possible that these mafic bodies are satellite intrusions of the Alaskan-type ultramafite which outcrops to the northeast and southwest of the map area (Tipper *et al.*, 1981).

A coarse-grained biotite-rich tonalitic pluton occurs in the southernmost part of the map area. Although the contact zone is epidote rich and highly fractured as a result of local fault movements, intrusive relationships are evident. Jurassic to Tertiary granitic plutonism has been widespread in Takla rocks (Monger, 1977a), and the tonalitic intrusion may be of similar age.

DEFORMATION

The Takla Group is cut by several major northwest-striking vertical to moderately east-dipping transcurrent faults. Numerous minor faults of various orientations and movement directions are also observed. The fault zones are characterized by closely spaced fractures, epidote alteration, pyrite and quartz veining. Serpentine alteration, native sulphur and malachite are rare. Fine-bladed crystals of yellowish green epidote are developed over widths of tens of metres, and occasionally up to 100 metres either side of fault zones. Euhedral cubic pyrite commonly 2 millimetres in diameter, but occasionally reaching up to 5 millimetres, is also common within several metres of fault zones. A shear fabric may be developed parallel to the fault. Where a shear zone deforms a porphyritic unit, the phenocrysts are extensively smeared. Major northwest-trending faults have rotated bedding, demonstrating a dextral sense of movement. Small-scale kink folding is also associated with some major faults. In Block E, minor steeply dipping reverse faults with minimum displacements of 1 metre, and their associated shear zones, occur at intervals of approximately 20 metres (Plate 1-26-5).

INTERPRETATION

Takla Group rocks in the study area are considered to be pyroclastic products of at least one highly explosive eruption. They have many characteristics compatible with formation from pyroclastic flows. However, these same characteristics are typical of high-velocity turbidity currents (Walker, 1984). They consist of monotonous upward-fining units in which all beds can be explained using the Bouma sequence.

Very little is known about the physical interaction between hot gas-supported particulate pyroclastic flows and a cold body of water, and the boundary conditions that exist between them (Cas and Wright, 1987). It is not clear whether a flow can maintain its cohesion upon entering water, or if epiclastic processes become dominant. If water is ingested through the flow front and mixed into the body of the flow, a water particulate debris flow or granular mass flow may develop (Walker, 1984). To convincingly prove that these rocks are deposits of subaqueous pyroclastic flows, a high emplacement temperature must be demonstrated.

Plate 1-26-5. Steeply dipping reverse faults with minimum 1 metre displacements.

The study of facies variations within flow units may shed some light on this problem. However, the analysis and interpretation of facies and their associations are difficult in the area of study, due to the effects of diagenesis and metamorphism, and because large displacements across major transcurrent faults do not allow facies correlations between fault blocks.

Future work will involve detailed microscopic and microprobe examination to determine the exact character of the Takla rocks and whether these volcaniclastic mass-flow deposits are primary eruptive products or if epiclastic processes are involved in their deposition; geochemical studies will be done to determine their tectonic affinity.

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