British Columbia Geological Survey
Geological Fieldwork 1989

TUMBLER RIDGE, NORTHEAST BRITISH COLUMBIA (93P/2, 3, 4; 93I/14, 15)

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KEYWORDS: Coal geology, Tumbler Ridge, stratigraphy, structure, automated data analysis.

INTRODUCTION

This study completes the geological mapping project done in the Bullmoose and Kinuseo areas. Work during this segment of the program concentrated on corrections to previous mapping, and additional mapping in a portion of the 93P/2 map sheet. In addition to completion of surface mapping, work began on integration of subsurface information and application of computer-based analysis procedures.

The study area contains the two producing coal mines which comprise the northeast British Columbia coal development. About one half the value of British Columbia's coal production comes from these two mines. This is approximately one eighth of the total value of mineral production in the province. The Sukunka, Bullmoose, Wolverine, Grizzly North and Grizzly South producing gasfields and the shut-in Murray field are also located in the study area. Interest in coalbed methane as an economical energy resource adds a new resource value to this area as well as all coal-bearing areas of the provinces. Exploration programs have outlined significant additional coal resources which only require improved markets to reach production. Significant new natural gas discoveries have encouraged major exploration activity for this commodity in the study area. The Tumbler Ridge Project of which this season's work was a part, will document the structure and stratigraphy of the area, evaluate coal maturation, estimate coal resources and coalbed methane potential and provide all raw data in computer processable form. This status report briefly describes the stratigraphy of the area, the data distribution and illustrates the penetrative fold-axis orientation of the area.

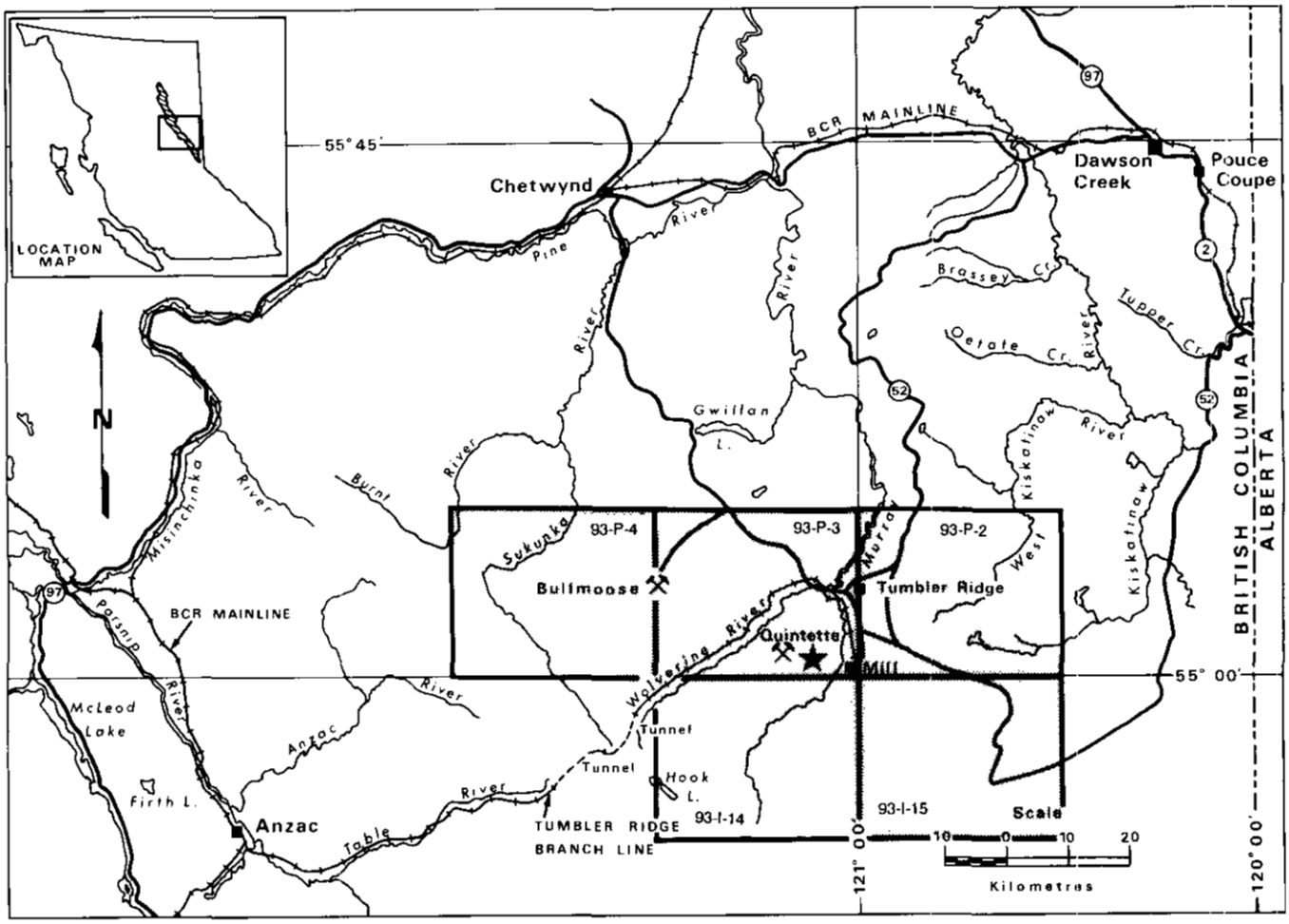

Figure 4-6-1. Location map of the study area. Stippled area illustrates the zone in which mapping was concentrated.

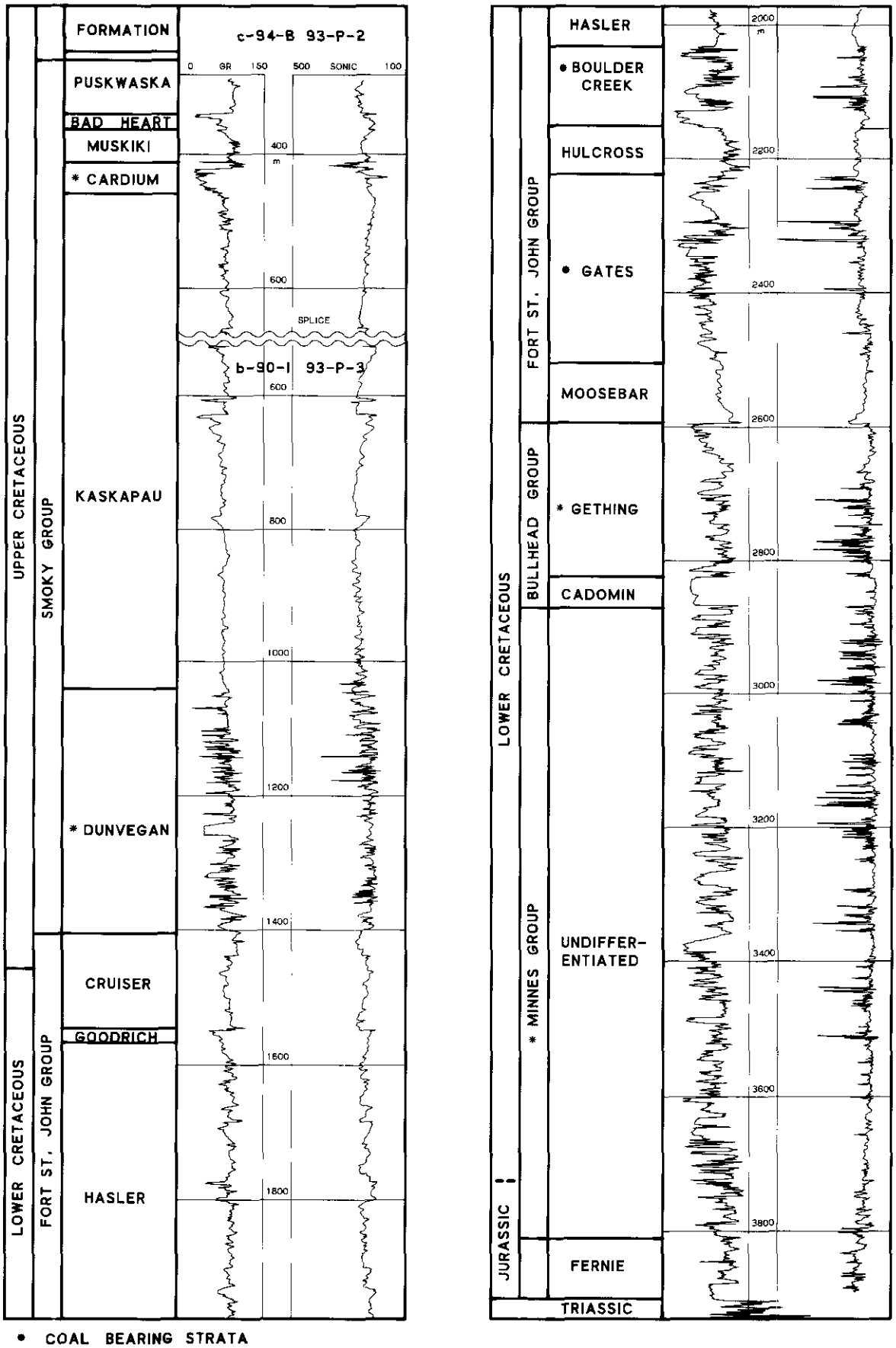

Figure 4-6-2. Table of formations with their geophysical log responses. Coal-bearing formations are noted with a star. No suitable log was available for the Wapiti Formation.

LOCATION

The map area is located in northeastern British Columbia and is centred at approximately latitude 55°N and longitude 121°E (Figure 4-6-1). Mapping covered parts of five 1:50 000 map sheets and was bounded on the west by the Rocky Mountain Front Ranges and on the east by a convenient outer foothills structure.

The town of Tumbler Ridge is situated near the centre of the map area and provided an excellent base for fieldwork. Three paved and all-weather roads connect Tumbler Ridge with other communities such as Chetwynd and Dawson Creek. Within the area there is generally good access to most of the coal-bearing strata by means of petroleum and coal exploration roads, forestry and railroad access roads. The drainage and physiography of the area have been described by Kilby and Wrightson (1987a), and Kilby and Johnston, (1988a).

PREVIOUS WORK

This project draws extensively on the efforts of past workers as it is essentially a compilation and re-interpretation with relatively minor infill mapping. Petroleum exploration in the area has provided excellent data sources including Jones (1960) and Hughes (1956). The federal government effort in the area has been led by Stott, (1967, 1968, 1973 and 1982). University studies include the work of Carmichael (1983) and Leckie and Walker, (1982). Previous work under this project has been reported by Kilby and Wrightson (1987a, b, c) and Kilby and Johnston (1988a, b, c).

1989 FIELD ACTIVITIES

Mapping during the 1989 field season concentrated on the re-examination of previously mapped areas. Some of the early maps were based extensively on compiled data and interpretation. Several problem areas were identified by industry users of the maps, as well as by re-interpretation using the expanded database. Those areas that warranted review were the priority for this year's work. In general the coal-bearing areas are very well mapped and have required virtually no revisions of the existing coal company interpretations. However, in areas which were mapped on a regional scale more than 15 years ago it was found that significant changes are required in the positioning of formation contacts. Much of this re-interpretation is now possible due to new information from recent exploration activities not available to previous workers.

FUTURE ACTIVITY

Production of 1:50 000-scale geology maps of the study area will be completed in early 1990. An automated structural analysis will be performed in order to construct a regional digital model of the map area. Both in-house software and commercially available programs will be used. A publication will be produced to describe the structure and stratigraphy of the area as well as demonstrate the numerical analysis techniques used during the study. All data compiled or generated during the project will be made available in digital form as Open File releases. For example, files of the outcrop and drill data will be available, as will CAD files of the geology maps and the constructed digital deposit models along with analysis programs.

STRATIGRAPHY

Formations mapped during this project ranged from the Jurassic Fernie Formation to the Upper Cretaceous Wapiti Formation. A representative section of this interval is about 4500 metres thick (Figure 4-6-2). Coal occurs in the Minnes Group and the Gething, Gates, Boulder Creek, Dunvegan, Cardium and Wapiti formations. The major coal-bearing formations are the Gething, Gates and Wapiti with the only current production coming from the Gates Formation. When evaluating the coalbed methane potential of a section, seams less than a metre thick may prove economic. Under this scenario all coal-bearing formations in this section are of interest.

The stratigraphy is essentially an alternating sequence of marine shales and marine or nonmarine clastics, resulting from marine transgressive and regressive cycles. Examination of the natural gamma trace in Figure 4-6-2 illustrates this feature. This geophysical method measures the natural radioactivity of rock and as such is excellent for distinguishing the shaliness of the strata. A marine shale will generally have a high gamma count while a clean sandstone will have a low count. Using this relationship, several coarsening-up sequences indicative of marine regressions can be identified. For example, in the upper Gething, Moosebar to Gates transition and the Goodrich, Cardium and Bad Heart formations. The sonic log, which measures interval transit times indicates coal horizons together with other features. Formation identification based solely on single outcrops is dubious; in areas of isolated sandstone and shale outcrop, interpretation relies heavily on subsurface data. Where exposure is good there is little difficulty in correctly identifying stratigraphic position.

DATA

Large amounts of geological information have been collected during this project, necessitating the use of computer techniques for data handling and compilation. The data are stored in three major files.

Outcrop information was collected from the best geology maps available. The Canada–B.C. Coal Information Collection Project facilitated the capture of the majority of the outcrop data used in this study. Orientation, stratigraphic position, geographic position, structure type and data source are recorded for each outcrop location providing about 22 000 data points (Figure 4-6-3).

Subsurface information from coal company boreholes was obtained from work carried out during the Canada–B.C. Coal Information Collection Project and log analysis was performed as part of the Tumbler Ridge Project. Information from petroleum and natural gas wells was obtained by log

analysis performed during the Tumbler Ridge Project. For ease of storage and manipulation these two datasets are stored in a manner similar to outcrop information. Each subsurface intersection that is recorded is treated as a single outcrop. There are 1205 coal exploration boreholes (Figure 4-6-4) which generally only penetrate the coal-bearing horizons and tend to be less than 500 metres in depth. Sixty-one petroleum and natural gas wells (Figure 4-6-5) penetrate much deeper and provide stratigraphic and in some cases structural data across many formations.

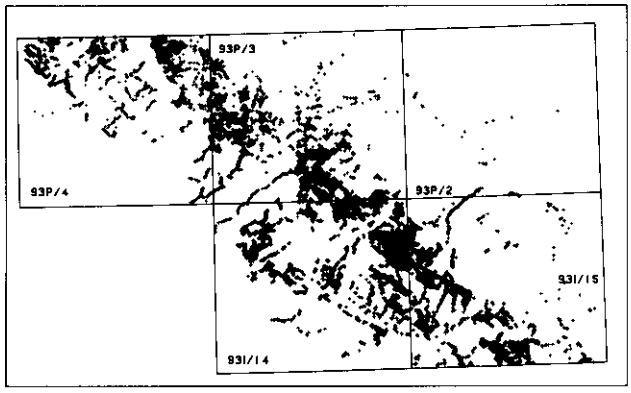

Figure 4-6-3. Distribution of outcrop data within the study area.

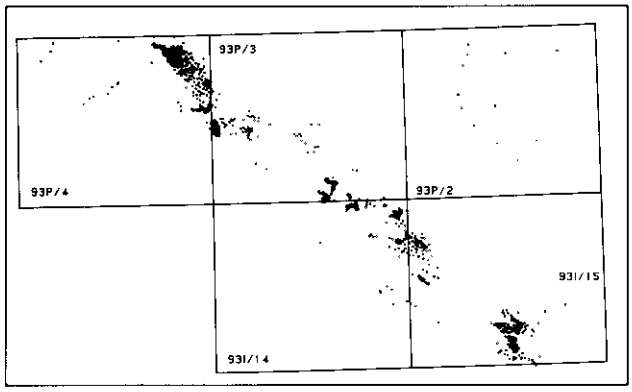

Figure 4-6-4. Distribution of the coal exploration boreholes within the study area.

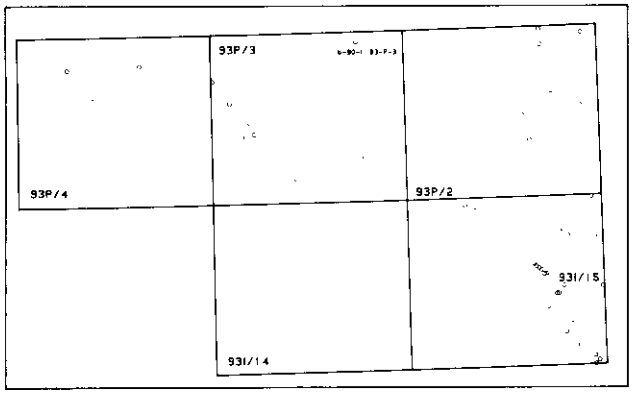

Figure 4-6-5. Distribution of the petroleum and natural gas exploration and production wells in the study area.

STRUCTURE

In the study area the structural style varies eastward across the regional trend of the Rocky Mountain Foothills, depending upon lithology and distance from the Front Ranges. Folding in the Minnes Group is extremely complex, usually consisting of short-wavelength inclined chevron folds which are not pervasive. Large rounded folds are present only when thick competent units of strata are involved. In the middle of the sequence under study, the Gates Formation is dominated by major long-wavelength folds, often forming large box anticlines. The uppermost section which is located along the eastern edge of the study area, shows strata simply deformed into gentle warps associated with the Alberta syncline. Smallscale faults are numerous, occurring in nearly every outcrop, but very few major regional faults are present, exceptions being the Bullmoose and Gwillan Lake faults. All faults identified in the area are thrusts. Figure 4-6-6 is a pi-diagram of all the bedding orientation data from the study area (approximately 21 000 points). The plot forms a girdle of poles to bedding indicative of cylindrically folded strata. Following Charlesworth *et al.* (1976), a numerical procedure was used to obtain a more precise calculation of the regional fold axis. The eigenvalue/eigenvector technique calculated a regional fold axis orientation of 309°/1°. The major and intermediate eigenvalues are approximately equal and the minimum eigenvalue is more than an order of magnitude less than the other two axes. This result is characteristic of a good cylindrical distribution of bedding poles. The cylindrical nature of deformation in the area suggests the use of the down-plunge projection technique will be successful in examining the structure.

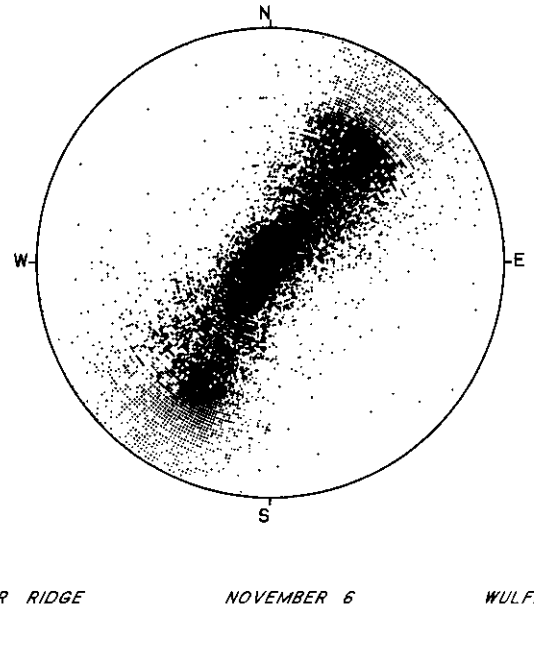

Figure 4-6-6. Pi-diagram of the bedding orientation data for the whole study area, about 22 000 outcrops.

ACKNOWLEDGMENTS

The authors would like to thank members of the coal and petroleum industry for their constructive comments and discussions about the study area. In particular D. Johnson (Quintette Coal Limited), M. Cooper (B.P. Resources Canada Limited), C. Bickford (consultant) and B. Wrightson (consultant). Quintette Coal Limited's Housing Division has supplied members of this project with excellent accommodation for the last two field seasons.

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