COAL INVESTIGATIONS

CROWSNEST COALFIELD

By David E. Pearson and D. A. Grieve

INTRODUCTION

Systematic 1:7 000 scale mapping of Crowsnest Coalfield continued in the 1977 field season when approximately 100 square kilometres was mapped. The area covered by this mapping project is indicated on Figure 10. Preliminary maps to be published during 1978 relating to this project will cover Fernie Ridge from Coal Creek, Fernie to Hosmer Ridge (contiguous with Sheet 2, Preliminary Map No. 24); and the northern portion of the Southern Dominion Coal Block. These preliminary maps will contain both measured sections and petrographic data on rank for each seam over 1 metre.

FERNIE RIDGE

Detailed mapping of Fernie Ridge has established that several seams previously mined in Coal Creek can be traced northward and correlated with seams exposed on Hosmer Ridge. A major rank change takes place in this section as the isorank plane separating high from medium-volatile bituminous coals cuts down section to the north (Fig. 10). Thus fixed carbon contents of coals decrease along the seams and computed coke stabilities decrease both up stratigraphic section and northward toward the Northern Dominion Coal Block.

MORRISSEY RIDGE

Mapping along Morrissey Ridge has not been completed but the following data have been gathered. The ridge exposes a strike section of coal measures and most of the seams identified in Coal Creek can be traced southward to Morrissey Creek. The ridge is capped by Blairmore Group rocks, and much of the ridge is underlain by Elk Formation. One noteworthy feature is the rank of the coal. At the south end of the ridge, coals in the lower third of the succession have a rank of low-volatile bituminous (reflectance, in oil, $\bar{R}o$ >1.51 per cent, volatile content (d.m.m.f.) <22 per cent).

The key area of Morrissey Creek will be mapped in 1978.

SOUTHERN DOMINION COAL BLOCK

This area, centred on Mount Taylor, occupies a gentle syncline with a north-south-trending axis. Beds at the top of the mountain are vertical and overturned, which implies that erosion has removed an overlying thrust-separated panel of rock. The important Flathead fault (Price, 1965), which is a shallow-dipping normal fault, juxtaposes Elk member rocks with only 170 metres of coal measures immediately north of

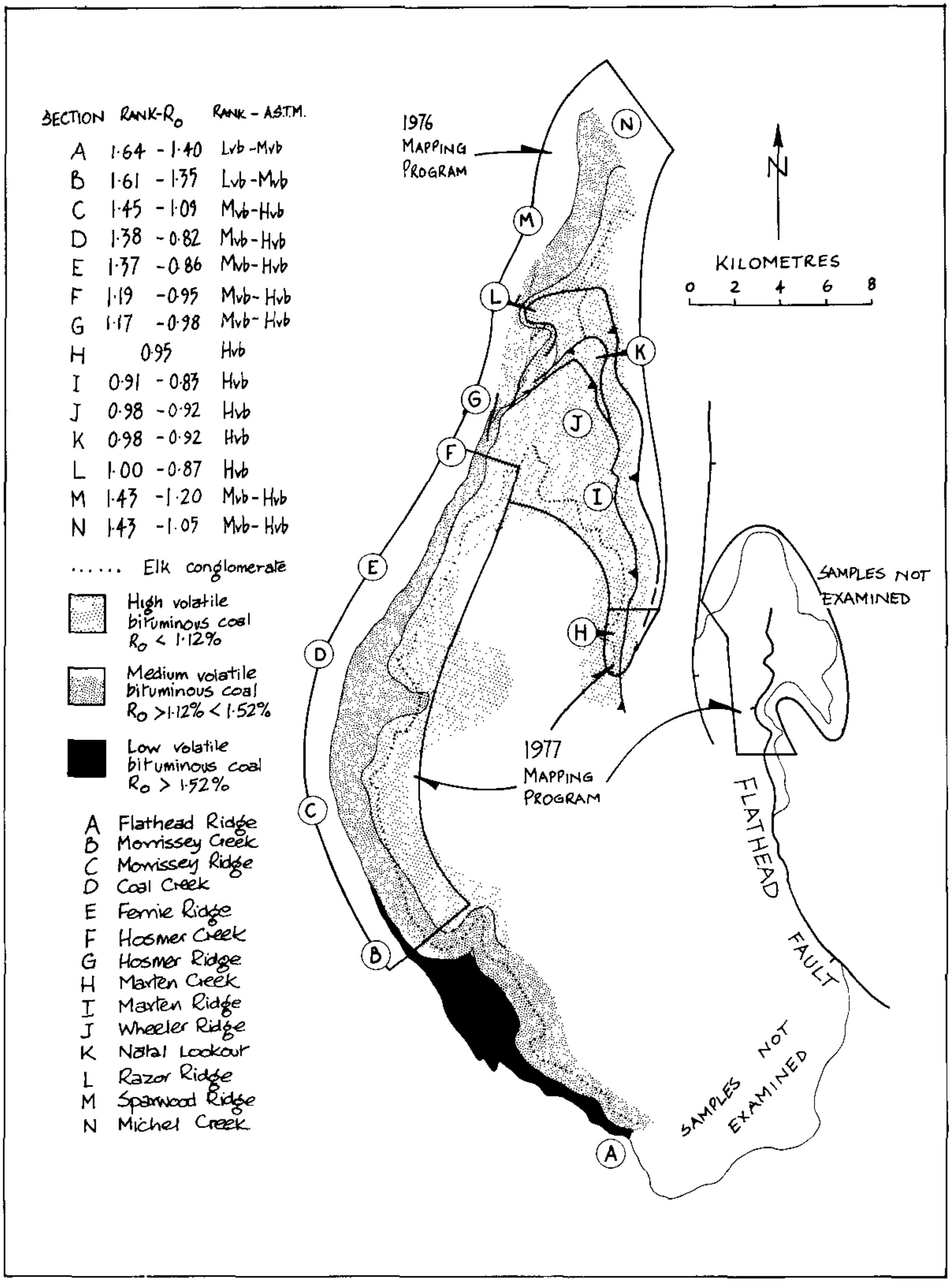

Figure 10. Preliminary rank map over Crowsnest Coalfield.

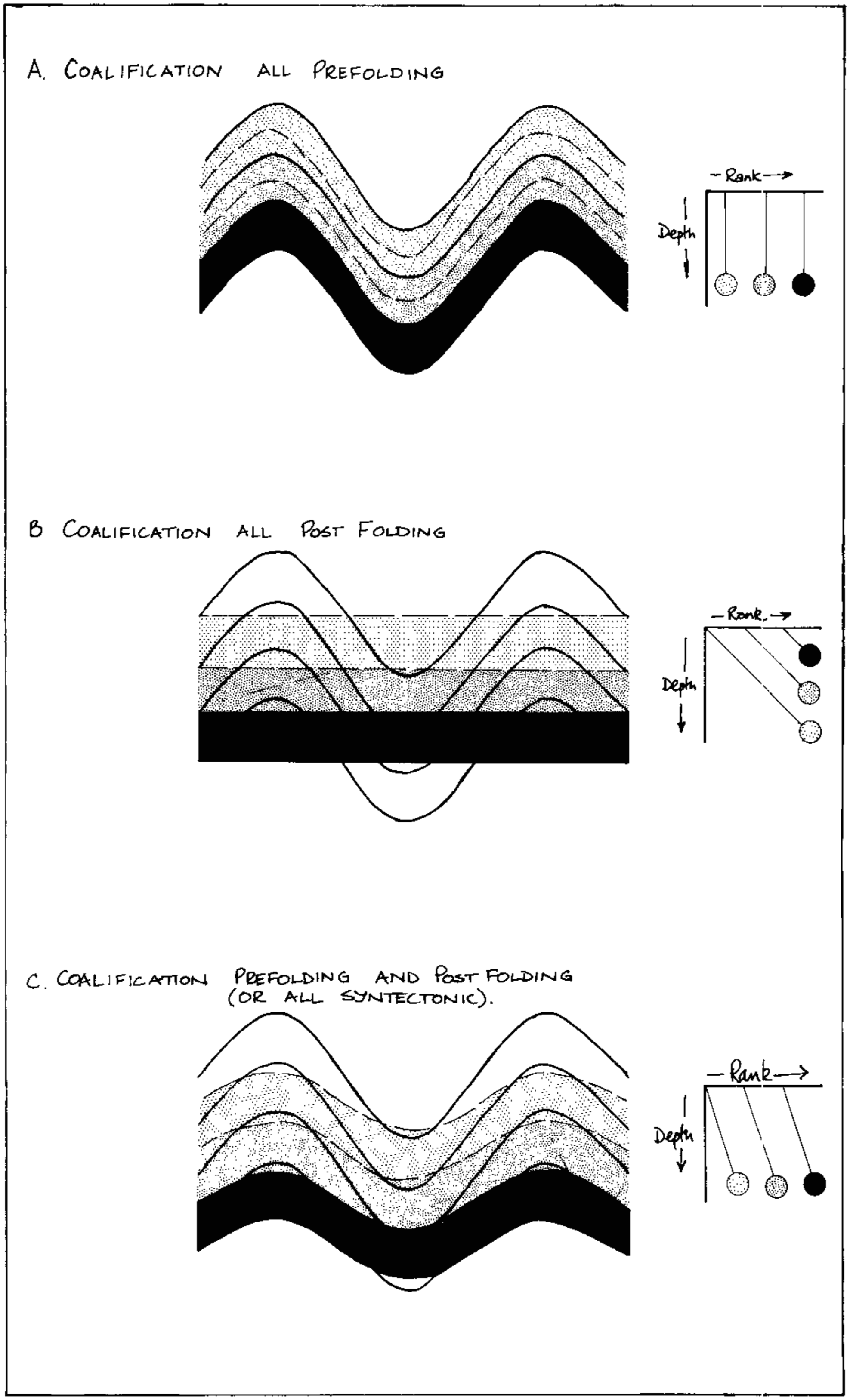

Figure 11. Sections showing possible configurations of coalification planes and coal seams together with rank/depth graphs.

Leech Creek, but the fault terminates rapidly northward so that at the north end of Mount Taylor the full 470 metres of succession is preserved. Samples collected from this area have yet to be analysed petrographically.

RANK STUDIES

Because the coking power of a metallurgical coal depends principally upon rank and only to a lesser extent upon the maceral composition of that coal, a Leitz MPV-1 photometer for coal petrographic work has been used to produce an accurate rank map of the Crowsnest Coalfield. A generalized version of this map together with the rank range of coals found in 13 principal sections is shown on Figure 10.

A number of important features which deserve amplification are as follows:

All of the coal samples so far examined are hard bituminous, but the distribution is not symmetrical. Low-volatile coals, for example, are exposed only in the south of the coalfield. Medium-volatile coals rim the west margin of the coalfield, whereas high-volatile coals form the inner margin of the coalfield where coal measures are in contact with overlying formations.

The complete coal-bearing succession preserved on Razor Ridge has a high-volatile rank (Fig. 10, locality L), as do the virtually complete stratigraphic sections of Natal Lookout, Wheeler Ridge, Hosmer Ridge, Marten Ridge, and Marten Creek. Given the correct petrographic composition, these coals should produce high crucible swelling numbers (FSI's) indicating high caking capacity, but coke stabilities (ASTM) will probably be below 50.

From the mining point of view it is important to determine the time of coalification relative to folding and thrusting. Work by the Teichmüllers in Germany and Hacquebard and Donaldson (1970, 1974) in Canada has outlined the principles involved in such interpretations (Fig. 11).

In coalification that occurred prefolding, rank changes systematically with stratigraphic position and the rank remains the same along any seam (Fig. 11, a). In areas where coalification occurred postfolding, changes in rank occur systematically with stratigraphic position, but more importantly, **rank changes down the dip of the seam** (Fig. 11, b). This is important for mining because it means coal quality increases with depth. Finally, in areas where coalification commenced prior to, continued during, and terminated after folding, isorank lines are curved and dip in the same direction as seams though at a shallower angle (Fig. 11, c). Rank/depth diagrams for these three principal types of coalification are shown on the right-hand side of Figure 11.

Our thoughts at present are that a large amount of coalification postdates thrusting because the rank does not change markedly over the major structures shown on Figure 10.

In Crowsnest Coalfield and elsewhere, mapping of ridges provides little information on the relative age of coalification because coal seams and isorank planes outcrop in strike section. The vital information can only be gathered in valleys which cross the strike. Such valleys are those of Michel Creek, Coal Creek, and Morrissey Creek.

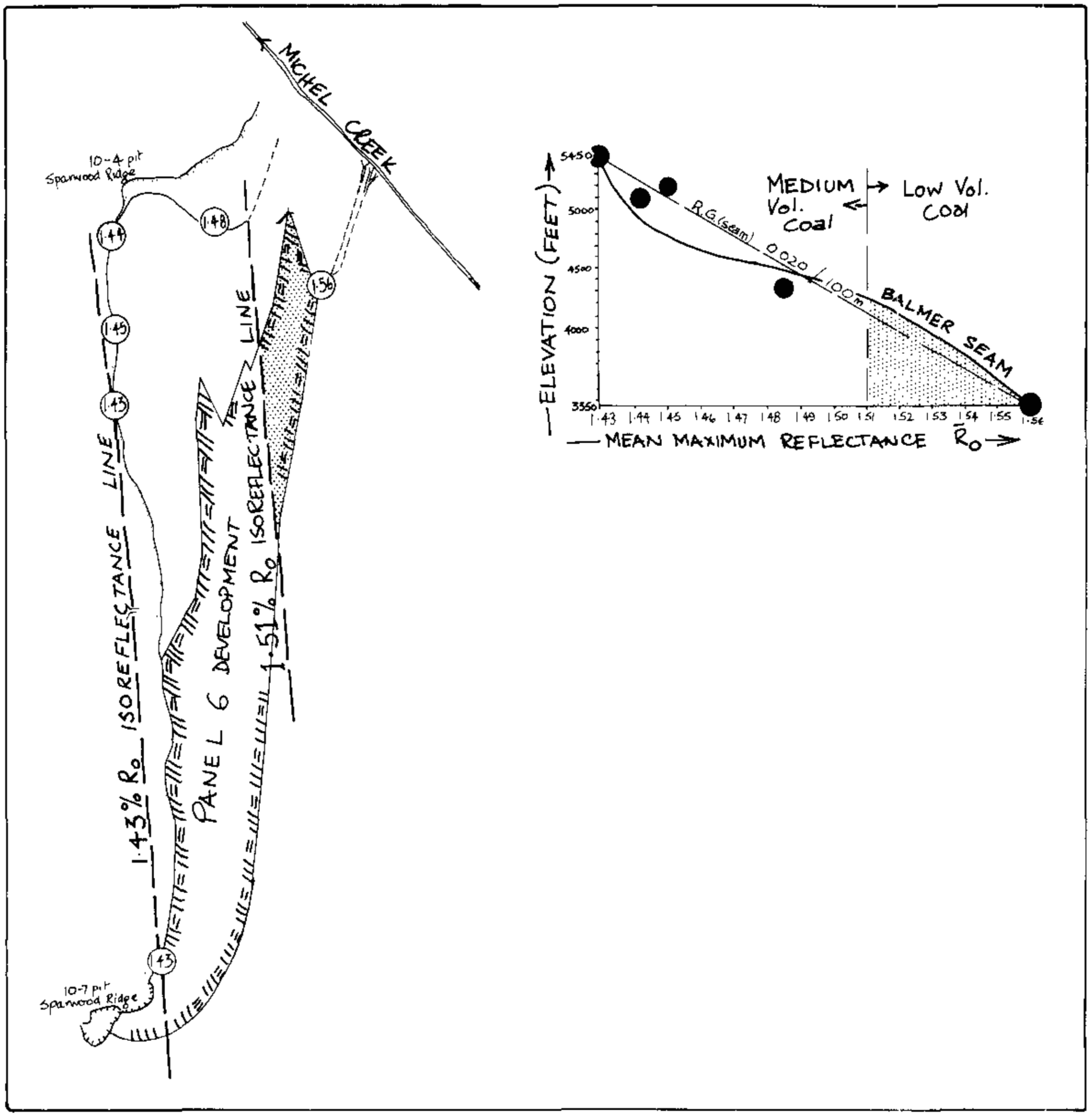

Figure 12. Coalification map of Balmer seam over the 'Panel 6' development with location of petrographic samples, location of isorank lines, and cross-section of Balmer seam showing rank change with elevation.

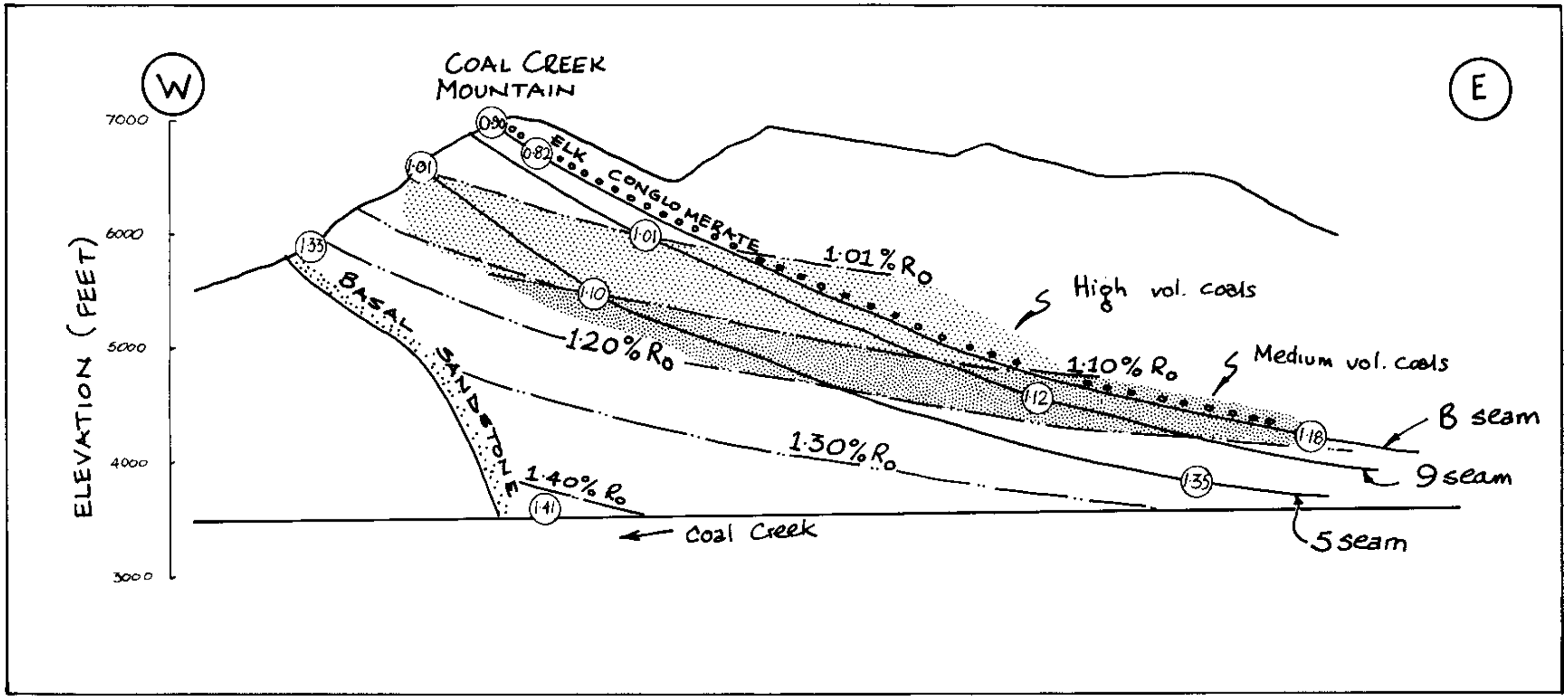

Figure 13. Cross-section of the north side of Coal Creek, Fernie, showing positions of petrographic samples, rank change of seams with depth, and approximate positions of isorank lines (even though some data points are anomalous).

(a) **Michel Creek**

Five samples of Balmer coal covering an interval of 600 metres (2,000 feet) have been ranked petrographically (Fig. 12). The highest elevation sampled was from 10 seam at 1 661 metres (5,450 feet) on Sparwood Ridge, where a rank of $\bar{R}o$ = 1.43 per cent was obtained. This is the same rank as Balmer coal at the 10-7 pit 3 kilometres to the south. The lowest elevation sampled was in Kaiser Resources' new hydraulic mine at 1 021 metres (3,350 feet) elevation, at the dewatering site of the Panel 6 development. Here, a rank of $\bar{R}o$ = 1.56 per cent was obtained. It is therefore obvious that the rank of Balmer coal **changes down the dip of the seam.** Consequently, coking power of Balmer coal must be variable and this is apparent from the coalification map of Balmer seam in the area of the new Panel 6 mine (Fig. 12) from which it can be seen that nearly one-fifth of proposed production will be of low-volatile bituminous coal.

(b) **Coal Creek**

Eight samples of coal from seams B, 9, and 5 in Coal Creek have been examined (Fig. 13). In each case they demonstrate conclusively that these coals change rank from high volatile to medium volatile **down the dip of the seam.** Thus, coal quality increases with depth. It can even be predicted that 'O' seam, the equivalent of Balmer coal in this section, although of medium-volatile rank on the ridge of Coal Creek Mountain, is probably of low-volatile rank only 150 metres (500 feet) beneath the valley floor (Fig. 13).

RANK GRADIENT (R.G.'s)

Changes in rank can be quantified in terms of percentage rank change per 100 metres (%$\bar{R}o$/100 m).

Thus, in any stratigraphic section or borehole, the distance between the top and basal coal seams records a rank gradient referred to as R.G.(m.s.). If there has been postfolding coalification, that is, if the rank of a seam changes, it too can be quantified and referred to as R.G.(s). Finally, that amount of coalification contributed to the total stratigraphic gradient [R.G.(m.s.)] prior to folding can be determined from the following formula:

$$\text{R.G.(p.f.)} = \text{R.G.(m.s.)} - \text{R.G.(s)}$$

For the Coal Creek and Michel Creek sections these gradients have been computed and are shown graphically on Figure 14. From these graphs it is apparent that 39 per cent of the total coalification gradient in Coal Creek occurred postfolding, compared to only 25 per cent in the Michel Creek section.

This fact, together with the recognition of low-volatile coals exposed at the south end of the coalfield, suggests that the whole southwestern margin of the coalfield was more deeply buried than the rest of the Fernie Basin. This may be evidence that the Hosmer Nappe, a major recumbent anticline exposed on the Three Sisters west of Fernie and in the Lizard Range southwest of Fernie once extended further to the northeast.

The writers acknowledge the assistance of Frank Gigliotti and Mickey Welder during the field season.

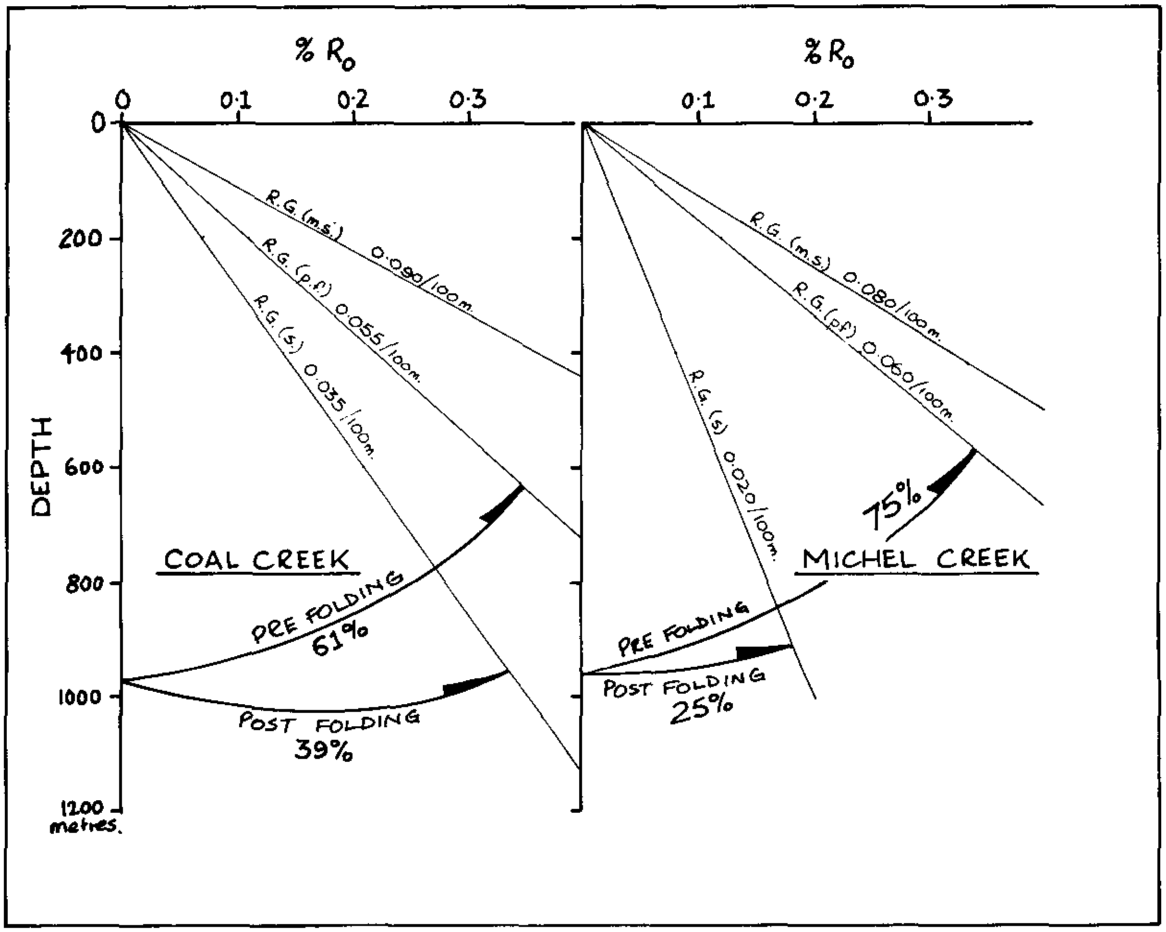

Figure 14. Rank-gradient graphs for Michel Creek Balmer seam and Coal Creek 'B' seam.

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