VITRINITE REFLECTANCE AS A CORRELATION TOOL IN THE *CARBON CREEK COAL MEASURES* (93O/10, 15)

By R. H. Karst

INTRODUCTION

The core from two diamond-drill holes in storage at the Charlie Lake core library was sampled for coal in October. The holes were selected on the basis of a correlation problem that existed in the coal measures of the Carbon Creek basin. It was hoped that a study of coal rank within the cored intervals using vitrinite reflectance would provide another tool useful in the determination of the correct correlation.

CARBON CREEK COAL MEASURES

The coal-bearing Gething Formation occurs in a large asymmetric syncline occupying the Carbon Creek drainage basin, approximately 56 kilometres west of Hudson Hope. From 1971—1976 Utah Mines Ltd. has actively explored the basin for its coal potential, drilling 93 diamond-drill holes, 152 rotary holes, and driving six coal adits. The coal property is a multi-seam deposit with 14 separate coal horizons having production potential. Coal thicknesses are characteristically 1.5—2.0 metres with local occurrences of seams 3 to 4 metres thick.

Two of the main areas of delineated coal reserves having mining potential are the Central and North areas (Fig. 21). Drill-hole correlation within each area is readily identifiable using core descriptions, coal quality, and gamma logs as correlation tools. Also, the density of drilling within each area is sufficient for the reserves to be considered of the measured category. A problem exists, however, in the correlation of coal measures of the Central area with coal measures of the North area. Although the two areas are less than 1.5 kilometres apart, the correlation methods previously mentioned have been inadequate in providing a convincing linkage.

In an effort to bridge the gap Utah Mines drilled four holes immediately south of Seven Mile Creek, the north bank being too steep for a drill set-up. Unfortunately these drill holes were very difficult to correlate with each other let alone with holes in the reserve areas. Utah finally arrived at the correlation shown on Figure 21, based on structural projections and the 'best gamma fit possible.' The immediate implication of this correlation was that the Gething Formation at Carbon Creek was over 1 100 metres in thickness, almost double the accepted maximum thickness recognized for the Gething sequence. Several outside critics suggested that the correlation was in error and that coals in the North area were stratigraphically equivalent to coals of the Central area, thus reducing the formation thickness to more acceptable levels. Utah's geologists were the first to admit that the correlation was speculative.

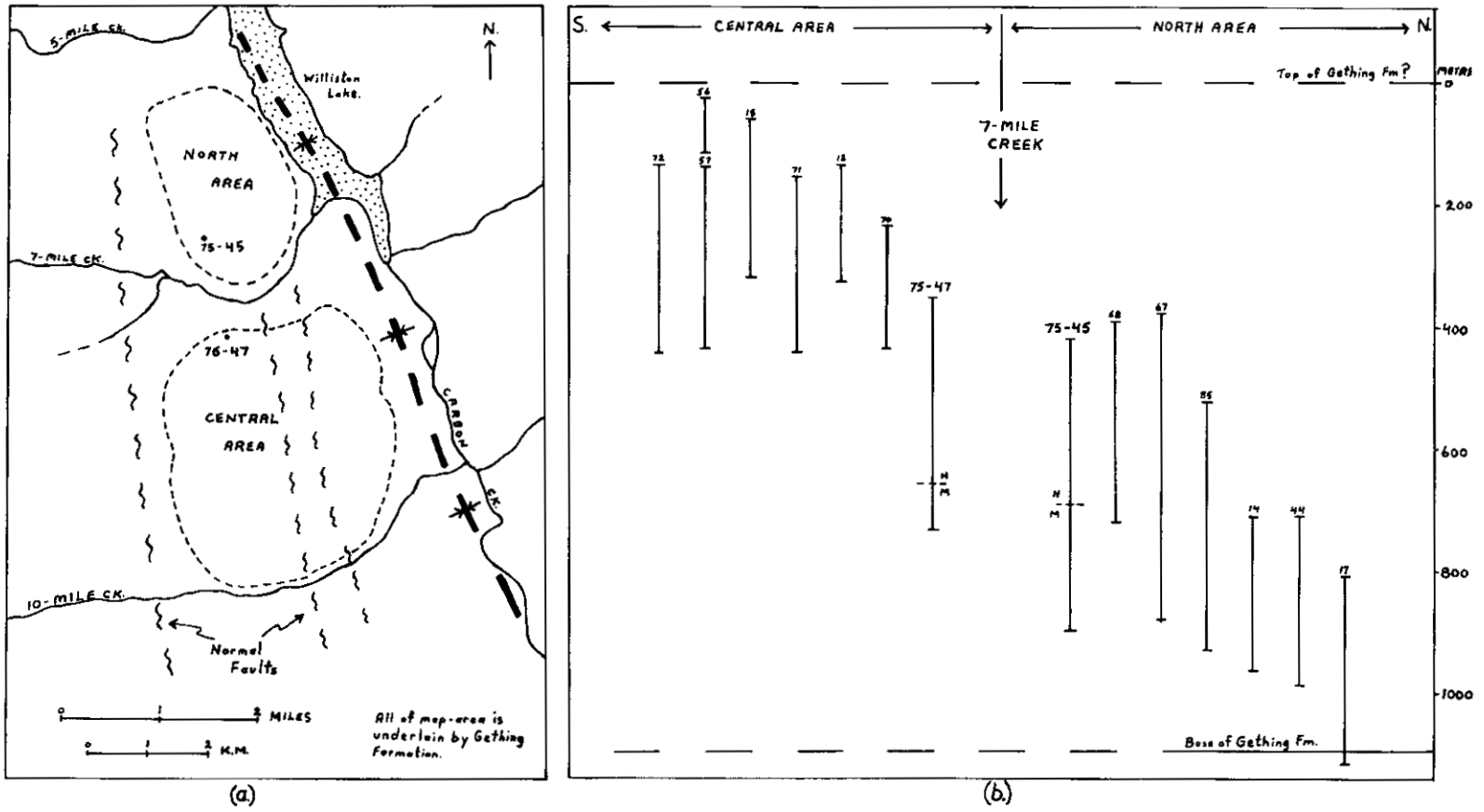

Figure 21. (a) Location map of the central and northern coal reserve areas; (b) schematic correlation chart showing the stratigraphic relationship of selected drill holes; bed 31 has been used as datum.

CURRENT STUDY

Since there is no evidence of structural disturbance on surface or in the core of the Seven Mile Creek area the author does not believe the correlation problem to be related to geologic structure. Instead it is felt that constant facies change and bed lenticularity of sedimentary origin are responsible. A correlation tool is needed that is independent of bed continuity or lithologic units.

Coal rank is primarily a function of temperature during the coalification process and increases proportionally with increasing depth of burial because of the geothermal-gradient effect. The paleo isotherms in a structurally undisturbed sedimentary basin should be nearly parallel to the bedding of the sedimentary sequence, at least over relatively short distances such as 1.5 kilometres. These isotherms would be independent of changes in the lithology of the sedimentary sequence. Coal rank is an accurate indicator of these isotherms.

Petrographically, coal rank can be obtained by measuring the reflectance of vitrinite. Increasing reflectance ($\bar{R}_o$) indicates increasing coal rank. The relationship between vitrinite reflectance and volatile-matter content (the normal coal rank parameter) has been quantified by numerous coal petrology specialists. One advantage of vitrinite reflectance in coal-rank determination is that only a very small sample is required.

Carbon Creek drill holes 75-45 and 75-47 were selected for the coal-rank studies. These holes are firmly correlated to their respective areas on the basis of lithology, coal quality, and geophysical logs (Fig. 22). Each hole is presently stored at the British Columbia Ministry of Mines and Petroleum Resources' core storage facility at Charlie Lake. Although the coal core from the major seams is missing (sampled by Utah staff during the drill program), numerous coals less than 0.5 metre in thickness still remain in the core boxes. These coals were sampled for vitrinite reflectance.

RESULTS

The reflectance values versus depth for the coals sampled in each drill hole are plotted on Figure 22. Since the range in coal rank represented by these samples is relatively small compared to the entire lignite/anthracite progression, the points on the graph should be linear. A noticeable amount of scatter in the points is evident but this phenomena is typical when coals having only subtle differences in rank are examined. This occurs because coal macerals, of which vitrinite is one, do **not** have fixed compositional formulae such as minerals. Vitrinites of the same rank may have minor compositional differences which will effect the reflectance to some degree. By drawing the best line to fit the points (coalificiation line) and examining the range of the line alone, the scatter is effectively averaged out. Figure 22 displays the reflectance range of each coalificiation line. This figure also indicates the stratigraphic relationship between the drill holes based on coal rank; drill hole 75-47 is spudded at a stratigraphically higher level than 75-45 but both holes share much of the same stratigraphic intervals.

The reflectance value of 1.12 per cent is regarded as the division between high-volatile and medium-volatile bituminous coal. This $\bar{R}_o$ value (or any other) can be used to test the validity of the correlation on Figure 22 by matching the 1.12 per cent $\bar{R}_o$ value with its corresponding depth in each bore hole. The

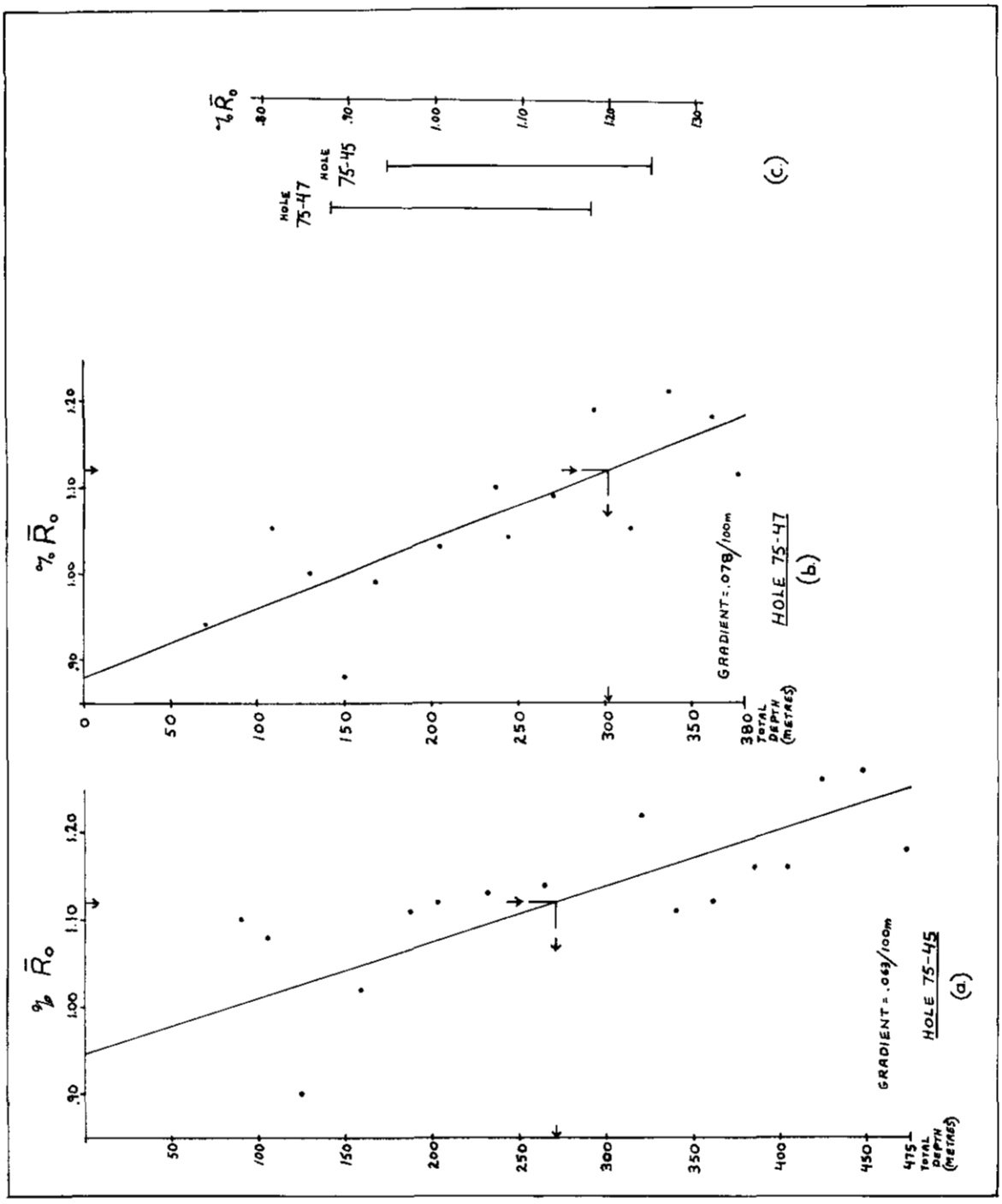

Figure 22. (a) vitrinite reflectance versus depth for drill hole 75–45; (b) vitrinite reflectance versus depth for drill hole 75–47; (c) reflectance range of the coalification line for each borehole.

high/medium volatile boundary occupies approximatley the same stratigraphic level in the existing correlation between bore holes, thus collaborating the correlation. It is interesting to note that each graph contains one anomalously low $\bar{R}_o$ point located considerably to the left of the coalificiation line (Fig. 22). With the present correlation, these points may represent the same coal horizon.

CONCLUSIONS

The postulated correlation across Seven Mile Creek appears to be correct.

The Gething Formation is at least 1 100 metres thick.

The possibility exists that the Gething sequence may have been even thicker than this figure because no overlying Moosebar Formation has ever been seen in drill core or in outcrop within the Carbon Creek basin.

The Peace River Canyon (Gething Formation's type section) was previously regarded as the thickest Gething occurrence (550 metres). There are two possible mechanisms which could be responsible for this tremendous formational thickening: (1) Carbon Creek is much closer to the Lower Cretaceous sediment source area and had a more rapid rate of subsidence; (2) major formational facies changes exist in the overlying Moosebar Formation or Gates member to the west such that the Carbon Creek coal measures may encompass stratigraphic equivalents of these formations. A detailed fossil examination would be required to choose the correct mechanism.

The core storage facility at Charlie Lake has the core on file which may answer these and many more questions about the geology of northeastern British Columbia.

ACKNOWLEDGMENTS

The author would like to thank Dr. D. E. Pearson for the original idea of this study and Mr. D. A. Grieve for his instruction on the vitrinite reflectance technique.

REFERENCES

LeNobel, D. N. and Karst, R. H. (1976): Exploration Activity in the Carbon Creek Basin, *B.C. Ministry of Mines & Pet. Res.*, Assessment Reports P R—Carbon Creek, 76 (1 to 6) C and 76 (1 to 6) D.

Stott, D. F. (1973): Lower Cretaceous Bullhead Group Between Bullmoose Mountain and Tetsa River, Rocky Mountain Foothills, Northeastern British Columbia, *Geol. Surv., Canada,* Bull. 219.

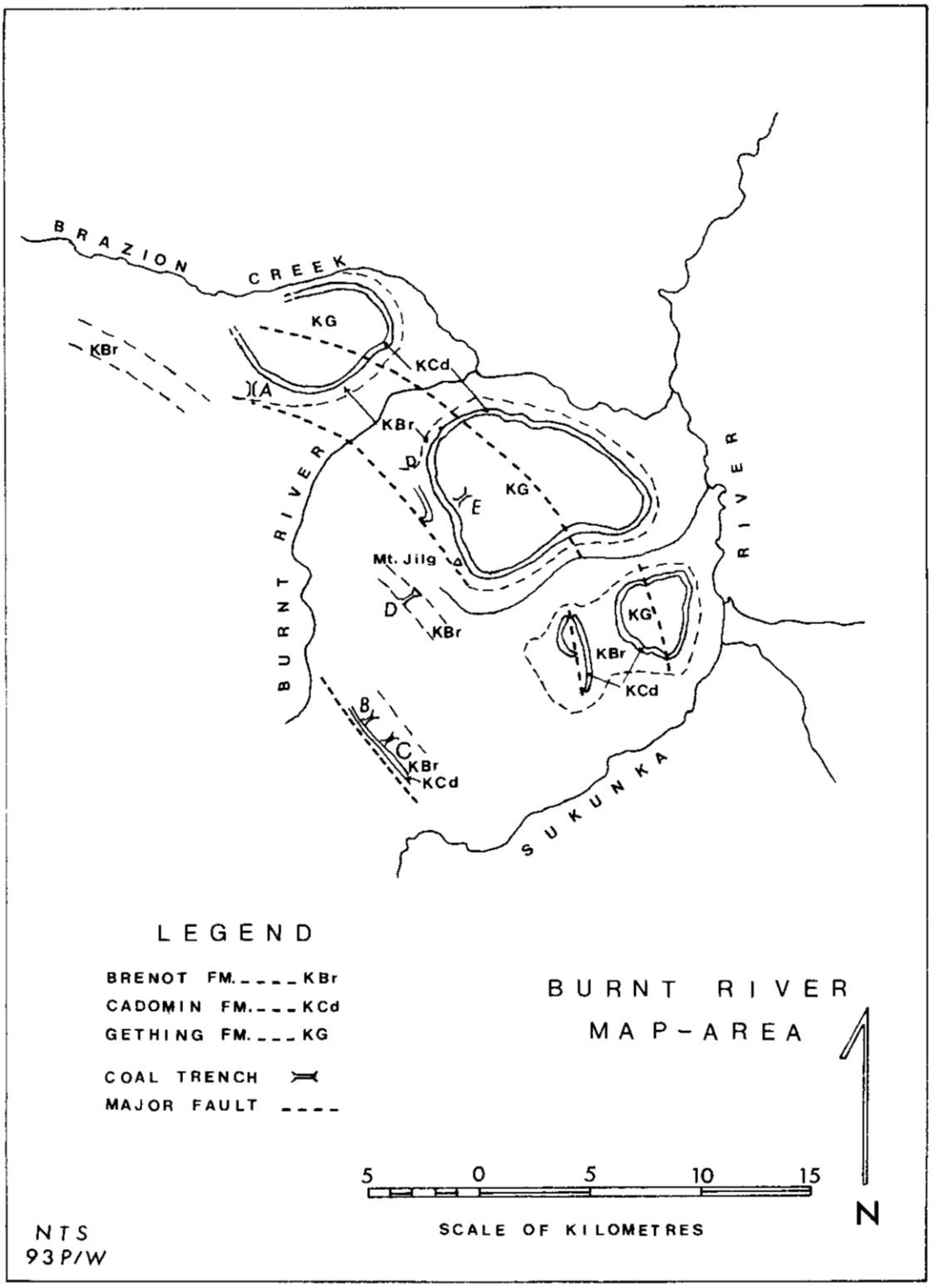

Figure 23. Burnt River map-area.