CHAPTER 2

2 STRATIGRAPHY

2.1 LITERATURE REVIEW

An understanding of stratigraphy is of fundamental importance in defining the coal distribution patterns within the Highveld Coalfield (Le Blanc Smith, 1980). The lithostratigraphy for the Karoo basin is shown on Table 1.1.

An important, early Karoo stratigraphic subdivision was that of Du Toit (1954) who subdivided the Ecca Series into the Lower Ecca Beds, the Middle Ecca Beds and the Upper Ecca Beds. Sehlke and Van der Merwe (1959) defined the Highveld Coalfield lithostratigraphy as follows:

Upper Ecca Formation	Shale, blue to dark gray, black, yellowish, 0-43m.
Middle Ecca Formation	Shaly sandstone, fine- to coarse-grained sandstone, grit, carbonaceous shale with subordinate shale bands 157-222m, and coal seams.
Lower Ecca Formation	Sandy shale and black shale, 9-12m.
Dwyka Formation	Tillite with sandstone, shale and siltstone at the top; occasional pre-Karoo rocks towards the base, 4.6-24m.

The South African Committee for Stratigraphy (S.A.C.S., 1980) defined, in detail, the formal lithostratigraphic nomenclature for the Karoo Supergroup. Here, the Karoo Supergroup replaces the terms Karoo System and the Lower, Middle and Upper Ecca were redefined as the Pietermaritzburg, Vryheid and Volksrust Formations.

For this study, the Vryheid Formation, as the main coal-bearing unit, is lithostratigraphically important. The coal seams in the Vryheid Formation, form stratigraphic markers, in a “layered cake” fashion. However, this approach has caused numerous problems. Seam splitting, pinch-outs, shale-outs and cut-outs occur within seams and between seams (Cadle, 1982; Winter, 1985; Cairncross, 1986). These problems prompted a genetic stratigraphic approach to coalfield stratigraphy (Le Blanc Smith, 1980, see section 2.2).

Cadle (1982) proposed the concept of progradational and aggradational depositional sequences for the Vryheid Formation separated by laterally persistent transgressive deposits. Cadle (*op. cit*.) introduced informal terms such as No. 2 seam, No. 4 seam, No. 5 seam and No. 6 seam depositional sequences. This study was followed by Winter (1985) who subdivided the stratigraphy in the Highveld Coalfield into the No. 2 seam, No. 4 seam, No. 5 and No. 6 seam sequences. This scheme was further adopted by Cairncross (1986) in the eastern Witbank Coalfield, who used the informal terms No. 2, No. 4 and No. 5 seam sequences to describe the strata.

2.2 GENETIC STRATIGRAPHY

A genetic stratigraphy was originally defined by Busch (1971) for marine deposited deltaic sediments. Le Blanc Smith (1980) presented a genetic stratigraphy, which provides a valuable framework for inter-coalfield correlation of sedimentary packages. Each genetic sequence is named after a major coal seam. Table 2.1 shows the stratigraphic column and depositional sequences in the Highveld Coalfield as a graphic summary of the vertical and lateral facies variations.

An exhaustive regional lithostratigraphic analysis is beyond the scope of this study. However, a brief, detailed local stratigraphic framework will provide a valuable norm with which to compare and contrast the stratigraphic interrelationship between the various lithofacies assemblages. A detailed stratigraphical column of the Highveld Coalfield is shown in Figure 2.1.

2.3 THE 4 SEAM GENETIC SEQUENCE-THIS STUDY

The genetic sequence above No. 2 seam commences with a carbonaceous siltstone where the No. 2 seam is absent, to the roof of the No. 4 seam or the No. 4 Upper seam. The No. 3 seam is thin, less than 1m thick, laterally impersistent and consists of a high quality coal. The No. 3 seam is predominantly overlain by cross-bedded sandstone and carbonaceous siltstone which grades upwards into a fining-upward, interlaminated sandstone-siltstone. Alternatively, the No. 3 seam can be overlain by a fining-upward, granule conglomerate. The thickness of the No. 3 to No. 4 seam interval shows a slight variation, and thickens to over 5m towards the south-east, at the New Denmark study area.

LITHOSTRATIGRAPHY	GENETIC STRATIGRAPHY
Vryheid Formation	6 Seam Genetic Sequence
	5 Seam Genetic Sequence
	4 Seam Genetic Sequence
	2 Seam Genetic Sequence
Dwyka Formation	

Table 2.1. An informal genetic stratigraphy for the Highveld Coalfield (modified after Winter, 1985).

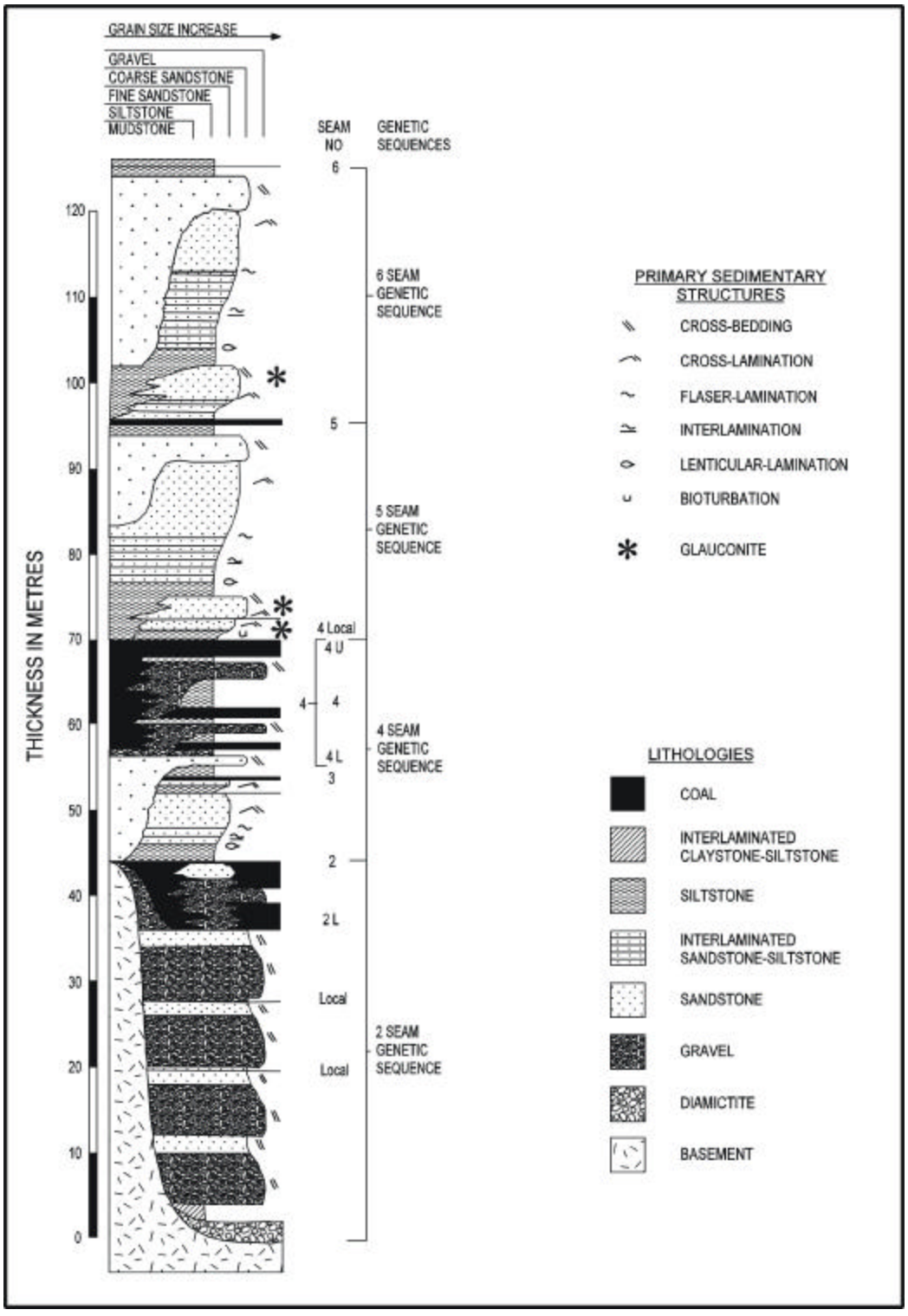

Figure 2.1. The stratigraphic column and depositional sequences of the Highveld Coalfield (modified after Winter, 1985).

The most common No. 4 seam lithological sequence has carbonaceous siltstone, overlain by lenticular-laminated siltstone, interlaminated sandstone-siltstone, and flaser to cross-laminated and cross-bedded sandstone. This assemblage is intensely bioturbated in places, resulting in intermixing of sandstone and siltstone, thereby producing a homogenized sequence. This bioturbated zone provides a valuable stratigraphic marker unit.

The No. 4 seam occurs throughout most of the Highveld Coalfield has an average thickness of 5,5m and an average depth below surface of 60m (Figure 2.2). However, in the New Denmark study area, No. 4 seam, is found at an approximate depth of 200m below surface, with an average thickness of ± 2m (Figure 2.3). The regional Highveld Coalfield stratigraphy is somewhat similar to the study area, although certain subtle differences do exist when compared with the lithostratigraphy.

In the study area, the No. 4 seam (Figure 2.4) has an average thickness of ± 2m and an average depth below surface of ± 200m. Thickness variations in the study area show that this interval thickens towards the west. The No. 4 coal seam is locally split by sedimentary partings into the lower No. 4 seam and the overlying No. 4 A seam. These splits are composed of cross-bedded sandstone and conglomerate, and cross-laminated sandstone facies. These strata are in turn overlain by glauconitic sandstone. The thickness variations of the No. 4 seams are between 0m and 0.70m.

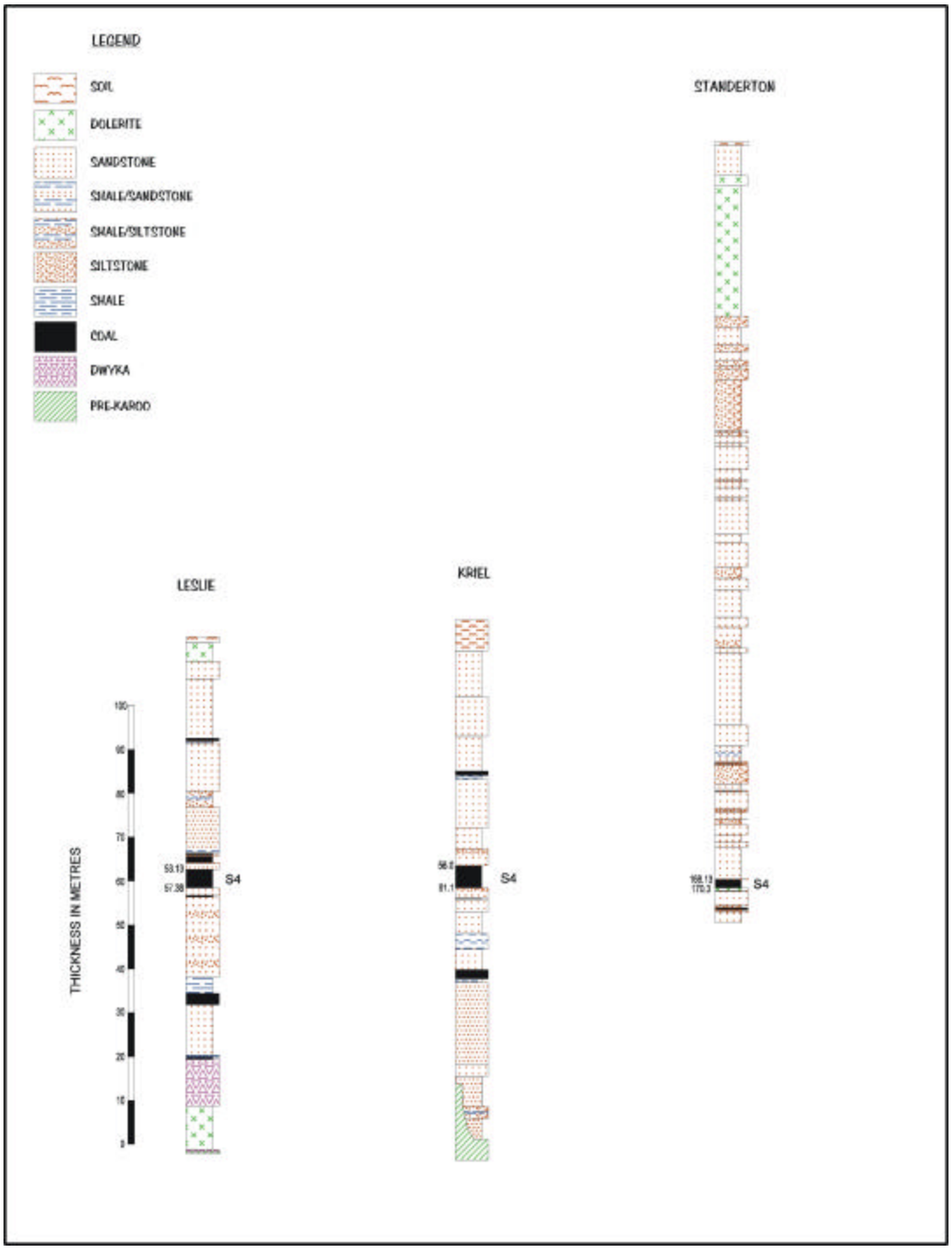

Figure 2.2. Typical stratigraphic columns, illustrating the stratigraphic variations for different parts of the Highveld Coalfield, compared to the study area.

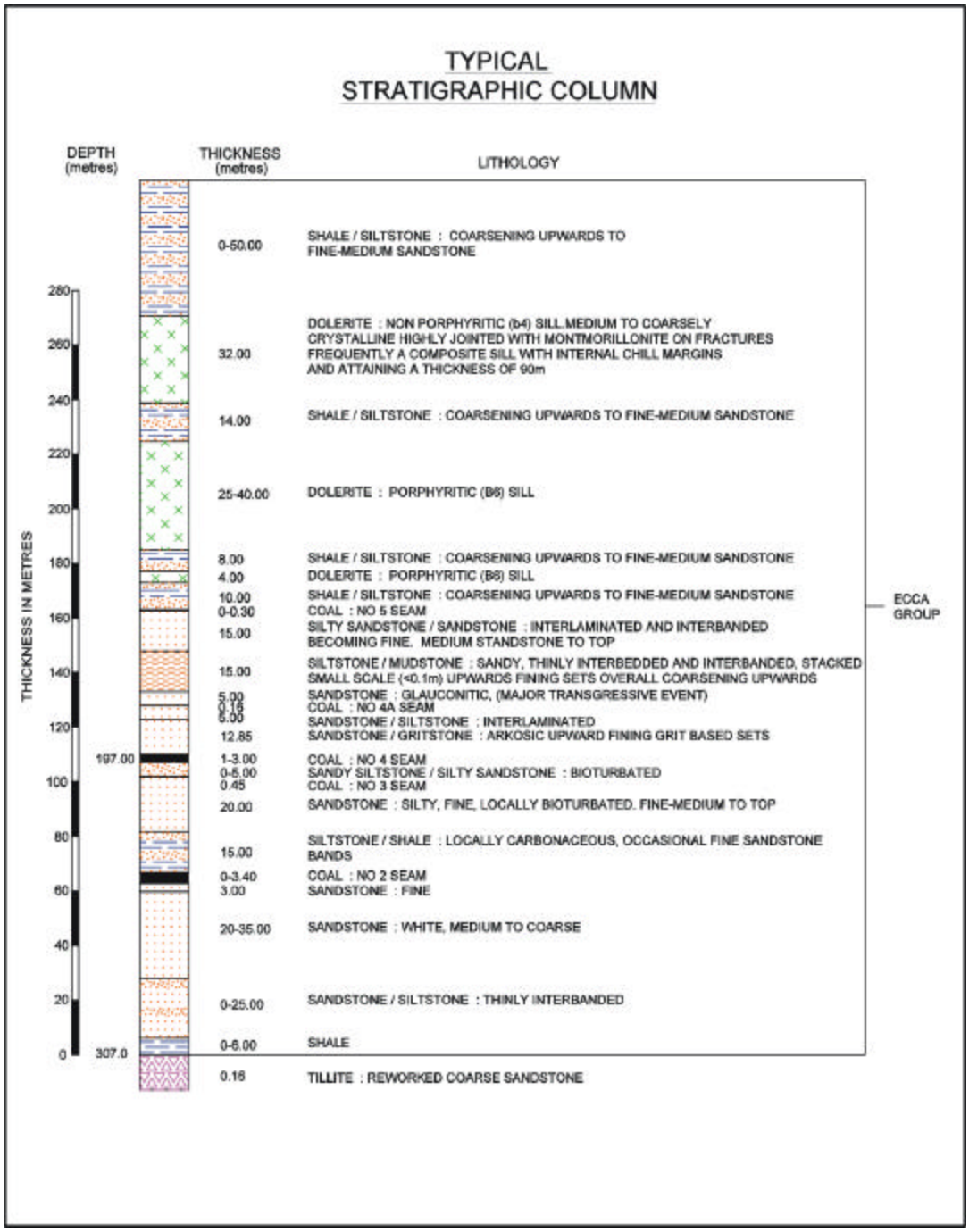

Figure 2.3. Typical stratigraphic column for the New Denmark study area.

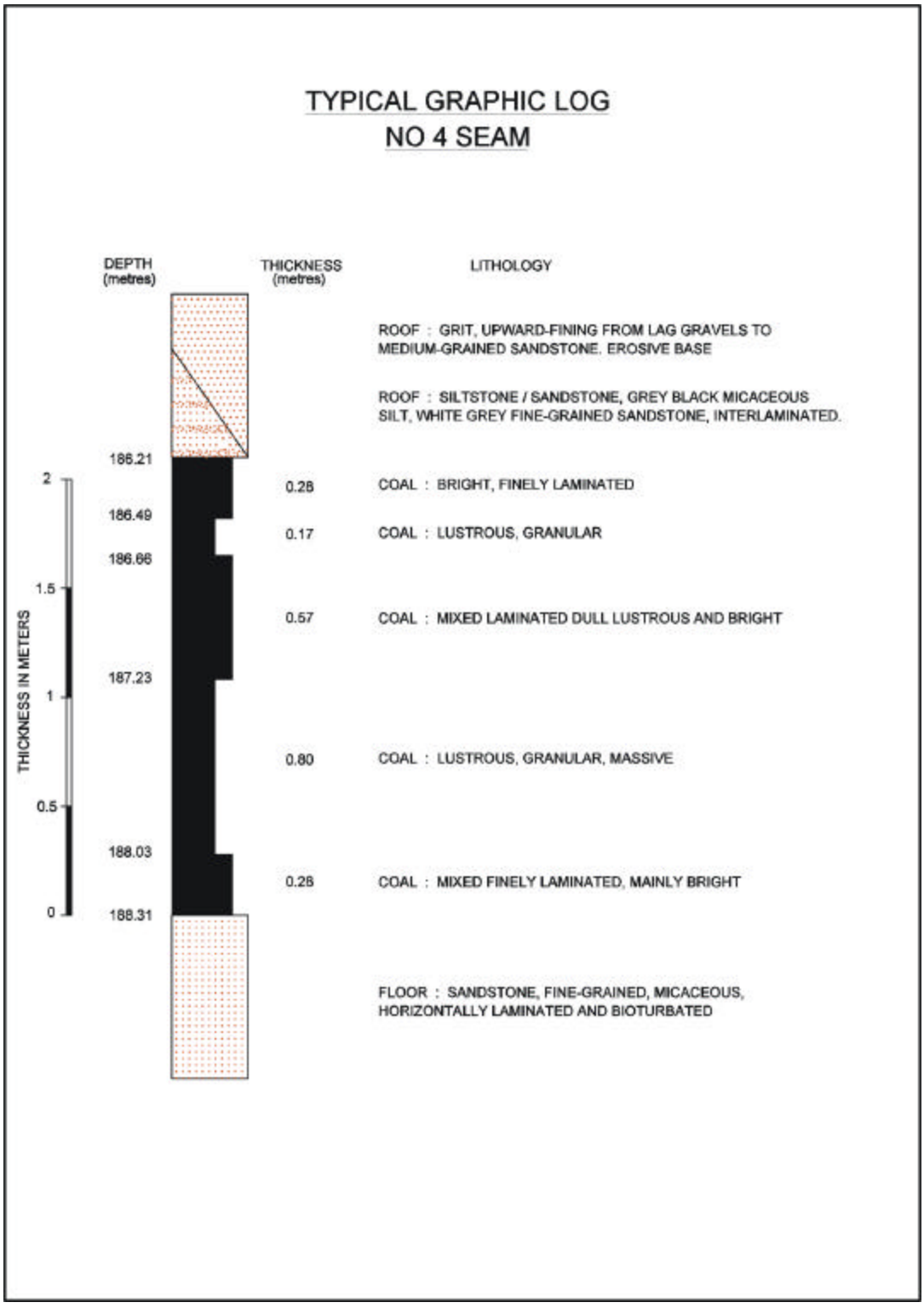

Figure 2.4. Typical graphic log for the No. 4 seam at New Denmark Colliery.

2.4 THE 5 SEAM GENETIC SEQUENCE-THIS STUDY

The No. 5 seam genetic sequence represents the interval between the roof of No. 4 or 4 A seam and the roof of No. 5 seam. A laterally continuous unit of glauconitic sandstone and siltstone occurs 20m above the roof of No. 4 seam and terminates this sequence. This sedimentary unit is overlain by lenticular and wave-ripple laminated carbonaceous siltstone and trough cross-bedded, slightly glauconitic sandstone, which is bioturbated at the base. The No. 5 seam genetic sequence is capped by the thin No. 5 seam. It is relatively easy to recognize and distinguishes the No. 5 seam genetic sequence, as it is a coarsening-upwards sedimentary interval separating the No. 4 seam from the No. 5 seam. Borehole cross-sections of the sequence indicate that the No. 5 seam is thin and laterally persistent towards the east of the study area.