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MIOCENE STRATIGRAPHY AND INDUSTRIAL MINERALS, BONAPARTE TO DEADMAN RIVER AREA, SOUTHERN BRITISH COLUMBIA* (92I/14, 15; 92P/2, 3)

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INTRODUCTION

This report summarizes results from 49 days of fieldwork spent investigating the distribution of Miocene rocks, their stratigraphy, and the occurrence of industrial minerals in the area between Bonaparte and Deadman rivers. In the Miocene, the principle industrial minerals are diatomaceous earth and volcanic ash. In addition to the regional geology of the area of Monger (1982) for the Ashcroft area (92I), and Campbell and Tipper (1971) for the Bonaparte Lake area (92P), McCammon (1960) described volcanic ash and its pozzolanic properties at Sherwood Creek; Cockfield (1948) and Hora (1986) reported on the Red Lake diatomite; and Read (1988) discovered diatomite north of the junction of Gorge Creek and Deadman River. Laboratory investigations of samples are in progress, but tests of materials relative to ASTM specifications have not yet started.

MIOCENE STRATIGRAPHY

Within the mapped area (Figure 3-7-1), the Miocene succession consists of up to 350 metres of fluviatile rhyolite ash and fine clastic sediments underlying a minimum thickness of 500 metres of olivine basalt flows. The core from two drill holes east of Chartrand Lake indicates that the basalt flows and sediments are intercalated over a thickness of 150 metres. All of these rocks belong to the Chilcotin Group, which Mathews (*in press*) defined as consisting of Neogene basalt, and intercalated sedimentary and pyroclastic strata in south-central British Columbia. The rhyolite ash, and fluviatile and lacustrine sediments up to the first appearance of basalt belong to the Deadman River Formation (Campbell and Tipper, 1971), and the overlying olivine basalt flows and intercalated rhyolite ash and sediments belong to the newly proposed Chasm Formation.

The Deadman River Formation outcrops in a few roadcuts, slide scarps and stream bottoms on the western side of the map area, along sections of Bonaparte River, and Loon and Scottie creeks. On the east side of the map area, it underlies parts of the valley walls of Deadman River and the north-trending valley containing Young Lake. White to buff-weathering, unbedded rhyolite ash dominates, and white tuffaceous sandstone, siltstone and shale occur near the top of the sequence. Although there are only a few exposures of carbonaceous shale and siltstone near the top, two drill holes near Chartrand Lake show layers up to few metres in thickness are scattered throughout the formation. In the Deadman River valley, Campbell and Tipper (1971) suggested that diatomaceous layers up to 4 metres thick occur near the bottom of the succession, but in Loon Creek, diatomaceous earth outcrops near the base and at the top. In Loon Creek, pebble conglomerate and sandstone form a minor part of the formation, and according to Campbell and Tipper, similar rocks occur near the mouth of Chasm Creek and within a few kilometres south and west of Clinton.

Most of the sediments are fluviatile and partly fill deeply incised, steep-walled valleys very similar to the present valleys of Deadman and Bonaparte rivers and Chasm Creek. Local debris-flows from the steep valley walls form some of the fill. North of the junction of Gorge Creek and Deadman River, a cross-section of the Miocene Deadman channel, abbreviated as Mio-Deadman, is 2 kilometres wide and 380 metres deep with the lower 200 metres filled mainly with rhyolite ash of the Deadman River Formation. The northwest side of Loon valley, near Wohlleben Creek, has a few exposures of Deadman River Formation that outline the cross-section of the Mio-Bonaparte channel which is 5 kilometres wide and more than 400 metres deep, with a fill of more than 365 metres of rhyolite ash, conglomerate and diatomaceous earth. The Mio-Bonaparte channel is still more than 2 kilometres wide along the bottom of Loon Creek which indicates that the channel depth not only exceeds 400 metres but could easily approach 500 metres. The Miocene interfluves were probably similar to the present rolling hills of the map area. East of Deadman River, in the southeast corner of the map area, unbedded airfall rhyolite tephra covers the interfluves to depths approaching 20 metres. The restricted areal distribution and up to 20-metre thickness of tephra on the interfluves imply proximity to local rhyolite vents rather than the distant calcalkaline arc volcanoes lying to the southwest, as suggested by Bevier (1983). About 4 kilometres north of Red Lake, diatomaceous earth exposed at the Western Clay Products deposit, formerly the DEM deposit, is part of a lacustrine succession that lies on Eocene basic volcanics. The base of the succession is perched about 300 metres above the base of the nearby Miocene channels and is clearly not part of the fluviatile channel fillings.

The Chasm Formation typically forms a chain of cliffs up to 50 metres in height at the top of the present valley sides.

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British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1988, Paper 1989-1.

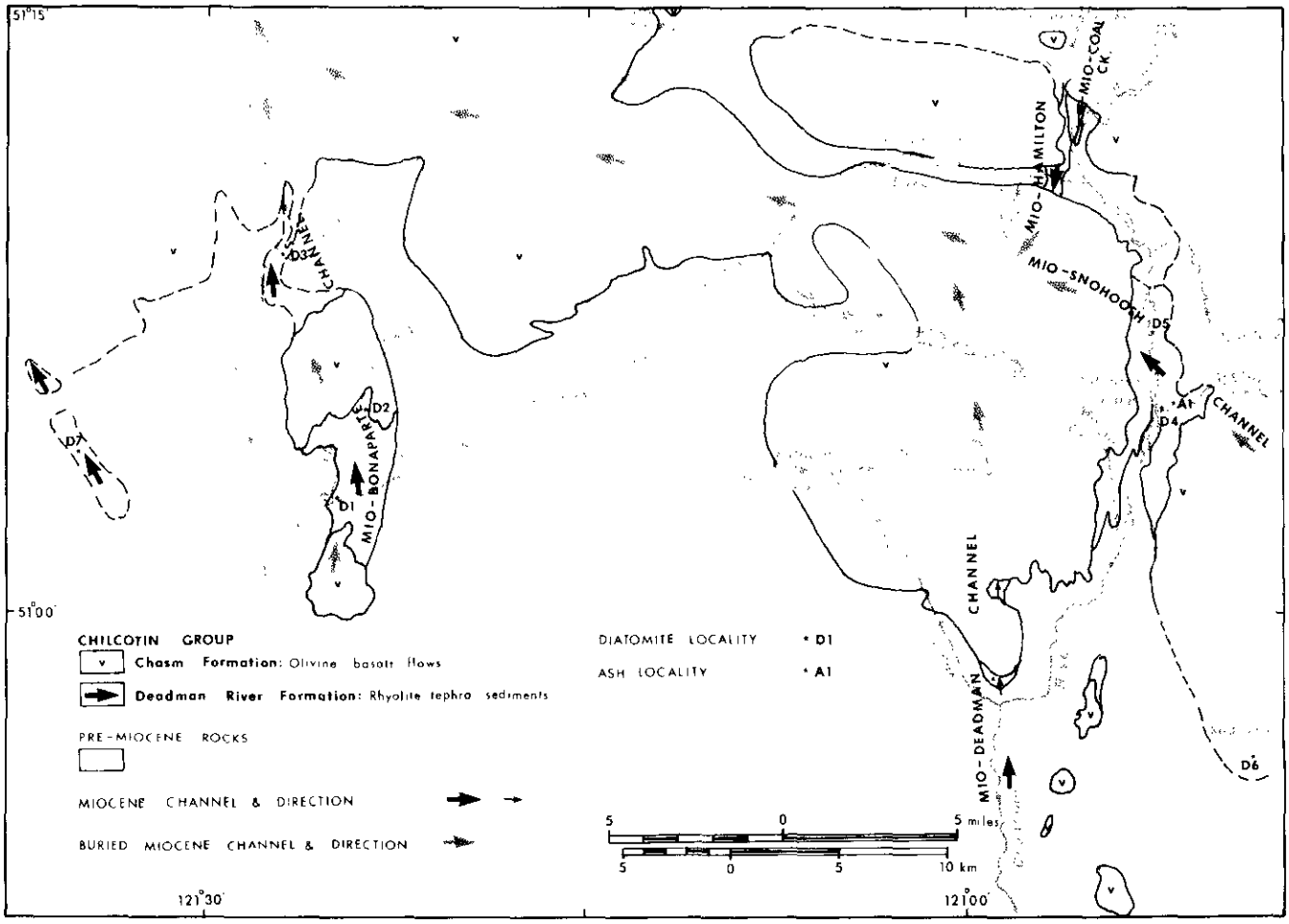

Figure 3-7-1. Simplified geological map of the area between Bonaparte and Deadman rivers showing the distribution of the Chilcotin Group, exhumed and buried Miocene drainage channels, and industrial mineral occurrences. Geological boundaries are *dashed where taken or modified from Campbell and Tipper (1971).*

The postglacial channel of Chasm Creek, ringed by cliffs of 100 metres or more, exposes up to a dozen olivine basalt flows ranging in thickness from 1 to 15 metres. Only near the margins are the flows vesicular or amygdaloidal with zeolites as the common filling. Away from the margins, most of the flows are medium to dark grey with prominent olivine and plagioclase. The outcrops are blocky to columnar jointed, and lack platy jointing or flow layering. These outcrop characteristics distinguish the Miocene olivine basalt flows from the typically grey, aphanitic and platy jointed flows of the Eocene Kamloops Group. In addition, Miocene volcanic breccias are very local in contrast to the widespread distribution of breccias in the Eocene. Near the base of the formation, some of the Miocene basalt flows have a weak platy jointing and contain ultramafic nodules such as those near the mouth of Fly Creek, or olivine xenocrysts as in basal flows near Moose Creek. Drill holes east of Chartrand Lake show that the lower 150 metres of the formation consists of olivine basalt flows with intercalations of rhyolite ash, siltstone, shale and carbonaceous sediments ranging from 2 to 9 metres thick. Ten kilometres to the south, Bevier (1983) noted a few airfall silicic tephra layers between basalt flows. The base of the Chasm Formation is set at the first appearance of olivine basalt and thus the formation includes the overlying silicic tephra and sediment layers among the olivine basalt flows.

Within the map area, the succesion of flat-lying olivine basalt flows is nearly 500 metres thick as exposed in the valleys of Bonaparte River, Loon Creek, and Deadman River. Such a thickness must contain dozens of flows and is many times the average thickness of 67 metres for the Chilcotin Group or the thickest section of 141 metres measured by Bevier (1983) in her regional study. Because the flows form a third or less of the Miocene channel fills, most spread out over a rolling topography that had more than 800 metres of relief, but which lacked the deeply incised valleys that the Deadman River Formation had already filled.

MIOCENE DRAINAGE

Bevier (1983) noted that the present courses of the Fraser and Chilcotin rivers were established during the Late Miocene. The near coincidence of the Mio-Bonaparte channel and present Bonaparte river, Mio-Deadman and present Deadman, and Mio-Snohoosh with Snohoosh Lake may have the same implication of Late Miocene development. However, the fascinating observation of Mathews and Rouse

(1984) is that the Miocene sediments in the vicinity of Gang Ranch on the Fraser River have current directions indicating a flow to the north or northwest.

In the mapped area, because massive rhyolite ash dominates the Deadman River Formation, current indicators are extremely rare. At four different locations in cliffs of conglomerate in the Mio-Bonaparte channel on the south side of Loon Creek, pebble imbrication indicates northerly flow. Other sites for the measurement of current indicators are present near Clinton but uncooperative landowners will not allow access. In the absence of other current indicators, the angle of intersection of Miocene channels and the differences in elevations along the channel bases provide relevant information (Table 3-7-1).

TABLE 3-7-1
CHARACTERISTICS OF MIOCENE CHANNELS

Channel	Channel	Angle of Intersection
Mio-Deadman	Mio-Bonaparte	Acute towards northwest
Mio-Snohoosh	Mio-Hamilton	Inferred acute towards west
Mio-Snohoosh	Mio-Deadman	Inferred acute towards northwest
Mio-Hamilton	Mio-Coal Creek	Acute towards south
Channel	**Elevations**	**Direction of Elevation Decrease**
Mio-Coal Creek	1020 m (3350') 975 m (3200')	Southward
Mio-Bonaparte	850 m (2800') <700 m (2800')	North-northwestward

In the mapped area, these data indicate that most of the Miocene channels drained to the north and west, in contrast to the present drainage system which is to the south and southwest. In the Mio-Bonaparte channel, pebble imbrication, and a northward decrease in the elevation of the channel prove north-northwest flow in a channel that is subparallel to, but about 4 kilometres east of Bonaparte River. Deadman valley exposes parts of four Miocene channels which from south to north are Mio-Deadman, Mio-Snohoosh, Mio-Hamilton and Mio-Coal Creek. Of these, the southward decrease in the elevation of the base of the channel of Mio-Coal Creek and its angle of intersection with Mio-Hamilton Creek require a southward flow in both channels. The elevation of the base of Mio-Hamilton Creek, at less than 930 metres (3050 feet) in Hamilton Creek where the Miocene channel is 0.5 kilometre wide in the creek bottom, implies that Mio-Deadman and Mio-Snohoosh cannot be part of a south-flowing Mio-Hamilton channel because Mio-Deadman and Mio-Snohoosh bases are not less than 915 metres (3000 feet) and 925 metres (3025 feet) respectively. If Mio-Deadman and Mio-Snohoosh are not part of a south-flowing system, then the channels must be north flowing and join with Mio-Hamilton beneath a thick cover of basalt flows under the mid-course of Brigade Creek. The low elevation of the base of olivine basalt flows in Loon Creek where it is less than 915 metres (3000 feet) and in Bonaparte River at less than 715 metres (2350 feet) provides evidence of a west-northwest-flowing Miocene channel which joins the four Miocene channels exposed in Deadman valley with the Mio-Bonaparte near the mid-course of Chasm Creek. The regional distribution of Miocene rocks and the elevations of the underlying basement preclude an eastward drainage of any significant Miocene channel toward the North Thompson River.

INDUSTRIAL MINERALS IN THE CHILCOTIN GROUP

Industrial minerals in the Chilcotin Group are restricted to diatomaceous earth and volcanic ash which are found only in the Deadman River Formation. Because much less than 1 per cent of the area underlain by the formation contains outcrops, it cannot be adequately prospected for industrial minerals without trenching or drilling.

DIATOMACEOUS EARTH

The Mio-Bonaparte channel contains diatomaceous earth. A 3-metre-high roadcut on Tomlin Road within 100 metres of its junction with the Loon Lake Road at 700 metres (2300 feet) elevation and UTM coordinates FM0610050mE, FM5655900mN (**D1**) (Figure 3-7-1) exposes diatomaceous earth near the bottom of the channel fill. Roadcuts on an old logging road shown on NTS sheet 92P/3 just east of Wohlleben Creek expose diatomaceous earth between 1030 and 1045 metres (3375 and 3425 feet) at FM0612350mE, FM5660250mN (**D2**) which lies within 30 metres of the top of the channel fill. The potential for further occurrences of diatomaceous earth in Mio-Bonaparte channel exist near the junction of Chasm Creek and Bonaparte River but uncooperative landowners will not permit access to the area. Mio-Deadman channel has float of diatomaceous earth exposed in roadcuts at FM0648100mE, FM5648200mN (**D3**) (Read, 1988). Near the bottom of Mio-Snohoosh channel, Campbell and Tipper (1971) reported two layers of diatomaceous earth 2 to 3 metres thick on the east side of Snohoosh Lake, north of Sherwood Creek close to FM0649200mE, FM5661200mN (**D4**). Farther north along the channel, both McCammon (1960) and Campbell and Tipper (1971) noted three diatomaceous layers ranging from 2 to 5 metres in thickness near FM0648700mE, FM5664300mN (**D5**). The sparse outcrops of the Mio-Hamilton and Mio-Coal Creek channel fills show no diatomaceous layers. Of all the diatomaceous earth occurrences only the deposit of Western Clay Products Ltd. (**D6**) near Red Lake at 1235 metres (4000 feet) and FM0653700mE, FM5645150mN has been an intermittent producer of pet litter. Drilling has outlined a lacustrine accumulation of diatomaceous earth which is up to 37 metres thick and covers an area of more than 65 hectares. Campbell and Tipper (1971) found gravel, sand and some diatomaceous silts in logging roadcuts about 2 kilometres south of Clinton and the British Columbia Railway (**D7**). Because of proximity to rail transportation, this area is worth prospecting.

VOLCANIC ASH

Massive rhyolite ash of the Deadman River Formation is the dominant rock filling the Miocene channels. To date, prospecting efforts and testing have concentrated on the north side of Sherwood Creek at 915 metres (3000 feet) and FM0649300mE, FM5661000mN (**A1**) where McCammon

(1960) tested the ash for its pozzolanic properties. Although it meets ASTM specifications, it has not been used as a pozzolan nor has it found use as a cream glaze on ceramicware (McCammon, 1960), or as an abrasive (Eardley-Wilmot, 1924 and 1927). Similar appearing but untested ash is widespread and localities in the Mio-Bonaparte channel, such as the south side of Loon Creek, might be closer to major transportation routes or the cement plant in Marble Canyon.

REFERENCES

Bevier, M.L. (1983): Regional Stratigraphy and Age of Chilcotin Group Basalts, South-central B.C., *Canadian Journal of Earth Sciences* Volume 20, pages 515-524.

Campbell, R.B. and Tipper, H.W. (1971): Geology of Bonaparte Lake Map-area, B.C., *Geological Survey of Canada*, Memoir 363, 100 pages.

Cockfield, W.E. (1948): Geology and Mineral Deposits of Nicola Map-area, B.C., *Geological Survey of Canada*, Memoir 249, 164 pages.

Eardley-Wilmot, V.L. (1924): Natural Abrasive Materials in Canada, *in* Investigations of Mineral Resources and the Mining Industry, 1923, *Mines Branch, Canada Department of Mines*, Publication Number 616, pages 14-15.

——— (1927): Abrasives, Part I, Siliceous Abrasives, *Mines Branch, Canada Department of Mines*, Publication Number 673, pages 85-89.

Hora, Z.D. (1986): New Developments in Industrial Minerals, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Geological Fieldwork 1985, Paper 86-1, pages 239-240.

Mathews, W.H. (*in press*): Neogene Chilcotin Basalts in South-central British Columbia: Geology, Ages and Geomorphic History, *Canadian Journal of Earth Sciences*.

McCammon, J.W. (1960): Pozzolan, *B.C. Minister of Mines*, Annual Report 1959, pages 178-184.

Mathews, W.H. and G.E. Rouse: (1984): The Gang Ranch - Big Bar Area, South-central British Columbia: Stratigraphy, Geochronology, and Palynology of the Tertiary Beds and Their Relationship to the Fraser Fault, *Canadian Journal of Earth Sciences*, Volume 21, pages 1132-1144.

Monger, J.W.H. (1982): Bedrock Geology of Ashcroft (92I) Map Area, *Geological Survey of Canada*, Open File 980, Sheet 1.

Read, P.B. (1988): Industrial Minerals in the Tertiary of the Bonaparte to Deadman River Area, Southern B.C., *B.C. Ministry of Energy, Mines and Petroleum Resources*, Geological Fieldwork 1987, Paper 1988-1, pages 417-419.