Photo 31. Looking northwest at the most northerly exposure of carbonate of unit Cc found along the Split Top Mountain thrust fault. This photograph clearly shows the cliff-forming nature of this lithology. This panel shows internal folding along the edge of the thrust fault and there are indications that it is also cut by another thrust to the east.

Photo 32. View to the southeast from the eastern slopes of Brownie Mountain. Split Top Mountain is the isolated peak at the right of the skyline. This picture shows the well exposed nature of unit Cc which delineates several thrust panels in this locality.
Age and Correlation of Units Cc and Ccs

No fossils were recovered from carbonates or siliciclastics of this package within the map area. The age of these rocks is based on correlations with similar lithologies farther to the south. Fritz (1980a) describes two sections of Cambrian rocks 50 and 80 kilometres south of the study area, near the headwaters of the Gataga River. These sections are dominated by siliciclastics in the lower parts and succeeded by clean carbonates, a sequence not unlike Csc and Cc in the Terminus Mountain area. Late Early Cambrian fossils were recovered from the base of the carbonate at one locality. Late Cambrian fossils were collect from the upper parts of both sections, although the top of one section is Dresbachian in age, whereas the other extends upwards into the Trempealeauan. In our study area, polymictic conglomerate and maroon beds of probable early Middle Cambrian age are exposed below carbonate of unit Cc, suggesting the base of the unit, like the top, may be diachronous.

Unit Cc essentially corresponds to Gabrielse’s (1962a) unit 5. These carbonates can be traced into the Driftpile Creek and Akie River areas where McClay et al. (1988) and MacIntrye (1992, 1998) describe thick carbonate sequences at the top of the Cambrian succession. Gabrielse et al. (1977) also describe thick, isolated carbonate buildups of Middle and Late Cambrian age in the southern Kechika Trough. As Fritz (1991) has pointed out, these carbonates are essentially the northward extension, albeit somewhat more condensed, of the well known Middle and Late Cambrian carbonate succession that comprise the spectacular peaks of the Eastern and Main ranges of the central Rocky Mountains.

North of 60°, thick sections of Middle and Late Cambrian carbonates reappear along the Mackenzie platform and comprise dolostone of the Avalanche Formation and dolostone, limestone and siliciclastics of the Broken Skull Formation (Gabrielse et al., 1973; Gordey and Anderson, 1993).

ENVIRONMENT OF DEPOSITION AND TECTONIC SIGNIFICANCE OF CAMBRIAN STRATA

Overall, Cambrian lithologies in the eastern and northern parts of the map area are more pelitic, finer grained, and much less calcareous than those exposed in the highlands along the southwestern or southeastern margin. Restoration of shortening represented by thrusting and folding would probably result in a considerable separation between the two depositional environments. A preliminary interpretation of these observations is that Early Cambrian facies in the southwestern part of the map area represent a relatively shallow-marine to intertidal setting, with sedimentation fluctuating between coarse siliciclastic and carbonate deposition, resulting in interfingering lithological units. In contrast, the contemporaneous sedimentation represented by the Cambrian rocks farther east probably took place in deeper water and under more uniform conditions. This latter environment received periodic influxes of coarse carbonate debris shed from buildups to the west.

This sedimentation was interrupted at the beginning of the Middle Cambrian by uplift along steep faults, probably related to extensional tectonism and possibly linked to
alkaline volcanism represented by unit CPv. This tectonism led to the deposition of the coarse fanglomerates and ma-roon beds of units Ccq and Ccqgm. More stable conditions returned to the area with sedimentation dominated by shallow-water carbonate deposition which may have been localized along the tops of rotated blocks produced during the early Middle Cambrian tectonism. Water was relatively deep between carbonate build-ups, resulting in starved shale basin deposition.

Similar regional facies variations in Lower, Middle and Upper Cambrian successions have been documented else-where in the Selwyn and Kechika basins (Gabrielse, 1981; Fritz, 1979, 1991; Taylor et al. 1979; Gordey and Anderson, 1993). Siliciclastic to carbonate facies variations within the platformal sections of the Early Cambrian Sekwi Formation are well documented in the Selwyn Basin as is its basinward change into the Gull Lake Formation (Fritz, 1991; Gordey and Anderson, 1993). The Lower Cambrian facies distribution represented by units Cs and Csc suggests that the west-ern edge of the Kechika Trough may have been located within the map area during this time.

In the southern Kechika Trough, Gabrielse (1981) doc-umented the existence of six facies within rocks of Middle (and Late?) Cambrian age. These included thick carbonates in a platform or northwest-trending linear reef configuration surrounded by shale, siltstone, sandstone and platy lime-stone of clastic or starved basin settings. Sections of olistostromes and debris flows were also found between ar-eas of large carbonate build ups.

In the Ware map area, along the eastern margin of the Kechika Trough, up to four facies sequences were recog-nized in the Middle Cambrian (Taylor et al., 1979; Fritz; 1979, 1991). A complete description is beyond the scope of this paper, but these facies describe the presence of a north-trending trough (Fritz, 1979) and are very similar to Middle and Upper Cambrian lithologies observed in the course of this study. The trough received detritus, some of which has a distinct red colour, from uplifted areas around it. In some localities the redbeds consist of coarse red-weathering conglomerate which can be related to large normal faults. These coarse clastics are succeeded locally by thick sections of limestone or dolomite which can be shown to shale-out westward. Carbonate deposition is believed to have been restricted to the shallower parts of up-lifted blocks towards the west (Fritz, 1979).

Our observations are entirely consistent with the extensional tectonism and sedimentation described in the southern Kechika Trough. Furthermore, if alkaline volcanics of unit CPv are Middle Cambrian as theorized, then they would lend further support to this time being a period of ma-jor extensional tectonism within the northern part of the an-cestral North American miogeocline.

**Kechika Group (COK,COKS)**

The name Kechika Group was first proposed by Gabrielse (1963) in the Cassiar Mountains and was later used by Jackson et al. (1965) to describe Upper Cambrian to Upper Ordovician strata in the Trutch and Ware map areas and in the Tuchodi Lakes map area by Taylor and Stott (1973). Middle and Upper Ordovician strata of the Kechika Group that lie east of the Northern Rocky Mountain Trench were later reassigned to the overlying Road River Group. The present application of the term ‘Kechika Group’ to argillaceous carbonates and shales of Late Cambrian to Early Ordovician age in Kechika Trough was first used by Gabrielse et al. (1977) in the Ware map area. Cecile and Norford (1977), working in the east half of the Ware map area, suggested that this unit be termed a formation. Considering the facies variation within this package, group status is probably more appropriate and will accommodate any future subdivisions.

Rocks of the Kechika Group, like the underlying Mid-dle to Upper Cambrian carbonates of unit Cc, exhibit a marked facies change and thinning from southeast to north-west in the southern part of the study area. This transition is quite abrupt and roughly corresponds to the disappearance of the underlying thick sequences of Lower to Upper (?) Cambrian limestone and quartzite. Sections of Kechika Group are calcareous and approximately 500 metres thick along the southeastern margin of the study area and decrease northwestward, along strike, to less than 50 metres of dark slate. A maximum of only 50 metres of Kechika rocks is also found along the southern part of the Netson Creek thrust panel where Middle and Upper Cambrian carbonates are missing. These rocks thin further to the northwest and were recognized only locally in the lowlands south of Horneline Creek. Furthermore, it is sometimes difficult to determine if black slates between silstone of unit SDRR and siliciclastics of unit Cc are part of the Kechika Group or the lower Road River Group. This is particularly evident in the well exposed highlands east of Split Top Mountain, where Silurian rocks of the Road River Group are found less than 50 metres above Cambrian clastics and only black slates of possible Ordovician Road River affinity separate the two. The apparent absence of these thin, recessive rocks in the subdued regions to the north may be a function of the overall poor exposure in this area. North of Horneline Creek, the Kechika Group again thickens and becomes more calcareous. Structural sections suggest thicknesses upwards of 1000 metres. In the north, the Kechika Group contains thicker horizons of limestone and abundant calcareous siltstone, neither of which is well represented in the southern part of the map area.

Some of the thickest and best exposed sections of this unit are found in the south, between Terminus and Split Top mountains. Relatively good exposures crop out along northeast-trending ridges emanating from the high ground between Gataga and Terminus mountains. Outcrops are also found along the banks of many of the creeks throughout the map area. Only small, isolated outcrops are found along ridges or hilltops north of Horneline Creek and good exposures are only found along creek valleys.

South of Terminus Mountain, the Kechika Group is characterized by interlayered grey to dark grey, soft slate, calcareous slate or rare silty slate and grey, buff or orange-weathering, very finely crystalline limestone or dolostone (Photos 34, 35). The carbonate layers are generally discontinuous to lenticular and typically 0.1 to 2 centi-
metres thick, although locally they reach several metres in thickness. They comprise up to 50 per cent of the section locally but average 20 per cent. This facies is exposed above thrust panels of Cambrian limestone. The northernmost outcrop area of this lithology is on the lower slopes of the Rocky Mountain Trench, north of Terminus Mountain, where it is characterized by banded to mottled, orange to brown-weathering, grey to dark grey calcareous slate to silty slate. This facies of the Kechika Group covers a wide area east of Gataga Mountain, reflecting the northward plunge of the Brownie Mountain anticline. These rocks also cover a large area along the lower reaches of Matulka Creek. The thickness of Kechika slates and carbonates is difficult to determine due to strong deformation. Structural sections suggest upwards of 500 metres of Kechika rocks immediately south of Matulka Creek.

The base of the formation, where seen, is typically composed of 25 to 50 metres of black to dark grey slate with lenses or discontinuous layers of grey to orange-weathering limestone or dolomite. This is particularly well exposed along the top of unit Ce in the hangingwall of the Netson Creek thrust fault and west of Brownie Mountain. This sequence is very similar to thin Kechika sections seen resting directly on top of siliciclastics of unit Cs.

Immediately east and southwest of Brownie Mountain and south of the Gataga River, the Kechika Group is lighter coloured and typified by grey to silvery slate, calcareous slate and silty slate with lesser thin beds or lenses of grey limestone (Photo 35). In this area, Kechika slate has characteristic light and dark grey laminations resulting from increased silt and/or carbonate content within lighter coloured horizons. Thin interlayers of grey limestone, from 0.5 to 10 centimetres thick, are abundant in the lower 50 metres.

The calcareous nature of this facies of the Kechika Group is lost up-section and the upper half or one-third is characterized by grey to dark grey or black, blocky to shiny
fissile slate, with characteristic faint discontinuous, paler grey laminae. Thin, discontinuous or lensoidal beds of finely crystalline limestone are occasionally present in the lower part of this sequence. Sections of dark grey banded slate, up to 100 metres thick, occur in typical calcareous sections of lower Kechika slates west of Gataga Mountain and are probably infolded sequences of upper Kechika Group. These upper slates are difficult to differentiate from Ordovician Road River slates and have been grouped with them over most of the map area (see below).

East of the headwaters of Matulka Creek, the pale coloured and soft calcareous facies of the Kechika Group is recognized in only a few localities. Interlayered grey to buff-weathering, thinly bedded limestone and slate or calcareous slate outcrop along the top of the first ridge northwest of Netson Lake. These lithologies are exposed near the base of a sequence which passes upward through dark grey to black slate into black graptolitic slates of the Road River Group. This section appears to be several hundred metres thick.

Elsewhere in the central and southern parts of the map area, calcareous Kechika rocks are uncommon and a thin section of dark grey or black shale or slate and lesser carbonate, up to 50 metres thick, occupies the same stratigraphic position. Assignment of these rocks to the Kechika Group is based on their overall similarity to basal parts of thick Kechika sections seen sitting directly above Cambrian carbonate of unit Cc. These rocks are very similar to sections south of Horneline Creek; this thin, noncalcareous facies occurs above fine basinal siliciclastics of Cambrian age. This is in sharp contrast to the thicker, calcareous Kechika Group which is found above the thick Middle to Late Cambrian carbonate of unit Cc. The Kechika slates in this area have a characteristic siliceous and more dolomitic. The rocks consist of thinly interlayered grey to orange-weathering, calcareous slate and calcareous siltstone to fine sandstone, all of which are locally finely laminated to crosslaminated (Photo 36). Mica flakes are visible on some bedding surfaces. These rocks locally grade into silty limestone or dolostone. North of Gemini Lakes, grey to beige-weathering, dark grey, platy micritic limestone to argillaceous limestone forms sections up to 10 metres thick. This limestone is locally dolomitic, contains thin slate partings and displays a spaced cleavage in the more argillaceous parts. The Kechika Group in this area has similarities with equivalent strata to the east which is found closer to the platform edge.

The nature of the lower Kechika Group contact is equivocal. The Kechika Group appears to rest unconformably on Cambrian carbonates at several localities. Along the eastern foot of Brownie Mountain, the very base of the Kechika Group contains cobble-sized clasts(? or lenses(?) of carbonate similar to limestone in underlying unit Cc. A similar situation is seen in the southeastern part of the map area, along the footwall of the Netson Creek thrust, where basal Kechika slates contain blocks of the underlying Cambrian carbonate. Northeastward along the same thrust panel, uppermost carbonate units of unit Cc appear to grade into overlying basal slates and calcareous slates of the Kechika Group over a distance of approximately 1 metre (Photo 37a). The lower 5 to 10 metres of the Kechika Group contains discontinuous layers or lenses of grey carbonate up to 50 centimetres thick which are very similar to underlying carbonate of Cc. Fritz (1980) describes similar, apparently conformable relationships between these two units south of the Kechika River.

This relationship is also ambiguous where the thick Middle and Upper Cambrian carbonates are lacking and Kechika slates rest directly on slates and siltstones of unit Cs. This contact is well exposed east of Split Top Mountain where the first orange-weathering limestone beds of the Kechika Group overlie approximately 25 metres of dark grey to black slate which gradationally overlies Cambrian siliciclastics (Photos 37b, 39). These dark slates are similar
in appearance to slates interlayered with the overlying orange and grey limestones of the Kechika Group. The relationship here appears conformable.

Similarly, upper slates of the Kechika Group appear to grade into basal slates of the overlying Road River Group. The similarity of these two packages makes separating them difficult. This is particularly evident in areas where only the thin, slaty facies of the Kechika Group is present.

**Age and Correlation**

Micro and macrofossil collections made over the course of mapping suggest a Late Cambrian to Early Ordovician age for the Kechika Group (see Table 3a and b). No diagnostic fossils were recovered from the base and the top of this package. Graptolites within lower Road River Group, several metres above the upper contact of the Kechika Group, indicate a late Early Ordovician (early to middle Arenigian) age. Conodonts from the base of the Kechika Group, only a few metres above limestone of unit Cc, span Late Cambrian to Tremadocian (earliest Early Ordovician) time (locality F25; see Table 3a). This is in agreement with a regional Late Cambrian lower age range for the Kechika Group. Although several of the fossil collections extend into the early Middle Ordovician (Llandoverian), most suggest a late Early Ordovician age for the upper age range. This is again consistent with the highest beds of the group being Arenigian (B.S. Norford, personal communication, 1994).

Immediately south of the Gataga River, Fritz (1980a) collected fossils from the very base of the Kechika Group, and at the top of underlying carbonate equivalent to unit Cc. The data suggest a Late Cambrian age and also indicate the contact between the two units is diachronous. In one section, fossils indicate the contact is Dresbachian (early Late Cambrian), whereas collections from a nearby section suggest the top of the underlying carbonate is Trempealeauan (late Late Cambrian) in age.

The Kechika Group, and its equivalents, represent a widely distributed shelf and basin carbonate facies found along the entire length of the Canadian Cordillera. The name is used within the Kechika Trough, into the MacDonald and Kakwa platforms, and across the Northern Rocky Mountain Trench in the Cassiar platform (Gabrielse, 1963, 1998; Gabrielse et al., 1977; Cecile and Norford, 1979; Taylor et al., 1979; Taylor and Stott, 1973; Thompson, 1989). In the Mesilinka River map area, Gabrielse (1975) referred to this sequence as the Mount April Formation; one of the original two formations of the Kechika Group first proposed by Jackson et al. (1965) in the northern Rocky Mountains. Gabrielse’s (1966) unit 4 within the Watson Lake map area is in part, or entirely, equivalent to rocks of the Kechika Group. To the east, Gabrielse and Blussson’s (1969) unit 8 in the Coal River map area has the same age and lithologic character as rocks of the Kechika Group. These rocks can be traced northward into the Flat River and Glacier Lake map areas where they are termed the Rabbitkettle Formation (Gabrielse et al., 1973). This name has been applied to rocks of the same age and character over much of the Selwyn Basin (see Gordey and Anderson, 1993). Platform equivalents of these units are not preserved in the MacDonald and Kakwa platforms. Shallow-water correlatives along the Mackenzie Platform, to the north, include the parts of the Broken Skull and Franklin Mountain formations (Gabrielse et al., 1973; Gordey and Anderson, 1993).

The regional significance of thinning and facies variation within the Kechika Group of the study area, particularly in the south, is not fully understood. Generally, the Kechika Group is thicker, and contains abundant calcareous material where it sits above Middle to Upper Cambrian carbonate of unit Cc (Figure 16). Where Cambrian carbonate is lacking, rocks assigned to the Kechika Group are typically less than 50 metres thick, composed almost entirely of dark slate and indistinguishable from basal Road River slates. This latter scenario strongly suggests the presence of a sub-upper Road River unconformity.
Photo 37. These two photographs display sections of dark grey to black argillite and calcareous argillite with distinctive interlayers or lenses of grey to orange-weathering (primarily along bedding surfaces) limestone to dolomite. Both sections are from 25 to 50 metres thick and are assigned to the basal Kechika Group. Section (a) occurs immediately above several hundred metres of carbonate of unit Ge some 6 kilometres east of Split Top Mountain and is succeeded by more typical interlayered light to dark grey calcareous argillite, slate and minor siltstone of the Kechika Group. Section (b) occurs just north of Bluff Creek and along the top of the panel of Cs sediments with no thick carbonate of Ge between the two lithologies. Approximately 5 metres of grey limestone, with a few per cent floating sand grains, sits conformably below this lithology and the carbonate grades downwards into some 50 metres of black slate which sits conformably on typical siliciclastics of Cs. Black graptolitic slates of Middle Ordovician age, and belonging to the lower Road River Group, sit only 50 metres stratigraphically above the base of the Kechika section shown in section (b).
### TABLE 3A

**FOSSIL IDENTIFICATIONS FOR THE SOUTHERN MAP AREA**  
**MAP NUMBERS REFER TO LOCALITIES PLOTTED ON FIGURE 2**

<table>
<thead>
<tr>
<th>Map No.</th>
<th>Rock Unit</th>
<th>GSC Loc. No.</th>
<th>Field No.</th>
<th>Northing</th>
<th>Easting</th>
<th>Taxa</th>
<th>Classification</th>
<th>Age</th>
<th>Remarks</th>
</tr>
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<td>6516620</td>
<td>623200</td>
<td>archaeocyathids</td>
<td>archaeocyathids</td>
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<td>Tabulocconus does occur with dateable trilobites in the Mackenzie Mountains (Fritz, 1976), suggesting that the present collection is from the lower part (but not lowest) of the Bonnia-Olenellus Zone</td>
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<td>C-208903</td>
<td>JN95-3-4</td>
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<td>6501600</td>
<td>graptolites, ?Clonograptus sp., Didymograptus sp. (extensiform), Tetragraptus sp., T. ex gr. T. quadribachiatius (Hall), Pendegraptus fruticosus (Hall)</td>
<td>Early Ordovician, Arenigian, P. fruticosus Zone or possibly lower part of overlying D. bifidus Zone</td>
<td></td>
<td></td>
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<td>25</td>
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<td>C-208904</td>
<td>JN95-7-8</td>
<td>609100</td>
<td>6514900</td>
<td>graptolites, ?Caryocaris sp., ?didroid graptolite, Clonograptus sp., Didymograptus sp. (extensiform), Tetragraptus ex gr. T. quadribachiatius (Hall)</td>
<td>Early Ordovician, Arenigian, T. akzharenis Zone, P. fruticosus Zone, or possibly lower part of D. bifidus Zone</td>
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<td></td>
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<td>26</td>
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<td>6503985</td>
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<td>Not determined</td>
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<td></td>
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<td>6509675</td>
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<td>C-208318</td>
<td>CRE95-23-3</td>
<td>618570</td>
<td>6512275</td>
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<td>C-208328</td>
<td>FFE95-25-6-2</td>
<td>626850</td>
<td>6514545</td>
<td>conodonts, sponge spicules, ramiform elements, ?Spathognathodus sp. (2), ?Panderodus (1)</td>
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<td>617380</td>
<td>6527370</td>
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<td>Silurian to Middle Devonian, Pb, Sc, Sb, Sa elements</td>
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<td>FFE95-41-3</td>
<td>607700</td>
<td>6524525</td>
<td>conodonts, sponge spicules, mazuelloids, Aspelundia fluvei (Walliser 1964) (2), ?Walliserodus? sp. (1)</td>
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<td></td>
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<td>FFE95-43-5</td>
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<td>C-208339</td>
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<td>624245</td>
<td>6515650</td>
<td>conodonts, ?lichytholiths, conform element (1)</td>
<td>Late Cambrian to Ordovician</td>
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<td>C-208341</td>
<td>CRE95-34-12</td>
<td>614360</td>
<td>6520950</td>
<td>tubes, ?protoconodonts</td>
<td>Late Precambrian to Early Ordovician</td>
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<td>C-208342</td>
<td>CRE95-35-10-2</td>
<td>612830</td>
<td>6520160</td>
<td>sponge spicules</td>
<td>Phanerozoic</td>
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<td></td>
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<tr>
<td>36</td>
<td>Road River Group</td>
<td>C-208344</td>
<td>CRE95-39-7</td>
<td>607230</td>
<td>6527160</td>
<td>sponge spicules, inarticulate brachiopods</td>
<td>?Ordovician to Devonian</td>
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<td>C-208345</td>
<td>CRE95-44-3</td>
<td>610260</td>
<td>6527260</td>
<td>conodonts, sponge spicules, mazuelloids, Distomodus? sp. (1)</td>
<td>Probably Early Silurian, Originally assigned to Earn Group, Platform fragment resembles icriodiniform element. Accompanying microfossils are the same as those in Ffe-41-3</td>
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TABLE 3A CONTINUED

| 38 | Road River Group | C-208860 | JN94-3-10 | 645200 | 6485975 | graptolites | ?Protospongia sp., Monograptus sp., Orthograptus sp. | Early Silurian, possibly late Landoverian | Collected from Silurian siltstone scree In northeastern British Columbia sponges have been documented from rocks of the Road River Group that are stratigraphically above beds with latest Llandovery graptolites (Davies, 1966; Rigby and Harris, 1979), thus the age of this collection is likely to be Wenlockian. |
| 39 | Road River Group | C-208861 | JN94-7-8 | 645150 | 6485790 | graptolites | ?Climacograptus sp., Orthograptus calcatus cf. acutus Elles and Wood, Monograptus retrograptus cf. R. geinitzi Hae | late Middle to Late Ordovician |
| 40 | Road River Group | C-208866 | FFE94-20-8 | 638540 | 6495300 | graptolites | Dicellograptus sp., Orthograptus calcaratus cf. acutus Elles and Wood, Monograptus retrograptus cf. R. geinitzi Hae | Middle Ordovician, Caradoc bicorinis Zone or clingani Zone |
| 41 | Road River Group | C-208872 | FFE94-3-16-3 | 642800 | 6488930 | conodonts | ramiform elements | Early Devonian, Emsian |
| 42 | Road River Group | C-208876 | FFE94-7-15-2 | 640650 | 6490450 | conodonts | ramiform elements | Early Devonian, Emsian |
| 43 | Road River Group | C-208879 | FFE94-8-5 | 639770 | 6491205 | conodonts | ramiform elements | Early Devonian, Emsian |
| 44 | Road River Group | C-208885 | FFE94-22-2 | 642175 | 6490470 | conodonts | sponge spicules | Late Ordovician to Middle Silurian, Ashgillian-Wenlockian |
| 45 | Road River Group | C-208888 | FFE94-34-2-2 | 629360 | 6484215 | conodonts | criocorinids | Middle Devonian, early? Eifelian |
| 46 | Road River Group | C-208891 | JN94-7-10 | 643925 | 6487100 | conodonts | ramiform element | Ordovician to Devonian |
| 47 | Road River Group | C-208892 | JN94-3-10 | 645200 | 6485970 | conodonts | ramiform elements | Early Devonian, Emsian |

Graptolites were also recovered in scree at the same locality.
TABLE 3A CONTINUED

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<thead>
<tr>
<th>Map No.</th>
<th>Rock Unit</th>
<th>GSC Loc. No.</th>
<th>Field No.</th>
<th>Easting</th>
<th>Northing</th>
<th>Taxa</th>
<th>Classification</th>
<th>Age</th>
<th>Remarks</th>
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<td>Kechika Group</td>
<td>C-207906</td>
<td>FFE96-14-3</td>
<td>588995</td>
<td>6586147</td>
<td>conodonts</td>
<td>coniform elements (26)</td>
<td>Early Ordovician, ?Arenigian</td>
<td>A diverse collection of small elements</td>
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<tr>
<td>2</td>
<td>Kechika Group</td>
<td>C-208347</td>
<td>CRE96-5-9</td>
<td>605156</td>
<td>6556269</td>
<td>conodonts</td>
<td>coniform elements (27)</td>
<td>Early Ordovician, ?Arenigian</td>
<td>Collection includes drepanodiform, oistodiform, and scolopodiform elements</td>
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<td>CRE96-18-5</td>
<td>576248</td>
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<td>coniform elements (6)</td>
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<td>6530491</td>
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<td>5</td>
<td>Road River or Earn Group</td>
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<td>FFE96-12-9</td>
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<td>ramiform elements (23)</td>
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<td>6602865</td>
<td></td>
<td>graptolites</td>
<td>Climacograptus sp.</td>
<td>Upper Ordovician, Caradocian</td>
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9Field Identification

TABLE 3B

FOSSIL IDENTIFICATIONS FOR THE NORTHERN MAP AREA

MAP NUMBERS REFER TO LOCALITIES PLOTTED ON FIGURE 3

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<tr>
<th>Map No.</th>
<th>Rock Unit</th>
<th>GSC Loc. No.</th>
<th>Field No.</th>
<th>Easting</th>
<th>Northing</th>
<th>Taxa</th>
<th>Classification</th>
<th>Age</th>
<th>Remarks</th>
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<td>1</td>
<td>Kechika Group</td>
<td>C-207906</td>
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<td>2</td>
<td>Kechika Group</td>
<td>C-208347</td>
<td>CRE96-5-9</td>
<td>605156</td>
<td>6556269</td>
<td>conodonts</td>
<td>coniform elements (27)</td>
<td>Early Ordovician, ?Arenigian</td>
<td>Collection includes drepanodiform, oistodiform, and scolopodiform elements</td>
</tr>
<tr>
<td>3</td>
<td>Kechika Group</td>
<td>C-207902</td>
<td>CRE96-18-5</td>
<td>576248</td>
<td>6609287</td>
<td>conodonts</td>
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<td>Road River Group</td>
<td>C-207903</td>
<td>CRE96-20-9</td>
<td>604142</td>
<td>6530491</td>
<td>conodonts</td>
<td>“Oulodus” sp. (1)</td>
<td>Early Silurian, Llandoveryan</td>
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<td>Road River or Earn group</td>
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<td>576417</td>
<td>6588609</td>
<td>conodonts</td>
<td>ramiform elements (23)</td>
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<td>6</td>
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<td></td>
<td>573930</td>
<td>6602865</td>
<td></td>
<td>graptolites</td>
<td>Climacograptus sp.</td>
<td>Upper Ordovician, Caradocian</td>
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</table>

2Miller and Harrison (1981)

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Figure 16. Schematic representation of thickness and lithologic variation of the Kechika Group within the map area.
This situation changes at the latitude of Horneline Creek, where the Kechika Group again begins to thicken and contain abundant calcareous material without the presence of underlying Cambrian carbonate of unit Cs. This siliceous, planar to crosslaminated limestone and dolostone is not typical of the of the Kechika Group in the project area, although regional correlatives with similar features occur in the Selwyn Basin (Gordey and Anderson, 1993; Cecile, 1982). The transition to this atypical Kechika lithology occurs rather abruptly across the Graveyard Lake valley, which may follow a long-lived basinal structure later utilized during contractional or strike-slip deformation.

The intermittent identification of the Kechika and lower Road River groups between rocks of the Upper Road River and siliciclastics of unit Cs north and east of Terminus Mountain is not fully understood. Their omission may be depositional in nature (i.e. lack of sediment input) or the result of a sub-Upper Silurian Road River Group unconformity. A similar unconformity is postulated by Gabrielse (1981) to explain the apparent lack of lower Road River strata in the Ware area. Sub-Upper Silurian erosion or non-deposition has been inferred in the northern Kechika Trough by Cecile and Norford (1991). Although evidence for the presence of an unconformity is compelling, periodic recognition of thin Kechika and basal Road River may simply be a function of poor exposure, the recessive nature and thinness of these units. Furthermore, Middle Ordovician slates of the lower Road River Group are found above a condensed, slaty facies of the Kechika Group north of Bluff Creek, which strongly suggests that this thinning is not entirely due to later erosion or that, if an unconformity is present, it occurs below the lower Road River Group.

If the thinning of the Kechika Group is entirely depositional, it implies that certain parts of the basin received more sediment than others during Kechika time. The Kechika Group is very calcareous where its stratigraphic thickness is much greater than 50 metres. The lack of this calcareous material would result in a relatively condensed sequence of shale or argillite. This further suggests a relatively shallow-water environment where the Kechika Group is thickest, allowing for the production and deposition of more calcareous material. The basin must have been much deeper, and its sediment load much lighter, where the Kechika Group is considerably thinner and composed almost entirely of dark shale. These conditions mimic, to some degree, those in underlying Middle and Upper Cambrian sediments. Thick carbonate of unit Cs is believed to be reeval in character, which by its nature indicates shallow water. Between, and north of this carbonate, deeper water siliciclastics of unit Cs predominate. It seems that during Kechika time, sedimentation occurred along depositional elements formed in the Middle to Late Cambrian, although in somewhat deeper water conditions due to regional subsidence. This is, in part, substantiated by the conformable contact between Cambrian carbonate and overlying Kechika sediments seen at several localities in the map area and south of the Gataga River (Fritz, 1980).

In summary, it is not clear if the thinning and increased shaliness of the Kechika Group, together with the ‘shaling-out’ of underlying Cambrian carbonates are related, but their coincidence suggests that this part of the basin was subject to tectonic instability from Cambrian to Devonian times, resulting in marked facies changes and thinning or erosion of stratigraphy.

**KECHIKA - LOWER ROAD RIVER GROUPS (COkr)**

Over much of the map area, slates of the upper Kechika Group are sometimes difficult to distinguish from overlying slates of the lower Road River Group and, for mapping purposes, Kechika and lower Road River rocks have been combined into a unit designated COkr. In the central and eastern parts of the study area, south of Horneline Creek, dolomitic siltstones of the upper Road River Group are locally separated from Cambrian siliciclastics by a relatively thin section of blocky to fissile, dark grey to black slate to siliceous slate occupying the same stratigraphic position as the Kechika and lower Road River groups. Structural sections suggest combined thicknesses of, at the most, 100 metres. In many parts of the map area, proximity of Road River siltstones to Cambrian siliciclastics leaves little room for intervening slates of either the lower Road River or the Kechika groups.

Although these rocks share similarities with parts of both the Kechika and lower Road River groups, this thin section of dark coloured slates has more affinities with the lower Road River Group. It is best developed in thrust panels west of the Nelson Creek thrust fault and east of Terminus Mountain, where it is composed of grey to brown-weathering, grey to dark grey or black shiny slates which are locally soft and fissile. Faint, paler grey colour banding or laminations are common and locally grade into more silty horizons with the characteristic motting of the overlying Road River siltstones. Some outcrops contain sections of sooty black, slaty siltstone. Parts of this unit are characterized by dark grey to black siliciclastic argillite or slate with 1 to 3-centimetre beds of grey to black chert.

**ROAD RIVER GROUP (DRDRA)**

Gabrielse et al., (1973, 1977) extended the name Road River Formation into the Selwyn Basin and then into the Northern Rocky Mountains from its type locality in the Yukon. There, it was first used to describe Lower Cambrian to Lower Devonian strata in the Richardson Trough (Jackson and Lenz, 1962). The usage in this report follows that of Gordey and Anderson (1993) whereby the unit is raised to group status. This reflects the two major subdivisions of this package in the study area which are broadly equivalent to the two formations recognized in the Nahanni map area (Duo Lake and Steele formations).

The two units of the Road River Group recognized in this study are: a lower succession of Ordovician to Early Silurian black slates with lesser limestone and chert; and a succeeding section of Siluro-Devonian dolomitic siltstone with minor limestone and chert. An enigmatic package of slate, calcareous slate and limestone informally referred to as the ‘Kitza Creek Facies’ is provisionally included with the Road River Group. Sections of the lower Road River
Group were recognized in only a few localities; usually this package is grouped with the dolomitic siltstone unit.

In the southern part of the map area, the Road River Group primarily outcrops along a narrow, complexly folded and faulted belt along the footwall of the Split Top Mountain thrust fault. This band widens northward, such that between Terminus and Chee mountains the Road River Group is the most areally extensive rock unit exposed. These rocks then disappear below the Chee Mountain thrust fault and reappear east of Boya Hill. They may also crop in the lower Red River and Kitza Creek areas. No Road River Group strata were recognized farther north on the Liard Plain.

**Lower Road River Group (OSRR)**

The lower Road River Group generally forms a thin, recessive slaty succession through most of the map area. Sections within it closely resemble the upper Kechika Group. As a result, this unit is usually not mappable within the study area and is combined with the either the upper Road River or Kechika groups.

Complete sections of Ordovician Road River strata are confined to the southern part of the project area. Approximately 125 metres of this unit is exposed along the footwall of the Netson Creek thrust, some 5 kilometres east of Split Top Mountain. Upwards of 160 metres of Ordovician black slates are also reasonably well exposed along the top of the same thrust panel, several kilometres further east. This sequence is only sporadically recognized; it thins to 115 metres immediately south of Bluff Creek and only 50 metres are well exposed on the ridge north of the creek. Poor exposures farther north along this thrust panel also suggest a thickness of only 50 metres.

Slates that can be confidently assigned to this unit crop out in only a few other localities in the map area. Lower Road River black slate is structurally interleaved or infolded with Road River siltstone and Kechika slate immediately above and below rocks assigned to the Kechika Group (RK). No thick, clean carbonate belonging to unit Cc is found in this section.

---

Photo 38. Looking north at the head of the valley immediately east of Gataga Mountain where an imbricated section of Kechika (C0K) to Road River (SDRR and OSRR) lithologies is exposed in the footwall of the Gataga Mountain thrust fault below the Gataga Volcanics. This

Photo 39. Looking southeast at the ridge containing unit Cs within the upper part of Cs. This ridge is approximately 5 kilometres southeast of the northeast flowing part of Bluff Creek. In general, the more resistive units such as the interlayered quartz sandstone, siltstone and shale of unit Cs and the siltstone of SDHR form the peaks along the ridge, whereas the incompetent shales and argillites of the Kechika and lower Road River groups (C0KR), and Earn Group (DME) occupy the saddles. Also visible in this photograph is the section of black slate above Cs and below rocks assigned to C0KR. No thick, clean carbonate belonging to unit Cc is found in this section.
east of Gataga Mountain in the footwall of the Gataga Mountain thrust. This structural imbrication becomes less complicated some 5 kilometres to the northwest, where 50 to 75 metres of Ordovician black slates, siltstones and carbonates separate Kechika slates and Road River siltstones in the immediate footwall of this thrust fault. Middle and Upper Ordovician slates, with interbeds of baritic limestone, are exposed in the centre of the map area, approximately 2 kilometres south of the first big bend in Matulka Creek, along a creek that cuts the western overturned limb of a syncline. This section appears to be several hundred metres thick, although this is probably the result of structural thickening. It also contains lithologies typical of the Kechika Group. Lower Road River black slates crop out within the core of the northeast-verging syncline east of Brownie Mountain. These continue northward to the headwaters of Matulka Creek where they are cut by a thrust fault. To the north, these rocks cannot be distinguished from those of the Kechika Group.

Elsewhere it is difficult to separate slates of the lower Road River from those of the Kechika Group and they have been grouped together in many cases (see previous section). The weathering characteristics and overall lithology of these slates and siltstones is also very similar to those of the Earn Group, making it difficult to differentiate between them, especially in isolated outcrops or where intervening, stratigraphically younger Road River rocks are poorly exposed. This is particularly true in the low-relief area northwest of Brownie Mountain and east of Split Top Mountain, where a series of tight folds and related faults repeat Road River dolomitic siltstone and Earn Group lithologies. It is possible that some of the poorly exposed lithologies assigned to the Earn Group are misrepresented lower Road River Group. Biserial graptolites, which only occur in the Road River slates, are helpful in resolving this problem.

A narrow, relatively poorly exposed belt of slates, some 5 kilometres north of Terminus Mountain, best illustrates this problem. The section is composed of blocky to splintery, dark grey to black, sooty slate and argillite to siliceous argillite in beds up to 20 centimetres thick. The rocks high(?) in the section are locally interlayered with well bedded nodular, dark grey to black argillaceous limestone. Slate and silty slate associated with these limestone layers also contain horizons of nodular barite up to 50 centimetres thick. Superficially, particularly taking the baritic horizons into consideration, these rocks resemble the Earn Group and were initially mapped as such (Ferri et al., 1996b). Subsequently conodont identification indicated an Early Silurian age, placing them within the lower Road River Group. This relatively thick section of argillite is atypical of lower Road River Group sections in the map area.

The basal part of the Road River Group is typically composed of graptolitic, dark grey, blue-grey and black shiny graphitic slate and siliceous slate to siltstone (Photos 38, 39). Slates of the lower Road River and Kechika groups appear conformable where observed. The slate is commonly soft and friable, although resistant layers of dark grey to black graphitic chert and siliceous argillite locally form layers 1 to 5-centimetres thick in the upper 5 to 10 metres of the unit. Slaty sections may contain thin, paler grey bands or laminations. Grey-brown and orange-weathering graded siltstone, up to 2 metres thick, and thin, grey, tan to orange-weathering, thin planar-laminated limestone beds are less common lithologies within this slate succession. Some siltstone layers are graded and intercalated with beds of buff to orange-weathering calcareous slate to silty limestone or dolostone up to 3 centimetres thick. These carbonate horizons may contain tiny (0.1 to 5 millimetres) authigenic barite crystals. Thin (1 to 2 centimetres) sandstone beds were observed very locally.

The lower Road River Group is poorly represented north of Trail Creek. Rocks interpreted to be lower Road River form several exposures south of Horneline Creek, although lack of fossil or structural control makes it impossible to rule out these rocks being part of the Earn Group. In these areas, lower Road River rocks characteristically consist of dark grey to bluish grey carbonaceous black shale, siliceous shale to argillite, siltstone, cherty siltstone to chert and grey to bluish grey limestone. Beds are up to 30 centimetres thick. Interlayered cherty argillite and chert, with lenticular bodies of limestone, are locally developed. On Horneline Creek, possible lower Road River rocks are composed of sooty black slate with interbeds of black argillite, and pale grey slate to silty slate. Lack of fossil data precludes separation of these rocks from the remainder of the Road River Group.

The lower Road River Group, together with underlying Kechika rocks, thin southward and are apparently not present below the Silurian siltstone unit throughout much of the southern map area. Omission of these units may be due to a sub-Silurian siltstone unconformity in the southern Kechika Trough, as theorized by Gabrielse (1981), or may be due to a condensed sequence coupled with the inability to recognize these recessive units in the poorly exposed terrain. This problem is discussed in more detail in the section on the Kechika Group.

**Silurian Siltstone (SDRR)**

The thickness of the siltstone unit of the Road River Group also varies significantly over the map area. No sections were measured, but structural interpretations indicate thicknesses ranging from 200 metres in the southeast to possibly 1000 or more metres in the north. Structural thicknesses tend to be smaller along the top of the Netson Creek thrust panel. They range from 200 to 300 metres in the Split Top Mountain area, to 400 metres east of Brownie Mountain and approximately 250 metres south of Netson Lake. Thicknesses ranging from 550 to 700 metres were deduced for the next poorly exposed section west of this panel. The large expanse of Road River siltstone between Matulka Creek and Chee Mountain may reflect this increased thickness, together with the effects of low-amplitude folding and moderate faulting. At one locality south of the headwaters of Horneline Creek, Earn lithologies rest above only some 100 metres of Silurian siltstone, suggesting rapid thickness variations.

Resistant, buff-orange weathering, grey to greenish grey, bioturbated dolomitic siltstone is the dominant member of the upper Road River Group (Photos 39, 40). Compositonally, this is the most uniform unit in the map area. This lithology is commonly referred to as the ‘Silurian
Photo 40. Typical outcrop of grey to orange-weathering, bioturbated dolomitic siltstone ('Silurian Siltstone') of the upper part of the Road River Group. This exposure is in the footwall of the Gataga Mountain thrust, approximately 5 kilometres southeast of Terminus Mountain.

Photo 41. Picture of Zoophycus(?) trace fossil in dolomitic siltstone of the Road River Group. These fossils are very common in the Gataga Mountain area.
siltstone’, although Early Devonian conodonts have been recovered from its upper part. It is relatively competent compared to the other basinal facies in the area and tends to form the ridges in the more subdued terrain north of Matulka Creek. Complete sections of this unit are not well represented and are only found underlying the high ground east of Split Top Mountain.

The dominant siltstone lithology is thin to thickly bedded or massive. It is commonly bioturbated, producing a mottled or wispy texture due to the disruption of laminae, which makes recognition of bedding difficult except in thick-bedded shale and siltstone intervals. In many outcrops bedding is discerned from subtle colour variations reflecting changes in argillaceous or dolomite content (Photo 40). Partings are typically blocky, although, in the absence of bioturbation, the relatively planar stratification produces platy to flaggy outcrops. Monoserial graptolites are typically preserved within these flaggy, non-bioturbated successions. In addition, several trace fossils were observed. The most common type is a series of overlapping, oval, dish-like impressions on bedding surfaces, tentatively identified as Zoophycus. They are open at one end, marked by concentric ridges, and up to tens of centimetres wide (Photo 41). Less common are worm casts, 0.5 to 1 centimetre thick, either inclined or perpendicular to bedding (Photo 42). Sediment infills of these tubes or burrows provide a useful top indicator where visible in cross-section.

Slates of the lower Road River Group are gradational into overlying Silurian siltstones over an interval ranging to tens of metres thick. The upper parts of the Ordovician lower Road River slate sequence contain paler grey slate to silty slate bands which become thicker with more silt up-section and exhibit a mottling typical of the overlying siltstones. The basal part of the Silurian siltstone locally contains sections of grey, nondescript slate and silty slate more than 100 metres thick. Grey slates and siltstones in the footwall of the Split Top Mountain thrust fault have been assigned to the upper Road River Group because they are on strike with typical Road River lithologies to the northwest. Thin-bedded orange-weathering planar-laminated, flaggy limestone to silty limestone is locally developed. Buff-weathering, grey, wavy laminated to thinly layered limestone locally forms metre-thick sections within this unit in the central part of the map area.

Minor lithologies include grey limestone, grey to grey-brown banded chert, and fine to very fine grained, grey to dark grey quartz sandstone to quartzite. Local recessive beds of grey to dark grey argillite to silty argillite are gradational into enclosing siltstone. Just northwest of Gemini Lakes, grey dolomitic siltstone is associated with blocky black argillite and grey, fetid bioclastic limestone containing crinoid ossicles, rugose corals, bryozoan and shell fragments occurs in an isolated outcrop. Their association with typical upper Road River lithologies is uncertain.

The top of the siltstone section is locally marked by a limestone-chert couplet from 5 to over 20 metres thick. These subunits are best developed south of Horneline Creek, although sections in the Kitza Creek area are similar. In many localities this unit is immediately overlain by siltstones and slates of the Earn Group. This, together with its distinctive character, makes it an excellent marker unit. The stratigraphic order of chert and limestone appears to vary, with chert generally succeeding limestone between Brownie Mountain and Horneline Creek whereas the opposite occurs southwest of Brownie Mountain.

In the south, the chert-limestone succession is 10 to 15 metres thick (Photo 43). Dark grey-brown, grey and white, thin to thickly bedded chert, with interlayers of dark grey cherty argillite, comprises the basal 2 to 3 metres of this sequence. Approximately 1 to 2 metres of thin to moderately bedded, cream to light grey weathering, grey, silty to argillaceous micritic limestone, interlayered with thin beds of typical Silurian siltstone, are exposed 1 to 2 metres above the chert sequence. Several metres of orange-weathering, bioturbated siltstone succeed this limestone sequence and grade into overlying lithologies of the Earn Group across a stratigraphic thickness of 50 centimetres.

North of Brownie Mountain, the sequence is over 20 metres thick and the sections of typical dolomitic siltstone are absent. The limestone is micritic and dolomitic, grey to buff weathering, dark grey to grey-brown, and up to 20 metres thick. It commonly displays faint laminar bedding traces and breaks into blocky or platy pieces from 1 to 20 centimetres thick. It is locally argillaceous and has a slightly
Photo 43. The hammer is lying on grey to brown chert which is overlain by thinly interlayered limestone, all of the uppermost Road River Group. Dark argillite and shale of the Earn Group is exposed only a few metres to the right of the limestone. This locality is along a ridge top some 3 kilometres southeast of the northeast-flowing part of Bluff Creek.

Photo 44. Strongly folded and faulted calcareous argillite, siltstone and slate along the lower parts of Horneline Creek. These rocks have been tentatively assigned to the Kechika Group, but have characteristics similar to lithologies found in the Kitza Creek area.
fetid odour when broken. Like the overlying chert member, the limestone also contains 1 to 5-centimetre interbeds of argillite to cherty argillite.

Chert to argillaceous chert, up to 2 metres thick, is typically found above the limestone, although they are interlayered in some localities. Chert is pale grey to black or orange-brown to maroon in colour. Bedding is planar to very poorly developed, with beds ranging from 1 to 50 centimetres thick. This unit is commonly shot through with tiny quartz veinlets and has blocky to platy partings.

On the east side of the Kechika River, just south of the confluence with the Red River, limestone at the top of the Silurian siltstone is followed by several metres of massive, grey, calcareous quartz sandstone with well rounded, spherical quartz grains. This sandstone is succeeded by 10 to 15 metres of sooty, dark grey to black slate to argillite with thin beds of dark grey calcareous argillite to limestone. Slate and argillite become limier up section and the uppermost part is composed almost entirely of thick-bedded to massive, sooty and fetid, very fine grained, limestone to argillaceous limestone. These calcareous rocks are estimated to be 15 to 20 metres in thickness and are succeeded conformably by Earn lithologies. A very similar sequence of argillite, slate and partly oolitic limestone is found along the Kechika River, north of its confluence with the Gataga River. This fault-bounded section is of similar stratigraphic thickness and is interpreted to be along strike from Earn rocks. Both of these sections contain Middle Devonian fauna.

Kitza Creek Facies (ODRK)

Around Kitza Creek, there are mappable areas of Silurian siltstone of the Road River Group, and also substantial areas of dark grey to black, carbonaceous calcareous siltstone, silty limestone, siltstone, argillite, slate, sandstone and chert. The stratigraphic position of the latter group of rocks is not clear because fossil control is very poor, and contact relations with the Road River have not been observed. Although the slates and argillites resemble those of the Earn Group, the associated abundant calcareous material is not typical of the Earn regionally and is more characteristic of Road River lithologies in the southern Kechika Trough (Gabrielse, 1981; MacIntyre, 1992, 1998). These rocks are tentatively assigned to the Road River Group, although limited control does not rule out the possibility that some may be older or younger.

Kitza Creek rocks are characterized by dark grey to black, carbonaceous siltstone to silty argillite and shaly slate (Photos 44, 45, 46). All may be calcareous to varying degrees and be interlayered with thinly to thickly bedded buff, pale to medium grey weathering, dark grey to black, silty to argillaceous fetid limestone. Limestone is platy to blocky and poorly cleaved, and in some sections is quite thick, forming prominent topographic ribs. Thin layers of grey-weathering, calcareous quartz sandstone to sandy limestone and pale grey calcareous tuff are associated with these lithologies. The sandstones consist of rounded quartz grains, and argillite and carbonate clasts. Sandstone horizons can be massive and several metres thick. Quartz wacke or quartz-carbonate clastic horizons are found locally. Limestone is also seen with thinly laminated, orange to brown-weathering, grey dolomitic siltstone. Calcareous and silicilastic rocks are locally interbedded with medium bedded, dark bluish grey to black chert. In one locality, these rocks are associated with debris flows composed of angular chert clasts and limestone intraclasts that are up to cobble size. Elevated barium concentrations are present in argillaceous limestone at one locality on Kitza Creek.

Photo 45. Folded, interlayered, dark grey argillite and tan to buff-weathering siltstone to dolomitic siltstone assigned to the Kitza Creek facies along the south bank of the lower Red River. These rocks are also characterized by a conspicuous banding, as shown here.
Rocks similar to the Kitza Creek facies crop out along the Red River and along the lower parts of Horneline Creek (Photos 44 to 46). Contact relationships with surrounding units in both localities are obscured or faulted. On the Red River, calcareous argillites and limestones (Photo 46), similar to those near Kitza Creek, are associated with rusty weathering, dark grey to black, carbonaceous slate or argillite with interbedded thin laminae or wispy layers of tan to buff-weathering dolomitic siltstone. The dolomitic horizons give the rock a characteristic striped appearance (Photo 45). Siltstone layers are from 0.1 to 10 centimetres thick and comprise up to 50 per cent of the rock. The dark grey to black argillites and slates resemble those of the Earn Group, but the dolomitic siltstones are more characteristic of the Silurian siltstone. This suggests these rocks may be part of the upper unit of the lower Road River Group, transitional into the Silurian siltstone unit.

Age and Correlation

Graptolites collected 2 kilometres west of Terminus Mountain are from the lowermost part of the Ordovician Road River, approximately 1 metre above its lower contact. The collection consists of early to middle Arenig graptolites (T. akzharensis Zone, P. fruticosus Zone or possibly the lower part of the D. bifidus Zone; B.S. Norford, personal communication, 1995). Fossil collections made from the lower Road River Group elsewhere in the map area indicate a Llandeilan (late Middle Ordovician) lower age range, although the apparently conformable contact commonly seen with underlying slates of the Kechika Group also suggests they are as old as Early Ordovician. South of Bluff Creek, Ashgillian to Wenlockian (late Late Ordovician to late Early Silurian) conodonts were recovered from the Silurian siltstone, several metres above its gradational contact with lower Road River slates, and indicate a late Early Silurian upper age range for these slates. North of Terminus Mountain, rocks assigned to the lower Road River Group yielded Llandovery (earliest Early Silurian) conodonts.

Dolomitic siltstone within the Silurian siltstone unit ranges in age from late Early Silurian (Llandovery) to late Early Devonian (Emsian) based on its stratigraphic position above uppermost lower Road River slates and below the chert-limestone marker. Calcareous black slate, limestone and sandstone at the top of the Road River Group contains Middle Devonian (early(?Eifelian) and Middle to Late Devonian (Eifelian-?Frasnian) conodonts (Table 3).

Road River Group lithologies, particularly the Silurian siltstone unit, are widespread within the Kechika and Selwyn basins. Gabrielse (1981), Gabrielse et al. (1977), MacIntyre (1980b, 1981b, 1992; 1998), McClay et al. (1988) all describe a bioturbated dolomitic siltstone unit of broadly Silurian age in the southern Kechika Trough. Cecile and Norford (1979), in Ware, east half, describe a Siluro-Devonian succession of dolostone, siltstone, shale and sandstone which is probably a more proximal equivalent of this unit. Lower Road River Group rocks in the southern Kechika Trough are dominated by deep-water shales and limestones and are broadly similar to those of the map area, although there are differences due to the proximity of some areas to the margin of the Paleozoic carbonate platform. Rocks of the study area are, for the most part, restricted to deeper, more distal parts of the Kechika Trough resulting in thinner, more argillaceous deposits than seen elsewhere.

Early to Middle Devonian chert, limestone, calcareous slate and sandstone found above the Silurian siltstone unit are similar in age and character to Early Devonian rocks informally referred to as the Paul River formation in the southern Kechika Trough (MacIntyre, 1998). The base of the Paul River formation consists of a thin unit of black chert and dolomitic mudstone, siltstone and limestone which, in the deeper parts of the basin, is overlain by grey calcareous siltstone and black silty shale. This succession is followed by quartz wacke and sandstone along the eastern margin of the southern Kechika Trough, close to the carbonate platform. This unit is followed, in turn, by limestone debris-flows and black shales (MacIntyre, 1998). This latter sequence becomes finer grained and thins away from Early to Middle Devonian limestone buildups represented by the Kwadacha, Akie and Pesika reefs (MacIntyre, ibid.). This succession, particularly the sandstone and limestone debris-flows, bears strong similarities to sandstone, slate and
calcareous slate exposed at the top of the Road River Group immediately south of the mouth of the Red River. This, together with local bioclastic deposits within Silurian siltstone, suggests that upper Road River deposition in the northern-most Kechika Trough was closer to carbonate buildups representing either isolated linear reefs or the western edge of paleo-platform carbonate deposition.

In the Selwyn Basin, rocks of the Road River Group are widespread and are dominated by shale and chert facies. Those equivalent to the Silurian siltstone unit crops out in the Watson Lake map area (unit Ss; Abbot, 1981) and in the Nahanni map sheet (Steele Formation; Gordey and Anderson, 1993). Similar rocks are extensively exposed in the northern Cassiar platform (Gabrielse, 1963; Nelson and Bradford, 1993).

The exact age of the Kitza facies is not known. Early Late Ordovician (Caradocian) graptolites are reported from rocks presently assigned to typical Road River lithologies (Miller and Harrison, 1981a). The lithological make-up of this unit suggests that it is probably part of the Road River Group, although, considering the limited amount of exposure in the area, parts could be younger or older. Horizons of quartz-rich limestone debris suggests units in the Kitza Creek area were deposited proximal to carbonate buildups or the ancient carbonate platform, as suggested for the northern parts of the Road River Group in the map area (see above). This could easily explain the complexity and uniqueness of many of the units present in this region. Our mapping south of this area was concentrated within what was the most basinal part of the Kechika Trough during Road River time. Consequently, units are distal, condensed and dominated by shale. The character of the Road River Group changes dramatically close to flanking carbonate buildups. This is well documented in the southern Kechika Trough where there is a marked increase in thickness, and the amount of coarse clastics and carbonate, toward coeval platform carbonates (MacIntyre, 1998). Lithologies within the Kitza facies bear many similarities to units within the Road River Group along the eastern margin of the southern Kechika Trough (MacIntyre, 1998), particularly the relatively abundant quartz sandstone, carbonate and lesser lithologies, such as conglomerate and tuff. The poor exposure in the Kitza Creek area, coupled with limited control points, does not allow subdivision of these rocks or confident stratigraphic placement relative to the Silurian siltstone unit.

One of the dominant lithologies of the Kitza facies, a sequence of interbedded calcareous argillite and limestone (Photo 46) exposed in the Kitza Creek, Red River and Horomeline Creek areas, bears some resemblance to lower Road River lithologies mapped by Gabrielse (1981) in the Paul River region of the southern Kechika Trough.

**EARN GROUP (DME)**

Black slate, siltstone, chert and minor sandstone, limestone and conglomerate of late Middle Devonian to early Mississippian? age in the map area are assigned to the Earn Group. The name was first proposed by Campbell (1967) in the northwestern Selwyn Basin and extended southward by early workers in the Gataga district, who noted the striking similarity between Devonian-Mississippian strata of the Kechika and Selwyn basins (Jefferson et al., 1983; Pigage, 1986; MacIntyre, 1992, 1998; Gordey et al., 1982).

In the northern Kechika Trough, the Earn Group has been subdivided into three informal units: blue-grey weathering siliceous argillite of the Middle to Upper Devonian Gunsteel formation; rusty weathering, soft grey shale of the Late Devonian to Early Mississippian Akie formation; which grades laterally into chert-quartz siltstone, sandstone and conglomerate of the Warneford formation (MacIntyre, 1992, 1998; Pigage, 1986; Jefferson et al., 1983). Although these three lithological variations were recognized in the map area, it was not possible to map out the individual facies. This is due not only to the poor exposure of this succession, but also to the apparent interfingering of the various lithologies.

A structurally thickened section of Earn and Road River rocks extends from the Gataga River, immediately east of Split Top Mountain, northwestern to the headwaters of Matulka Creek. This zone widens northward, such that Earn rocks are confined primarily to synclinal cores within Road River rocks. The unit is well exposed along ridges in the southern part of the map area, whereas to the north, topography becomes more subdued and the best exposures are in creek valleys. A particularly good section occurs along a north-flowing creek about 5 kilometres north of Terminus Mountain. Earn rocks are also found in the footwall and hangingwall of the Split Top Mountain thrust fault. More limited exposures of the Earn Group are mapped along the lower parts of Bluff Creek, along the footwall of the Netson Creek thrust, south of Horneline Lake and as small outliers between Gemini Lakes and the Kechika River. Sections of the Earn Group are believed to occur along the Red River, although differentiating them from rocks of the Road River Group was not possible.

The true thickness of this succession was not determined in the map area because the upper contact was never found. A minimum of 600 metres is inferred along poorly exposed slopes south of Netson Lake. Structural sections suggest at least several hundred metres are present in thrust panels and folds between Brownie Mountain and Matulka Creek.

The Earn Group is composed of grey to blue or silvery blue-grey weathering, dark grey to black, carbonaceous fissile shale to siliceous shale and slate (Photo 47). Sequences of blocky grey to dark grey, sooty argillite to siltstone and siliceous argillite or chert are found within this shaly succession. All these rocks have a characteristic yellowish stain on weathered surfaces. Blocky argillaceous to silty sections contain 1 to 20-centimetre beds with thin interlayers of shale and, higher in the sequence, display light to dark grey colour banding. Less siliceous shale or slate sections are recessive and appear to be present throughout the sequence. Slate is quite fissile to splintery, and very locally contains nodules of radiating barite crystals up to several centimetres in diameter. Bedding is planar to wavy, and is generally accompanied by slaty cleavage except in chert, siltstone and some argillites. Sections of grey to dark grey to rusty weathering,
sooty slate, with lustrous cleavage planes, crop out along the middle part of Bluff Creek.

Limestone, although rare in this fine clastic sequence, forms conspicuous sections when present. Limestone is grey to dark grey weathering, grey to black and argillaceous. It is nodular to well bedded (beds 1 to 30 centimetres) and forms sections up to 2 metres thick. A 2 to 3-metre section of grey-weathering, grey to dark grey, slightly argillaceous limestone with 1 to 10-centimetre argillaceous partings is exposed several kilometres north of Bluff Creek.

Dark grey to rusty weathering, dark grey, granule to pebble conglomerate was noted in one locality towards the top of the Earn succession south of Bluff Creek. Clasts consist predominantly of subrounded to well rounded, light to dark grey chert and mono- to polycrystalline quartz with lesser sandstone, quartz wacke, slate, siltstone and rare feldspar fragments. This bed is 1.5 metres thick and exposed for 15 metres along strike.

Local, less siliceous slate to silty slate and siltstone in the upper parts of Earn sections may be equivalent to the Akie facies of the southern Kechika Trough. Coarser siliciclastics were mapped in the Earn Group locally, such as those exposed along a steep-sided, north-flowing tributary of Davie Creek. This section consists of interlayered, finely laminated to crosslaminated, brown to buff-weathering, grey siltstone to very fine grained sandstone and dark grey to black fissile slate, up to 10 metres thick. Siltstone/sandstone horizons are 0.1 to 30 centimetres thick and are faintly micaceous on bedding surfaces. These coarser lithologies may be distal tongues of the Warneford facies which, in the southern Kechika Trough represents westerly derived clastics in the upper part of the Earn Group (MacIntyre, 1992; 1998).

One of the characteristic features of the Earn Group in the Gataga district is the presence of red to orange limonitic seeps which locally cement glacial and soil material forming a ferricrete deposit or pavement (Photo 48). These deposits are numerous and easily seen from the air in the high alpine country south of the map area, but are more difficult to locate in the more subdued and wooded terrain covered by our mapping. Several are well exposed on the south side of Bluff Creek and numerous other occurrences were found in creek valleys and slopes underlain by the Earn Group south and east of Netson Lake.

The lower part of the Earn is dominated by shale, siliceous shale and slate which regionally hosts significant deposits of bedded barite=pyrite=sphalerite=galena (Photo 49). Several occurrences of stratiform or nodular barite and pyrite are found within the lower part of the Earn Group inside the project area. Stratiform or bedded barite up to several metres thick is commonly calcareous and grades into silty baritic limestone. The limestone and baritic units sometimes have thin interlayers, lenses or nodules of dark grey to black chert. In the southeastern part of the map area, barite is also associated with finely laminated, grey to dark grey siltstone or mudstone of possible turbidic origin.

The contact between Road River and Earn rocks was observed in only a few localities and appeared to be rela-
tively abrupt, but conformable. In two localities south of Bluff Creek, grey siltstone immediately above chert and limestone at the top of the Road River Group gives way to dark grey slate and siltstone of the Earn Group. In another locality, the limestone-chert marker is not developed, and dolomitic siltstones of the Road River Group are abruptly, but conformably, succeeded by slates and siltstones of the Earn Group. This section is exposed along the western limb of an easterly overturned syncline approximately 1 kilometre upstream from the mouth of the large creek flowing west into Matulka Creek.

Age and Correlation

Few fossils were found in Earn Group rocks within the map area and these only indicate a Middle to Late Devonian age range. Earn rocks sit stratigraphically above Eifelian (early Middle Devonian) strata of the Road River Group, giving a maximum lower age range for these rocks. In the southern Kechika Trough, lower Earn Group rocks are believed to range down to the late Middle Devonian (latest Givetian; MacIntyre, 1998; Irwin and Orchard, 1989). Brown-weathering siltstones, slates and fine sandstone north of Terminus Mountain are similar in character to rocks of the Warneford Formation of the southern Kechika Trough, which ranges into the Mississippian (MacIntyre, 1998). Syngenetic barite mineralization could not be accurately dated in our study area. To the south it is Fammenian
(latest Late Devonian; MacIntyre, 1992, 1998; Irwin and Orchard, 1989; Paradis et al., 1998). From these data, the Earn Group is believed to be Middle Devonian to Mississippian in age.

The Earn Group in the map area is dominated by fine-grained and siliceous rocks similar to the Gunsteel formation of the southern Kechika Trough (MacIntyre, 1998) and the Portrait Lake Formation of the southeastern Selwyn Basin (Gordey and Anderson, 1993). The other members of the Earn Group were seen locally within the map area but could not be differentiated due to poor exposure. These include coarse clastics equated with the Warneford formation in the south or the Prevost Formation of the Selwyn Basin. Brown-weathering slates and siltstones, informally referred to as the Aikie formation in the southern Kechika Trough, and grouped with the Prevost Formation in southeast-central Selwyn Basin, were also seen in several localities.

The Earn Group, and its equivalents, comprise a eastwardly prograding basinial sequence found throughout most of the ancestral North American miogeoclinal of western Canada. It can be traced from northern Yukon (Canol, Imperial and Tuttle formations: Norris, 1985; Earn Group: Campbell, 1967; Gordey et al., 1982; Gordey and Anderson, 1993), into the southern Kechika Trough (MacIntyre, 1998) across into the Cassiar Terrane (Nelson and Bradford, 1993; Big Creek Group: Ferri and Melville, 1994; Black Mountain Group: Struk, 1988) and eastward onto the ancient miogeoclinal platform (Besa River Formation: Thompson, 1989).

These basinial rocks flooded eastward across the ancient platform, bringing carbonate deposition to a close and, in the process, erasing regional depositional elements which spanned much of early and middle Paleozoic time. Furthermore, the western part of this shale package contains northwestward and westward-thickening sections of coarse clastics (Prevost, Warneford and Guyet formations) which were sourced from the northwest and west, and not from the ancient craton to the east. The regional tectonic process behind this fundamental change in ancient miogeoclinal deposition is still the topic of much debate and a detailed examination of the various hypotheses is beyond the scope of this bulletin. There are two views on the significance of Earn deposition: one suggesting that these rocks are different from the result of extension, with coarse clastics derived from elevated blocks along the western miogeoclinal (Gordey et al., 1987) and the other suggesting that these basinial rocks are part of a foredeep produced by contractional deformation (Smith et al., 1993). In this latter scenario, coarse clastics would represent distal tongues of eroded material shed from thrusting terranes to the west.

**MOUNT CHRISTIE FORMATION(?) (MPMC)**

Approximately 5 kilometres south of the Liard River, some 5 metres of grey to buff-weathering, pale grey to dark grey and mottled, moderately to thickly bedded chert crops out along the top of a small knoll. Bedding is planar to wavy and there is extensive limonitic staining. Pale grey chert is also exposed along the top of Mount Earle. Thin and well bedded, pale salmon and green chert with pale green argillite partings also occurs stratigraphically above the Earn Group at the Roman showing along the Liard River (see Economic Geology section).

**Age and Correlation**

No significant sections of pale coloured chert have been seen in the Earn Group or older stratigraphy anywhere else in this mapping project, suggesting that these rocks are a different, younger unit. Thick sections of post-Earn chert have been described in the Selwyn Basin and assigned to the upper part of the Mississippian to Permian Mount Christie Formation (Gordey and Anderson, 1993). Farther east, in the Rocky Mountains, chert of similar age is included in the Permian Fantasque Formation (Bamber et al., 1991). Pale red and green chert, of broadly Mississippian to Permian, age has also been described in the Cassian Mountains (Nelson and Bradford, 1993) and may be a western equivalent of the Liard River cherts. Consequently, the sporadically exposed, pale coloured cherts in the northern part of the map area are tentatively assigned to the Mississippian to Permian Mount Christie Formation, in accordance with established Selwyn Basin nomenclature.

**TUYA FORMATION(?) (TQT)**

Massive to fragmental, fresh-looking basalt outcrops on several hilltops between Black Angus and Kloye creeks, approximately 10 kilometres southwest of the Liard River. These rocks are grey-weathering, dark grey-brown to dark green, anaphitic or plagioclase-olivine-phyric basalt (Photo 50). Basalt fragments may be vesicular, angular to subrounded and up to 30 centimetres in size; small pockets of black volcanic glass were also noted. The tuffaceous matrix displays a yellow to tan colour locally, indicating some alteration. It is not known if these volcanics are subaerial or subaqueous. Chemically they are high-silica basalts verging on basaltic andesites (Table 2). They are relatively high in alkalis, falling close to the dividing line between alkaline and subalkaline basalts as defined by Irvine and Barager (1971; Figure 11) and, based on an AFM plot, are calcalkaline in composition.

**Age and Correlation**

Pleistocene or Tertiary basalt has been described from the McDame (Gabrielse, 1963) and Jennings River (Gabrielse, 1969) map areas. The volcanics form prominent flat-topped volcanic cones in the Jennings River area and are grouped within the Tuya Formation. The basaltic rocks in our study area are similar to descriptions of Tuya Formation volcanics to the west and are grouped with them.

**CASSIAR TERRANE (CA)**

Several traverses were made westward across the Northern Rocky Mountain Trench, north of the Red River. West of Mount Monckton, strong shearing in grey, laminated phyllite is believed to reflect deformation in the fault zone. Immediately to the west, presumably in the Cassiar Terrane, rocks are quite variable and range from quartz-feldspar-bearing sandstone of Late Proterozoic age to siltstone of possibly Siluro-Devonian age. The medium
grey, moderately to thickly bedded quartz sandstone with rare feldspar clasts and phyllitic partings is most likely Late Proterozoic and belongs to the Ingenika Group. The affinities of the other rocks are more problematic due to lack of data. These include: grey to yellow or orange-weathering, grey to green, massive to finely laminated dolomitic siltstone, cherty siltstone and chert; yellow to orange, grey, faintly laminated calcareous quartz sandstone to quartzite and grey slate. These lithologies may belong to the Road River, Kechika and Atan groups, respectively.

**INTRUSIVE ROCKS**

Intrusive rocks occupy a very minor portion of the map area. The most abundant are the relatively large bodies of gabbro within the Kechika Group exposed in the Gemini Lakes area. The remainder consist of small dikes and plugs. Intermediate to felsic intrusions on Boya Hill, although small, are economically significant as they are associated with tungsten-molybdenum mineralization.

**GABBRO (PG)**

Northeast of Gemini Lakes, gabbro forms several elongate bodies intruding rocks of the Kechika Group. It is orange-brown weathering, speckled green and white, unfoliated, equigranular and medium to coarse grained. Plagioclase is grey to pinkish and comprises between 40 to 50 per cent of the rock. The remainder consists of dark green pyroxene, hornblende and biotite. Intrusive relationships were seen in only a few outcrops, and in one it appears that the gabbro is a sill-like body.

**Age and Lithologic Correlation**

Gabrielse (1962a) described dikes and sills of gabbro in rocks of Proterozoic and early Paleozoic age, and suggested that they are no younger than Kechika age because they are never found intruding younger rocks (H. Gabrielse, personal communication, 1996). Our observations support this conclusion.

If this is correct, then magmatism was coeval with Kechika deposition. In the Tuchodi Lakes area, dikes and sills are seen within the Kechika Group which also contains thick sections of volcanics (Taylor and Stott, 1973). Mafic volcanics are also present in the Kechika Group in south-central Yukon, along the west side of the Cassiar Terrane (Gordey, 1981), in eastern Selwyn Basin (Gordey and Anderson, 1993) and in similar rocks in the Anvil Range along the west side of the Selwyn Basin (Gordey, 1983).

**BOYA HILL INTRUSIVES (EKp)**

Tungsten-molybdenum stockwork-skarn mineralization on Boya Hill is related to north-trending dikes and sills of texturally and mineralogically homogenous, fine to medium-grained quartz-biotite-feldspar porphyry (Moreton, 1984). Peatfield (1979a) also describes quartz porphyry dikes in the area. These porphyry intrusions are commonly altered, together with the surrounding clastic and carbonate succession (see section on Economic Geology). Sills are from 2 to over 100 metres thick, and traceable for up to 450 metres (Moreton, ibid.). These rocks were not examined in detail during our mapping and the following descriptions are taken from Moreton (1984) and Peatfield (1979a).

**Modal analysis indicates that the quartz-biotite-feldspar porphyry is of tonalite to granodiorite composition.** Phenocrysts comprise up to 65 per cent of the rock; the average is 35 per cent plagioclase and 13 per cent each of quartz and biotite. The unaltered rock has abundant potassium feldspar in the groundmass, in addition to quartz, plagioclase and biotite. Hornblende locally comprises up to 15 per cent of the phenocrysts. Quartz porphyry is leucocratic and only weakly porphyritic such that it locally appears aplitic. The groundmass typically contains abundant potassium feldspar and in some localities there are sparse potassium feldspar and biotite phenocrysts. Narrow dikes of both quartz-feldspar ±biotite porphyry with a dark purplish groundmass and, dark brown mafic rock of predominantly plagioclase composition with variable amounts of hornblende and biotite are also present in this area.
Age and Lithologic Correlation

The age of these intrusions is believed to be approximately 100 Ma (late Early Cretaceous) based on whole rock K-Ar dating of hornfelsed sediments and a quartz-feldspar granodiorite dike. Analysis of hornfelsed sediments returned a 100±3 Ma age (unpublished date; T.G. Schroeter, 1980). The granodiorite dike is 100±2 Ma (Hunt and Roddick, 1987). It is sericitized, but unmineralized and believed to post-date mineralization associated with the quartz-biotite-feldspar porphyry (Hunt and Roddick, 1987), although its composition is consistent with the mineralized intrusions.

These intrusive rocks are part of the mid-Cretaceous Selwyn Plutonic Suite, a group of high-level, discordant stocks of granite, granodiorite and quartz syenite found throughout the Omineca Belt of the Yukon (Woodsworth et al., 1991; Gordey and Anderson, 1993). They were intruded between 88 and 114 Ma and are believed to have been formed by partial melting of the thickened continental crust in response to regional compression. As a result, these intrusions display strong S-type characteristics (Woodsworth et al., 1991).

OTHER INTRUSIONS

Numerous felsic dikes and small stocks are exposed throughout the map area north of Chee Mountain. The exact age of these bodies is unknown, but their relatively fresh appearance suggests they are Cretaceous or Tertiary. Considering the late Early Cretaceous age for igneous activity in the Boya Hill area and the widespread early Middle Cretaceous granitic intrusions in the eastern Selwyn Basin, most of these rocks are probably Middle Cretaceous in age.

KP

Several feldspar and quartz-feldspar porphyry dikes intrude the low-grade metamorphic rocks of the Aeroplane Lake panel, and also occur in the footwall of this thrust panel. The groundmass of these dikes is generally medium bluish grey and weakly calcareous. Phenocrysts are pink to orange-buff feldspar and brown biotite. These bodies are up to several metres across, and where observed have chilled margins and cut the fabric of the hostrocks.

Age

Their age is unknown but they may also be related to the Boya Hill intrusions, 10 kilometres to the southeast, in which case they would be late Early Cretaceous.

KTP, KTg

A small body of speckled grey, medium-grained granite or granodiorite (KTg) with subhedral quartz phenocrysts up to 2 millimetres in diameter is exposed several kilometres west of Mount Monckton. Fracture surfaces are coated with magnetite or hematite. An intrusion of pale yellow, altered quartz porphyry (KTP) crops out a few kilometres southeast of Mount Monckton.

Age

Rocks underlying Mount Monckton are strongly hornfelsed, indicating proximity to a large intrusive body. Several outcrops of intrusive rock were also found in the area, which is along the extension of the Northern Rocky Mountain Trench fault zone. Their undeformed condition suggests they are younger than the fault, making them no older than latest Cretaceous or Early Tertiary.