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STRATIGRAPHIC HIGHLIGHTS OF BEDROCK MAPPING IN THE SOUTHERN NECHAKO PLATEAU, NORTHERN INTERIOR PLATEAU REGION (NTS 93 F/2 AND 7)

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KEYWORDS: Interior Plateau, Hazelton Group, Ootsa Lake Group, Chilcotin Group.

INTRODUCTION

The Blackwater River is a natural division in the central part of the British Columbia Interior Plateau that separates the Nechako Plateau to the north from the Fraser Plateau to the south. Bedrock mapping in the southernmost part of the Nechako Plateau began in 1992, and to date an area of 3500 square kilometres, centred on the Fawnie and Nechako ranges, has been mapped at 1:50 000 scale (Figure 1). This work provides a geological framework for surficial geological mapping, till and lake sediment geochemistry surveys and mineral deposit studies undertaken by the British Columbia Geological Survey Branch as part of a joint Federal-Provincial Mineral Development Agreement to provide geoscience data and assess mineral potential in the Interior Plateau region. The integrated approach of these programs in this underexplored region has successfully identified significant areas of anomalous till and lake sediment geochemistry and new mineralized epithermal showings. Since the inception of these studies, numerous maps and reports have been published; these are listed in Brown *et al.* (1995). Publication of a summary volume containing reports on the various projects in the Interior Plateau region conducted under the Mineral Development Agreement (1991-1995) is planned for early in 1996.

The purpose of this report is to highlight stratigraphic insights gleaned from the mapping program. The study area is part of a broad, structurally uplifted zone referred to as the Nechako uplift (Diakow and Webster, 1994). In the Nechako River map area (93F) and more specifically, in the Fawnie and Nechako ranges, the uplifted area is manifest as a topographically high-standing Lower and Middle Jurassic sequence, and a single exposure of Upper Triassic basement. These older rocks are unconformably overlain by isolated erosional remnants of Lower Cretaceous and Tertiary rocks. To the north and south, the uplifted area is flanked by an extensive blanket of mainly Eocene and younger volcanic rocks.

STRATIGRAPHY

BASEMENT AND JURASSIC ROCKS

Upper Triassic black siltstone, containing fossil shells tentatively identified as *Monotis* or *Halobia* is exposed at a single locality along the Red road, which hooks around the northern end of the Nechako Range. It is the oldest known rock unit in the study area, and a rare glimpse of presumed 'basement'. Jurassic volcanics interlayered with subordinate sediments comprise the most widespread map unit in the Fawnie and Nechako ranges. This unit, first mapped in the Natalkuz Lake area (93F/6) in 1992, and designated unit J(v,s) was described as a monotonous succession dominated by mainly basaltic flows characterized by fresh pyroxene phenocrysts and sparsely distributed feldspathic marine sediments that contained probable Middle Jurassic fossils (Green and Diakow, 1993; Diakow *et al.*, 1993).

The following year, mapping extended the distribution of these rocks to the south into the Fawnie Creek area (93F/3) where, in addition to the diagnostic lithologies of unit J(v,s) an older, conformable volcanic sequence was recognized. These two lithostratigraphic divisions constitute the informal Naglico formation (Diakow and Webster, 1994). The lower division consists predominately of subaerial rhyolitic volcaniclastic rocks and minor flows, and in places, well layered maroon and green lapilli and finer tuffs (unit MJN1 of Diakow and Webster, 1994). In contrast, the upper division is a sequence of calcalkaline, augite-phyric flows of mafic to intermediate composition and volumetrically minor, intravolcanic fossiliferous sediments (units MJN2 and MJNs of Diakow and Webster, 1994). The sediments are composed mainly of volcanic detritus that includes angular plagioclase and lithic fragments in deposits of feldspathic greywacke, tuffaceous siltstone and sharpstone conglomerate. Fossils identified in these sediments by Dr. H.W. Tipper of the Geological Survey of Canada, loosely bracket deposition of the upper division between early Bajocian and early Callovian time. Three dates on single zircons from rhyolitic rocks in the lower division, analyzed by the Pb-Pb evaporation technique, are equivocal as they range in age from Permian to Middle Jurassic. Uranium-lead data on one sample suggests inheritance from older assimilated crust.

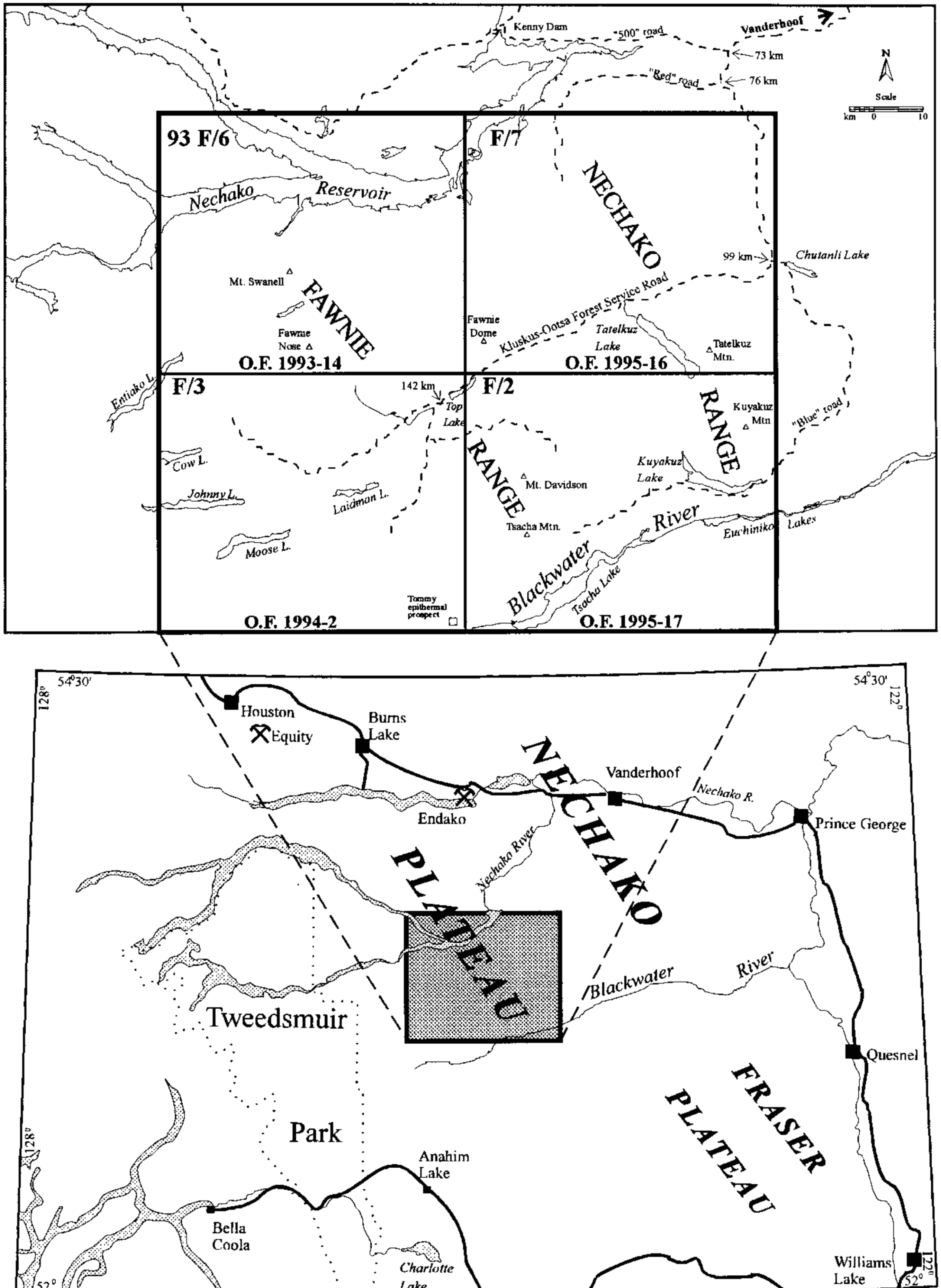

Figure 1. Location of published 1: 50 000-scale bedrock mapping on the Nechako Plateau.

During 1994, mapping was extended eastward into the Tsacha Lake (93F/2) and Chedakuz Creek (93F/7) areas. This work builds upon the twofold lithostratigraphic division of Jurassic strata established in the adjoining Fawnie Creek map area to the west. A major change in depositional environment is recognized in rocks of the lower division exposed in the Fawnie Range and those underlying the Nechako Range, 20 kilometres to the east. It is indicated by the change from subaerial felsic volcanics in the west to coeval intermixed felsic volcanic and marine sediments in the east. The marine sediments are further subdivided into two facies. A near-shore, sandy facies, that is traceable along part of the western flank of the Nechako Range, and a more distal, mudstone facies to the east and northeast. Both depositional facies exhibit felsic tuff interbeds and abundant lithic fragments thought to be derived from a nearby volcanic source.

Rhyolitic lapilli tuff and rare laminated flows assigned to the lower division crop out sporadically in the southern part of the Fawnie Range. They represent the eastward extension of a subaerial volcanic pile that is widespread in the Fawnie Creek area. Correlative epiclastic rocks to the east are exposed intermittently along the lower, southwest-facing slope of the Nechako Range between Kuyakuz Lake and Tatelkuz Mountain. They represent a near-shore facies composed primarily of sandstones and siltstones that are rich in angular feldspar detritus, and conglomeratic interbeds with subangular felsic lithic fragments. A particularly important outcrop is a roadcut near the 38-kilometre marker on the Blue road. Here reworked waterlain crystal tuff characterized by abundant quartz fragments is directly overlain by feldspathic siltstone containing the middle to late Toarcian ammonite, *Collina*. Because felsic volcanism appears to be contemporaneous with sedimentation, this fossil provides a minimum depositional age for rocks of the lower division. Moreover, in the absence of fossils it would be impossible to draw the direct correlation between these sediments and those representative of a deeper marine facies that lie to the north-northeast. This facies is also late Toarcian, determined from the small, but diagnostic bivalve, *Bositra*. The *Bositra* beds consist of recessive, black limy mudstone that commonly contain impure limestone concretions, lenses and discrete, white ash-tuff laminae. They are exposed in the low-lying area immediately adjacent to the northeast-facing slope of the Nechako Range between the Red road in the north and the latitude of Tatelkuz Lake in the south.

The Late Toarcian beds are found locally in close proximity but not in direct contact with lithologically similar, but older mudstone and siltstone. Several species of ammonites from this lower succession are early Toarcian, which suggests that a relatively quiet marine trough probably existed close to the same geographic location through most of Toarcian time. Field evidence also suggests that a middle to late Toarcian shoreline lay to the west, and beyond a subaerial volcanic field that periodically provided felsic airborne tephra and shed volcanogenic-epiclastic debris into the basin.

A distinctive, local stratigraphic marker composed mainly of lapilli tuff, minor accretionary lapilli and reworked waterlain crystal-rich tuff is exposed along the axis of the Nechako Range, southwest of Tatelkuz Mountain to the eastern end of Kuyakuz Lake. Its distinguishing lithological features are felsic potassium-bearing pyroclasts and angular quartz fragments. Although the lower contact was not observed, these deposits bear compositional and lithological resemblance to the underlying Toarcian rocks. Therefore, they are interpreted to represent a younger section that is stratigraphically continuous with the underlying Toarcian section. Epiclastic beds slightly lower stratigraphically than the volcanic marker unit yielded a fossil collection originally reported to contain the early Bajocian ammonite, *Witchellia* (Tipper, 1963, p. 28). This collection was recently re-examined by Dr. H.W. Tipper and re-assigned an Aalenian age. This new age assignment effectively extends the record of coeval felsic volcanism and marine sedimentation of the lower division of the Naglico formation from at least the middle Toarcian into the Aalenian.

Basaltic and andesitic flows, distinguished by the common occurrence of vitreous pyroxene phenocrysts, conformably overlie the Toarcian to Aalenian succession in the Nechako Range. In the northern part of the range these rocks appear to rest against a Lower Cretaceous clastic assemblage. The nature of the contact is uncertain; it may be either a fault or an unconformity. Fresh hornblende in the flows immediately adjacent to the sediments was sampled for an Ar-Ar date that should resolve the dilemma of possibly two lithologically similar mafic flow sequences - one Middle Jurassic and the other Early or Late Cretaceous. Similar flows, interlayered with maroon, fine-grained tuffs containing rare quartz phenocrysts, are found locally in the Fawnie Range on map sheets 93F/2 and 7. Based on corresponding lithologic characteristics, these rocks represent the eastern extension of strata comprising the upper division of the Naglico formation, which underlies much of the Fawnie Creek (93F/3) and Natalkuz Lake (93F/6) map areas.

Sedimentary units comprise relatively thin, recessive beds that are generally spatially associated with, but rarely in direct contact with volcanic rocks assigned to the upper division. This apparent relationship is noted at a number of localities, however, because the sediments are recessive, their contacts with bounding volcanic rocks are rarely exposed. The sediments are composed of immature feldspathic greywacke, black feldspathic mudstone, and scarce accumulations of granule and pebble conglomerate. Another unifying feature is a rich assortment of fossils that includes some ammonites, but mainly thick-shelled molluscs, indicative of a shallow-water marine depositional environment. Except for several fossil collections from the Fawnie Creek area that are questionably early Bajocian, most are early Callovian in age. Despite comparatively minor marine sedimentary interbeds, the depositional environment of the volcanic pile was mainly subaerial. Nowhere in this succession have pillowed lavas been found, and deposits interpreted as hyaloclastite are scantily distributed. It appears the volcanic pile was, at times, inundated by relatively warm, shallow marine water. The most significant of these transgressive(?) events in the study area appears to be marked by widespread early Callovian sedimentary rocks. Alternatively, the volcanic pile may have been slowly subsiding during quiet stages of volcanism, allowing marine conditions to encroach.

POST-JURASSIC ROCKS

Jurassic rocks in the study area are unconformably overlain by Lower Cretaceous sediments, and Tertiary volcanic sequences of Eocene and probable Miocene ages. The Cretaceous clastic assemblage is exposed semi-continuously along the axis of the Nechako Range; either it occupies a medial belt between flanking belts of lithologically similar pyroxene-bearing flows or, as described briefly above, is stratigraphically below or in fault contact with pyroxene-bearing flows. Correlative strata were previously mapped in the southwest corner of the Fawnie Creek map area where they are in fault contact with older Jurassic rocks (*cf.* unit MJNs; Diakow and Webster, 1994, p. 21). The hallmark of these rocks is abundant grey chert and black mudstone clasts in well sorted pebble-cobble conglomerates that are interlayered with light grey sandstone, and light green and black siltstone-mudstone beds. A rare ammonite from mudstone discovered by T. Richards prior to this project is tentatively identified as a Lower Cretaceous form. Other collections of shelly fauna are currently being examined by the Geological Survey of Canada.

Eocene and younger, subaerial volcanic rocks thin above the Nechako uplift; forming outliers that rest unconformably on Jurassic rocks. Eocene rocks of the Ootsa Lake Group apparently thicken north of the Natalkuz fault (Diakow *et al.*, 1993), a major northeast-trending structure that roughly demarcates the southern structural margin of a broad Tertiary volcanic field juxtaposed against older basement of the Nechako uplift. Eocene rocks in the western part of the study area are associated with a subvolcanic pluton and epithermal precious metal mineralization at the Wolf property. Based on similar lithologies, these rocks correlate with volcanic strata of the Ootsa Lake Group described in a section along the western flank of the Fawnie Range (Diakow and Webster, 1994, p. 22). Recent mapping has extended the distribution of this volcanic succession to the east-facing slope of the range, mainly between Top Lake and Mount Davidson. No Eocene rocks are recognized east of the Fawnie Range. Near Mount Davidson, the base of the Eocene section is marked by distinctive off-white and mauve, laminated rhyolite flows and related flow breccias. Another rhyolitic unit at the top of the section forms a massive sheet-like deposit capping Mount Davidson and other prominent knolls in the immediate area. The pyroclastic origin of these rocks is readily interpreted from lapilli-size lithic pyroclasts and abundant quartz fragments (up to 15%) supported by a well indurated groundmass. This pyroclastic deposit is both compositionally and texturally homogeneous, unusual features in light of its dimensions, locally as much as 250 metres thick, and an areal extent of about 20 square kilometres. The most plausible interpretation is that the deposit represents a uniformly welded ash-flow tuff resembling thick intra-caldera fill. The age of this unit is also in question. It contains scarce interbeds of flows, laharic breccia and minor volcanogenic siltstone that resemble lithologies in the upper division of the Naglico formation. The unit has been sampled for a U-Pb dating on zircon to determine the timing of crystallization.

Andesitic flows are exposed between conformably underlying and overlying rhyolitic rocks. The lithologic similarity of these rocks to those of the Naglico formation makes distinguishing the two successions difficult. By comparison, Eocene andesites in the area are relatively unaltered and contain slender plagioclase phenocrysts up to 5 millimetres long. Vitreous pyroxene is rarely observed in the Eocene rocks whereas it is often present in the Naglico formation (*cf.* unit MJN2; Diakow and Webster, 1994). In general, these andesite flows are very easy to confuse with older andesites unless they are very close to distinctive Eocene rhyolitic rocks.

A sequence of crudely layered, flat-lying flows that unconformably overlie Eocene rhyolitic volcanics, mainly north of the Nechako Reservoir, is assigned to the Endako Group (Diakow *et al.*, 1993). They have been mapped intermittently to the southern boundary of the Natalkuz Lake area and, in the east, to the northeastern corner of the Chedakuz Creek area where they overlie Jurassic flows. Despite the appearance of basalt, major elements from a representative suite of these rocks indicate they are andesitic in composition. They also contain modal clinopyroxene and orthopyroxene.

The youngest volcanic rocks in the study area are olivine basalt flows of the Chilcotin Group. Their distribution is most widespread in the southern part of the Fawnie Creek (93F/3) and Tsacha Lake (93F/2) areas where they underlie a relatively flat plain with pronounced escarpments at the erosional edge. In the study area, along the Nechako uplift, there appears to be only minor overlap of Endako and Chilcotin lavas. We suspect that the Nechako uplift may have acted as a topographic barrier to

Chilcotin lavas encroaching from the south and Endako lavas from the north. An overlap of these successions may occur along the southern boundary of the Natalkuz Lake area where Endako flows are exposed below topographically higher and more northerly exposures of Chilcotin lavas. Field evidence for a direct contact relationship was anticipated in the broad northwest-trending valley that lies between the Fawnie and Nechako ranges. Instead the lava sequences are widespread at the opposite ends of the valley, and Jurassic and Lower Cretaceous rocks are exposed in the central area. High on the western flank of the Nechako Range, at nearly 1350 metres elevation, an unexpected exposure of Chilcotin lava caps a granitic pluton. In this instance and another reported in the Naglico Hills (Diakow and Webster, 1994, p. 23) these young flows (*ca.* Miocene to Pliocene) occur well above exposures in valley bottoms at about 1150 metres elevation. This difference in elevation is believed to reflect block faulting.

MINERAL POTENTIAL

The Nechako Plateau is underlain by a prospective geological environment favourable for a variety of economic mineral deposit types. Porphyry deposits such as Endako, Fish Lake and Gibraltar occur peripherally as do epithermal precious metal deposits such as Blackdome and Silver Queen. Deposits that comprise a range of high-temperature polymetallic replacement lenses and disseminations, such as Equity Silver, also occur in the region.

These various mineral deposit types are repesented on the Nechako Plateau by the Wolf (MINFILE 93F 045) and the Tommy (MINFILE 93F 055) epithermal and the Capoose "transitional" prospects. The CH (MINFILE 93F 001, 004) and Ben (*see* Lane and Schroeter, 1995, this volume) porphyry prospects occur on 93F/7, in the Nechako Range, and the PEM (Blackwater-Davidson, MINFILE 93F 037), possibly transitional, prospect occurs in the Fawnie Range of 93F/2. Other occurrences include prospects on Tsacha and Kuyakuz mountains and a diatomite showing (MINFILE 093F 041) on the south side of Tsacha Lake.

There is good potential for a variety of deposit types, especially intrusion-related occurrences, to exist in the Jurassic Naglico formation that underlies the Fawnie and Nechako ranges. Lake sediment geochemical data (Cook and Jackaman, 1994a b) indicate numerous anomalous sites, plus, recently released areomagnetic data (Geophysical Data Centre, 1994) delineates potential near-surface intrusions in this area. These new data, including the surficial geology mapping (Giles and Levson, 1995 and Weary *et al.* 1995) and bedrock mapping (Diakow *et al.* 1995a, b) , could be instrumental in new discoveries.

TABLE 1. ANALYTICAL DATA FOR ASSAY SAMPLES COLLECTED ON NTS 93F/2 AND 7.

Field No.	UTM East	UTM North	Rock Description	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	Th	Sr	Cd	Sb
			unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
IWE 13-2	397950	5912500	stratabound sulphides exposed in a trench	13	1193	81	51772	6.7	3	31	5850	17.17	19762	5	13	602	14
IWE 17-1	374650	5983450	disseminated and shear hosted pyrite in volcanic rock	4	89	146	2668	2.9	1	44	1689	5.58	41	4	8	7	2
IWE 22-9	399049	5889063	pyritic shears in basalt	19	171	2	534	0.1	37	36	809	5.31	6	2	44	1.5	2
IWE 24-3	384800	5922650	quartz veins in mudstones and siltstones	1	4	2	17	0.1	8	184	96	0.41	5	2	8	0.2	2
IWE 24-5	383073	5921862	quartz veining and potassic alteration	4	2	4	17	0.1	1	48	223	0.27	191	5	3	0.2	3
IWE 24-5	383073	5921862	quartz veining and potassic alteration	6	2	2	26	0.5	1	55	134	0.42	358	5	2	0.2	5
IWE 24-5	383073	5921862	quartz veining and potassic alteration	7	1	2	15	0.2	2	63	47	0.4	172	5	2	0.2	2
IWE 28-3	394350	5915650	pyritic laminated rhyolite	3	44	6	65	0.1	3	52	491	3.85	9	2	37	0.2	2
JWH 7-4	395225	5913956	pyrite and chlorite bearing hornfels	2	52	2	83	0.1	2	31	598	4.29	7	3	47	0.2	2
JWH 9-2	368750	5907050	pyrite and chalcopyrite in pyroxene porphyry	2	646	9	48	0.8	61	23	333	2.56	2	4	49	0.2	2
JWH 9-3	369100	5906975	disseminated pyrite in maroon to green silicified rock	3	82	18	105	0.2	32	27	465	4.28	7	2	91	0.3	2
JWH 16-1	375120	5985775	pervasively silicified zone with ~3% pyrite	5	88	6	1236	0.2	70	46	152	3.44	234	2	386	5.4	2
JWH 17-8	368214	5885863	gouge zone and quartz vein in intrusion	2	51	2	71	0.1	41	167	1655	10.84	13	4	10	0.2	2
JWH 21-3	393050	5902080	quartz vein with malachite/pyrite at an intrusive contact	7	4611	59	41	18	21	21	331	2.81	7	2	94	0.5	2
JWH 32-8	373604	5882916	altered maroon flows with quartz veining	2	7	11	24	0.1	1	21	305	1.12	4	5	4	0.2	3
LDI 18-1	368121	5875599	quartz breccia with malachite in maroon flows	5	31647	16	8	51	1	23	304	0.76	29	2	167	0.2	5

continued

Field No.		Bi	V	Ca	P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	Au
	unit	ppm	ppm	%	%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppb
IWE 13-2		8	25	0.56	0.023	2	8	0.21	14	0.01	2	0.5	0.01	0	##.#
IWE 17-14		5	20	0.33	0.058	15	4	0.28	53	0.08	5	1.4	0.04	0.2	31
IWE 22-9		3	171	3.03	0.132	9	42	1.92	16	0.26	4	2.9	0.08	0.1	10
IWE 24-3		2	5	0.05	0.004	2	11	0.11	16	0.01	10	0.2	0.01	0	5
IWE 24-5A		2	2	0.02	0.005	22	6	0.01	21	0.01	9	0.4	0.05	0.2	23
IWE 24-5B		2	2	0.01	0.003	18	4	0.01	24	0.01	13	0.5	0.03	0.3	65
IWE 24-5C	*(see sample descriptions above)*	2	2	0.03	0.006	22	5	0.01	25	0.01	12	0.5	0.02	0.2	59
IWE 28-3		2	46	0.82	0.086	4	7	1.01	120	0.23	4	1.5	0.07	0.3	9
JWH 7-4		3	140	0.78	0.095	3	3	1.61	92	0.38	2	1.9	0.19	1.6	1
JWH 9-2		2	94	4.27	0.127	9	55	1.98	61	0.16	10	3	0.07	0.2	10
JWH 9-3		4	195	2.61	0.131	9	26	1.51	65	0.24	10	3	0.18	0.3	4
JWH 16-10		4	15	5.31	0.107	3	12	0.12	48	0.11	4	7.2	1.05	0	19
JWH 17-8		5	163	0.33	0.130	2	34	3.1	12	0.03	3	3.7	0.02	0.1	3
JWH 21-3		321	62	1.9	0.117	7	42	1.08	15	0.17	4	1.2	0.05	0.1	57
JWH 32-8		2	3	0.06	0.010	22	2	0.01	165	0.01	4	0.3	0.01	0.3	1
LDI 18-1		19	10	3.44	0.002	3	1	0.02	100	0.01	5	0.2	0.01	0.1	1

Anatytical method: all elements by ICP from a 0.5 gram sample; Au by FA/ICP from a 20 gram sample.

Analytical results for grab samples collected during this bedrock mapping project are listed in Table 1. Samples 94IWE 24-5A, B and C of strongly bleached, potassically altered and quartz veined rock were collected from an approximately 25 by 25 metre, flat-lying outcrop. The three samples contain elevated gold abundance and interestingly high arsenic and manganese. There is potential for this alteration zone to extend, probably at shallow overburden depths, over a much larger area than is now exposed. Visible copper mineralization occuring at intrusive contacts was collected at stations JWH 17-8 and 21-3. Other samples, some of which are anomalous in copper, zinc and gold, are listed in Table 1: brief rock descriptions are included.

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We thank Dr. H.W.Tipper for his keen interest and geologic contributions to the project. He is responsible for identifying numerous fossil collections from this study, and re-assessing his own collections that date back to his original work in the Nechako River area during the early 1950s. Without this paleontological work, our attempts to subdivide and make sense of the Mesozoic rocks would have been significantly more difficult. It was a pleasure meeting Barry and Marian Mills and their entertaining family. We appreciated access to lodging and logistical support provided by the Mills family at their Tatelkuz Lake ranch. As usual Joyce, and Joe Meier of Northern Mountain Helicopters, kept the blades turning safely and on schedule. We also welcomed and benefited from discussions with prospectors and industry geologists working in the area.

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