BULLMOOSE MAPPING AND COMPILATION PROJECT* (93P/3, 4)

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INTRODUCTION

The Bullmoose mapping and geological compilation project is an amalgamation of several existing projects utilizing data from various sources. The objective is to compile 1:50 000-scale geological maps for NTS map sheets 93P/3 and 93P/4. Semi-automated techniques were used for data handling, interpretation and presentation. Open file geology maps will be produced and existing data from all available sources compiled into computer processable format for distribution. This initial project will test the applicability of microcomputer-aided geological analysis on a regional scale. Work is ongoing with final products nearing completion; this review will focus on the data and techniques utilized during the project.

LOCATION

The map area is located in the heart of the Northeast British Columbia coal development and includes the pit areas of both the Quintette and Bullmoose operations. The area encompasses some 1640 square kilometres and lies mainly within the inner and outer foothills physiographic regions. The southwest corner of the study area covers a portion of the main and front ranges of the Rocky Mountains and this geology is not addressed.

Elevations vary from 730 metres to 1980 metres. Three major river systems drain the area: Sukunka, Wolverine and Murray. In general these waterways cut across the northwest-trending regional geological strike (Figure 5-6-1). The orientation of these water courses is controlled by Pleistocene glaciation which resulted in classic U-shaped valleys and cirque topography. Vegetation varies from alpine tundra to pine and spruce forests which are the basis of a significant forestry industry.

Access consists of one paved provincial highway (No. 29), several major forestry access roads, the Tumbler Ridge branchline of British Columbia Railway and numerous coal company access roads. The new town of Tumbler Ridge is located just off the eastern edge of the map area.

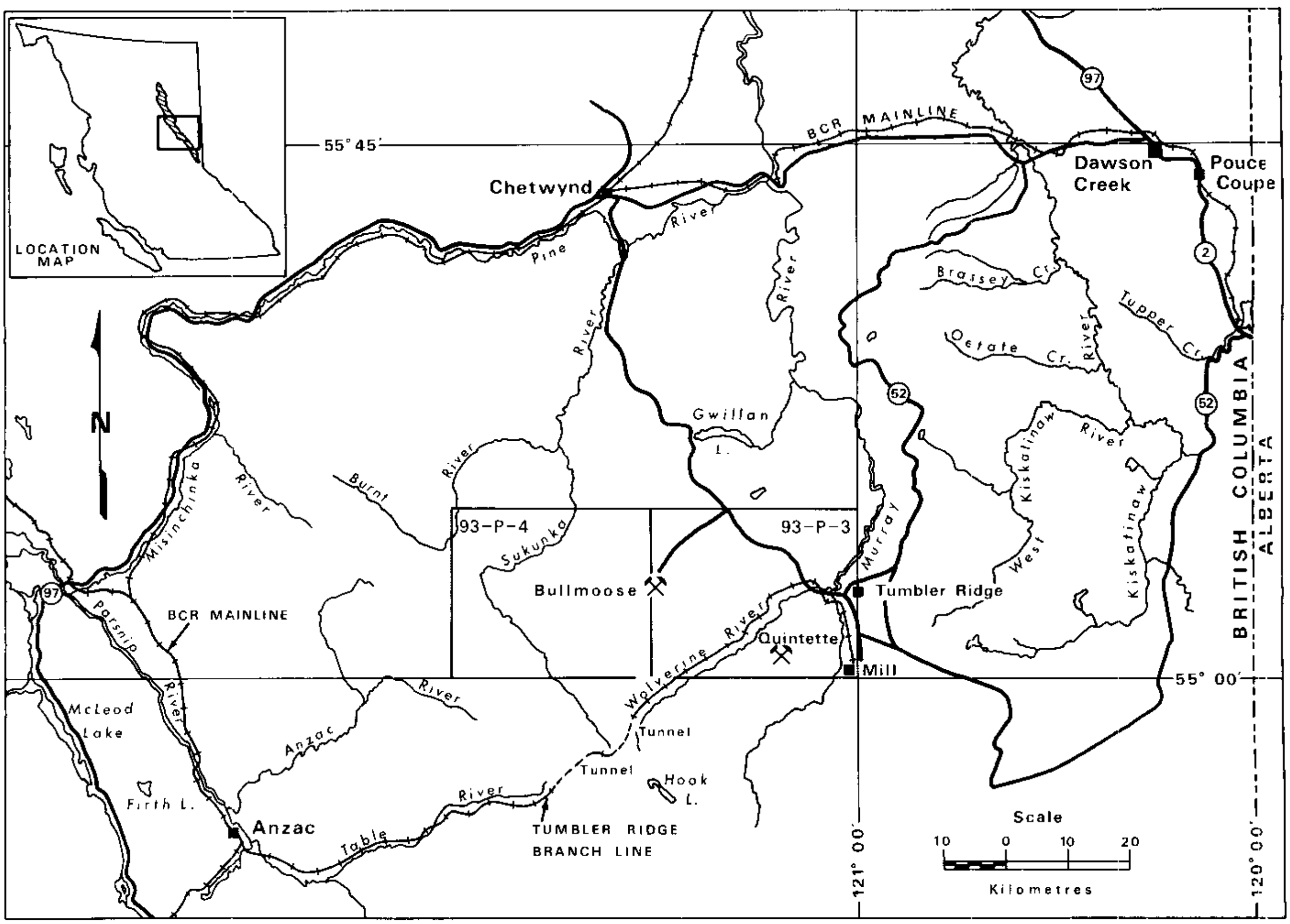

Figure 5-6-1. Study area location map.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1986, Paper 1987-1.

STRATIGRAPHY

The stratigraphy of the area has been investigated and described by numerous workers, most notably D.F. Stott (1968, 1973, 1982). Rocks ranging in age from Devonian to Late Cretaceous are exposed in the area. This study concentrated on rocks of the Jurassic Minnes Group and Cretaceous Bullhead and Fort St. John Groups. The general depositional history has been well described by previous authors and is beyond the scope of this report. The formation names and general characteristics, including approximate thicknesses, are summarized in Figure 5-6-2. Coal measures of economic interest are found within both the Gething and Gates Formations of the Bullhead and Fort St. John Groups respectively. Current production in the Peace River Coalfield is limited to Gates Formation rocks. Minor coals are also found in the Upper Minnes Group and the Cadomin and Boulder Creek Formations.

MINNES GROUP

The Minnes Group comprises in excess of 1800 metres of interbedded sandstone, shale, siltstone and minor coal. Further north it has been subdivided into four formations. Complex structural geology and the absence of readily mappable units have prevented subdivision of the Minnes Group in this map area.

The Minnes Group is unconformably overlain by the Cadomin Formation of the Bullhead Group.

BULLHEAD GROUP

CADOMIN FORMATION

The Cadomin Formation is a resistant conglomerate unit. It commonly consists of three prominent conglomerate bands with interbeds of more recessive sandstone. The upper and lower contacts of the formation are abrupt and easily identifiable in the field.

SERIES	GROUP	FORMATION	THICKNESS IN METRES	LITHOLOGY
UPPER CRETACEOUS	SMOKY	KASKAPAU	≈ 440+	Dark grey marine rubbly shale with sideritic concretions and sandstone
		DUNVEGAN	≈ 475	Marine and non-marine sandstone and shale
	FORT ST. JOHN	CRUISER	≈ 110	Dark grey marine shale with sideritic concretions; some sandstone
LOWER CRETACEOUS		GOODRICH	≈ 50	Fine-grained, crossbedded sandstone; shale and mudstone
		HASLER	≈ 250	Silty, dark grey marine shale with sideritic concretions; siltstone and sandstone in lower part; minor conglomerate
		BOULDER CREEK	≈ 120	Fine-grained, well sorted sandstone; massive conglomerate; non-marine sandstone and mudstone
		HULCROSS	≈ 100	Dark grey marine shale with sideritic concretions
		GATES	≈ 130	Fine-grained, marine and non-marine sandstones, conglomerate; coal, shale and mudstone
		MOOSEBAR	≈ 130	Dark grey marine shale with sideritic concretions; glauconitic sandstone and pebbles at base
	BULLHEAD	GETHING	≈ 375	Fine- to coarse-grained, brown, calcareous, carbonaceous sandstone coal, carbonaceous shale, and conglomerate
		CADOMIN	≈ 40	Massive conglomerate containing chert and quartzite pebbles
	MINNES	UNDIFFERENTIATED	≈1700	Thinly-thickly interbedded, shale, sandstone, siltstone and coals
JURASSIC		FERNIE	≈ 700	Black marine shale

Figure 5-6-2. Stratigraphic framework (modified after Stott, 1983).

GETHING FORMATION

The Gething Formation is a coal-bearing deltaic unit predominantly nonmarine, but including significant marine trangressive-regressive intervals. A large marine tongue which thins to the south has been referred to as the middle Gething. Coal seams in the upper Gething, Chamberlain Member, have been extensively evaluated on the Sukunka property and coals in the lower Gething have been investigated north of the Sukunka River toward the Peace River.

FORT ST. JOHN GROUP

MOOSEBAR FORMATION

The marine Moosebar Formation lies between the Gething and Gates Formations. The lower portion of this formation is massive black mudstone. Above this a series of upward-coarsening cycles culminates in a clean beach sandstone. This upper portion of the Moosebar is known as the Torrens Member. The lower contact of the Moosebar is usually marked by a thin lag conglomerate with associated glauconite occurrences. This glauconitic unit has been referred to as the Bluesky equivalent, but this reference is abandoned in this study due to the problem of which of two units do in fact correlate with the Bluesky Formation of the subsurface. A glauconite-rich zone with an associated lag conglomerate also occurs at the base of the middle Gething marine tongue. This horizon correlates with the Gething-Moosebar contact in the Pine and Peace River areas.

GATES FORMATION

Studies of the Gates Formation by Leckie and Walker (1982) and Carmichael (1983) have shown that the shoreline during this time was oriented approximately east-west and fluctuated across the map area. Coals in the Gates Formation become thinner and less frequent a short distance to the north, due to persistent marine conditions. In the map area coals in this formation are being exploited by Quintette Coal Mines Ltd. and Bullmoose Operating Corp. To the south the Gates Formation and equivalent formations extend as far as the North Saskatchewan River in Alberta.

HULCROSS FORMATION

The Hulcross Formation is a marine shale unit overlying the Gates Formation. Locally a thin conglomerate bed marks the lower contact.

BOULDER CREEK FORMATION

The Boulder Creek Formation overlays the Hulcross Formation and consists of resistant weathering conglomerate and sandstone strata.

SHAFTESBURY FORMATION

The sequence of Hasler-Goodrich-Cruiser Formations is commonly referred to as the Shaftesbury Formation to the south of the map area and in the subsurface of the plains. This name change is dependent upon the presence or absence of the Goodrich Formation. The Goodrich is a sandstone unit which pinches out in the southern portion of the map area. The Hasler and Cruiser Formations are dark marine mudstone units with few distinguishing features.

SMOKY GROUP

DUNVEGAN FORMATION

The Dunvegan Formation is a marine to nonmarine unit with fluvial sand channels superimposed on thinly bedded mudstone and siltstone strata. The sandstone channels often form discontinuous sandstone ridges on hillsides.

KASKAPAU FORMATION

This marine shale formation outcrops in the eastern portions of the map area. It is generally recessive and forms large grassy slopes if capped by a resistant sandstone unit.

DATA

Efficient handling of data is one of the major objectives of this project. Existing data from geological maps and well logs were collected and stored in a processable form. Newly acquired mapping data were quickly added to existing information to provide a database for analysis.

Existing outcrop information was collected from assessment reports submitted on properties located in the study area. The following information was recorded for each outcrop location using a digitizing tablet and microcomputer:

- Outcrop identification,
- Outcrop UTM coordinates,
- Outcrop elevation,
- Formation,
- Structure type,
- Structure dip direction or trend,
- Structure dip or plunge.

A significant portion of the outcrop data was collected by contract personnel under the Canada/British Columbia Coal Data Acquisition Program.

Coal company borehole information was available from the Ministry of Energy, Mines and Petroleum Resources computer-based COALFILE database and hard-copy reports on file with the Ministry. Location and identification data were readily available in machine processable form. Analysis of the borehole data required manual interpretation of the hard-copy logs.

Oil and gas well logs were reviewed and interpreted at the Ministry's facilities in Victoria. Formation and marker contacts were recorded and provided much needed deep subsurface control.

Surface formation contacts and fault lines were digitized from assessment report maps to facilitate interpretation in the field.

Topographic data for the map area were taken from 1:50 000-scale National Topographic System maps. A digitizing tablet and microcomputer were used to collect the data which were then stored as a network of elevation points. Figure 5-6-3 displays these data in a three dimensional format.

A large amount of information was available in addition to data collected this field season. The complete database included: 7567 outcrop stations, 660 coal company boreholes, 15 oil and gas wells, and 6731 topographic points on 500-metre centres.

Examination of the data quickly showed which areas required close scrutiny and where additional fieldwork would be redundant.

In the field, outcrop data collected during traverses were entered periodically into the microcomputer system. The ability to enter data in the field reduces entry errors due to the time lag and elevates the power of computer analysis from an after-thought process to an interactive field geology tool.

HARDWARE, SOFTWARE AND TECHNIQUES

HARDWARE

A variety of computer hardware components were utilized during the project. A GTCO digitizing tablet connected to an IBM XT provided the digitizing capability used to record outcrop data, formation and structure trace location information, and topographic data. Analysis and data maintanence were performed on a Comtex IBM-compatible computer with an Epson FX 80 printer and Roland DXY 800 plotter as peripheral devices. A larger format Houston Instrument DMP-42 plotter was employed during the final analysis stage.

SOFTWARE

Digitizing software was written by Ward Kilby with data storage made compatible with the Geological Analysis Package of Cal Data Ltd. The Geological Analysis Package was used for all phases of data storage, manipulation and presentation. File management was performed with the Data Handler module; structural analysis and

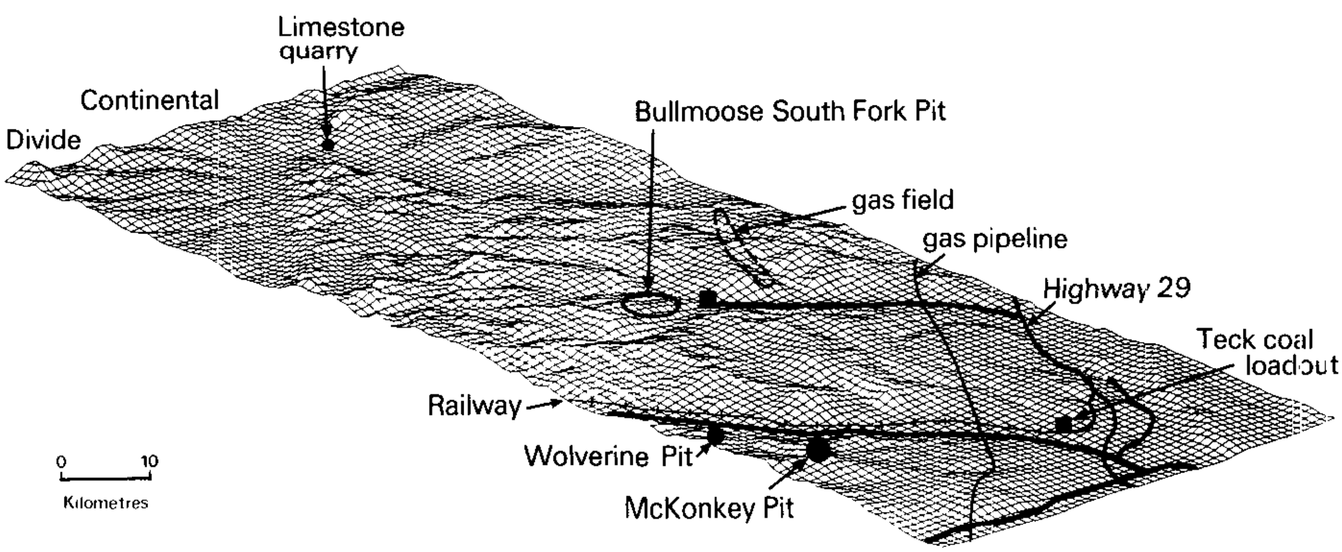

Figure 5-6-3. Isometric view of study area topography, showing location of infrastructure and major developments.

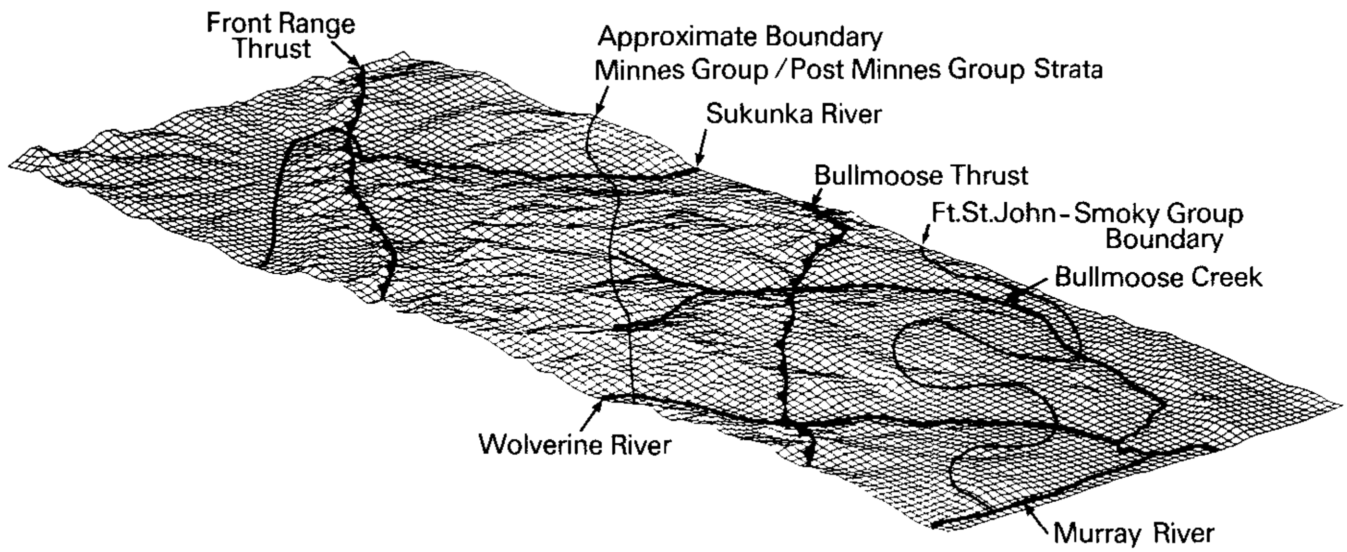

Figure 5-6-4. Surface traces of the Front Range and Bullmoose fault zones. Also noted is the approximate location of the trace of the upper contact of the Minnes Group and the Fort St. John-Smoky Group contact.

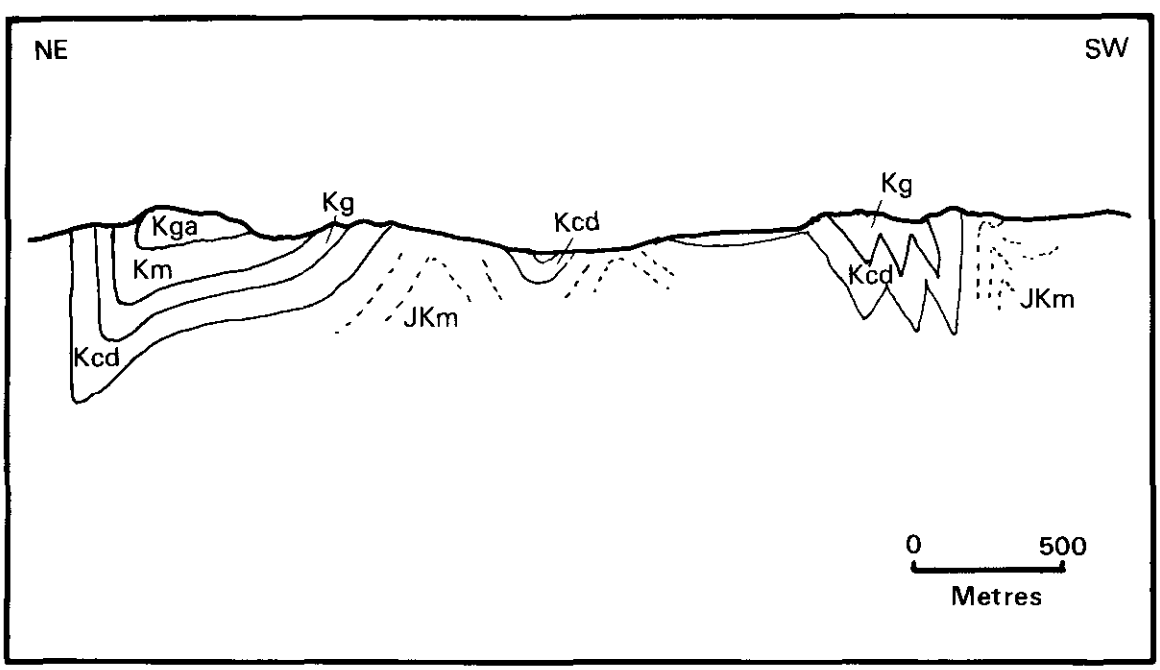

Figure 5-6-5. Line trace drawing from photographs illustrating the structural style in the Mount Reesor area.

data presentation functions were performed with the Structural Analysis module and surface modelling functions utilized the Grid Handler module.

Computer-based structural analysis techniques have been used throughout the coal-bearing regions of the Cordillera (Kilby, 1978; Langeberg, 1985; Wrightson, 1978). These techniques have been taught in short courses and undergraduate structural geology courses for more than a decade (Charlesworth *et al.*, 1976), but it has been the advent of the microcomputer which has made their field application possible.

STRUCTURE

The structural features of the study area have been described by numerous company and government geologists. Regional maps (1:250 000 and 1:500 000) have been produced by Stott (1968 and 1982). More detailed property mapping programs are described in numerous coal and petroleum assessment reports on file with the Ministry of Energy, Mines and Petroleum Resources.

The prominent structures are northwest-striking folds and thrust faults. Two major thrusts cut the area; the Front Range fault brings Paleozoic strata to the surface and marks the eastern edge of the Rocky Mountains. Further to the east the Bullmoose fault zone is the only major thrust fault to affect the surface exposures of the coal-bearing strata. The surface traces of these two faults are roughly parallel. The Front range fault dips steeply to the southwest. The Bullmoose fault also dips to the southwest, but is much shallower as suggested by its surface trace (Figure 5-6-4). There are undoubtedly blind thrust faults present in the map area but in the coal measures they are expressed as folding in the strata.

The structural geology of the area varies from relatively simple to complex. In general structures tend to become broader both in an eastward direction and up-section. The alternation of relatively competent and incompetent units, nonmarine and marine, tends to result in variable styles of deformation within the same structure. Very tight structures commonly visible in the Cadomin Formation are completely unrecognizable in the Gates Formation, due to disharmonic deformation in the intervening incompetent Moosebar Formation. Figures 5-6-5 and 5-6-6 illustrate some of the structural styles seen in the area.

ECONOMIC GEOLOGY

Two coal-bearing formations, the Gates and Gething, have attracted considerable exploration attention. At present two mining operations are exploiting the coal measures of the Gates Formation. Quintette Coal Mines Ltd. is producing 4.75 million tonnes of clean metallurgical product and 650 000 tonnes of thermal product per year. The Bullmoose Operating Corp. is producing 1.7 million tonnes of metallurgical coal annually.

Oil and gas exploration has resulted in the discovery of economic gas pools. Production from these wells is approximately 36 040 000 cubic metres per year, moved to market through the Grizzly Valley pipeline of Westcoast Transmission Ltd.

CONCLUSION

The Bullmoose project has successfully utilized large quantities of structural data from various sources to compile a regional geological interpretation. The application of computer-based techniques has proven useful and in fact may be essential. The project will meet its primary goal of providing 1:50 000 mapping coverage of the coal measures and adjacent strata of 93P/3 and 93P/4 map sheets. In addition the collection and filing of most available data at a much larger scale provide an excellent database for additional more detailed studies by the Geological Survey Branch and other researchers.

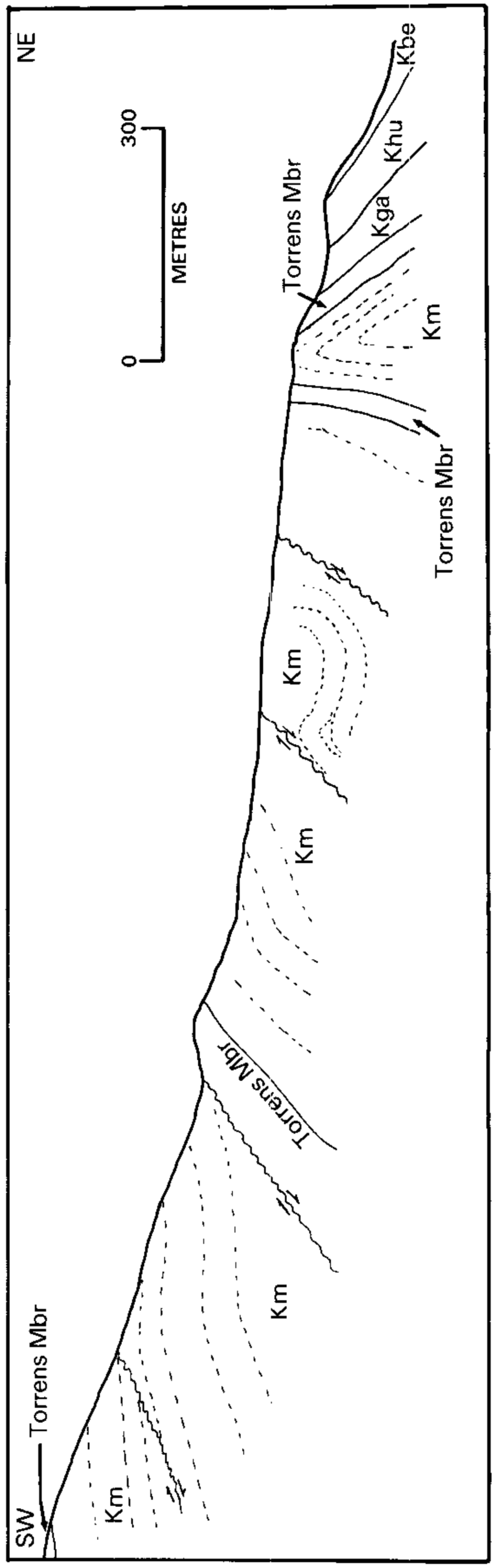

Figure 5-6-6. Line trace drawing from photographs illustrating the deformation style in the Bullmoose fault zone. Location is on east slope of Bullmoose Mountain.

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