

## **Geotour of the Smithers-Babine Lake-Hazelton area**

This geotour guide is intended for the use of geologists or other geoscience professionals interested in learning about the geology of the Smithers-Babine Lake-Hazelton area of west central British Columbia. This self-guided geotour examines the older component of Stikine Terrane in the region including the Upper Permian limestone to Upper Triassic island arc volcanic assemblages near Granisle on Babine Lake. In the Smithers and Hazelton areas the focus is on Jurassic, Cretaceous and Eocene overlap assemblages and post accretion structures related to crustal thickening and thinning events.

Our geotour begins on Highway 16 east of Topley. Here the highway skirts the northern edge of a broad area of tilted fault blocks that are capped by Eocene flows of the Ootsa Lake and Endako formations of the Nechako Plateau Group. These volcanics sit unconformably on late Triassic and early Jurassic volcanic and plutonic rocks of the Takla and Hazelton magmatic arcs of the Stikine Terrane.

At Topley we swing northward towards Babine Lake, climbing to the top of a broad plateau that is underlain mainly by Hazelton Group volcanic rocks. Our route parallels a major northeast trending fault that bounds a series of uplifted fault blocks east of the highway. This uplift exposes the late Triassic Tachek stock of the Topley intrusive suite and overlying late Triassic volcanics and sediments of the Takla Group.

As we descend towards Babine Lake, we transect a belt of strongly deformed rocks that include late Carboniferous-early Permian limestones of the Asitka Group, Triassic sediments and mafic volcanics of the Takla Group and Lower Jurassic andesitic volcanics of the Hazelton Group. The deformation, which is believed to be associated with amalgamation of Stikine and Cache Creek terranes, is cut by post kinematic porphyritic quartz monzonite dikes of early Middle Jurassic age (178 Ma).

At Granisle on Babine Lake we cross into a graben filled with porphyritic andesite of the Eocene Newman volcanics and early Cretaceous fluvial-deltaic sediments of the Skeena Group. The Newman volcanics are the extrusive equivalent of porphyritic granodiorite stocks that host the now defunct Granisle and Bell porphyry copper mines. Ar-Ar isotopic dating suggests magmatic activity took place over a 3 m.y. time span from 53 to 50 Ma.

This magmatic event and subsequent formation of the Granisle graben is believed to be related to a regional transpressive tectonic event that was active from Late Cretaceous to Eocene time.

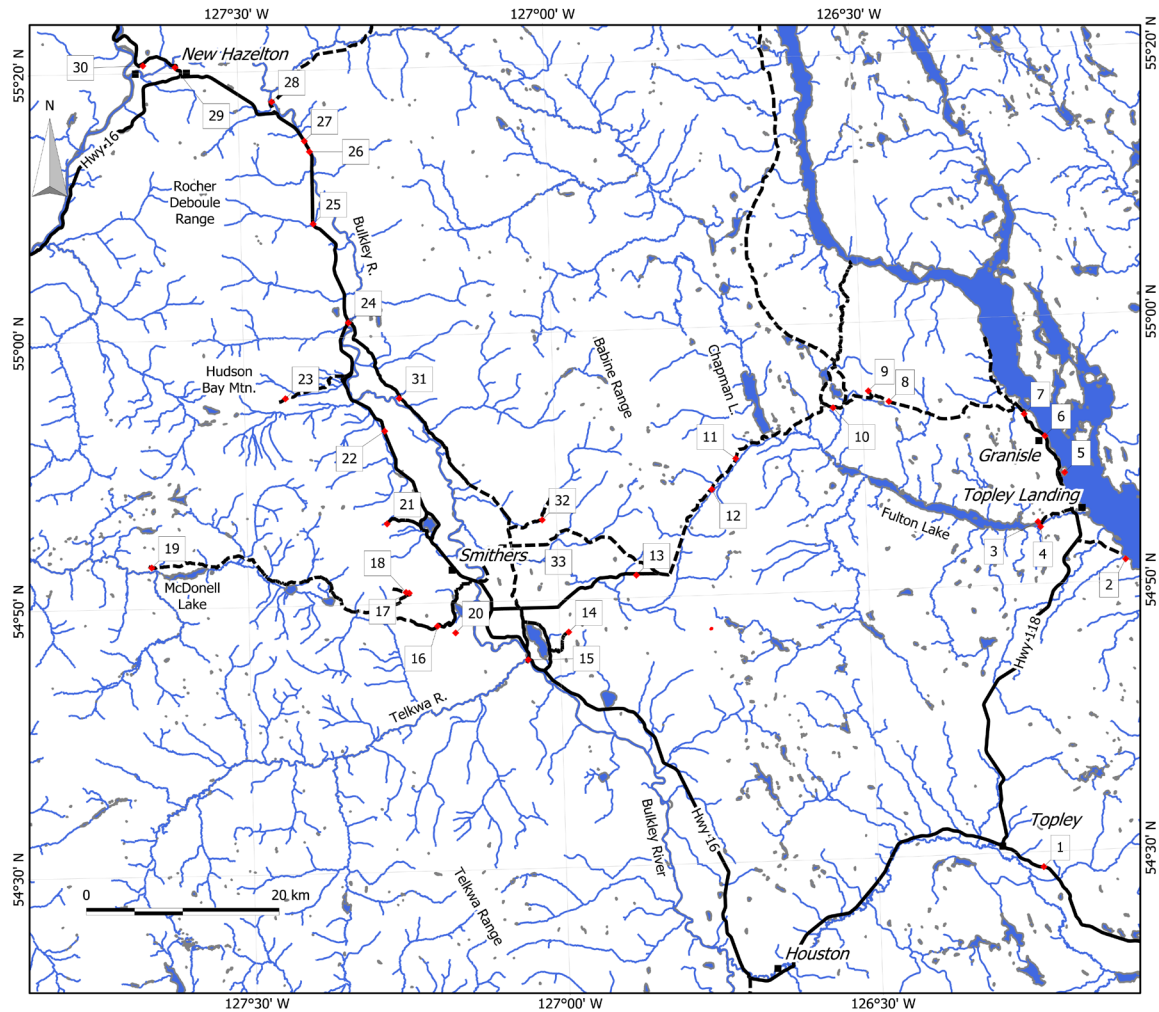
Returning to Smithers via the Granisle connector-Smithers Landing roads we pass through the Babine Range at McKendrick Pass. This pass is a major northeast fault of probable Early Tertiary age. South of the fault is Mt. McKendrick, an uplifted block of Late Triassic greenstone; north of the fault is a dip slope of early Cretaceous Skeena Group sedimentary rocks.

As we descend into the Bulkley valley we get a good view of the Telkwa Range to the southwest and Hudson Bay mountain to the northwest. These uplifts, which are predominantly Early Jurassic rocks of the Hazelton Group, bound the Bulkley valley graben. Rocks within the graben are predominantly folded Early Cretaceous and Eocene age sedimentary rocks. The uplifted areas bounding the graben are thrust plates directed away from the graben axis. Rocks as young as Eocene have been folded along northwest

trending fold axes. This contraction is probably related to Eocene or younger transpression. These structures are cut by northeast trending faults that accompanied uplift and southeast tilting of fault blocks in Eocene or younger time. This later event produced a basin and range geomorphology throughout the Smithers area.

Crossing the Bulkley valley we ascend the southeast flank of Hudson Bay Mountain via the ski hill access road. Here we pass through east dipping strata of the upper Telkwa Formation which includes rhyodacitic ash flows and maroon to red air fall tuffs.

From Smithers we travel north along the Bulkley river to Hazelton on Highway 16. Along this route we pass through a series of north trending grabens filled with tilted and folded mid-Cretaceous to Eocene volcanic and sedimentary rocks. We will stop first at Glacier Gulch where mid-Cretaceous Skeena Group sedimentary rocks overlie and are in fault contact with the Telkwa Formation. Next, we will examine Eocene or younger rocks at Moricetown, followed by the mid Cretaceous Rocky Ridge volcanic rocks and late Cretaceous Brian Boru volcanics of the Kasalka Group near Beamont.



### ***Stop 1 - Eocene volcanic rocks of the Goosly Lake Formation (679059E 6041114N)***

Stop 1 is on Highway 16, 8.4 kilometres east of the town of Topley. Outcrop occurs on both sides of Highway 16 and in a borrow pit on the right side of the highway. Turn left off the highway 100 metres before the road cuts and park in the borrow pit.

Rocks exposed in the quarry and in the roads cuts along the highway are feldspar phyric dacites and andesites that are locally flow banded. Neil Church of the BCGS (see Church and Barakso, 1990) has mapped these rocks as part of the Eocene Goosly Lake Formation. The Goosly Lake Formation is the lower part of a thick succession of Eocene flows that unconformably overlie Takla, Hazelton, Skeena and Kasalka Group rocks in the area south of Highway 16.

The Goosly Lake Formation, which regionally is mainly of feldspar phyric trachyandesite, is up to 500 metres thick and is overlain conformably by the Buck Creek Formation. The latter is comprised mainly of brown weathering, fine grained, amygdaloidal andesite and basalt flows. Most of the hills that can be seen to the southwest are capped by gently dipping flows of the Buck Creek Formation. Hills to the northeast are uplifted blocks of Late Triassic and Early Jurassic Takla and Hazelton Group volcanic rocks.

Church reports a  $48.8 \pm 1.8$  Ma K-Ar whole rock isotopic age for the Goosly Lake Formation and a  $48.2 \pm 1.6$  Ma K-Ar whole rock isotopic age for the Buck Creek Formation. These ages and lithologic similarities suggest the Goosly Lake and Buck Creek Formations are correlative with the Endako Group.

### **Return to Topley and the start of the Granisle Highway (Highway 118)**

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As we travel north on the Granisle Highway, we ascend to the top of a broad plateau that is underlain by rocks of the Early Jurassic Hazelton Group. Our route roughly parallels a major northeast trending fault that bounds an uplifted area of Late Triassic volcanics and plutons to the east.

As we approach the crest of the plateau at approximately 6.4 km from Topley we have a good view to the south of China Nose Mountain. This mountain and other hills in its vicinity are comprised of gently dipping Eocene lava flows of the Buck Creek Formation. Tilting of these flows here, as elsewhere in the Nechako plateau occurred during a period of Eocene or younger extension.

At around 7 kilometres from Topley is a view to the northeast of Tachek Mountain. This mountain is an uplifted block of Late Triassic to Early Jurassic hornblende-feldspar phyric andesite flows and breccias. The succession dips moderately to the southwest where the volcanics are overlain by argillites and shales. Near the base of the mountain is the Topley Richfield polymetallic vein deposit.

At around 22.8 kilometres from Topley we pass outcrop on the right side of the highway that is comprised of dark green tuffs and graphitic sediments typical of the Late Triassic Takla Group.

At around 32 kilometres from Topley there is a viewpoint on the right. From here we start to descend towards Babine Lake with good views of the lake and hills to the north. Red weathering outcrops north of the lake are Late Triassic to Early Jurassic granitic rocks of the Topley Intrusive suite.

At around 37 kilometres from Topley we turn right off the highway onto Dan's road (Spindrift Lodge road).

### ***Stop 2 - Late Triassic Tachek stock of the Topley Intrusive Suite (687548E, 6073089N)***

Stop 2 of the GeoTour is a quarry on the left side of the road at approximately 5.8 kilometres from the junction with the Granisle Highway. The rock exposed in this quarry is a coarse-grained, equigranular to megacrystic intrusive rock comprised of pink and white weathering feldspar, quartz and chloritized mafic minerals. It is typical of the Tachek stock which underlies much of the area south of Babine Lake. Whole rock chemical analysis of a sample from this locality suggests a granodiorite composition. The Tachek stock is typical of the oldest phase of the Late Triassic-Early Jurassic Topley intrusive suite. U-Pb isotopic dating of zircons extracted from a sample collected at this locality in 1995 gave a Late Triassic age of  $224 \pm 2.0$  Ma (Mike Villeneuve, GSC, Ottawa). The granodiorite is cut by several dark grey mafic dikes which are probably feeders to Eocene flows that unconformably overlie the Tachek stock east of this locality.

**Return to the junction of Dan's road and the Granisle Highway. Turn right and continue toward Granisle. Just past the Fulton River salmon hatchery turn left onto the Fulton river dam site access road.**

At the next two stops we will examine some of the oldest and most deformed rocks in the eastern part of the Stikine terrane. These rocks are part of the Late Carboniferous-Early Permian Asitka Group and Late Triassic Takla Group. These mafic volcanic-dominated successions are primitive island arc sequences that were precursors to the more extensive, largely subaerial, Hazelton calc-alkaline volcanic arc.

At around 2.5 kilometres along the Fulton river dam access road there is a borrow pit where outcrops of purple to dark green feldspar-pyroxene phyric andesite with strong epidote alteration are exposed. These rocks are probably near the top of the Takla Group, but could also be part of the Toarcian Saddle Hill volcanics of the Hazelton Group.

At 3.3 kilometres there is a fork in the road. The right fork leads to a borrow pit at the east end of Fulton Lake; the left fork leads to the Fulton River dam. Take the right fork and park in the quarry at the end of the road. Adjacent to the quarry is a boat launch site for Fulton Lake.

### ***Stop 3- Late Carboniferous to Early Permian Asitka Group limestone (678455E, 6076946N)***

The quarry at the end of the road has good exposures of Asitka Group limestone cut by feldspar porphyry dikes (Middle Jurassic?). The limestone is medium to thin bedded and partially recrystallized. The rocks here are typical of the Asitka Group limestone which elsewhere in the Fulton Lake area has yielded Late Carboniferous-Early Permian conodonts (identification by Mike Orchard, GSC). Outcrops along the road east of the

quarry are dark grey chert, metasilstone and chlorite  $\pm$  sericite schists. The protolith of these rocks is probably the Late Triassic Takla Group. Further east and presumably overlying Takla rocks are less deformed lapilli tuffs and amygdaloidal flows that are probably correlative with the Early Jurassic Saddle Hill volcanics of the Hazelton Group. The age of deformation is probably early Middle Jurassic because post kinematic porphyritic dykes at Tachek Creek, approximately 9 kilometres due south of the present locality, have given  $178 \pm 7$  Ma K-Ar isotopic ages (Carter, 1981). Deformation is believed to be related to folding and thrusting that occurred during a Middle Jurassic contractional event that was associated with amalgamation of Stikine and Cache Creek terranes.

Looking west down Fulton Lake, the outcrops on the north and south shore are medium grained monzonite. These rocks have been mapped as part of the Topley intrusive suite but are probably Middle Jurassic in age and therefore correlative with the Spike Peak intrusive suite.

Return to the fork in the road and take the left fork which leads to the dam site, a distance of approximately 600 metres. Park at the end of the road where it splits into three forks. Follow the middle fork a short distance to the top of a steep stairway that leads to the bottom of the Fulton river canyon. The dam and spillway are to your right.

#### ***Stop 4 - Middle Triassic cherts and metavolcanic rocks of the Takla Group (678712E, 6076432N)***

The outcrop on the left, at the top of the stairway, is mainly well-bedded chert that is tightly folded and cut by post kinematic feldspar porphyry dikes. Pyrite mineralization is associated with these dikes. Fabrice Cordey has identified Middle Triassic radiolaria in a sample of chert collected from this site. The cherts apparently unconformably overlie Late Carboniferous to Early Permian limestone of the Asitka Group.

To the east the chert is overlain by and in part structurally imbricated with chlorite and sericite schist of probable Late Triassic age (Takla protolith?).

From the first platform on the stairway going down to river level we get a good view of the north wall of the canyon below the Fulton River dam. If the light is appropriate one can discern contorted, near vertical beds of limestone, chert and metasediments cut by dikes. This exposure shows how deformed the Asitka and Takla rocks are at this locality. The age of this deformation is believed to be Middle Jurassic.

#### **Return to the Topley Landing road and turn left towards Granisle.**

At approximately 4.6 kilometres turn right into the Red Bluff Provincial Park and follow the road to the day use parking lot. From here follow the trail to the Red Bluffs.

#### ***Stop 5 – Early Jurassic Topley intrusion at Red Bluffs Provincial Park (681215E, 6082081N)***

Follow the trail from the parking lot at the day use area to the top of the cliffs overlooking Babine Lake. The red to pink rocks exposed in the cliffs are typical of the Topley Intrusive Suite. Compositionally these rocks are granodiorites with the reddish colour due to oxidation during a period of uplift and erosion. Radiometric age dates

indicate this suite of rocks is Late Triassic to Early Jurassic in age. Extrusive equivalents of these rocks are probably the maroon to pink weathering andesitic tuffs of the lower Telkwa Formation.

**Return to the Granisle highway and turn right towards Granisle.**

In Granisle, follow the highway past the main intersection (visitor information centre and museum on the right). Going down the hill, there is a fork in the road. Follow the right fork into the parking lot at the Granisle marina.

***Stop 6 – Viewpoint: Granisle graben and setting of the Eocene Newman volcanics (679161E, 6085868N).***

From the parking lot at the Granisle marina we have a good view north up Babine Lake toward Bear Island with Old Fort Mountain in the distance. This part of Babine lake is underlain by the Eocene Newman volcanics which are preserved within the core of a north-trending graben. This graben extends from just south of Granisle to Old Fort Mountain where it is truncated by a northeast trending fault. Old Fort Mountain is an uplifted block of early and middle Jurassic Hazelton Group rocks.

The Newman volcanics, which are flat-lying to southeast dipping are exposed on the west and east shores of the lake and on Bear Island. These rocks sit unconformably on folded early Cretaceous strata of the Skeena Group. The ridges east and west of the lake are tilted fault blocks comprised of volcanic and sedimentary rocks of the early to middle Jurassic Hazelton Group. These fault blocks are tilted inward towards the central part of the Granisle graben. The Newman volcanics are also found further to the west, outside of the Granisle graben where they form a broad plateau called Turkey Mountain.

The Newman volcanics are the last magmatic episode in the evolution of a continental volcanic arc that extended from Babine Lake to the Coast Mountains. This arc was active from Late Cretaceous to Eocene time and was built on uplifted Early Cretaceous and older rocks. Formation of this arc and its associated porphyry copper mineralization occurred during a period of transpression related to oblique subduction along the North American continental margin.

The plutonic and volcanic remnants of this arc are exposed at different structural levels by Eocene or younger extension and block faulting, a key factor that must be considered when exploring for associated mineral deposits such as porphyry copper deposits and epithermal vein systems.

The characteristic rock of the Newman volcanics is a hornblende+/-biotite+felspar andesite with a crowded porphyritic texture. The Babine intrusions, which are lithologically and compositionally identical, are coeval with the volcanic rocks and have important porphyry copper mineralization associated with them. Mike Villeneuve of the GSC has done Ar-Ar isotopic dating of the Newman volcanics as part of the Nechako NATMAP project (Struik and MacIntyre, 1999). Ages range from 53 to 50 Ma.

The town of Granisle was created in 1966 when the Granisle (Granby) mine opened on MacDonald-Sterritt island due east from our vantage point (mine site not visible from here). The Bell mine, located at the north end of the Newman peninsula (mine site not visible from here), opened in 1972. Granisle closed in 1982 and Bell in 1992.

**Quaternary geology note:** Like much of the northern Nechako Plateau, the Babine Lake area was extensively sculpted by multiple glacial cycles throughout the Pleistocene. During the late Wisconsinan Fraser Glaciation (29 - 11 Ka), ice accumulated in montane areas including the Skeena Arch and the Babine Mountains. Early ice flow was focused along the structurally-controlled pre-glacial Fulton, Babine and Hautête valleys. Around 19 Ka, the area was completely inundated by southeast flowing ice streams, forming part of the Cordilleran Ice Sheet. Evidence of late Wisconsinan iceflow is preserved at a variety of scales. Glacial striae and grooves are commonly preserved on bedrock surfaces throughout the area, and indicate regional palaeo-ice-flow directions ranging from 130° to 180°. This dispersal pattern is reflected in larger scale glacial streamlined landforms; including drumlins, flutes and crag-and-tail features. Regional iceflow has in part accentuated the local structural grain.

**Return to the junction of the marina access road and the highway and turn right onto the Granisle Connector (Cutoff) Road**

**Reset odometer to 0.0**

***Stop 7 - Lahars of the Eocene Newman formation (677011E, 6088146N).***

At approximately 3.4 kilometres from Granisle there is a poorly exposed outcrop on the left side of the road that is typical of lahars and debris flows of the upper part of the Eocene Newman formation of the Nechako Plateau Group. Over the years this outcrop has become somewhat overgrown with vegetation so it will require some rooting around. The rocks exposed here are poorly sorted with subangular to rounded clasts of hornblende-biotite-feldspar porphyritic andesite ranging from less than 10 centimetres to over a metre, supported by a matrix of ash and crystal fragments. As can be seen at this locality, the matrix of the debris flow is recessive and decomposes to a feldspar, quartz and hornblende rich sand.

Ar-Ar isotopic dating by Mike Villeneuve of the GSC as part of the Nechako NATMAP Project produced 8 new dates of Newman volcanics ranging from 54.6 to 50.6Ma and 9 new dates for the Babine intrusions ranging from 53.6 to 51.8 Ma (Villeneuve and MacIntyre, 1997).

Southwest of the current stop and capping the hill directly west of Granisle are amygdaloidal basalt flows that have given an Ar-Ar whole rock age of 50.9±0.5 Ma. These rocks, which lie stratigraphically above lahar of the Newman volcanics, are correlated with the Endako Group.

**Continue west along the Granisle Connector toward Smithers staying left at the junction with the old Bell barge road which is located at approx. 4.7 kilometres from Granisle.**

At around 6.9 kilometres there is an outcrop on the left side of road. This outcrop is comprised on maroon tuffaceous conglomerate with occasional clasts of chert and limestone. These beds, which dip moderately to the south-southeast, are probably near the base of the Lower Jurassic Telkwa Formation.

At around 10.6 kilometres there is an outcrop on the left side of the road at a blind corner. Small outcrops in the stripped area next to the road are well bedded, red to maroon tuffaceous siltstones and wackes with some finely laminated silty mudstone interbeds.

Bedding dips moderately to the southwest but load casts and cross laminations indicate the beds are actually overturned with stratigraphic tops to the northeast.

At around 11.9 kilometres there is another small outcrop this time on the right side of the road. This outcrop is comprised of maroon to red weathering feldspar phyric basalt, amygdaloidal flow top breccia and lapilli tuff. These rocks are probably part of the Lower Jurassic Telkwa Formation but could be older.

At around 13 kilometres there are borrow pits on both sides of the road. Rocks exposed here are strongly fractured green and maroon feldspar phyric andesite, green feldspathic volcanic wacke and dark siltstone. There is also a thin, light grey limestone exposed in a stripped area on the right side of the road. Outcrops along the east side of the borrow pit are sheared volcanic rocks cut by a diorite dike. These rocks are probably near the top of the Telkwa Formation and are Late Sinemurian or Early Pliensbachian in age.

At the crest of the hill, just beyond this site we get a good view to the west of Mt. Hyland in the Babine Range (weather permitting). The Babine Range is an Eocene or younger uplift of deformed Jurassic rocks of the Hazelton Group unconformably overlain by less deformed mid-and late Cretaceous sedimentary and volcanic rocks of the Skeena and Kasalka groups. The prominent peaks of Mt. Hyland and Mt. Cronin are both comprised of massive, grey weathering porphyritic andesite flows of the late Cretaceous Kasalka Group that sit unconformably on folded early Cretaceous Skeena Group sedimentary rocks. Kasalka Group rocks on Mt. Hyland give K-Ar isotopic ages between 77 and 83 Ma.

At around 15.6 kilometres there is a small outcrop on the right side of road. The outcrop here includes orange weathering maroon to grey lapilli-crystal tuff, limy mudstone, and granule conglomerate. These rocks were mapped as being near the base of the Lower Jurassic Telkwa Formation.

At around 16.3 kilometres there are some good views across a new clearcut on the left side of the road. To the southwest we can see Dome Mountain. , where numerous gold bearing quartz veins of probable late Cretaceous age are located. To the northwest are good views of the Babine Range as described previously.

At around 17 kilometres there are good view to the northwest of a broad, flat topped, circular hill locally called Turkey Mountain. Turkey Mountain is comprised of flat-lying to gently dipping porphyritic andesite flows, breccias and lahars of the Eocene Newman Formation of the Nechako Plateau Group. Light coloured outcrops visible from this vantage point are thick bedded lahars.

There is approximately a 300 metre elevation difference between the base of the Newman volcanics on Turkey mountain and the base of similar rocks in the Granisle graben and this difference is interpreted to be due to Eocene or younger extension and subsidence. Mike Villeneuve of the GSC, Ottawa, as part of the Nechako NATMAP project, has determined Ar-Ar isotopic ages of  $51.2 \pm 0.5$ ,  $52.3 \pm 0.6$  and  $52.7 \pm 0.6$  Ma respectively for porphyritic andesite flows at three different localities on Turkey Mountain. These ages are similar to those obtained elsewhere in the Babine Lake area for both the Newman volcanics and the coeval Babine intrusions.

***Stop 8 – Eocene Newman formation andesite flows (662969E, 6089435N)***



At approximately 20.3 kilometres there is a large outcrop on the right side of the road. This outcrop is mostly greenish grey to maroon hornblende phyric andesite of the Newman formation. These flows are probably near the base of the Eocene Newman formation and are interpreted to unconformably overlie Lower Jurassic Telkwa Formation rocks.

At around 22.5 kilometres going west on the Granisle Connector there are good views of hills southwest of the connector road. These hills are comprised of coarse, poorly sorted polymictic conglomerates that are interpreted to be at the base of the Hazelton Group. These conglomerates typically contain 1 to 20 centimetre rounded clasts of pyroxene phyric basalt, feldspar phyric andesite, coarse grained bladed feldspar porphyry, rhyolite, feldspathic volcanic wacke, banded siltstone, chert and limestone. The Mississippian to Permian Asitka Group and the late Triassic Takla Group are interpreted to be the source of these clasts. The conglomerate is interbedded with finer grained clastic rocks and is interpreted to be the basal member of the Hazelton Group.

### ***Stop 9 – Basal Hazelton Group conglomerate (660835E, 6090522N)***

At around 22.6 kilometres there is a sharp bend in the road. Pull off on the right side of the road and park. The outcrop at this stop requires a short walk through the woods to a prominent outcrop of basal Hazelton Group conglomerate. Starting from the road walk northwest for a distance of approximately 320 metres. The outcrop is quite large and should be easy to find.

The outcrop is comprised of a poorly sorted boulder conglomerate with clasts of coarse grained augite phyric basalt and limestone. This outcrop is one of a series of outcrops defining a northwest trending belt of conglomerates and wackes that extends from Fulton Lake to the present locality. These conglomerate beds are believed to be the basal member of the Jurassic Hazelton Group and as such underlie andesitic pyroclastics of the Telkwa Formation and overlie the late Triassic Takla Group from which many of the clasts have been derived. There are also clasts of Asitka Group limestone and granitic clasts presumably from the Topley Intrusive Suite. The augite phyric basalt clasts visible in the outcrop are characteristic of the lower part of the Takla Group while other lithologies present in the conglomerate occur higher in the Takla succession. The coarse, poorly sorted nature of these conglomerates and the variety of lithologies present suggest considerable uplift and erosion of the Takla Group prior to deposition of the early Jurassic Telkwa Formation. This uplift corresponds to a change from predominantly submarine to predominantly subaerial depositional environments.

At around 24.7 kilometres there is an outcrop on the left side at a sharp bend in the road. This outcrop is a poorly indurated, flat lying, polymictic boulder conglomerate.

This conglomerate is probably at the base of the Eocene Newman volcanics and unconformably overlies the early Jurassic conglomerates described above. Similar, poorly indurated conglomerates underlie Newman volcanics on the Newman Peninsula and also crop out in the lower part of Tachek Creek where they unconformably overlie Jurassic volcanic rocks.

At around 26.6 kilometre from Granisle there is a bridge crossing over Fulton Creek.

***Stop 10 – Andesitic lapilli tuffs of the Lower Jurassic Telkwa Formation (657172E, 6088780N)***

Around the 27 km mark of the Granisle Connector there is a large outcrop on the left side of the road. This outcrop is mainly maroon to red weathering lapilli and crystal tuff that is typical of the lower Telkwa Formation of the Hazelton Group. The rock here is distinguished by an abundance of maroon and grey feldspar phyric andesite clasts in a feldspathic matrix. These clasts indicate that the rock was deposited near an active volcano in a subaerial environment with oxidation producing a reddish to maroon colour. This is typical of the lower Howson subaerial facies of the Telkwa Formation and is believed to be mainly Sinemurian or older in age.

The lower andesitic pyroclastic member is typically overlain by amygdaloidal basalts. These basalts are often host to copper-silver occurrences which are found as high grade chalcocite and bornite in intensely epidotized flow top breccias. In the Telkwa Range and on Hudson Bay Mountain well bedded felsic pyroclastic rocks overlie the basalt member; elsewhere this member is absent.

In the Babine Lake area, subaerial pyroclastic rocks of the Telkwa Formation are also found on MacDonald-Sterrett Island (Granisle mine) and in outcrops east of Babine Lake.

At kilometers 27.2 and 28.4 there are two more outcrops similar to Stop 10.

**At around 28.9 kilometres is the junction with the Smithers Landing road.**

**Reset odometer to 0.0 km and turn left toward Smithers.**

Caution: be prepared to meet both logging trucks and motorhomes on the Smithers Landing road. Stay on your side of the road, especially at curves where there is limited visibility.

At 6.9 kilometres from the junction with the Granisle Connector road is a bridge over the Fulton river. Chapman lake is on the right side of the road.

At 8.2 km on the right is the junction with the Chapman Lake Forest Service Road. Watch for logging trucks entering the Smithers Landing road.

At around 12.3 kilometres is an outcrop on the right side of the road which is more Telkwa Formation volcanics similar to Stop 10.

At kilometre 13.4 is the start of the Cronin mine access road on the right. This road is no longer passable but is the start of a popular hiking trail across the Babine Range through the Babine Mountains Provincial Park.

***Stop 11 – Lower Jurassic Telkwa Formation crystal-lithic tuffs cut by a granitic dyke (647078E, 6083508N)***

At around kilometer 13.9 kilometres is a large outcrop of orange weathering maroon crystal-lithic tuff of the lower Telkwa formation. For safety reasons use the wide shoulder on the south (left) side of the road and watch for logging truck traffic.

The volcanic rocks exposed in the road cut are typical of the lower Telkwa Formation. Cutting the maroon volcanic rocks is a near vertical, grey weathering quartz-feldspar phyric granitic dyke. This dyke is probably Late Cretaceous in age and part of Bulkley Intrusive Suite.

At kilometre 15.7 is the start of the Little Joe trail which is a popular hiking trail in the Babine Mountains Provincial Park.

At kilometer 16.5 there is a good view to the right towards Little Joe creek. Mountains in distance are capped by Late Cretaceous Kasalka Group volcanic rocks.

***Stop 12 - Viewpoint: Southwest tilting of fault blocks along northeast fault structures and exposure of the Takla-Hazelton contact (644593E, 6080294N) .***

At around 17.85 kilometres there is a pull off on the right side of the road at the beginning of an old, decommissioned logging road. At this point on the Smithers Landing Road we are in McKendrick pass. This pass is a major northeast trending fault zone that cuts through the Babine Range. Mt. McKendrick, which we can see (weather permitting) looking south from our vantage point, is an uplifted fault block of late Triassic to early Jurassic volcanic rocks that has been tilted to the southeast.

Mid-Cretaceous sedimentary rocks of the Skeena Group crop out within the pass and on the north slope. This implies several hundred metres of stratigraphic offset along the McKendrick fault. Fault movement probably took place during a period of Eocene or younger extension.

Rocks exposed on the north face of Mt. McKendrick are greenstones cut by leucogranite sills. The greenstone and leucogranite sills are interpreted to be late Triassic or older. Attempts to date the sills were not successful. A heterolithic boulder conglomerate with leucogranite clasts overlies the greenstone and crops out at the top and on the flanks of the mountain. Maroon lapilli tuffs of the early Jurassic Telkwa Formation overlie the conglomerate further to the south. Bedding-cleavage intersections and small scale fold structures in the tuffs suggest a large anticlinal structure with a fold axis plunging to the southeast. The north face of Mt. McKendrick is a cross section through this anticline.

Southeast plunging fold axes are common in the southern half of the Babine Range where asymmetric, overturned fold structures have been recognized. These folds involve rocks as young as early late Jurassic (Oxfordian).

In the northern part of the Babine Range and elsewhere in the Babine Lake - Smithers area, folded Oxfordian rocks are unconformably overlain by less deformed mid-Cretaceous Skeena Group sediments. Slaty and crenulation cleavage in the Jurassic rocks is also cut by intrusions that give late Cretaceous isotopic ages further constraining the deformation. Folding in the Babine Range is probably related to a post mid-Jurassic - pre Mid Cretaceous contractional event that resulted in extensive uplift and erosion prior to deposition of Skeena Group rocks in mid-Cretaceous time. The fold structures in the Babine range are probably related to development of the Skeena fold and thrust belt recognized further north in the Bowser Basin (Evenchick, 1990).

The white weathering outcrop immediately northwest of the road is a conglomerate that has been intensely silicified. This conglomerate is part of the mid-Cretaceous Skeena Group. Silicification may be related to hydrothermal activity centered on the McKendrick Pass fault.

At kilometers 18.6 and 19.3 are small outcrops of sandstone and siltstone. These sedimentary rocks are mapped as part of the Lower Cretaceous Skeena Group and are in the downdropped fault block north of the McKendrick fault zone.

At the pullout on the north side of the road, just past the bridge at approximately kilometer 23 from the Granisle Connector road junction (and just before the 27 kilometre marker measuring the distances from the junction with Highway 16) there are good views of Mt. McKendrick and the Babine Range. Looking north we can see (weather permitting) Mt. Hyland in the distance. The grey weathering cliffs near the summit of Mt. Hyland are late Cretaceous Kasalka Group porphyritic andesite flows.

At kilometer 24.7 is the start of the Canyon Creek cross country trail on the south side of the road.

At kilometer 27 on the south side of the road is the parking lot for the start of the Dome Mountain trail.

At around kilometer 28.3 is the junction with the old Babine Lake road. Stay left.

***Stop 13 – Viewpoint: The Big Onion porphyry copper deposit and tilted fault blocks in the Babine Range (636764E, 6071393N).***

At around kilometre 36 (14 kilometres from Highway 16) there is a road entering from the south. Park at this intersection. From here we get a good view north toward Astlais Mountain which is an uplifted fault block of Lower Jurassic Telkwa Formation volcanic rocks that has been tilted to the west, possibly by a thrust fault. The prominent, orange weathering gossan in the middle of the mountain corresponds to the extent of quartz-sericite-pyrite alteration at the Big Onion porphyry copper prospect. This prospect has been drilled by several different companies over the past thirty years. Mineralization is associated with a northeast trending porphyritic quartz diorite dike that intrudes an earlier quartz-feldspar porphyry intrusion. Carter (1981) reports that biotite from a post mineral dike gave a K-Ar isotopic age of  $49.5 \pm 1.9$  Ma. However, the mineralization may be older.

At a cutoff grade of 0.25% copper equivalent, Big Onion is estimated to contain 76 million tons grading 0.397% copper equivalents at a stripping ratio of 2.18:1. Unlike most B.C. porphyry deposits, Big Onion does have significant supergene enrichment.

At kilometre 36.9 on the south side of the road is a poorly exposed outcrop of what has been mapped as Cretaceous diorite. The shoulders here are narrow so caution must be taken if stopping at this outcrop. A little further along the road we get good views to the north of the Babine Range and Astlais mountain.

At the cattleguard at approximately 40 kilometres from the Granisle Connector junction and we begin our decline into the Bulkley valley. Over the next 2 kilometers we have a panoramic view of the valley, the Telkwa Range to the southwest and Hudson Bay mountain to the northwest. The Bulkley valley is a north trending graben, filled with mid-Cretaceous Skeena Group and Eocene Driftwood and Canyon creek sedimentary rocks. These rocks were tilted and folded during an Eocene or younger tectonic event. The Telkwa Range is the type area of the Lower Jurassic Telkwa Formation of the Hazelton Group. The massive, cliff forming unit that forms the major peaks visible from the highway are basalt flows that are flat to gently west-dipping.

These flows are overlain by a discontinuous, relatively thin felsic pyroclastic member. On the west slope of the Telkwa Range, the Telkwa Formation is overlain by red air fall tuffs of the Toarcian Eagle Peak formation (formerly Red Tuff member of the Nilkitkwa Formation). These are overlain by Bajocian feldspathic wacke and siltstone beds of the Smithers Formation and finer-grained, deeper water Bathonian to Oxfordian siltstones and argillites of the Ashman Formation. The lower Jurassic Nilkitkwa Formation, which is several 100 metres thick further east in the Babine Range, is thin or absent in most of the Telkwa Range. Where it is present in the Telkwa River area it is a shore line facies with abundant petrified wood debris. At the same stratigraphic position are limestone patch reefs. Reefs of this type are very rare in rocks of Jurassic age.

**At around 44.25 kilometres turn left onto Telkwa High road. Follow this road for 1.4 kilometres and turn left onto the Tyee Lake Road. Follow this road for 4.7 kilometres and turn left onto Hislop Road.**

***Stop 14 - Feldspathic wacke and siltstone of the Middle Jurassic Smithers Formation (629748E, 6065481N)***

At around 6.3 kilometres up Hislop Road turn right onto Fir road. Approximately 200 metres from this intersection is a small outcrop on left. Pull off road just past outcrop on the left side.

This small outcrop is one of the few localities in the Smithers area where the Smithers formation is exposed and easily accessible. The feldspathic wacke and siltstone exposed here is typical of the Smithers formation. A few belemnite holes and bivalve casts can be found in the rubble lying on the outcrop.

The Smithers formation is the uppermost member of the Hazelton Group succession. In the Smithers area the Smithers Formation sits on red tuffs of the Toarcian Eagle Peak formation (formerly Red Tuff member of the Nilkitkwa formation). It is a shallow marine succession that is often rich in bivalve and ammonite fossils. Fossil ages are Middle Jurassic and range from Aalenian to Bajocian. On Ashman ridge west of Smithers and elsewhere in the Bulkley valley area, the Smithers formation grades up section into finer grained, deeper water marine sediments of the Middle to Upper Jurassic Ashman formation.

Return to the Smithers Landing road and turn left. At the junction with Highway 16 turn south toward Telkwa and Houston. At the main intersection in Telkwa turn right and park just before the bridge that crosses the Bulkley River.

***Stop 15 – North dipping Lower Cretaceous Skeena Group sandstone at the Telkwa bridge crossing (625542E, 6062598N).***

Outcrops on the east side of the bridge crossing the Bulkley River are light brown weathering, thick bedded sandstones that are mapped as part of the Lower Cretaceous Skeena Group. These rocks have been uplifted and possibly folded during formation of the Skeena Fold and Thrust belt in Mid-Cretaceous time. Some carbonaceous organic debris can be seen on bedding planes. These rocks are the same age as those hosting the important Telkwa coal beds further west up the Telkwa River valley.

**From Telkwa drive west onto Highway 16. After crossing the bridge over the Bulkley river turn south onto Tatlow road and follow the signs to the Hudson Bay Mountain Ski Resort.**

**Reset odometer to 0.0**

***Stop 16 – Lower Jurassic Telkwa Formation on the Hudson Bay Mountain Ski Hill Road (616123E, 6066085N)***

At approximately 5.3 kilometres on the Hudson Bay Mountain Ski Hill road is a large outcrop on the north or right side of the road. The rocks exposed in this road cut are typical maroon to red weathering tuffs of the Lower Jurassic Telkwa Formation. The strata here are dipping moderately to the east. This orientation is typical of the east side of Hudson Bay mountain. On the west or back side of the mountain the Telkwa Formation is thrust over an overturned syncline of Middle Jurassic sedimentary rocks of the Smithers Formation.

At kilometre 8.3 is a viewpoint on the left that offers good views east across the Bulkley valley toward the Babine Range in the distance.

At kilometre 9.2 is another outcrop of maroon to red tuffs of the Telkwa Formation.

At kilometre 15.5 is the junction with the McDonnell lake road. Stay to the right and continue up the Hudson Bay Mountain Ski Hill Road.

At kilometres 18.0, 18.4, 18.5 and 19.1 are outcrops of Telkwa Formation tuffs.

At kilometre 19.3 a road branches off to the right going to the base of the chairlift. Stay left and continue up hill.

***Stop 17 - Felsic pyroclastic rocks of the Lower Jurassic Telkwa Formation (613191E, 6069522N).***

At approximately kilometre 19.7 is an outcrop on the right at sharp bend in the road. Pull off at the bend and walk up road looking at outcrops in a stripped area and along the road cut.

The rock exposed in the stripped area beside the road and in adjacent road cuts is predominantly a volcanic breccia or agglomerate with subrounded to flattened medium grey quartz-feldspar phyric dacite clasts. The matrix of the breccia is light grey feldspar phyric dacite. Further up the road these rocks are seen to be interbedded with red to maroon weathering air fall tuff. The felsic pyroclastic rocks are interpreted to be ash flows that were deposited during a period of localized explosive volcanism late in the depositional history of the Telkwa Formation. The felsic pyroclastic succession, which underlies the summit and east slope of Hudson Bay mountain, is several hundred metres thick and dips moderately to the east. Locally this unit is referred to as the Ski Hill rhyolite because of excellent exposures in the vicinity of the ski hill. Zircons extracted from a sample collected at the top of the ski hill gave a  $194.8 \pm 0.6$  U-Pb isotopic age (R. Kirkham, pers. comm. 1997; dating by Jim Mortenson; unpublished). Similar rocks are found in the Telkwa Range to the south and in the Howson Range to the southwest, where they conformably overlie a thick succession of amygdaloidal basalt flows of Sinemurian age. Felsic pyroclastic rocks also occur sporadically at this stratigraphic position in the Babine Range on the east side of the Bulkley valley but are absent further

east in the Babine Lake area. In the Telkwa Range the felsic pyroclastic member of the Telkwa Formation is overlain by early Pliensbachian marine sediments of the Nilkitkwa Formation but on Hudson Bay Mountain it is unconformably overlain by mid-Cretaceous sedimentary rocks of the Skeena Group. On the west side of Hudson Bay mountain the Telkwa Formation is thrust westward over an overturned syncline cored by Middle Jurassic marine sediments of the Smithers and Ashman Formations. The Skeena Group sediments are also involved in this deformation suggesting thrusting is mid-Cretaceous or younger.

***Stop 18 – Red lapill tuffs with angular rhyolite clasts (612860E, 6069594N)***

At kilometre 21.0 just past stop 17 there are red weathering hematitic lapilli tuff with angular rhyolitic clasts. These air fall tuffs are interbedded with grey ash flows of the upper Telkwa Formation. The rocks at this locality formed as air fall ash deposits related to nearby volcanic eruptions. The red colour is due to oxidation that occurred after the ash was deposited. The ash deposits are interbedded with the grey ash flows that are also exposed along the ski hill road. Originally the GSC mapped these rocks as the uppermost part of the Telkwa Formation. This unit may be equivalent to the Eagle Peak Formation mapped further west by the BCGS in 1989. This formation is the same age and is comprised of interbedded red tuff and grey ash flows similar to those exposed here along the Ski Hill road. The Eagle Peak formation is equivalent to Tipper's Red Tuff member of the Nilkitkwa Formation.

Continue up the ski hill road to the first parking lot at the Ski Smithers day lodge. Turn around here and return down the ski hill road toward Smithers. At the junction with the McDonnell Lake Road turn right and follow this road to McDonnell Lake.

***Stop 19 – Fossil rich beds of the Middle Jurassic Smithers Formation near McDonnell Lake (586466E, 6072128N)***

Follow the McDonnell Lake forest service road to the 7029 road sign (kilometre 29). Outcrops next to the road are greenish siltstone with a wide variety of fossils including pelecypods, brachiopods, ammonites and belemnites. These fossils indicate a Middle Jurassic age. The coarse clastic nature of these rocks and the variety of fossils indicate these rocks were deposited in a shallow marine environment probably close to a shoreline.

Return to the Hudson Bay Mountain Ski Hill Road. At the last switchback going down into the Bulkley Valley turn right onto Ptarmigan Road then at 0.8 kilometres turn onto the Wood Creek forest service Road.

***Stop 20 – Quartz-feldspar-hornblende porphyry of the Late Cretaceous Bulkley Intrusive suite (618003E, 6065389N)***

Approximately 0.4 kilometres up this road is a stripped area on the right side of the road that has exposed grey weathering, medium grained, quartz-feldspar-hornblende porphyry. These rocks have been mapped as part of the Late Cretaceous Bulkley Intrusive Suite. Similar intrusive rocks occur as dykes and small plugs on Hudson Bay Mountain and probably are connected to a large body of granodiorite that occurs in the core of the

mountain. This larger intrusion was intersected in the underground workings and diamond drilling done at the Davidson Molybdenum deposit. Outcrops of the porphyritic grandiorite are also exposed at the toe of the Hudson Bay Mountain glacier which has been retreating over the last few decades.

### **Return to Smithers and Highway 16.**

On this leg of the geotour we will travel north along the Bulkley river to Hazelton on Highway 16. Along this route we pass through a series of north trending grabens filled with tilted and folded mid-Cretaceous to Eocene volcanic and sedimentary rocks. We will stop first at Glacier Gulch where mid-Cretaceous Skeena Group sedimentary rocks overlie and are in fault contact with the Telkwa Formation. Next, we will examine Eocene rocks at Moricetown, followed by the late Cretaceous Brian Boru volcanics of the Kasalka Group near Beamont and Rocky Ridge volcanic rocks further north toward Hazelton.

### **Driving north from Smithers turn left onto Lake Kathlyn Road then left onto Glacier Gulch road and follow the signs to the Twin Falls.**

At around 3.6 kilometres on the road to the Twin Falls there is a scree slope on the left. Rock from this site is used locally as building stone and road fill. Pull off and park at the gate.

### ***Stop 21 - Hornfelsed Lower Cretaceous Skeena Group near the Glacier Gulch porphyry molybdenum deposit (610891E, 6076712N)***

The rock in the scree slope is predominantly pyritic, hornfelsed, sedimentary rocks of the mid-Cretaceous Skeena Group. These rocks are downdropped into the Bulkley graben. The same rocks occur at much higher elevation on the steep east facing slope of Hudson Bay mountain where they overlie Telkwa Formation volcanics.

Looking west we see the twin falls of Glacier gulch and above the falls the toe of the Hudson Bay mountain glacier. Rocks on either side of the glacier are orange weathering due to the oxidation of abundant disseminated pyrite. This pyritic zone defines the extent of hydrothermal activity related to formation of the Glacier Gulch porphyry molybdenum deposit in late Cretaceous time. This deposit, which lies beneath the glacier and ridge to the south, has been periodically explored since the late 1960's. Drilling has been done mostly from underground workings.

At around 4.2 kilometres is the B.C. Forest Service recreation site parking lot. The trail to the twin falls starts at the end of the parking lot.

### **Return to Lake Kathlyn road and turn left toward Highway 16. At the junction with Highway 16 turn left toward Hazelton.**

### **Reset trip odometer to 0.0.**

As we travel north toward Hazelton on Highway 16 we get good views of Hudson Bay Mountain to the southwest, Rocky Ridge to the west and Brian Boru peak to the northwest.

### ***Stop 22 – Viewpoint: Geology of the Rocher Déboule Range from Rocky Ridge to Brian Boru Peak (610633E, 6086341N)***



At approximately 8.3 kilometres from the junction of Lake Kathlyn Road and Highway 16 is the Paul Lychak Community Centre. Turn right and stop in front of the hall. From here we have excellent views (if the weather is good) of Hudson Bay Mountain to the southwest, the Rocher Déboule Range to the northwest and the Babine Range to the east. Between them is the Kitsequecla valley which is a down dropped block or graben of late Jurassic Trout Creek chert pebble conglomerates intruded by a dike like body of feldspar porphyry dated at 70 ma.

To the north of the valley is Rocky Ridge, a prominent serrated ridge that is underlain by resistant subaerial feldspar-pyroxene phyric basaltic-andesite flows and related debris flows or lahars of the Rocky Ridge Formation. These volcanics overlie sedimentary rocks of the Kitsuns Bulkley Canyon formation of the Lower Cretaceous Skeena Group and are overlain by red bed sediments and chert-pebble conglomerates of the Red Rose (Rocher Déboule) formation. The succession on Rocky Ridge has been overturned to the north.

The large peak to the northwest is Brian Boru peak which is mainly Late Cretaceous Brian Boru volcanics (Sutherland Brown, 1960). These volcanics, which are correlated with the Upper Cretaceous Kasalka Group, underlie a large part of the Rocher Déboule range and are believed to be the erosional remnants of a Late Cretaceous volcanic basin or caldera that was subsequently uplifted in Eocene or younger time. Similar rocks underlie the area north of Mt. Cronin in the Babine Range. Further north in the Rocher Déboule range are Tiltusha, Red Rose and Hagwilget peaks all of which are cored by porphyritic granodiorite of the Late Cretaceous Rocher Déboule stock (Sutherland Brown, 1960).

At approximately 13.2 kilometres is the bridge over Trout Creek. At approximately 700 metres beyond the bridge is an outcrop on the left of Upper Jurassic Trout Creek sedimentary rocks.

Looking north along Highway 16 we can see a steep sided, flat topped hill that is comprised of gently dipping Eocene basalt flows. These flows sit on folded sedimentary strata of the mid Cretaceous Skeena Group.

**At around 15.2 kilometres is the junction with Kitsequecla Lake road. Turn left and follow the road towards Kitsequecla Lake**

***Stop 23 – Mid Cretaceous (?) rhyolite intrusion (600343E, 6089708N)***

At around 7.8 kilometres on the Kitsequecla Lake road is a scree slope and borrow pit on the right side of the road. The scree slope is comprised of white to grey weathering fine-grained rhyolite that forms a large west trending elongate intrusive body south of Rocky Ridge. This rhyolite has not been dated at this locality. Elsewhere in the Babine Lake area lithologically similar rhyolites have yielded U-Pb dates around 103-104 Ma. The Kitsequecla rhyolite may also be of this age.

Return to Highway 16 and turn left towards Hazelton

Morictown (Witset) view point. Pull off on the right.

***Stop 24 - Paleocene volcanics and sedimentary rocks at Morictown (Witset) and Eocene or younger folding (606864E, 6097602N)***

At the Moricetown (Witset) view point next to the information kiosk we have a view of the Moricetown rapids, a traditional fish gathering location for the Wet'suwet'en people. The rocks that constrict the Bulkley river here are mapped by Richards (1990) as the Moricetown volcanics which are believed to be Paleocene in age. Continue across the river to the parking lot just past the bridge. Outcrops below the parking lot are typical of the Moricetown volcanics. Various lithologies are present with andesite flows and flow breccia interbedded with sandstone, conglomerate, siltstone, shale and epiclastic volcanic sediments. Minor coal is also present. Most clasts appear to be derived from the late Cretaceous Kasalka Group. These Paleocene rocks are preserved within a north trending graben that follows the Bulkley river from here to just south of Bulkley Canyon. The Moricetown beds, like the underlying Skeena Group have been folded with fold axes trending northwest, further evidence for an Eocene or younger contractional event.

### **Return to Highway 16 and turn right toward Hazelton**

As we drive north toward Hazelton we get good views of Mount Seaton to the northeast. This uplifted block is comprised of moderately west dipping strata of the Upper Jurassic to Lower Cretaceous Bowser Lake Group. On the north side of Mount Seaton is Luno Creek which cuts through a large Late Cretaceous Bulkley intrusion. The rusty weathering rocks on Mt. Seaton are hornfelsed and contain disseminated pyrite.

### ***Stop 25 - Brian Boru volcanics of the Upper Cretaceous Kasalka Group (603215E, 6107857N)***

At approximately 11 kilometres from Moricetown pull off the road into a borrow pit on the right side, just past the East Boulder creek bridge.

The road cuts here are porphyritic andesites, lahars and thin bedded tuffaceous volcanic sediments of the Upper Cretaceous Kasalka Group. There is a well defined, northeast dipping contact between a 10 metre thick interval of dark grey, well bedded tuffaceous rocks and overlying light grey porphyry flows exposed on the west side of the road. At the base of the porphyry is a thin red tuff horizon. The porphyry, which is comprised of 25-30%, equant, 5-8 millimetre feldspar phenocrysts in a finer grained groundmass is typical of the Kasalka Group as defined in the type area near Tahtsa Lake (MacIntyre, 1985). The same rocks are found at higher elevations in the Babine Range.

At approximately 15.4 kilometres from Moricetown there are a series of rusty cream coloured outcrops of argillic altered volcanics (Kasalka?) containing disseminated pyrite exposed in the road cuts. The alteration and sulphide mineralization here is peripheral to a porphyry stock that underlies the area east of the river. The altered rocks have elevated concentrations of Pb and Zn. Drilling of the porphyry stock failed to intersect significant copper or molybdenum grades. The alteration displayed by the rocks along the road is interpreted to be high level and is similar to that found associated with subvolcanic intrusions at Buck Creek in the Houston area and Coles Creek, south of Tahtsa Lake.

### ***Stop 26 – Viewpoint and outcrops of basaltic andesite of the mid Cretaceous Rocky Ridge volcanics (602832E, 6115357N).***

At approximately 18 kilometres from Moricetown there is a viewpoint pull off on the right. This viewpoint offers good views of the Bulkley River. Road cuts across the highway from the viewpoint are dark greenish-grey weathering feldspar-augite pyritic

basaltic andesite flows that are interpreted to be part of the mid Cretaceous Rocky Ridge volcanics. It should be noted that Sutherland-Brown (1960) placed these rocks in the Brian Boru formation. Use caution when crossing the highway to view the road cuts.

***Stop 27 – Kitsuns Creek member of the Bulkley Canyon formation of the Skeena Group and overlying Rocky Ridge(?) volcanics (602293E, 6116465N).***

At approximately 19.5 kilometres from Moricetown there is a pulloff to the right at the end of a 900 metre continuous outcrop exposed in the road cuts on the left side of the highway. Cross the road and walk back to the start of outcrop using caution when crossing Highway 16.

The first part of the outcrop here is medium to thick bedded quartzo-feldspathic sandstone, siltstone and granule conglomerate that may correlate with the Albian to Cenomanian Kitsuns Creek member of the Bulkley Canyon Formation of the Skeena Group as defined by Bassett and Kleinsphen (1996). As seen at the start of outcrop, the strata dip moderately to the south with trends varying from 074 to 115 degrees. As we walk south and up stratigraphic section the rocks become coarser grained with increasing number and thickness of pebble and boulder conglomerate beds.

Clasts are a mix of chert, quartz, feldspar phiric volcanics, rhyolite and siltstone with the percentage and angularity of rhyolite clasts increasing up section. Several white weathering, argillic altered beds with an abundance of rhyolite clasts occur in a faulted interval. South of the fault zone are chloritic mafic volcanics that are probably correlative with the alkali basaltic rocks of the Rocky Ridge succession. The upward coarsening of sedimentary beds and increasing abundance of rhyolite clasts in the Skeena succession suggests a period of active tectonism and explosive rhyolitic volcanism occurred prior to the main episode of Rocky Ridge volcanism. In the Babine Lake area rhyolite domes occur in this part of the Skeena succession and have given 104-107 Ma U-Pb isotopic dates (MacIntyre, D.G., Webster, I.C.L and Villeneuve, M. 1997). There may be potential for volcanogenic massive sulphide deposits associated with felsic volcanic centers.

Bassett and Kleinsphen (1996) suggest the Rocky Ridge volcanics represent an early stage continental arc that formed during a period of intra arc extension in the Intermontane belt. The lack of evidence for a western provenance for detritus, progression to deeper water sedimentary facies westward and current paleomagnetic reconstructions for the Insular terrane suggest the Rocky Ridge arc was open to the ocean along its western margin. Using facies interpretations, paleocurrent indicators and major and trace element geochemistry they propose a model where the Rocky Ridge volcanics erupted on the forearc side of the southern Omenica Belt and Idaho Batholith and were subsequently moved 1100 kilometres north to their present latitude. For a more detailed discussion see Bassett and Kleinsphen (1996).

**At approximately 23 kilometres from Moricetown turn right onto the Suskwa forest service road.**

***Stop 28 –Borrow pit exposure of the Lower Cretaceous Bulkley Canyon formation of the Skeena Group (598903E, 6120538N)***

At approximately 1.6 on the Suskwa forest service road there is a borrow pit on the left side of the road, immediately after crossing over the Bulkley River. The borrow pit exposes south dipping beds of pebble conglomerates interbedded with siltstone, sandstone and mudstone. Carbonaceous wood fragments are common. These rocks are mapped as part of Bulkley Canyon formation of the Skeena Group as defined by Bassett and Kleinsphen (1996). The strata here dip towards the south.

**Return to Highway 16 and turn right toward Hazelton. In Hazelton turn right toward Old Hazelton and K'san village.**

***Stop 29 – Viewpoint of the Bulkley River canyon and Hagwilget peak (588876E, 6124103N)***

At 1.2 kilometres there is pullout on the right side of road to Old Hazelton, just before the bridge crossing over the Bulkley River 1.2 km - Hagwilget lookout just before bridge crossing. Below us the Bulkley river cuts through a steeply dipping assemblage of deltaic sedimentary rocks of the Bowser Lake Group. This vantage point is located at the confluence of three major graben structures - the Bulkley River graben to the east, the Skeena to the south and the Skeena-Kispiox to the north.

***Stop 30 - View of Hagwilget Peak from K'san village (585534E, 6124270N).***

At around 7.2 kilometres from the junction with Highway 16, turn left into the parking lot for the K'san village. To the south the uplifted horst block of the Rocher Déboule Range shows the prominent escarpment of the Hagwilget Peak underlain by granodiorite dated at 72 Ma that intrudes marine deltaic rocks of the Bowser Lake Group.

The horst block is bounded on the west and east flanks of the range by grabens containing Brian Boru volcanics of the late Cretaceous Kasalka Group.

North of Hazelton there are numerous small knob-like exposures of rhyolite to diorite dikes and plugs ranging in age from 55 to 72 Ma that intrude late Jurassic to early Cretaceous Skeena Group sedimentary rocks.

**Return to Highway 16 and turn left toward Moricetown.**

**In Moricetown turn left onto the Telkwa High road**

***Stop 31 – Steeply dipping beds of the Bulkley Canyon formation of the Lower Cretaceous Skeena Group (612145E, 6089743N)***

At approximately 19.8 kilometres on the Telkwa High Road there is a prominent outcrop on the left side of the road. Here dark grey carbonaceous siltstones are interbedded with poorly sorted pebble conglomerate with black rounded clasts. The strata here are steeply dipping to north. These rocks are part of the Bulkley Canyon Formation of the Lower Cretaceous Skeena Group as defined by Bassett and Kleinsphen (1996).

**At approximately 30 kilometres from Moricetown turn left off the Telkwa High road just past the Glenwood Hall and follow the signs to the Driftwood Canyon Provincial Park.**

***Stop 32 – Early Eocene fossil beds at the Driftwood Canyon Provincial Park (626990E, 6077125N).***

At approximately 4 kilometres turn right into the parking lot. Follow the well marked trails to the viewing platforms at the fossil beds. Note: access to the fossil beds is restricted and it is not permitted to collect samples. These light grey to cream coloured, thin bedded shales, siltstones and mudstones were deposited in an anoxic lake which enhanced preservation of organic material. Moss et al. (2005) report an unpublished U-Pb radiometric age of  $51.77 \pm 0.34$  was obtained from a prominent ash layer indicating the sedimentary rocks are early Eocene in age and therefore the same age as the Newman formation volcanic rocks at Babine Lake. The beds have yielded a rich collection of fossil fish, insect and plant specimens. In 2014 it was reported that the fossil jaws of a tiny hedge hog and a tapir were found. These are the first mammals ever identified in Canada south of the Arctic from the early Eocene epoch.

Return to junction with the Telkwa High Road and turn left. Continue 1.9 kilometres to the junction with the Old Babine Lake road

***Stop 33 – Lower Cretaceous Skeena Group in Canyon Creek (623997E, 6073037N)***

Stop at the bridge over Canyon Creek approximately 1.4 kilometres from the Telkwa High road-Old Babine lake road intersection. There is a well exposed outcrop of medium to dark grey well bedded siltstone and sandstone that dips moderately to the east. These rocks are mapped as part of the Bulkley Canyon formation of the Lower Cretaceous Skeena Group. These tilted beds are further evidence that Lower Cretaceous and older strata in the Bulkley valley graben were uplifted and folded during a pre mid Cretaceous contractional tectonic event.

**Return to Smithers via the Old Babine Lake Road.s**

**End of Geotour**