



## GEOLOGY BETWEEN TOODOGGONE AND CHUKACHIDA RIVERS (94E)

By L. J. Diakow

Regional mapping in the Toodoggone River area was extended in 1983 to include areas underlain by *Toodoggone volcanic rocks* (Gabrielse, *et al.*, 1977) not previously mapped by Ministry personnel (Panteleyev, 1982, 1983; Schroeter, 1981, 1982; Diakow, 1983). Approximately 300 square kilometres between the Toodoggone and Chukachida Rivers were mapped during July and August at scale 1:50 000. The objectives of mapping were to determine the distribution, stratigraphy, and lithologic nature of Toodoggone rocks and to define their contact relationship with adjacent rocks.

### PHYSIOGRAPHY

The area underlain by *Toodoggone volcanic rocks* is characterized by rounded mountains and ridges up to 1 900 metres in elevation separated by broad valleys. Outcrops are confined to steeper portions of ridges and to banks of creeks in deeply incised valley bottoms. Along the northern periphery of the surveyed area an abrupt change in relief marks the transition from Toodoggone volcanic to Takla volcanic rocks.

### STRATIGRAPHY

Toodoggone volcanic rocks were subdivided into five lithostratigraphic units. These map units were established by 'grouping' volcanic members with similar mineralogy, primary texture, clast morphology, and environment of deposition. The distribution of map units and stratigraphy is shown on Figures 53 and 54. In order of relative abundance, the volcanic assemblage is made up of ash-flow tuffs, lava flows, interbedded pyroclastic air-fall deposits, epiclastic rocks, and lesser chemical sedimentary rocks; mainly siliceous marls. The rocks are predominantly andesitic in composition, although quartzose andesite and trachyandesite are present locally. The five map units are as follows:

**UNIT 1:** These rocks underlie the west half of the surveyed area. The unit can be subdivided into a lower member (unit 1A) composed primarily of bedded air-fall deposits and an upper member (unit 1B) dominated by ash-flow tuff with a less abundant air-fall component.

Unit 1A is a heterogeneous succession of mainly crystal-lithic tuffs and some ash-flow sheets with limited lateral extent. The tuff sections normally are crudely layered although bedding is usually not evident where randomly dispersed lithic fragments supported by a matrix of plagioclase, hornblende, and biotite crystals and lithic ash occurs. Subangular quartz phenocrysts 1 to 3 millimetres in size and minute euhedral apatite crystals are present in this unit. Lithic fragments generally have rounded to subangular outlines and range in size from lapilli to blocks. Typically, the fragments are non-vesiculated, varicoloured, and porphyritic. The contact between layered air-fall tuff and ash-flow tuff is characterized by an increased resistance to weathering of ash-flow outcrops; possibly resulting from some welding accompanied by post-emplacement compaction.

Unit 1B is characterized by a preponderance of ash-flow sheets with intercalated crystal-lithic tuffs. The tuffs display little variation in composition or texture and are composed of plagioclase, hornblende, biotite, and subordinate quartz and apatite phenocrysts set within a pink to brick-red vitric matrix. Layering

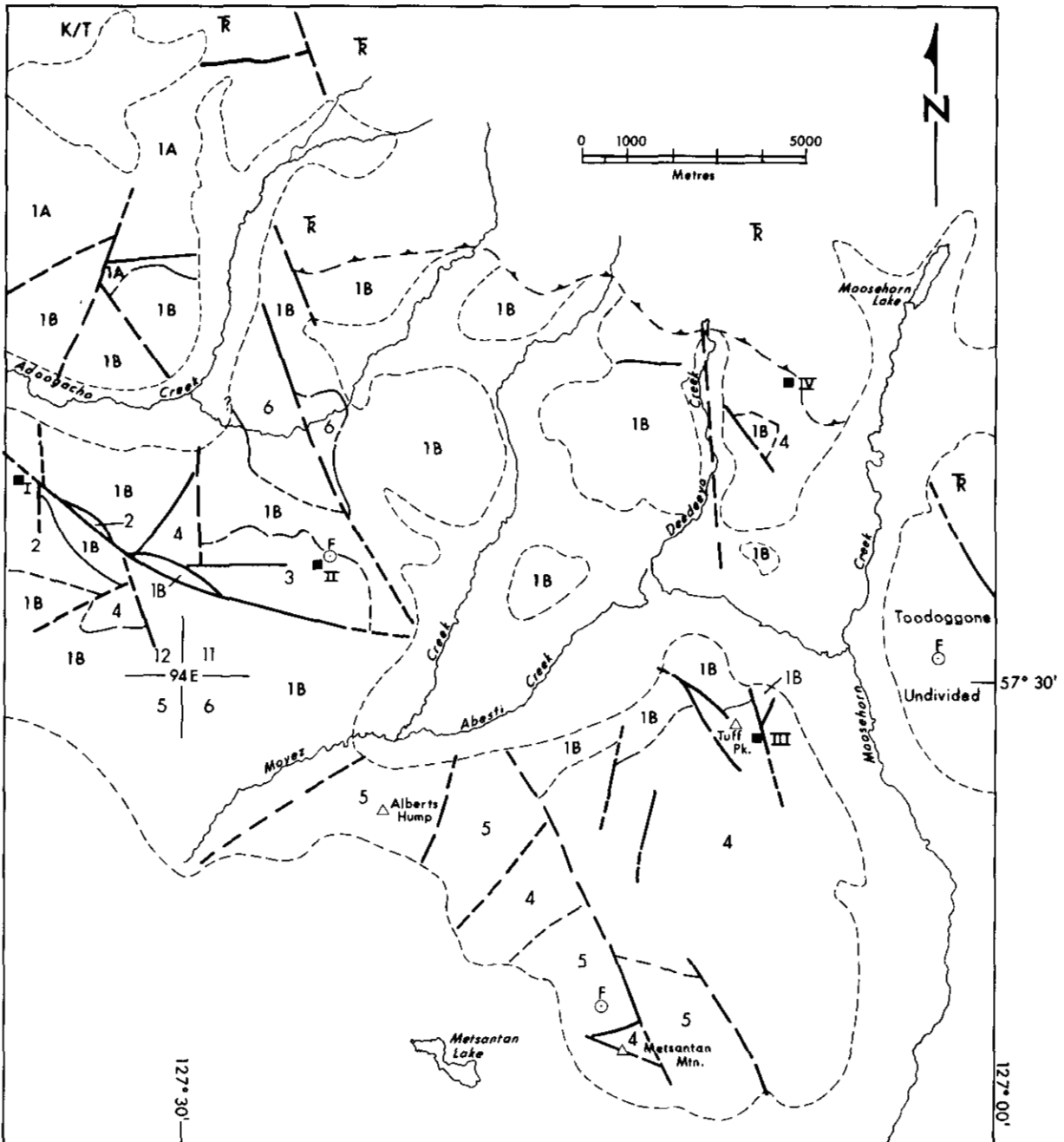


Figure 53. Geology between Toodoggone and Chukachida Rivers.

caused by aligned, flattened, aphanitic, non-vesiculated, porphyritic fragments is diagnostic of weakly welded zones within otherwise massive weathering ash-flow sheets.

Beds of interspersed air-fall tuff constitute a minor porportion of unit 1B. However, immediately west of Dedeeya Creek, approximately 140 metres of crudely bedded crystal lapilli tuff and block breccia, underlie the main welded ash-flow sheet. The contact between these deposits is sharp and well defined. North of Adoogacho Creek, a graded tuff section interpreted as a ground surge deposit, preceded the eruption of ash-flow tuffs. In detail, this deposit consists at the base of 1 metre of crossbedded crystal tuff overlain by 75 centimetres of thinly laminated dust tuff that grades upward through more than 50 metres of lapilli and block-sized pyroclastic flow debris.

**UNIT 2:** This is a lithologically diverse assemblage consisting of interbedded air-fall tuff, thin ash-flow sheets, and epiclastic and chemical sedimentary rocks. It is best exposed south of Adoogacho Creek where intraformational basal conglomerate disconformably overlies the irregular paleosurface of unit 1B. Lenses and beds of conglomerate that are 70 metres thick in depressions thin to 1 metre above positive relief features. The conglomerate is overlain by over 200 metres of well-layered dust tuff, crystal ash tuff, and lesser thin ash-flow sheets. The tuffs are composed of fine-grained plagioclase and biotite crystals and sparse lithic fragments in a purple, green, or brown ash matrix. The uppermost 50 metres of the section marks a transition from subaerial tuffs to a distinctive succession of limestone or marl interbedded with recessive-weathering crystal ash tuff, siltstone, and fine-grained volcanic sandstone. Typical outcrops of limestone are laminated to thinly bedded; they weather to a dark to pale grey colour and contain abundant black siliceous laminations.

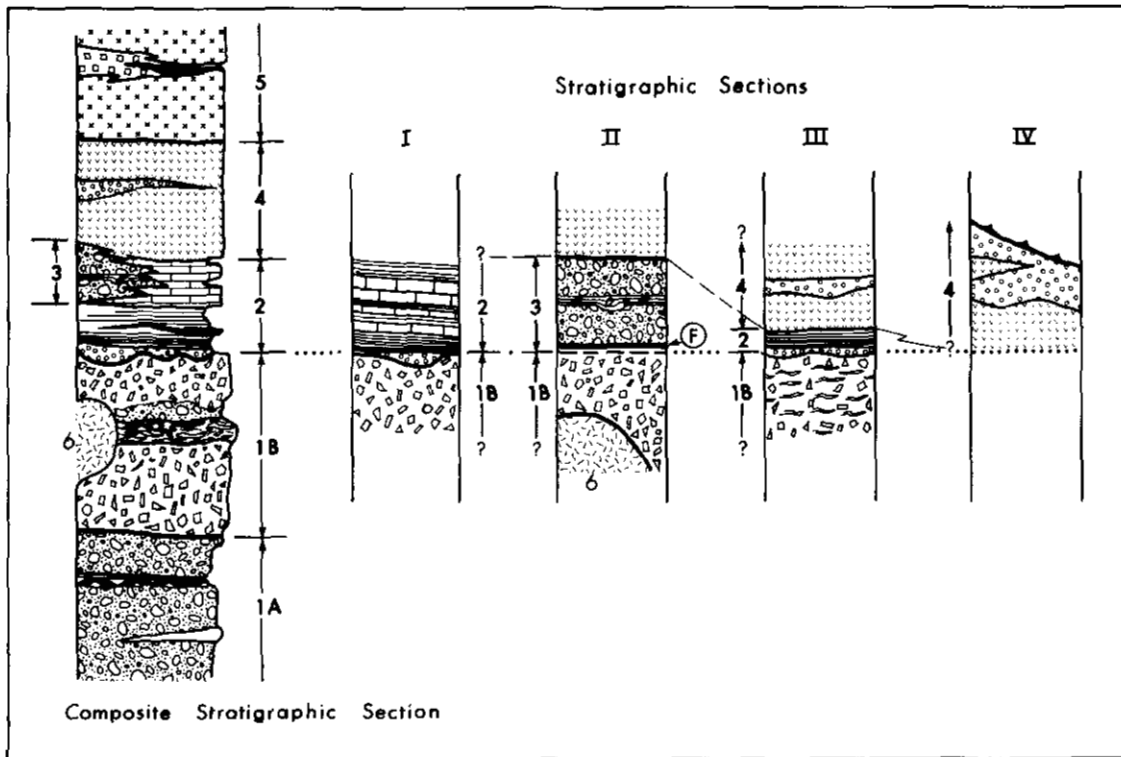
**UNIT 3:** These rocks are exposed as a flat-lying succession that overlies unit 1B. The unit consists of air-fall tuffs intercalated with volcanoclastic sedimentary rocks. The basal section of unit 3 comprises 10 metres of interbedded crystal dust tuff, mudstone, and fine-grained sandstone. At one locality south of Adoogacho Creek rare fossilized plant stems occur at the interface between mudstone and sandstone. This basal section is overlain by more than 150 metres of crudely bedded, poorly indurated lapilli block tuff. The rock contains round, monolithic, porphyritic, volcanic fragments in a pale green, feldspathic matrix containing sparse quartz phenocrysts.

The basal unit and overlying succession at first glance appear to record a continuous explosive cycle. However, detailed mapping suggests that the two lithologically similar tuff deposits are separated by an erosional break. The base of the upper volcanic cycle is recognized by the presence of a green, graded crystal dust tuff bed 2 metres thick, that forms a resistant stratigraphic marker within unit 3.

**UNIT 4:** Unit 4 is composed of trachyandesitic lava flows, comagmatic intrusive rocks, and local intraformational conglomerate. Near Tuff Peak, and south of Adoogacho Creek, unit 4 appears to be interdigitated with either units 1B, 2, and/or 3. The flows form massive, jointed outcrops with homogeneous composition containing plagioclase, augite, subordinate biotite, and apatite in an aphanitic, grey-green matrix. Quartz is absent or exceedingly rare, but sparse potassium feldspar megacrysts up to 1.5 centimetres in size serve to distinguish trachyandesite from the more widespread andesitic lava flows.

East of Tuff Peak and Dedeeya Creek volcanic conglomerate occurs as beds and lenses up to 80 metres thick between lava flows in unit 4. From a distance conglomerate has a chaotic appearance but closer inspection reveals crude internal bedding, grading, and laminated mudstone and sandstone beds. Clasts consist of rounded cobbles and boulders derived from underlying unit 4 flows.

**UNIT 5:** This map unit is well exposed on Metsantan Mountain where it overlies unit 4. The unit consists of massive-weathering flows with subordinate interfingered air-fall pyroclastic rocks. Quartz phenocrysts, varying from 1 to 3 millimetres in size are characteristic of unit 5 and distinguishes these flows from similar-



LEGEND (FIGURES 53 AND 54)

CRETACEOUS/EARLY TERTIARY

**K/T** POLYMICTIC CONGLOMERATE, SILTSTONE, SANDSTONE, LIMESTONE, AND MINOR BASALT FLOWS

LOWER JURASSIC

TOODOGGONE VOLCANIC ROCKS

**5** QUARTZ-ANDESITE LAVA FLOWS, MINOR CRYSTAL-DUST TUFF, CRYSTAL-LITHIC TUFF, AND SCARCE FOSSILIFEROUS SILTSTONE

**4** PREDOMINANTLY ANDESITIC LAVA FLOWS AND HYPABYSSAL INTRUSIVE ROCKS, MINOR TRACHYANDESITE LAVA FLOWS, OLIGOMICTIC CONGLOMERATE WITH INTERCALATED MUDSTONE AND SANDSTONE

**3** GREEN, CRYSTAL-LAPILLI TUFF, FELDSPATHIC CRYSTAL TUFF, CRYSTAL-DUST TUFF; MUDSTONE AND SANDSTONE CONTAINING FOSSILIZED PLANT FRAGMENTS

**2** PURPLE, GREEN, AND BROWN DUST TUFF, CRYSTAL-LAPILLI TUFF, AND MINOR ASH FLOW SHEETS; INTERBEDDED LIMESTONE, MARL, CHERT, SILTSTONE, SANDSTONE, AND OLIGOMICTIC CONGLOMERATE

**1B** PINK OR RED-WEATHERING ASH FLOW SHEETS INTERDIGITATED WITH AIR FALL CRYSTAL-LITHIC TUFF AND TUFF BRECCIA

LOWER JURASSIC (CONTINUED)

TOODOGGONE VOLCANIC ROCKS (CONTINUED)

**1A** GREEN, MAUVE, OR BROWN CRYSTAL-LAPILLI TUFF, BLOCK BRECCIA, AND CRYSTAL-DUST TUFF; MINOR ASH FLOW SHEETS

TRIASSIC

**R** TAKLA GROUP: DARK GREEN, PURPLE, PYROXENE, PLAGIOCLASE MEGACRYST AND AMYGDALOIDAL BASALT LAVA FLOWS; ANDESITE LAVA FLOWS AND HYPABYSSAL INTRUSIVE ROCKS; LAPILLI TUFF AND BLOCK BRECCIA

INTRUSIVE ROCKS

**6** PYROXENE BASALT WITH DIORITIC PHASES

SYMBOLS

GEOLOGIC CONTACTS, DASHED WHERE INFERRERD

FAULTS, DASHED WHERE APPROXIMATE

THRUST FAULT, ASSUMED

AREA COVERED BY ALLUVIUM, COLLUVIUM, OR VEGETATION

PLANT FOSSIL LOCALITY

STRATIGRAPHIC SECTION I II III IV

Figure 54. Generalized stratigraphic sections, Toodoggone River-Chukachida River area.

appearing flow rocks of unit 4. The air-fall pyroclastic rocks locally form well-bedded deposits of green or purple crystal dust tuff and lapilli tuff. Unit 5 was deposited in a predominantly subaerial setting although subaqueous conditions existed locally as evidenced by ripple marks, scour features, and rare fossilized plant fragments found within thin, discontinuous mudstone and siltstone interbeds.

## STRATIGRAPHIC CORRELATIONS

The five map units identified north of the Toodoggone River are only partially correlative with the lithologic units established by Panteleyev (1983) in the immediately adjoining area south of the Toodoggone River. Panteleyev's readily identifiable 'grey dacite' ash flow that forms a widespread marker unit south of Finlay River is absent or lacks a recognized facies equivalent within this surveyed area. The trachyandesite flows of map unit 4 with their distinctive potassium feldspar megacrysts constitute part of Panteleyev's 1983 map unit 5. The massive andesitic lava flows of map unit 5 overlie trachyandesite of map unit 4 north of Metsantan Mountain. They are shown as a separate map unit (unit 5) in this study but are included in Panteleyev's andesite-trachyandesite unit 5.

## INTRUSIVE ROCKS

*Intrusive rocks in the surveyed area include stocks of basaltic composition, and feldspar porphyry and andesitic dykes. One of the larger pyroxene basalt stocks intrudes unit 1B east of Adoogacho Creek. The basalt contains fresh, subhedral pyroxene phenocrysts on average 3 millimetres in diameter along with randomly oriented plagioclase microlites in a dark green, fine-grained matrix. Diorite, comprising medium-grained interlocking plagioclase, hornblende, and biotite crystals, forms a shallow embayment in the northeast contact of the stock. The origin of the diorite is uncertain, but its similar mineralogy and intimate association with the basalt suggests that the rocks may be comagmatic.*

Subparallel, feldspar porphyry dykes trending 110 degrees to 150 degrees azimuth intrude both Toodoggone and Takla rocks in several places east of Moosehorn Creek. These dykes form distinctive, resistant, salmon-pink-weathering outcrops. They contain plagioclase, chloritized hornblende, biotite, and sparse quartz phenocrysts in a pink-coloured aphanitic matrix.

On Alberts Hump relatively fresh feldspar porphyry dykes dissect intensely altered tuffs and flows of map unit 5, demonstrating that the dykes postdate hydrothermal alteration. The hydrothermally altered rocks, consisting of a mixture of alunite, dickite, and quartz, have yielded a potassium/argon date of  $190 \pm 7$  Ma (Schroeter, 1982). Similar dykes also intrude altered volcanic rocks in the Cloud Creek area (Diakow, 1983). South of the Toodoggone River, feldspar porphyry dykes intrude both Takla and Toodoggone volcanic rocks near Baker mine and Hazelton volcanic rocks east of Saunders Creek. Deep-seated fractures with district-wide extent are postulated to be the principal structural controls for these intrusions. Vertical northwest-trending, andesitic dykes crosscut feldspar porphyry dykes north and south of Toodoggone River. Characteristically, these dykes form recessive outcrops averaging 1 to 2 metres wide. They are dark green and have a fine-grained texture; amygdules are calcite filled.

## STRUCTURE

The contact between Toodoggone and Takla volcanic rocks has an arcuate trace along the north-northeastern periphery of the map (see Fig. 53). In two localities along the contact, Takla rocks appear to overlie Toodoggone rocks, implying a thrust fault relationship. Further west, a network of steep northwest and east-west-trending faults cuts this contact and juxtaposes unit 1 against Takla rocks.

Bedding measurements derived from layered epiclastic rocks, tuff, and alignment of flattened clasts in ash-flow tuffs indicate that all map units dip 25 degrees or less toward the south-southwest. Locally, beds are steeper where stratigraphy is disrupted near intrusions or block faults.

## DISCUSSION

Five major map units have been identified north of the Toodoggone River. The succession is predominately andesitic in composition and is composed of subaerial lava flows, ash-flow tuffs, and pyroclastic fall deposits. Interruptions in volcanism during tectonism resulted in periodic erosion and reworking of volcanic members to produce conglomerate and finer grained clastic interbeds. Locally, depressions were inundated by marine waters. Short-term tectonic stability during waning volcanic activity promoted the deposition of tuffaceous carbonate rocks, fine-grained clastic rocks, and siliceous tuffs in some areas flanking the subaerial deposits.

The map units are interpreted to be successively younger through units 1 to 5 and appear to have been erupted without major pauses in volcanic activity. It is probable that structurally controlled linear vent systems were connected at depth to a common magma source. Collectively the volcanic succession records a reduction in the magnitude of pyroclastic eruptions with time. Unit 1 is interpreted to represent an early major eruptive stage in the area that produced widespread ash-flow sheets and air-fall deposits. The intermediate stage is characterized by sporadic volcanic activity and is exemplified by the well-layered succession of coarse tuffs in unit 3. These rocks are temporal and lateral equivalents to dust tuffs that contain limestone beds in unit 2. The final stage is marked by major lava flow eruptions of units 4 and 5.

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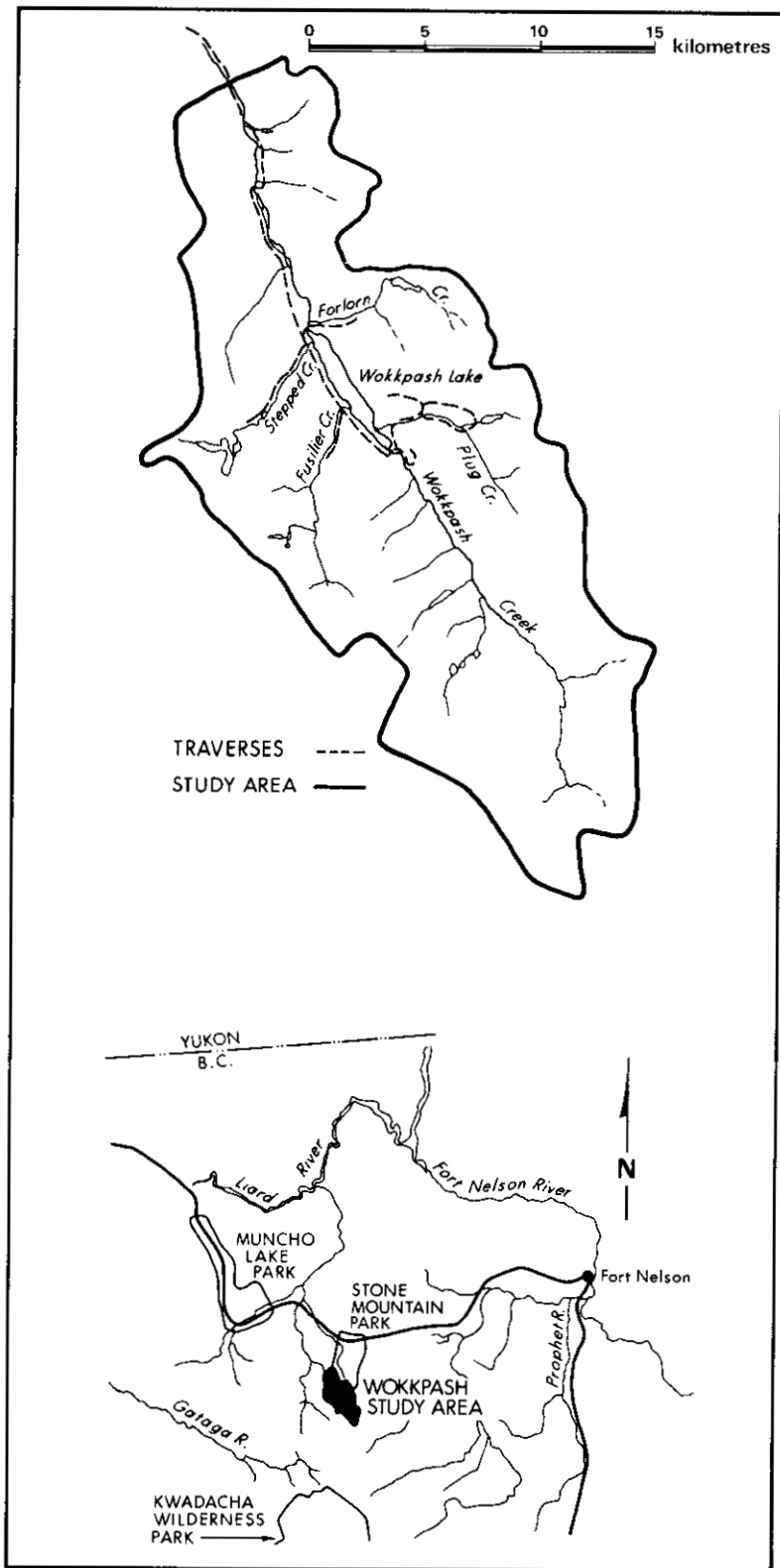


Figure 55. Location map with foot traverses shown: Wokkpash Park Proposal Area.