PROCEEDINGS OF 38TH SYMPOSIUM ON THE ADVANCES IN THE STUDY OF THE SYDNEY BASIN

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NOT WHAT IT "SEAMS"

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ABSTRACT

The "F" Ply – a pervasive tuff marker unit – is the key to regional correlation of the basal coal seams of the Western Coalfield. The "F" Ply has a distinctive gamma spike in down-hole geophysical logs, and is recognised in drill core from east of Ulan into the Hunter Valley and as far south as the Lithgow region. In the Western Coalfield, the basal Lithgow Coal is characterised by being largely free from tuff bands, and having a sandstone roof when not coalesced with the overlying Lidsdale Coal.

Recent exploration conducted by Mineral Resources in the Rylstone area has reaffirmed the regional picture of the thinning and onlapping/non-development of the Lithgow Coal towards the basin margin. The clear trends in the development of the Lithgow Coal and the stratigraphic position of the "F" Ply have implications for the existing correlation of seams currently mined immediately south of Rylstone at Charbon Colliery and Haystack Mountain, 30 km to the south at Airly Mountain, and a further 25 km southeast at Ivanhoe North and Cullen Valley Mine. A revised regional coal seam correlation demonstrates that it is not the Lithgow Coal that is mined at Charbon, Haystack Mountain and Airly, but the Lidsdale Lower seam.

INTRODUCTION

Bryan *et al* (1967) introduced the term Illawarra Coal Measures to the Western Coalfield after drilling and geological mapping confirmed the continuity of coal bearing sequences between the south coast and the western margin of the Sydney Basin. Bembrick (1983) established the stratigraphic subdivision of the Illawarra Coal Measures into four subgroups and sixteen formations by synthesising the early work of Carne (1908), Rayner (1954, 1956), Branagan (1960), Goldbery (1972) and Morris (1975), and after the examination of a significant number of borehole cores. This synthesis provides an excellent framework for the understanding and interpretation of the sedimentary units within the Illawarra Coal Measures.

The application of this terminology to the stratigraphy in the northern part of the Western Coalfield in the Ulan-Moolarben-Wilpinjong-Mt Penny-Bylong area (Figure 1) was historically unclear, as various authors have used terminology derived from the Hunter and Gunnedah Coalfields. Due to a paucity of data, at the time, between the coal mines operating in the Lithgow area and the Bylong valley, local names were often ascribed to regionally extensive coal seams, for example the Coggan Coal of McElroy Bryan and Associates (1983, 1985) in the Bylong area and the Mt Brace seam of Bayly *et al* (1988) in the Rylstone area.

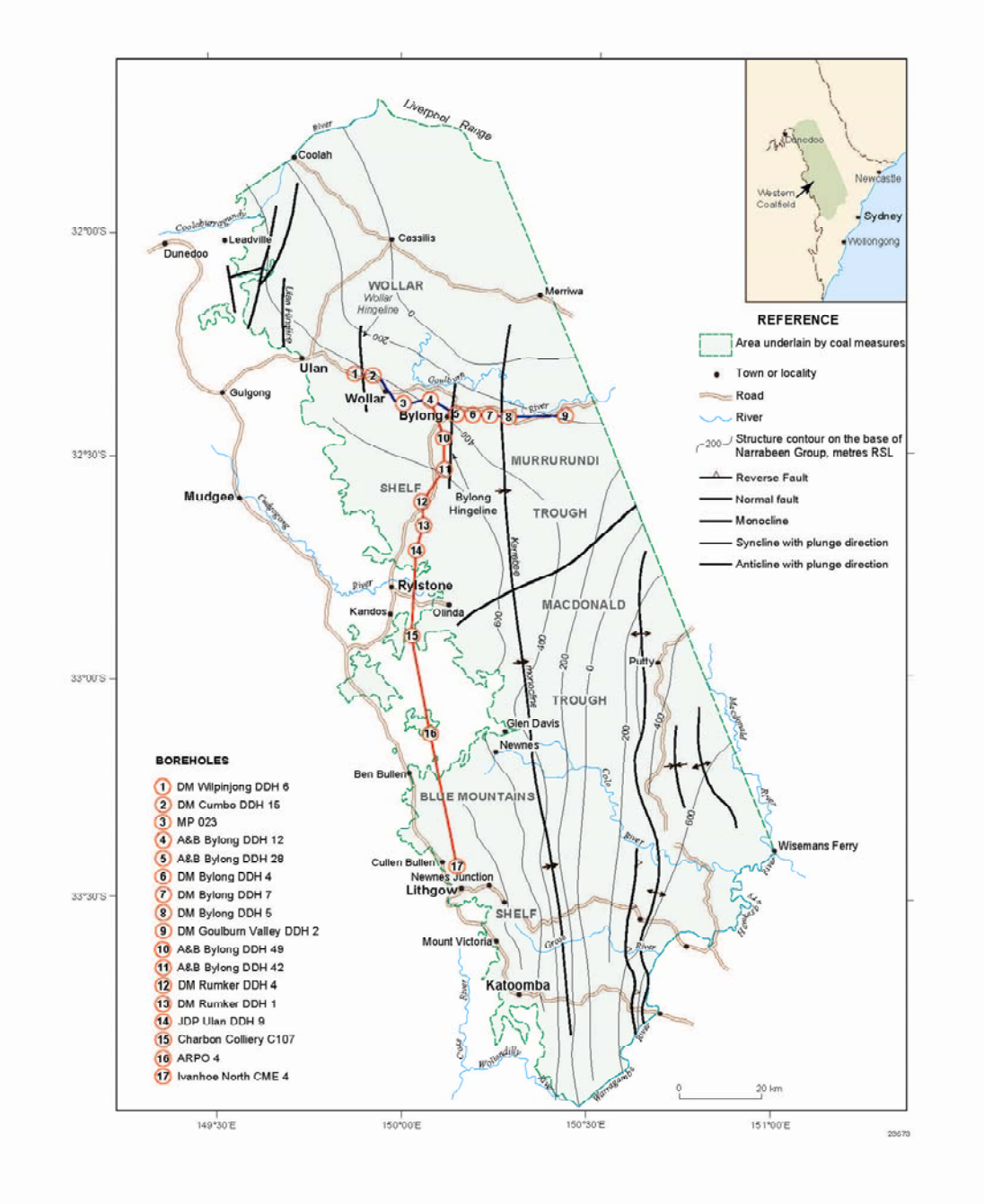

Figure 1 Western Coalfield map, showing position of major geological structures and boreholes (Modified after Yoo, 2001)

Mineral Resources has undertaken significant evaluation of the coal resources in the Western Coalfield, including regional coal exploration and mapping, which has led to the release of a number of tender areas and subsequent new mines. This exploration coupled with ongoing industry assessment of coal resources, has enabled an enhanced understanding of seam development and extent within the coalfield.

The main economic seams occur in the Cullen Bullen Subgroup of the lower Illawarra Coal Measures. Instrumental to the understanding and correlation of these seams is the pervasive tuffaceous band, referred to informally as the “F” Ply. Agnew & Bayly (1989a) introduced

the "F" Ply terminology to assist in tying in the alphabetically-based Ulan seam nomenclature established for the Ulan Mine to that of the typical Western Coalfield stratigraphy (Bembrick, 1983).

GEOLOGY

The Cullen Bullen Subgroup hosts the majority of the seams (Figures 2 and 3) mined within the Western Coalfield, where mining began in 1868 in the Lithgow area. This subgroup comprises two well recognised and widespread fluvial units, the Marrangaroo and Blackmans Flat Formations. These fluvial units comprise lobes of fluvial and braided channel deposits derived from erosion of the proximal Lachlan Fold Belt.

The Marrangaroo Formation occurs below the Lithgow Coal, and the Blackmans Flat Formation separates the Lithgow Coal and overlying Lidsdale Coal if developed (Figure 3). In areas where the Blackmans Flat Formation is not developed, the Lidsdale and Lithgow Coals converge. This converged entity is recognised within the mining operations at Springvale, Angus Place, Invincible, Ivanhoe, Ivanhoe North and Cullen Valley, in the southern part of the coalfield (Figure 1).

The Lithgow Coal in its type section (Austen & Butta Hartley Valley DDH 3) is characterised by predominantly dull coal with subordinate carbonaceous claystone and minor mudstone bands. Within the Rylstone-Bylong area the typical coal lithotype profile of the Lithgow Coal is represented in DM Kelgoola DDH 4 (Yoo, 2001) (Figure 2). In the working section of the Lithgow seam there are persistent carbonaceous claystone bands (i.e. the Bluestone band), but no ash fall tuffs are recognised. Regionally, the upward fining Blackmans Flat Formation typically has a sharp and often erosive contact with the underlying Lithgow Coal. This relationship is readily recognised in bores located within the marginal shelf area (Wollar Shelf) of the Western Coalfield (Figure 1). Exploration between Bylong and Ulan clearly demonstrates the thinning and onlapping geometry toward the basin margin of the Lithgow Coal (Figure 4).

In contrast, where the Lidsdale Coal is clearly separated from the Lithgow Coal by the Blackmans Flat Formation fluvial system, the Lidsdale Coal is characterised by dull and stony coal with claystone, carbonaceous claystone and tuff bands that are characteristically spaced throughout the seam. The Lidsdale Coal is divided into an upper and lower section by a tuffaceous claystone layer. This layer is recognised throughout the coalfield and correlates with the "F" Ply of the Ulan Coal (Agnew *et al* (1989a) and Yoo et al (2001) (Figure 3).

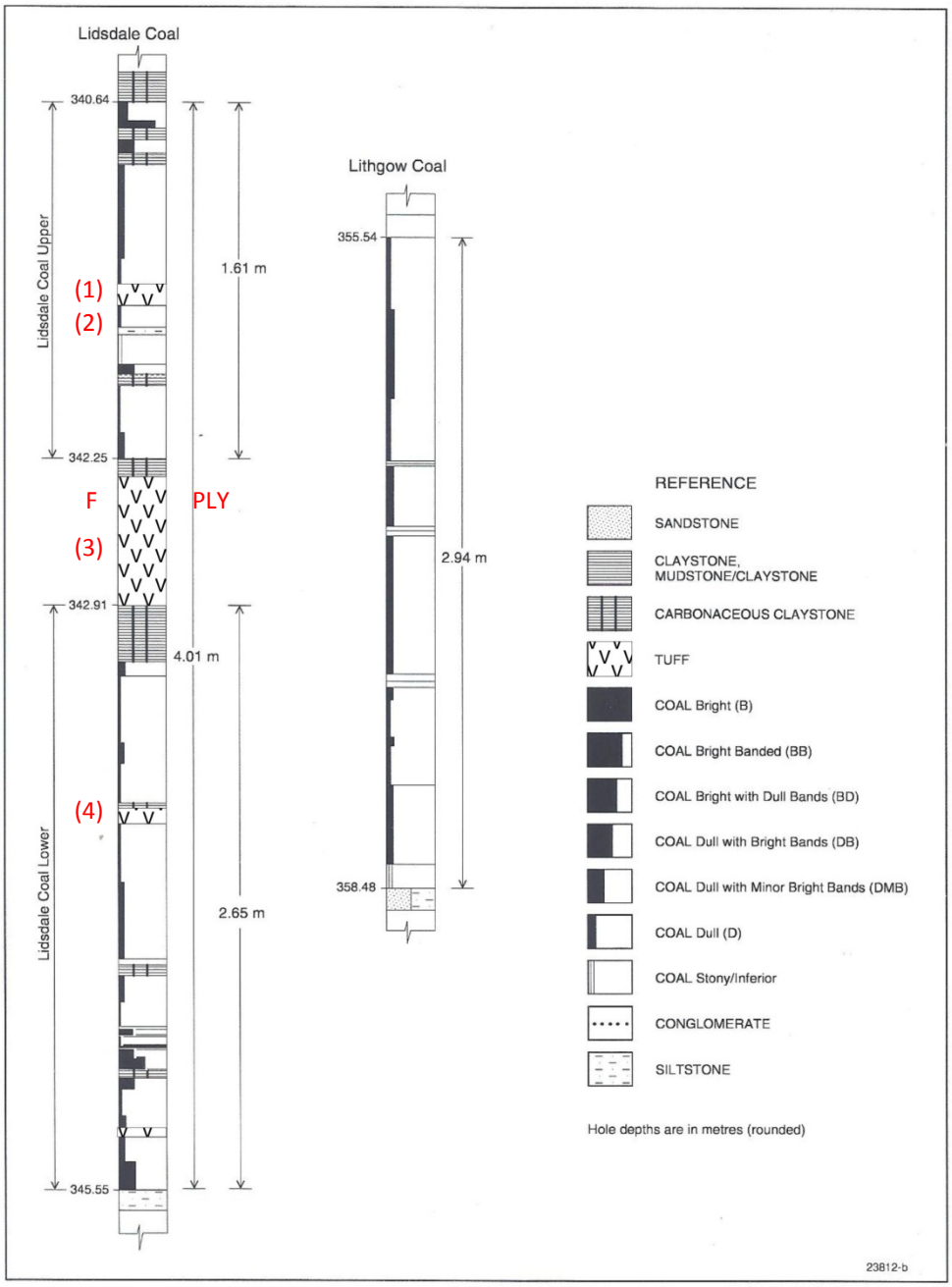

Figure 2 Coal lithotype profiles, Lidsdale and Lithgow Coals, DM Kelgoola DDH 4 (Modified after Yoo, 2001)

Preliminary age dating of the F Ply using high precision CA-IDTIMS U-Pb zircon dating (Nicoll, pers comm.) has provided an initial age of 257.03 My (DM Bylong DDH 5, Figure 1) suggesting correlation with the Fairford Formation of the Wittingham Coal Measures, some 40 kilometres to the east, and indicating the vast regional extent of this horizon.

The relationship between the Ulan, Lidsdale and Lithgow seams is best demonstrated using 4 cores (Photos 1,2,3 and 4) along a broad west-east section from Wilpinjong to east of Bylong and south to Rylstone (Figure 1). Regional cross sections can be viewed on the Western Coalfield Regional Geology (Northern Part) Geological Series Sheet Yoo (1998).

The core of DM Wilpinjong DDH 6 is informally used as the type section for the Ulan seam (repository, Gulgong Core Shed) (Figure 3). DM Cumbo DDH 15, drilled by the Department for the Wilpinjong Tender Area, spudded in the eastern portion of the tender area (Figure 1). DM Bylong DDH 4, drilled 30km east of DM Cumbo DDH 15, illustrates in particular the consistency of the ELR-ULG section (Photo 3). Note also the typical upward fining Blackmans Flat Formation and the erosional roof to the underlying Lithgow Coal. DM Rumker DDH 1 (Figure 1) is located 40km south west of DM Bylong DDH 4. Note the correlatability of the ELR-ULG composite section and the comparison with the section in DM Bylong DDH 4. This bore highlights the thickening trend of the Lidsdale Lower seam (ULG, 2.75m) toward Rylstone. The Blackmans Flat Formation is typically upward fining, with a basal lag conglomerate and erosional roof to the significantly reduced Lithgow Coal section.

A north-south cross section of graphic logs (Figure 5; see Figure 1 for borehole locations) clearly shows how the Lidsdale Lower seam, recognised in the Bylong area, can be correlated over 100km southwards to the Ivanhoe North Mine. The implication of this section is that mines interpreted as mining the Lithgow seam were in fact mining the Lidsdale Lower seam, or, as in the case of the Ivanhoe North Mine and adjacent collieries, the merged Lidsdale and Lithgow Coals. Figure 6 illustrates the thinning trend of the Lithgow Coal toward Charbon Colliery (C107), and its relatively unbanded character in comparison to the overlying Lidsdale Coal.

The coalesced section comprising the ELR-ULG plies has proven to be instrumental in understanding the regional development of the Lidsdale Coal. This section provides a characteristic lithostratigraphic sequence which has been used in this study to differentiate between the typical Lidsdale Coal and Lithgow Coal profiles.

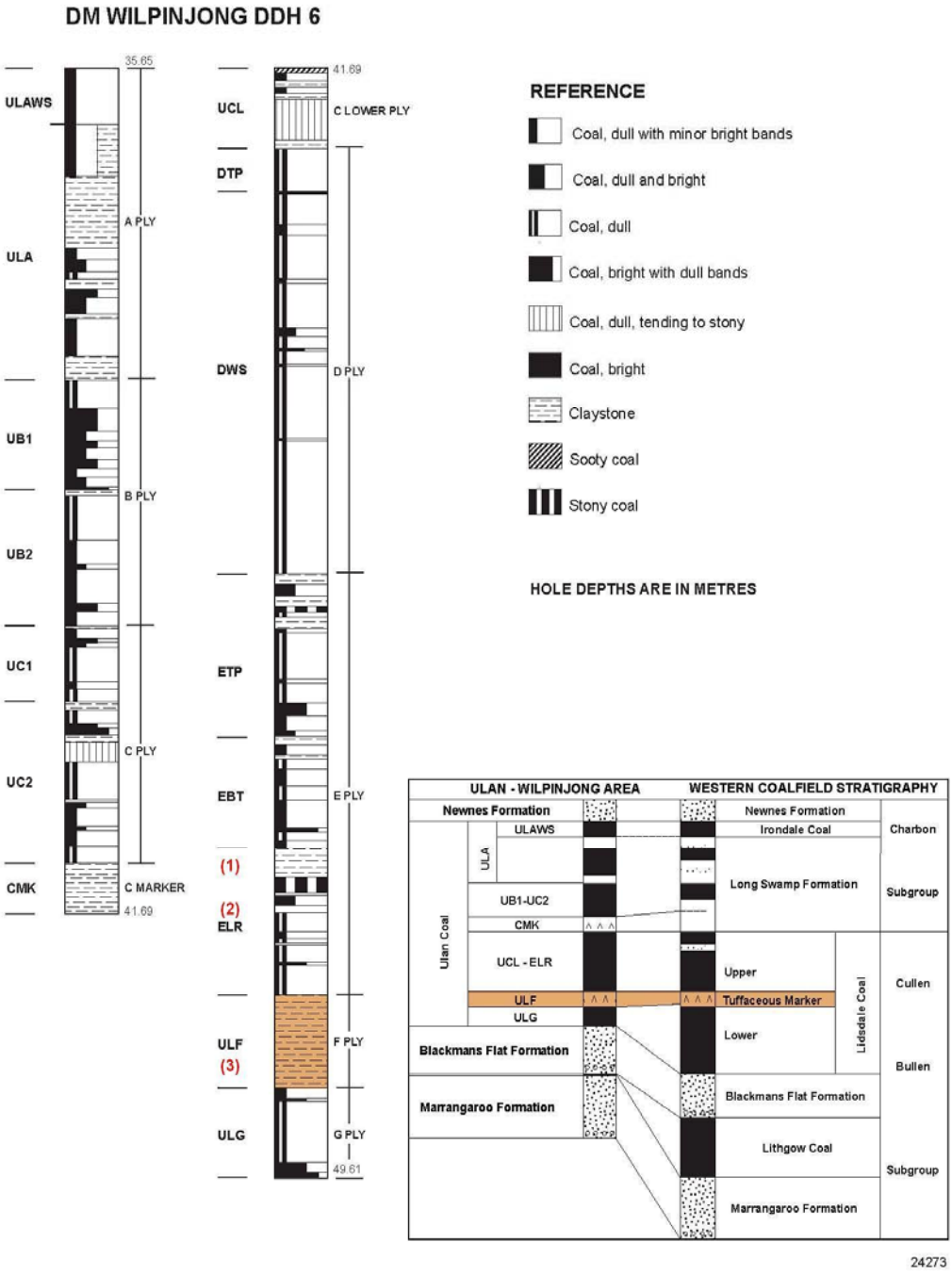
DM WILPINJONG DDH 6
35.65
ULAWS
ULA
UB1
UB2
UC1
UC2
CMK
A PLY
B PLY
C PLY
C MARKER
41.69
41.69
UCL
DTP
DWS
ETP
EBT
(1)
(2)
ELR
ULF
(3)
ULG
C LOWER PLY
D PLY
E PLY
F PLY
G PLY
49.61
REFERENCE
Coal, dull with minor bright bands
Coal, dull and bright
Coal, dull
Coal, bright with dull bands
Coal, dull, tending to stony
Coal, bright
Claystone
Sooty coal
Stony coal
HOLE DEPTHS ARE IN METRES
ULAN - WILPINJONG AREA
WESTERN COALFIELD STRATIGRAPHY
Newnes Formation
ULAWS
ULA
UB1-UC2
CMK
UCL - ELR
ULF
ULG
Ulan Coal
Blackmans Flat Formation
Marrangaroo Formation
Newnes Formation
Irondale Coal
Long Swamp Formation
Upper
Tuffaceous Marker
Lower
Lidsdale Coal
Blackmans Flat Formation
Lithgow Coal
Marrangaroo Formation
Charbon
Subgroup
Cullen
Bullen
Subgroup
24273

Figure 3

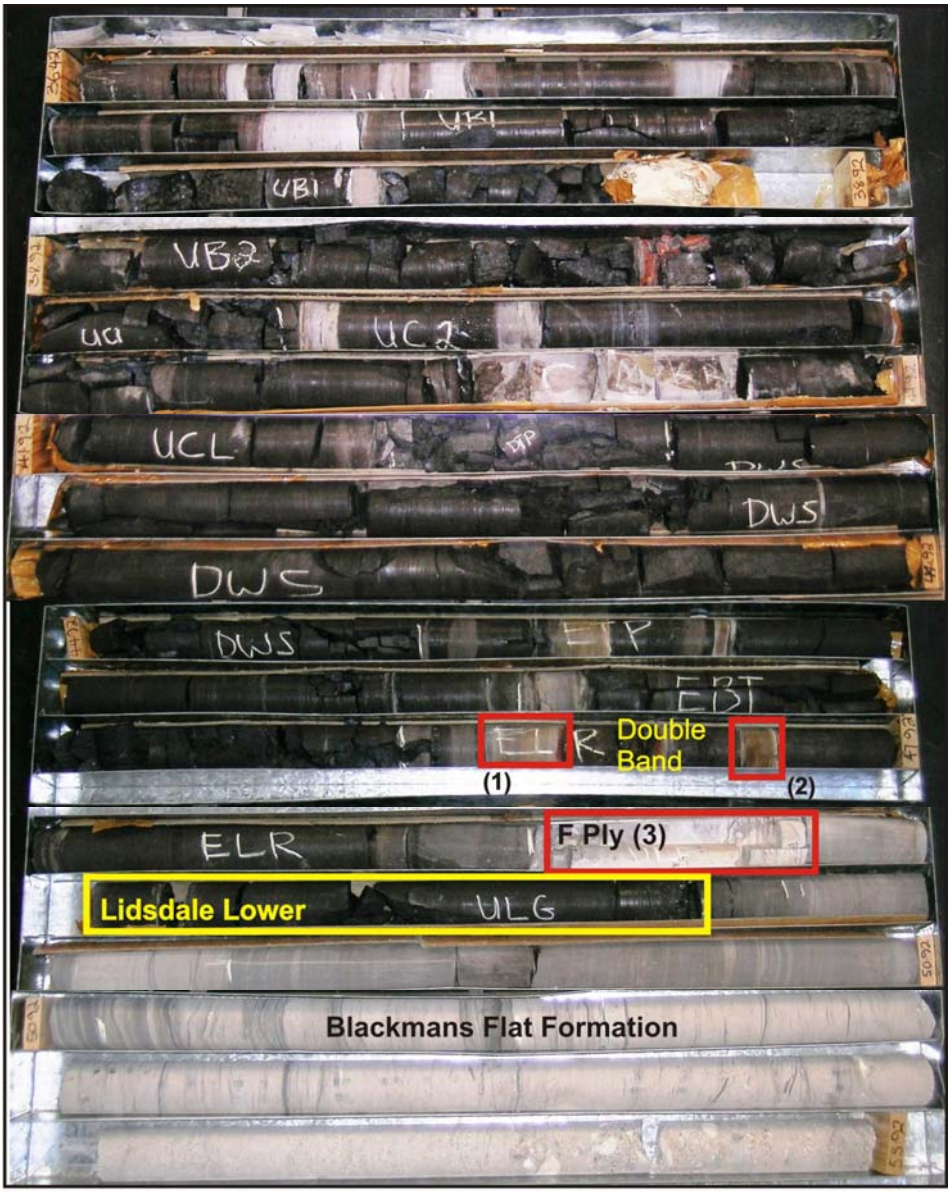

Photo 1 DM WILPINJONG DDH 6, 36.42 – 53.92m

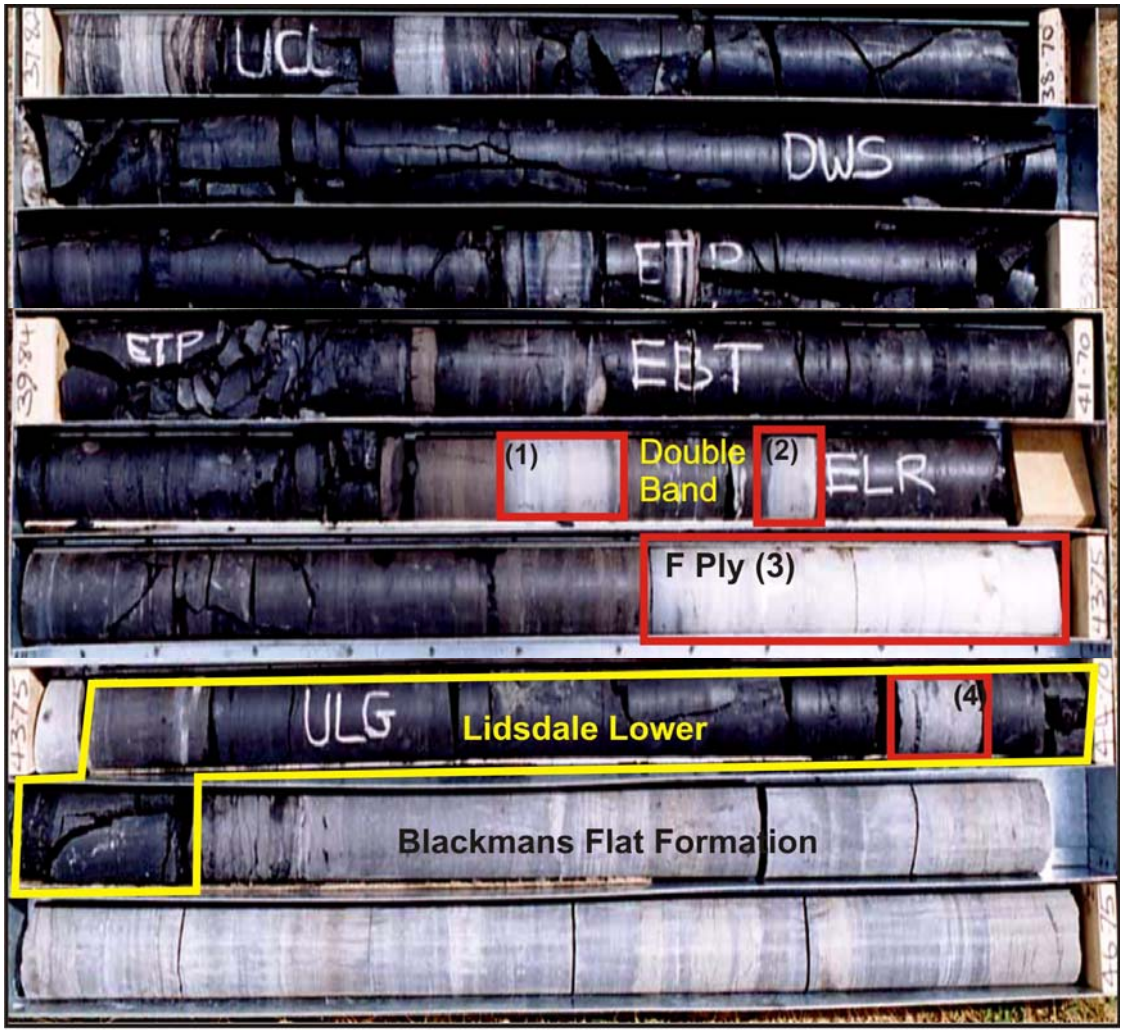

Photo 2 DM CUMBO DDH 15, 37.87 – 46.72m

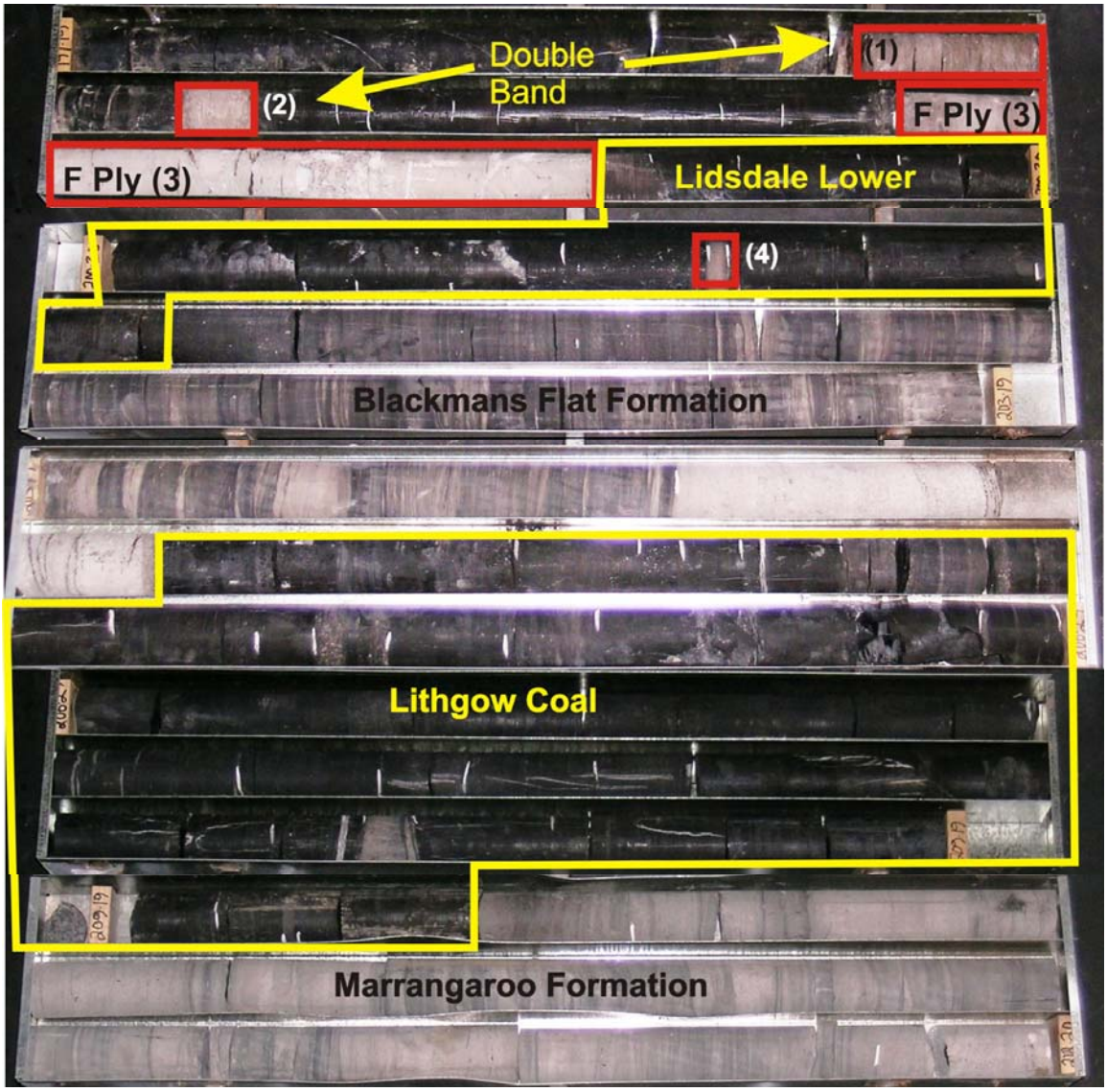

Photo 3 DM BYLONG DDH 4, 197.19 – 215.19m

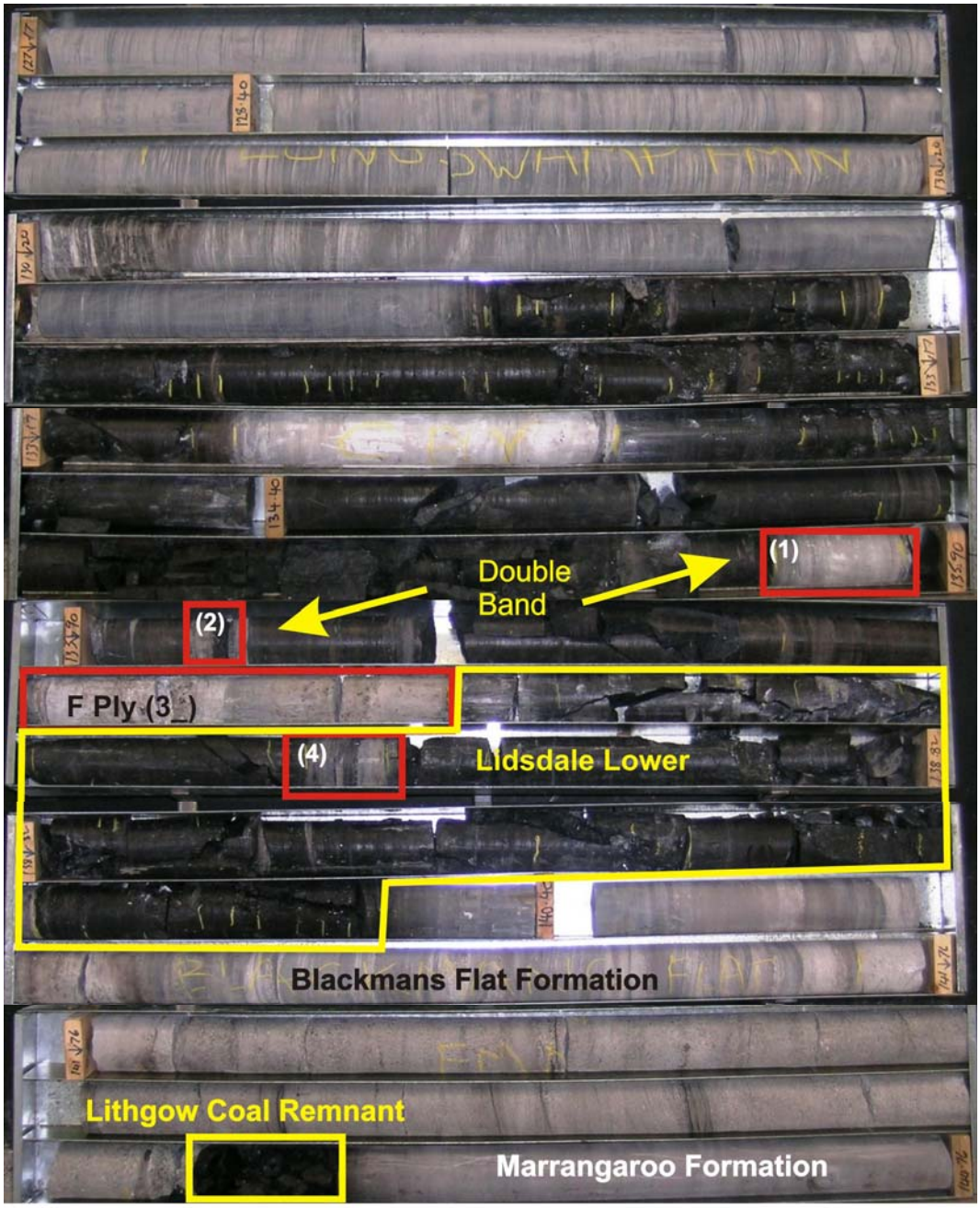

Photo 4 DM RUMKER DDH 1, 127.17 – 144.76m

The uppermost portion of the ELR Ply (Photos 1 - 4) is characterised by two tuffaceous claystone bands (1 & 2), with the upper band (1) consistently the thicker of the two. Within the Wilpinjong open cut this double band is referred to as E31. Mike Johnstone (pers. comm.) recognises this profile within the Mt. Penny area, 15 km to the east. This “double band” can also be readily identified in bores within the Wilpinjong (Peabody Energy, photos 1 & 2), Mt Penny (Cascade Coal), Bylong (Cockatoo Coal), Murrumbo (Photo 3), and the general Rylstone areas (Photo 4). The lower portion of the ELR Ply is stony coal, with inherent ash generally in excess of 40%.

Underlying the ELR Ply is the F Ply (band 3, Photos 1-4), readily identifiable in down-hole geophysical logs by its very high gamma response. It is generally between 20 – 50cm thick, but thickens eastward; in DM Bylong DDH 5 it is 71 cm thick, and further to the east in DM Goulburn Valley DDH 2 it is 92 cm thick (Figure 1). As noted earlier, this tuffaceous ply has been correlated with the Fairford Formation, and is readily identified on geophysical logs coupled with the persistent attendant stone and coal plies.

Immediately below the F Ply (3) is a dull coal, generally in excess of 20% inherent ash and consistently about 70 cm thick. This coal ply constitutes the upper portion of the Lidsdale Lower seam. Below this coal ply is a generally pervasive stone band (4, Photos 2-4) up to 10 cm thick. Where the upper coal ply of the Lidsdale Lower seam is relatively thin i.e. DM Wilpinjong DDH 6 (Photo 1), this stone band is either not developed or very thin. This observation is interpreted to be the result of the onlapping nature of seam development westward toward the basin margin. In a southward direction from Bylong toward Rylstone the section below this stone band progressively thickens from a few centimetres to in excess of 2 m. This coal section is generally less than 20% inherent ash, and is characterised by a small number of thin (often less than 5 mm) but pervasive claystone bands.

Whilst, as noted above, the underlying Lithgow Coal thickens eastward from Mt Penny to east of Bylong, regional industry and governmental exploration has shown that the Lithgow Coal progressively thins south of Bylong towards Rylstone (Figures 4 and 6). This was further illustrated in the recent drilling conducted by Mineral Resources in an area north of Rylstone (Photo 4).

This recently enhanced understanding of both the characteristics of the Lidsdale Coal, particularly the Lidsdale Lower seam, and the underlying Lithgow Coal, and their respective development, prompted an investigation of the operating collieries located close to the recent drilling. Charbon Colliery, Haystack Mountain, and Airly Colliery are stated to be extracting resources within the Lithgow seam, which is inconsistent with the regional development of the Lithgow Coal in this portion of the coalfield (Figures 4 and 6).

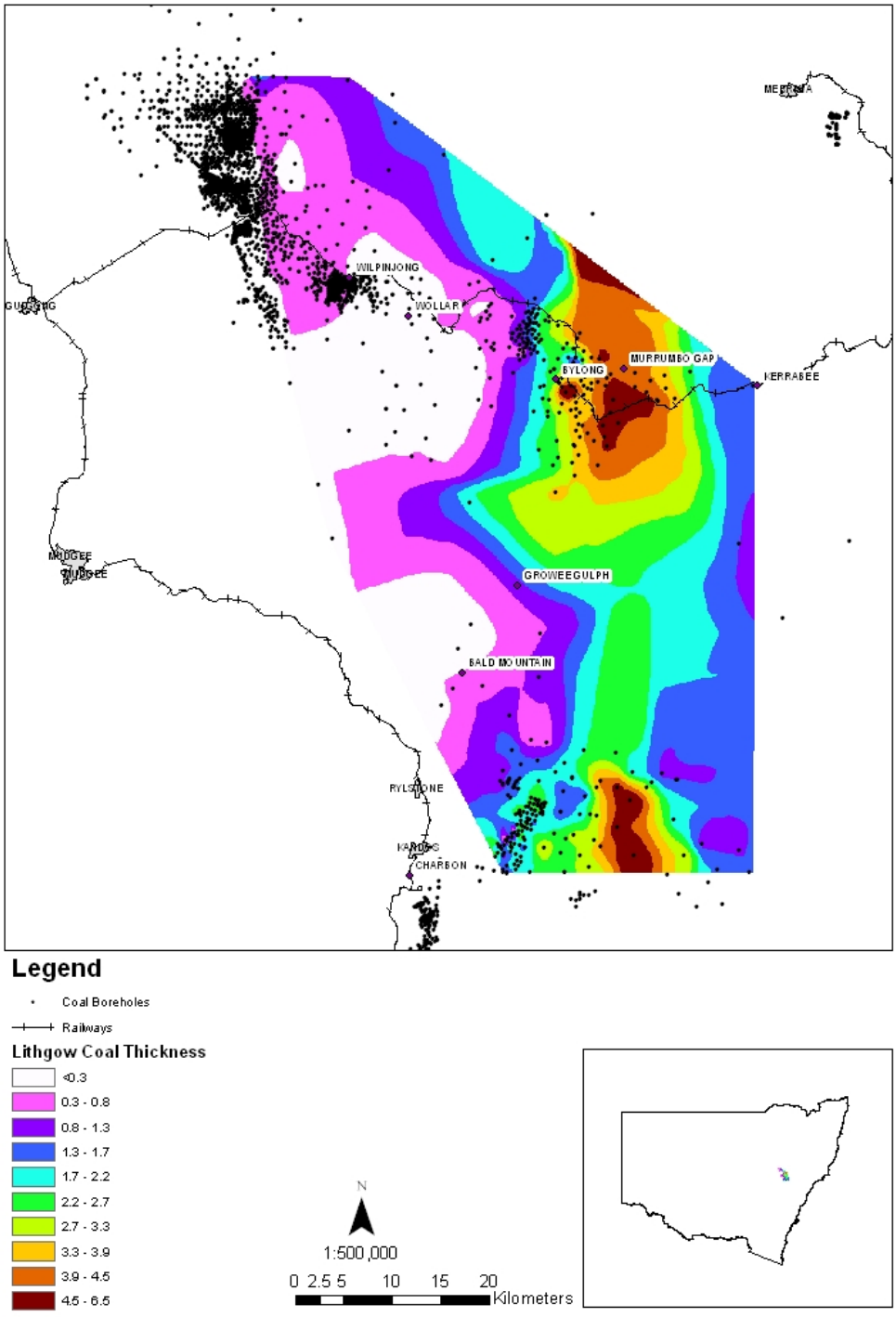

Figure 4 Isopachs of the Lithgow Coal

The box cuts at Charbon and the adjacent Haystack Mountain were examined, as well as at Airly and, a further 25 km to the south, Ivanhoe North. The coal lithotype and ash profiles of the seam across this area are illustrated in Figure 5.

In all box cuts examined, a prominent off white tuff (F Ply, band 3, this paper, age dating pending), locally referred to as LW1 or Blackmans Flat Formation, could readily be observed, underlain by an approximately 70 cm thick dull coal ply (locally referred to as LT3), and in turn underlain by a silty 6-10 cm stone band (LW2 locally, band 4, this paper). Overlying the white tuff, the 70-80 cm stony coal ply is in turn overlain by a persistent double band (bands 1 & 2, this paper), at Ivanhoe North and Airly. At Charbon and Haystack Mountain, and in JDP Ulan DDH 9 (Figure 5), this “double band” appears to coalesce, or the lower, thinner band is not very well-developed.

At Ivanhoe North, where the Lidsdale and Lithgow Coals converge, the prominent white tuff has been correlated with the Blackmans Flat Formation by the mine operators. This accordingly implies that the total section mined was the Lithgow Coal. From the regional geology presented in this paper, the author infers the white tuff to be the correlative of the F Ply (3), and not the Blackmans Flat Formation. As a result of this reappraisal of the stratigraphy, the majority of the section mined at Ivanhoe North, by open cut methods, is interpreted to be the Lidsdale Lower seam, with the basal dull unbanded coal unit, which ranges in thickness from 0.4 to 1.7 m, potentially the Lithgow Coal equivalent.

The seam profile examined in the box cut entry at Airly and in associated core (ARPO 4, Figure 5) has remarkable similarities to the coal lithotype profile presented for the Lidsdale Lower seam in this paper. Similarly, the section examined at Charbon and Haystack Mountain (Figure 5) is comparable to the coal lithotype profile of the Lidsdale Lower seam intersected in the recent drilling conducted by Mineral Resources in the Rylstone area, and not the typical unbanded coal lithotype profile of the Lithgow Coal (Figures 2 and 6).

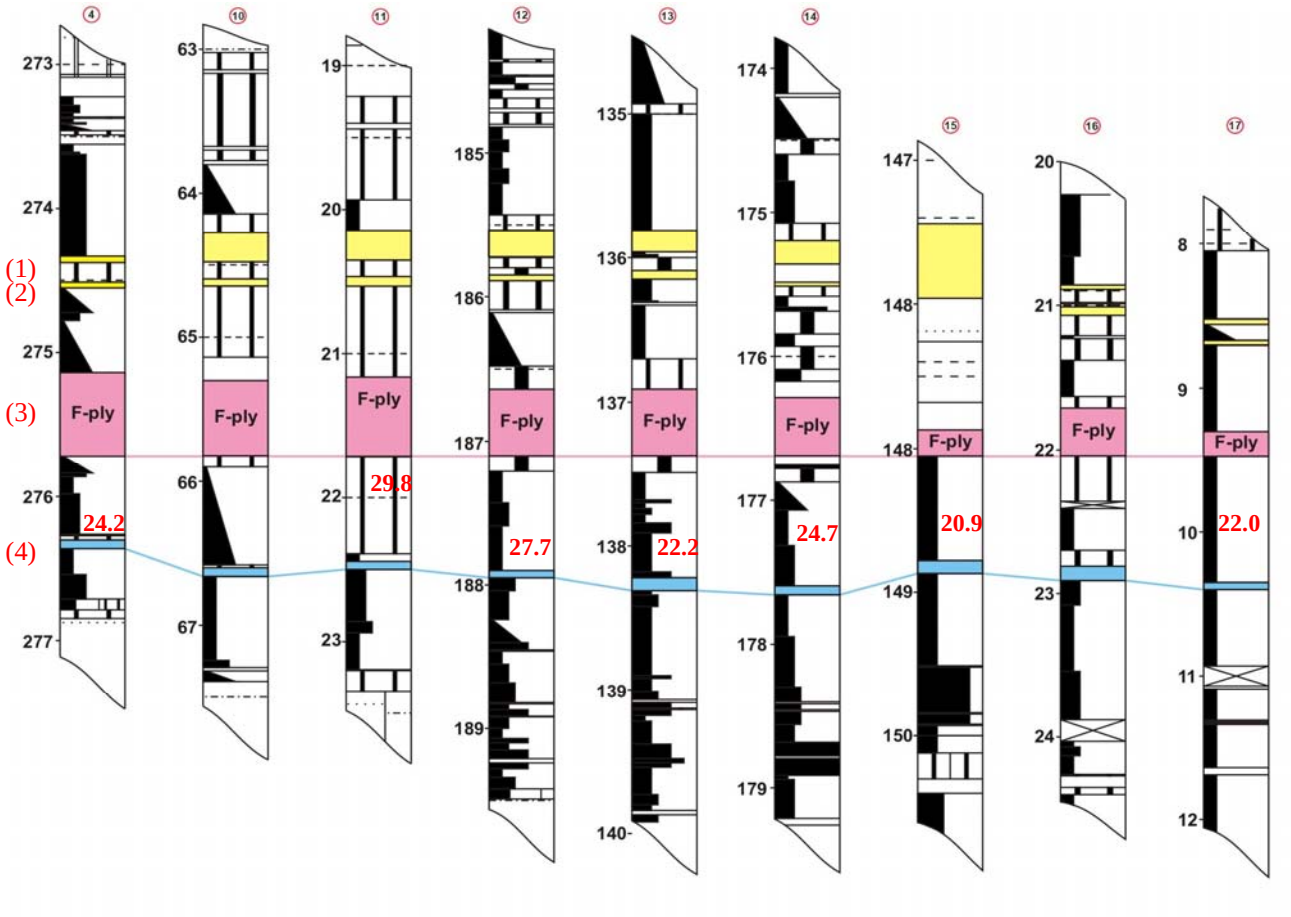

Figure 5 North-south cross-section from Bylong to Ivanhoe North, Lidsdale Coal (for location of boreholes see Figure 1)

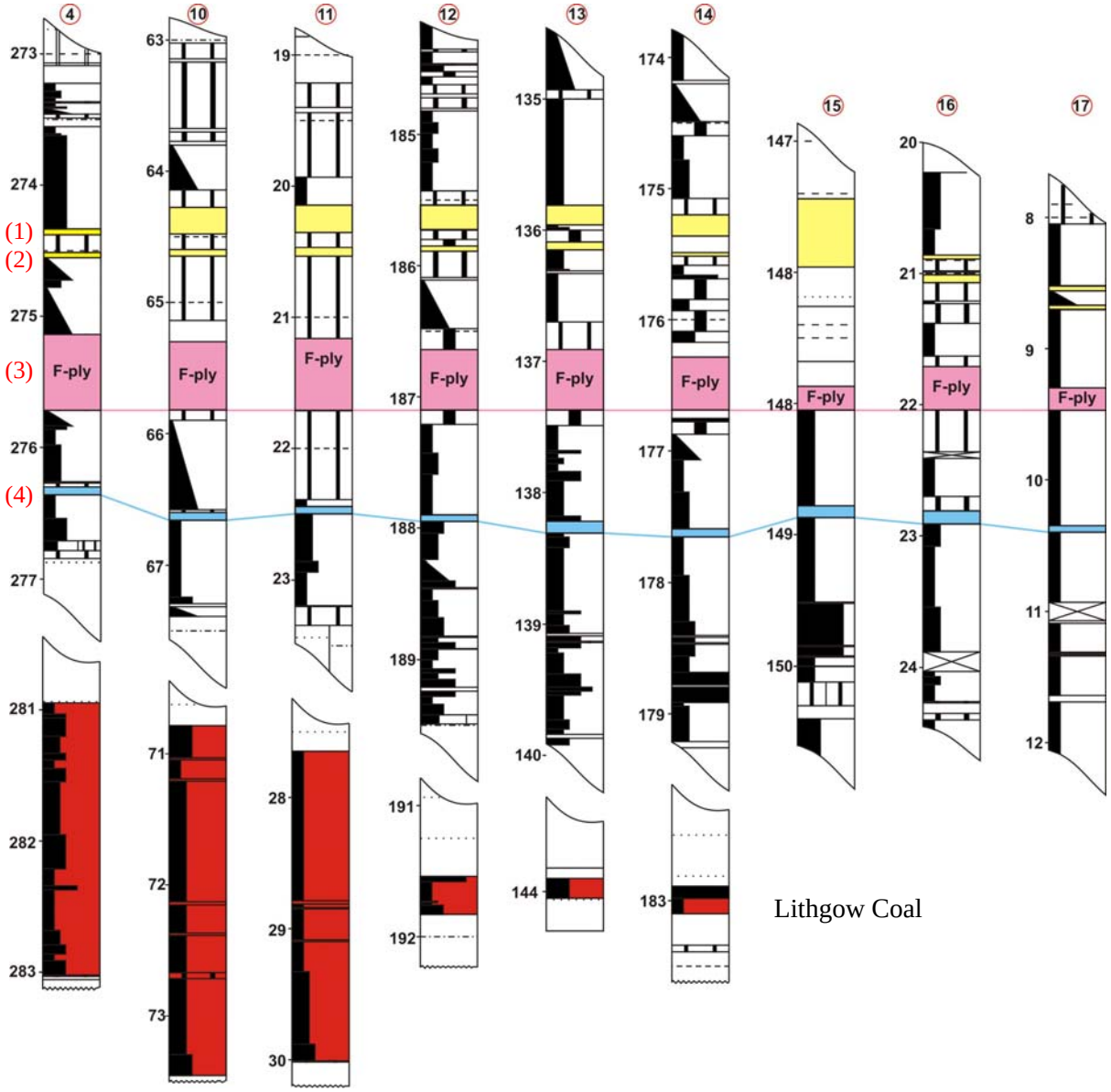

Figure 6 North-south cross-section from Bylong to Ivanhoe North, Lidsdale Coal and Lithgow Coal (boreholes as for Figure 5)

DISCUSSION

The interval below the CMK Ply (Figure 3), particularly the coalesced section comprising the ELR-ULG plies, has proven to be instrumental in understanding the regional development of the Lidsdale Coal. The ELR-ULG plies provide an informal "DNA bar coding", which has been used in this study to differentiate between the typical Lidsdale and Lithgow Coals.

Throughout much of the sedimentary history of the marginal areas of the Western Coalfield, the Wollar Shelf and Blue Mountains Shelf were stable structures which subsided at significantly slower rates than the neighbouring troughs. Yoo (1993, and Figure 1 in this paper), invoked three meridional north-south hingelines, Ulan, Wollar and Bylong, about which sedimentation rates were influenced. Eastward from the Ulan Hingeline the Denman Formation and Watts Sandstone progressively thicken. Between the Ulan Hingeline and the Wollar Hingeline the upper (CMK Ply and above, refer Figure 3) and lower (UCL to G Ply) sections of the "Ulan seam" maintain a uniform thickness. East of the Wollar Hingeline, the

upper section (CMK Ply and above, refer Figure 3) split and the plies become widely separated eastward to form the Long Swamp Formation and Irondale Coal. Whilst the upper plies of the Ulan seam split and become difficult to correlate basinward, the package of plies below the CMK Ply remain coalesced. The more stable sedimentary environment interpreted for this lower section of the "Ulan seam", the correlative of the Lidsdale Coal (Figure 3), facilitates confident regional seam correlation throughout the Western Coalfield.

CONCLUSION

The "F" Ply is the key to correlating the main economic seams in the Western Coalfield. The west-east and north-south cross sections provide compelling evidence that the seam currently mined at the Charbon, Haystack Mountain and Airly collieries is predominantly or entirely the Lidsdale Lower seam, and not, as currently interpreted, the Lithgow seam.

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