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COALFIELDS and COAL DISTRICTS of NOVA SCOTIA

The coal *resources* of Nova Scotia are estimated to be three billion tonnes. These coal deposits are spread over several coalfields and (smaller) coal districts, although the Sydney coalfield of Cape Breton Island contains the major portion. It is probable that undiscovered resources exist in some areas of the Province's *coal measures*. Figure 6 illustrates the distribution of known coal resources within the Province.

Coal quality varies significantly from coalfield to coalfield and, in some cases, even more so from seam to seam within a coalfield. The majority of coals are high *volatile* bituminous A, although high volatile bituminous B and medium-to-low volatile coals are present as well.

The majority of the Coal Section's efforts over the past few years has been in applied research and delineation of coal resources in various coalfields within the Province.

GEOLOGICAL BACKGROUND

The coals of eastern Canada were formed within the broad Fundy Basin of deposition (Poole 1967). This basin developed after the Acadian orogeny (mountain-building event), during the late Devonian period approximately 400 million years ago. The locus of major deposition was in the area of the Magdalen Islands (Bradley 1981). During the development of this large basin in the Carboniferous period, sedimentation was at times localized in depositional sub-basins (e.g., the Cumberland, Pictou, and Sydney basins), some of which contain sites where repeated episodes of coal accumulation occurred. These sites comprise the various coalfields of Nova Scotia.

The oldest coals of Nova Scotia are found as minor occurrences in the Devonian and Lower Carboniferous Horton Group. This early period of coal deposition was interrupted by widespread marine conditions, as represented by the deposition of Windsor Group *evaporites*. Major coal deposition did not occur until the terrestrial Late Carboniferous Riversdale Group was deposited over much of northern Nova Scotia and Cape Breton Island (Figures 7 and 8).The oldest productive coal districts in the Province belong to the Riversdale Group: the St. Rose – Chimney Corner and Port Hood coalfields, of Westphalian A age, on the west coast of Cape Breton Island.

More extensive coalfields were subsequently deposited in the Cumberland Group. These sediments are essentially restricted to the Cumberland Basin in the northwest mainland of the Province, where the Westphalian B Joggins-Chignecto and Springhill coalfields are situated. Other, less extensive, coal districts exist at Salt Springs and near Oxford.

The Pictou Group (and equivalent Stellarton and Morien Groups) of Westphalian C to D age was deposited over much of the northern mainland and Cape Breton Island. The most extensive and youngest coal deposits of Nova Scotia occur within this group, including the Sydney, Inverness, and Mabou coalfields and the Glengarry district of Cape Breton Island, and the Pictou and Debert-Kemptown coalfields of the northern mainland.

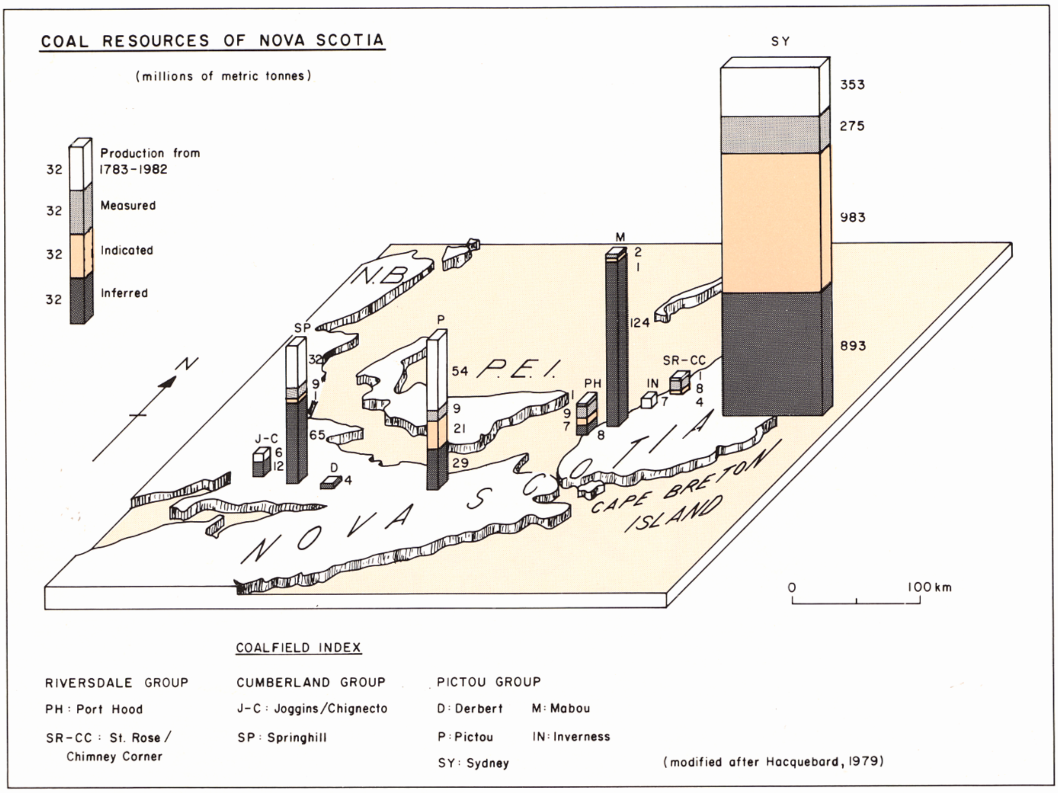

FIGURE 6. Relative distribution of coal resources by coalfield in Nova Scotia.

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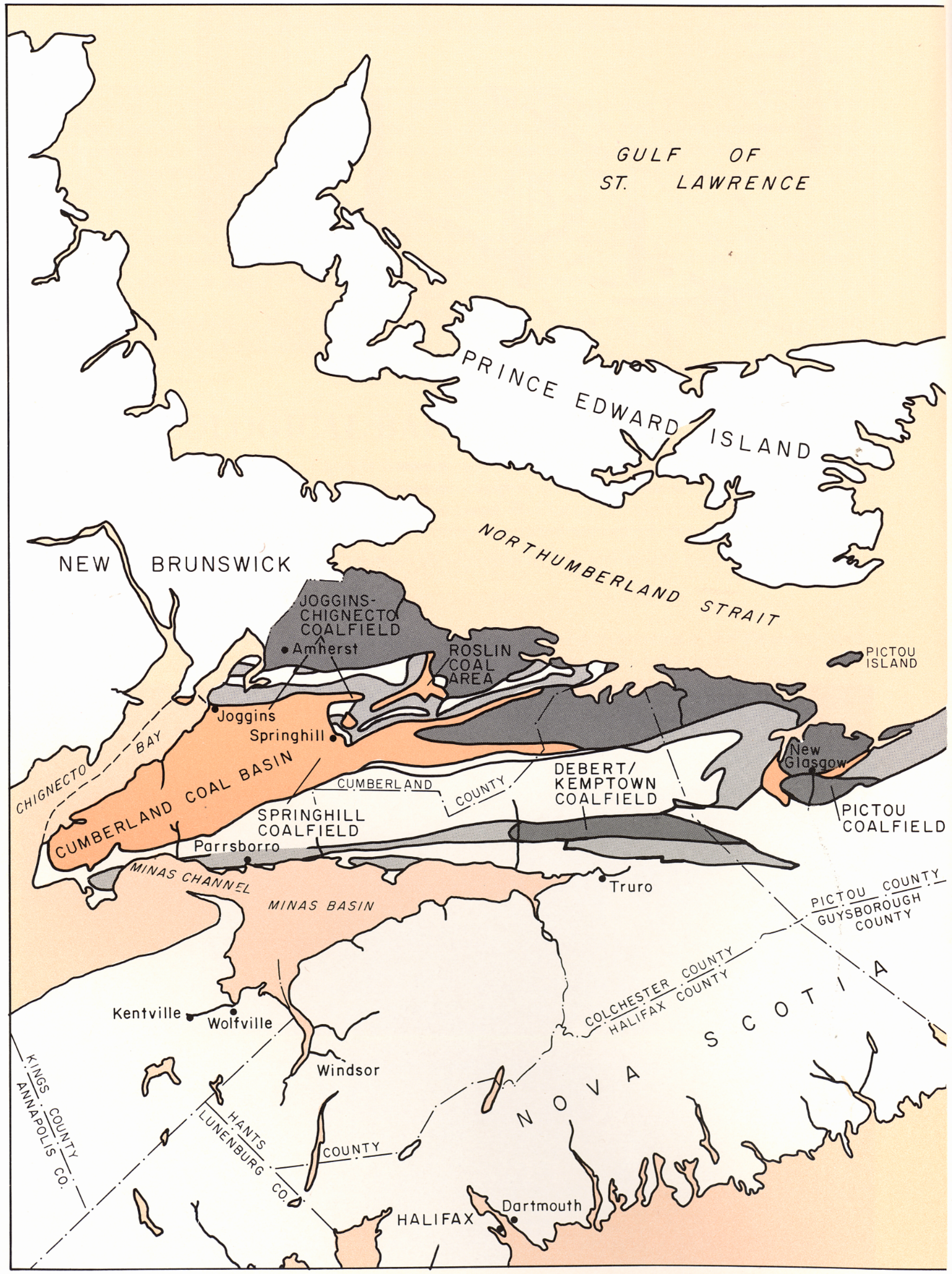
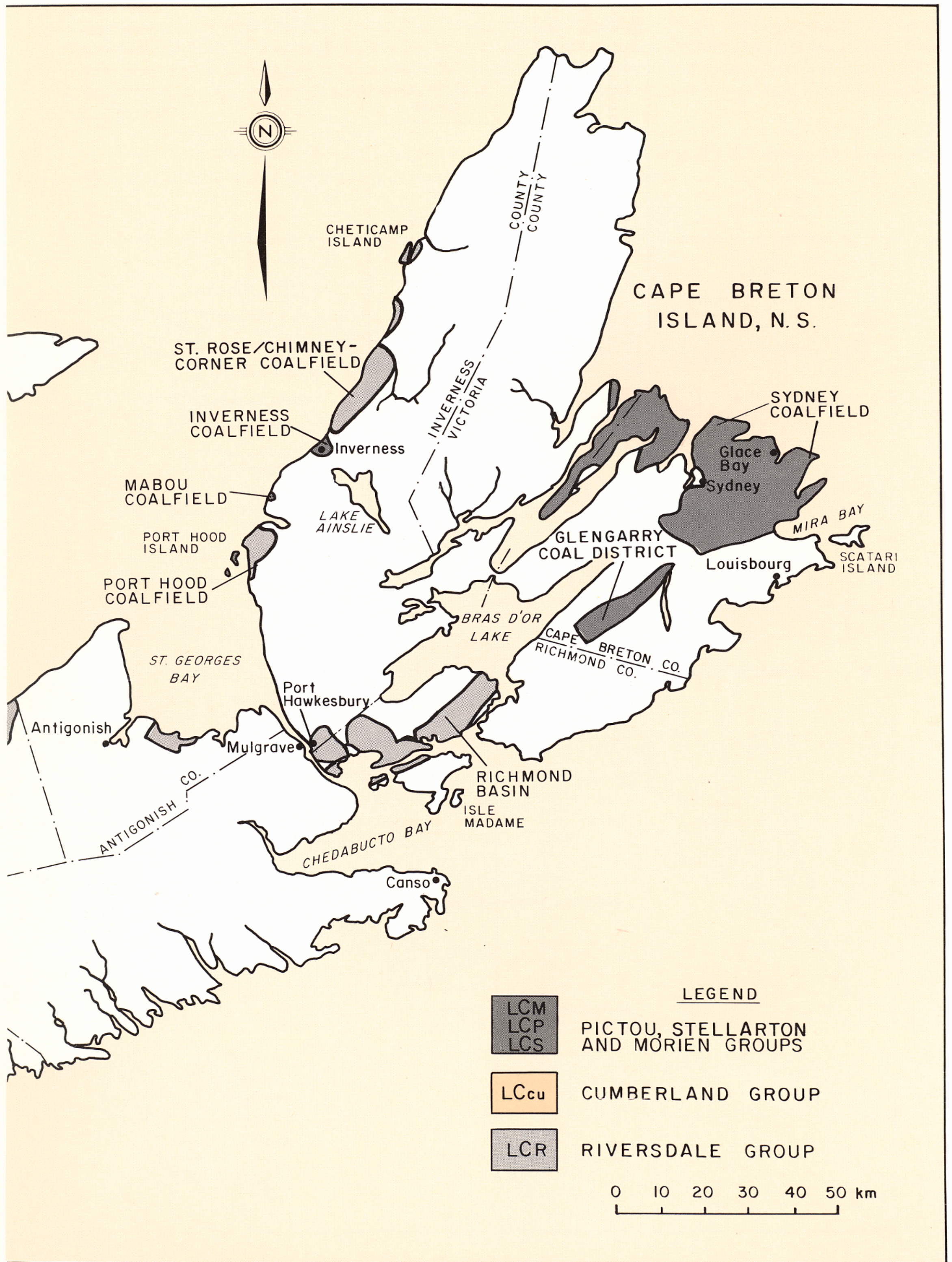
FIGURE 7. Coalfields and districts of Nova Scotia, showing distribution of coal-bearing Riversdale, Cumberland, and Pictou groups.





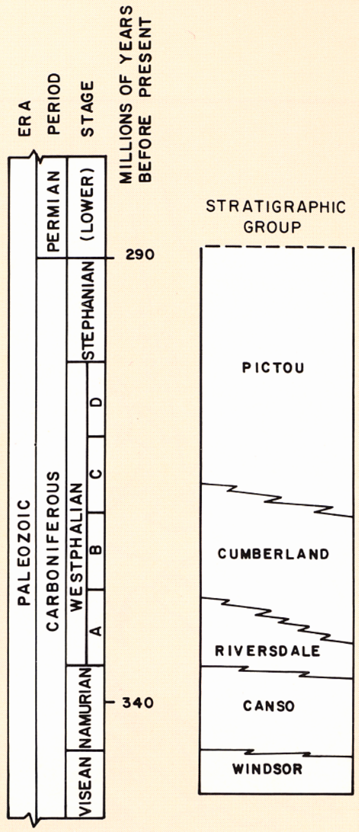


FIGURE 8. Geological groups of the Carboniferous period in Nova Scotia.

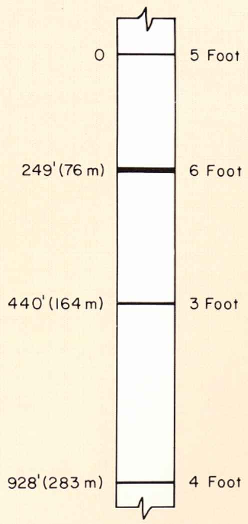


FIGURE 9. Major coal seams of the Port Hood coalfield.

COALFIELDS OF THE RIVERSDALE GROUP

PORT HOOD COALFIELD

The Port Hood coalfield lies on the west coast of Cape Breton Island, on the gently dipping east limb of a *syncline* which plunges to the southwest. The six-hundred-metre-thick coal-bearing section dips beneath the Gulf of St. Lawrence. Though only one mineable seam has been identified (Figure 9), the coalfield (Figure 10) is open-ended to the south and the possibility exists that coal seams may persist offshore beneath the southern tip of Henry Island. Gersib and McCabe (1981) describe the environment of deposition as a continental floodplain with *fluvial* and *fluvio-lacustrine* deposition.

The coals of Port Hood have a rank of high volatile B to C bituminous. Mining in this field was abandoned in 1969 primarily due to economic considerations.

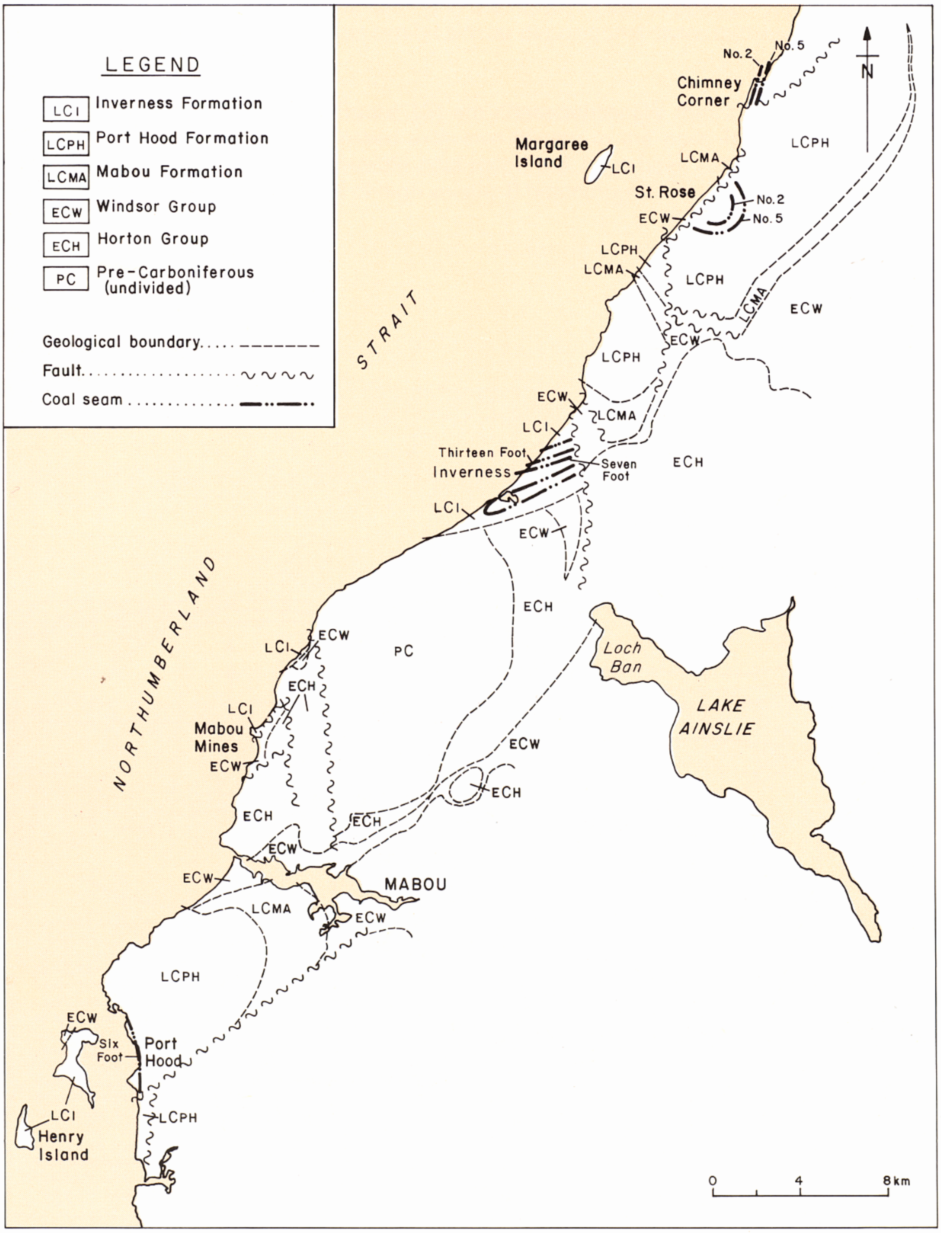


FIGURE 10. Coalfields of western Cape Breton Island.

ST. ROSE – CHIMNEY CORNER COALFIELD

The St. Rose – Chimney Corner coalfield also occurs on the west coast of Cape Breton (Figure 10). Separated from the Chimney Corner field to the north by a 3.2-km-wide zone of block faulting, the St. Rose field is of limited area due to a *fault* downdip of the mine workings which brings it into contact with evaporites of the Windsor Group.

The coal-bearing section is 150 m thick at Chimney Corner, increasing to 250 m at St. Rose. At Chimney Corner, the coal seams dip beneath the Gulf of St. Lawrence. Hacquebard (1951) has correlated the seams of the Chimney Corner and St. Rose fields (Figure 11) on the basis of microscopic coal *petrography*. Bivalve (shell) fossils overlying the coals suggest a *lacustrine* environment.

The rank of coals in both areas is high volatile C bituminous. A small underground mine (of the Evans Coal Company) has been in continuous operation at St. Rose since the late 1940s.

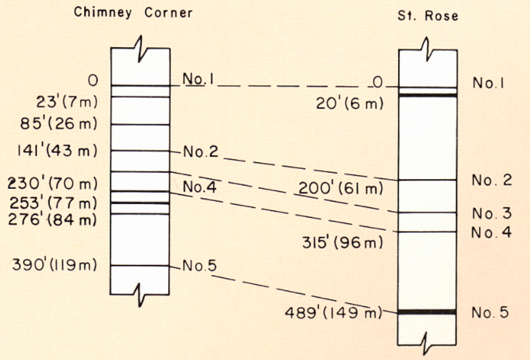


FIGURE 11. Stratigraphic columns of the Chimney Corner and St. Rose coalfields showing correlated coal seams.

COALFIELDS OF THE CUMBERLAND GROUP

JOGGINS-CHIGNECTO COALFIELD

The Joggins-Chignecto coalfield stretches over 30 km from the shores of the Cumberland Basin, Bay of Fundy, in the west through River Hebert, Maccan, Chignecto, and Fenwick to Styles Brook in the east (Figure 12). The seams dip to the south, on the south flank of the Windsor evaporite-cored Minudie *anticline*. This structure also forms the north limb of the Cumberland coal basin. At Joggins, the coal section (lower fine *facies* of the Cumberland Group) is approximately 1500 m thick, thinning dramatically eastward.

The depositional environment of the Joggins-Chignecto coalfield is one which has spawned some debate among geologists. *Paleoenvironments* suggested include *deltaic* (Duff and Walton 1972), meandering fluvial (Kaplan and Donahue 1980) and *anastomosed* fluvial deposition (Rust and Gibling 1983). Studies by the Coal Section in related coalfields of the Cumberland Basin indicate that the depositional environment is part of a complex of gradational facies changes within the basin from alluvial fans in the south to lacustrine in the north. Fluvial deposition with coals formed in a shoreline position is suggested. The coals exhibit similar depositional styles to those of the Salt Springs and Roslin area (Calder 1982).

The coals at Joggins (Figure 13) are characteristically thin, commonly less than one meter; however, the coalfield has witnessed extensive mining in the past. The last mining operation closed in 1979, and most readily accessible coal resources have been exhausted. The coals of the Joggins-Chignecto coalfield have a rank of high volatile B bituminous.

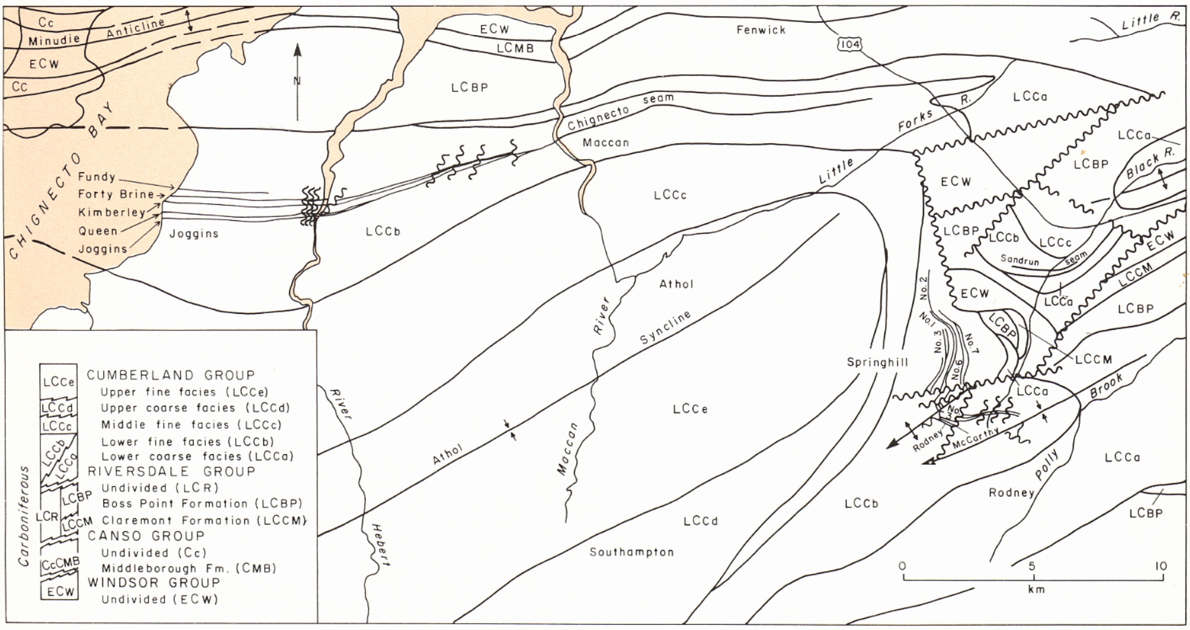


FIGURE 12. Coalfields of the Cumberland basin, Cumberland County, Nova Scotia.

SPRINGHILL COALFIELD

The Springhill coalfield occurs on the south limb of the Cumberland coal basin (Figure 12). The coalfield has been moderately to severely deformed by Windsor Group evaporites of the Black River *diapir*. The structural configuration of the Springhill coalfield is that of a southwesterly plunging anticline, the axis of which is severely faulted. The coal measures attain a maximum thickness of 1,080 m on the north limb of the anticline. Tentative correlation with a coal-bearing section intersected by drillholes (the Cera Caledonia 74-2 and 74-3, and Pettigrew boreholes) approximately 20 km southeast of Springhill indicates thinning to 150 m in a position more proximal to the pre-Carboniferous Cobequid highlands. This upland was the source of much of the sediment that filled the basin. The major coal seams of Springhill are depicted in a composite *stratigraphic* column in Figure 14.

Within the coalfield, seams exhibit *progressive onlap* over *braidplain* and *distal alluvial-fan* sediments derived from the Cobequids to the south. The center of coal deposition within successively younger seams migrates to the south. Elongate coal swamps formed adjacent alluvial fans to the south, and appear to have been controlled to the north by major-trunk meandering rivers (Calder 1984). Minor *ephemeral streams* occasionally invaded the coal-forming moor where it bordered the alluvial fans. Early basin filling may have been characterized by transverse flow terminating in a shoreline of possibly lacustrine origin.

The coals of the Springhill coalfield exhibit an increase in rank with depth from high volatile to medium volatile A bituminous. The bulk of remaining resources occur on the north limb of the anticline downdip from old workings. Below a vertical cover of 450-600 m, the workings are prone to rock bursts or "bumps," a phenomenon instrumental in the closure of the major collieries in the late 1950s. Notley (1980) has suggested that variations in mining methods could partially alleviate this significant problem. Resources of lesser quantity exist within the axial region of the anticline in a structurally complex geological setting. In 1983, Novaco Limited completed an open-pit operation in this area, which may be amenable to underground development.

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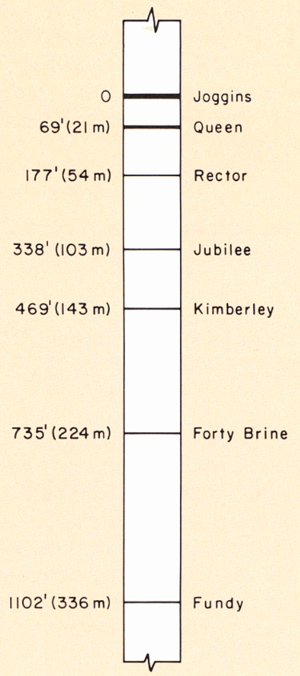


FIGURE 13. Major coal seams in the Joggins – River Hebert district of the Joggins-Chignecto coalfield.

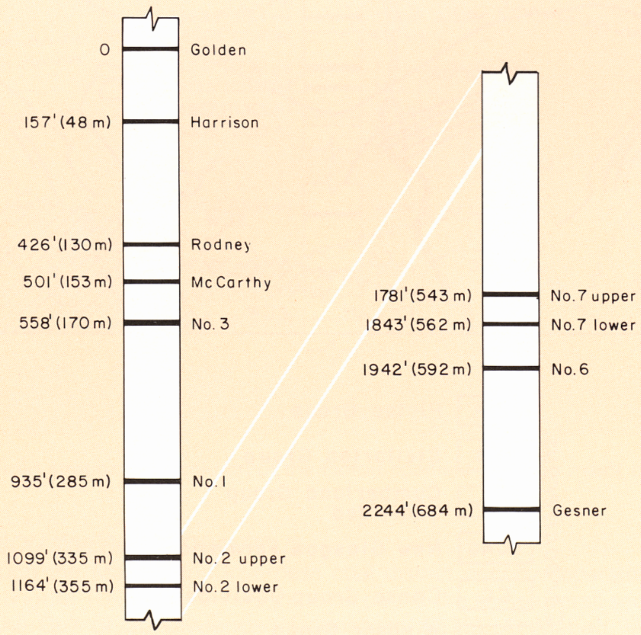


FIGURE 14. Idealized stratigraphic column of the Springhill coalfield showing major coal seams.

COALFIELDS OF THE PICTOU GROUP

DEBERT-KEMPTOWN COALFIELD

The Debert-Kemptown coalfield (Figure 7) is situated within a narrow, structurally complex, fault-bounded syncline. The extent of the coalfield has never been defined accurately. Within this syncline, the Pictou Group occupies an area of approximately 100 km. Although the depositional environment is largely undocumented, it is probably fluvial. The coals of the Debert-Kemptown field have a rank of high volatile B bituminous. The only coal operations in the district were the short-lived mines that operated between 1903 and 1936.

PICTOU COALFIELD

The Pictou coalfield is situated in the north-central part of Pictou County. The basin is 18 km wide (east and west) by 9 km long (north and south) and encompasses an area of approximately 165 km^2 (Figure 15).

Mining has taken place in this field over the past 160 years, and relative to its size, it has been one of the most extensively exploited coalfields in Canada. Approximately 55 million tonnes of coal have been mined in this field. At present, no large-scale mining is carried out.

The Pictou coalfield lies within a *graben*. The coal basin was slowly filled with a succession of sediments, beginning with the New Glasgow *conglomerate*, derived from highland areas to the southwest of the basin. Infilling of the basin continued until drainage was impeded, shallow lakes developed and the fluvio-lacustrine deposits of the Stellarton Group were laid down. Within the Stellarton Group, the coal deposits of the three mining districts (Westville, Stellarton, and Thorburn) of the basin are found. Deposition of the coal measures commenced in the Westville district with subsequent deposition occurring in the Stellarton and Thorburn districts: the center of deposition moved progressively west to east so that the oldest coal seams are found in the Westville district and the youngest coal seams in the Thorburn district.

As a result of their fluvio-lacustrine (Hacquebard and Donaldson 1969) depositional milieu, the seams tend to be characterized by low-ash coal in the center of the basin, grading laterally to high-ash coal, thence to shaly coal and finally coaly shale on the periphery of the basin. This phenomenon has been described as "lithification" (Hacquebard and Donaldson 1969).

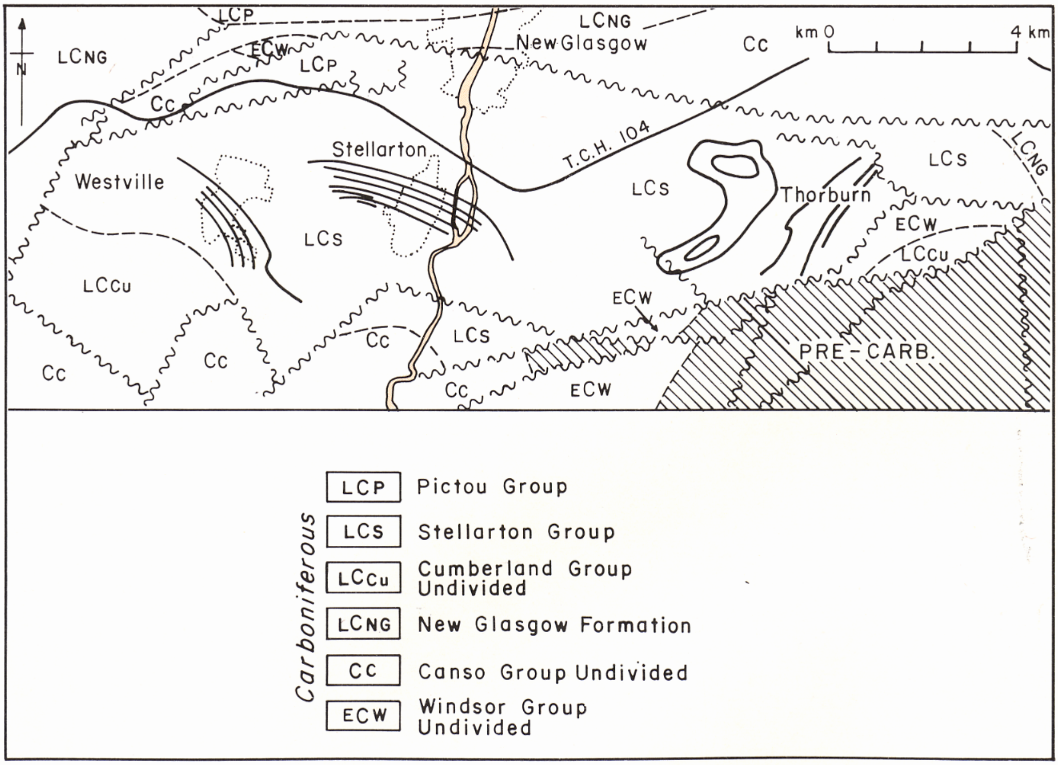


FIGURE 15. Geological map of the Pictou coalfield.

The coals of the Pictou coalfield are of thermal quality and are classed as high volatile A bituminous coals. The notable exception is the Acadia seam in Westville, the only known low volatile coal in eastern Canada. Petrographic studies have indicated that it is suitable for use as a blend with *metallurgical*-quality coal. There are fifteen major coal seams (Figure 16) in the basin ranging from 1-14 m in thickness; twelve have been mined in the past. Much of the better quality coal has been mined; the remaining resources lie in peripheral areas where quality deteriorates. Exceptions are the Acadia and Scott seams in Westville where remaining resources lie down*dip* of old workings, at a depth of 600-1200 m. Significant near-surface and deeper resources exist in the Stellarton district and in the Westville district within the Foord, Acadia, and Scott seams. In the Thorburn district, approximately one million tonnes may be amenable to surface mining.

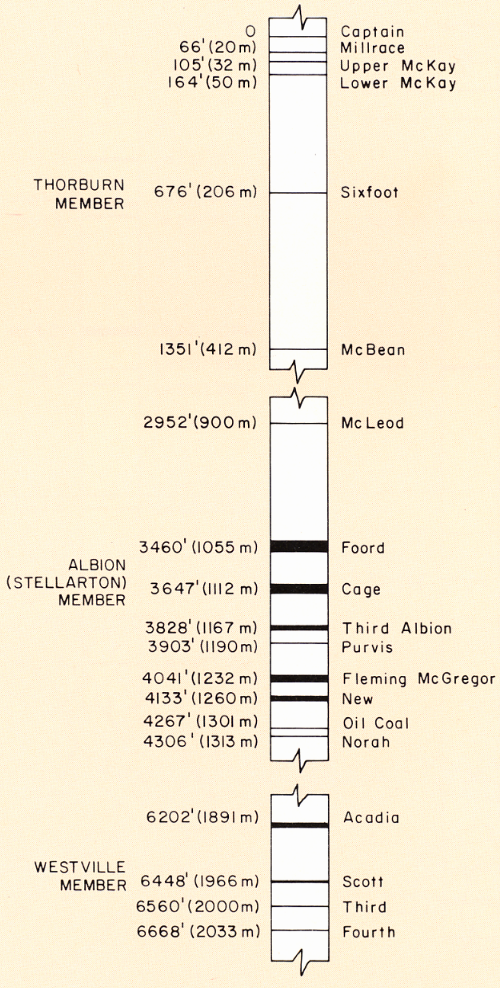


FIGURE 16. Idealized stratigraphic column of the Pictou coalfield showing major coal seams.

MABOU-INVERNESS COALFIELD

Though the Mabou and Inverness coal district occupy separate land areas approximately 10 km apart (Figure 10), they are thought to be part of the same overall sequence and to merge at depth beneath the Gulf of St. Lawrence (Hacquebard 1975). At Mabou, less than one square kilometre of coastline is underlain by the coalfield, which dips under the sea to the west. The exposed area is severely faulted, but there is a stratigraphic section of about 365 m along the shore in which six seams have been identified. Norman (1935) suggested that deposition took place on the *subaerial* portion of a delta.

Faulting obscures the relationship between the Mabou coalfield and the Inverness coalfield to the north; however, fossil spores, offshore drilling, and *seismic surveys* indicate that the seams at Inverness are stratigraphically higher (i.e., younger) than the Mabou section (Figure 17). Ten seams outcrop at Inverness again in a section which dips moderately seaward. Five seams have been mined; however, faulting offshore has limited their submarine extent. It is interesting to note, however, that a petroleum exploration well some 50 km offshore at Brion Island penetrated a six-hundred-metre-thick coal-bearing section in the Pictou Group that may correlate with the Mabou-Inverness section (Hacquebard 1975).

The coals are high volatile bituminous C. Limited mining went on at Mabou from 1899 to 1909. At Inverness, coal was first produced in 1865 but has not been mined since the mid-1960s.

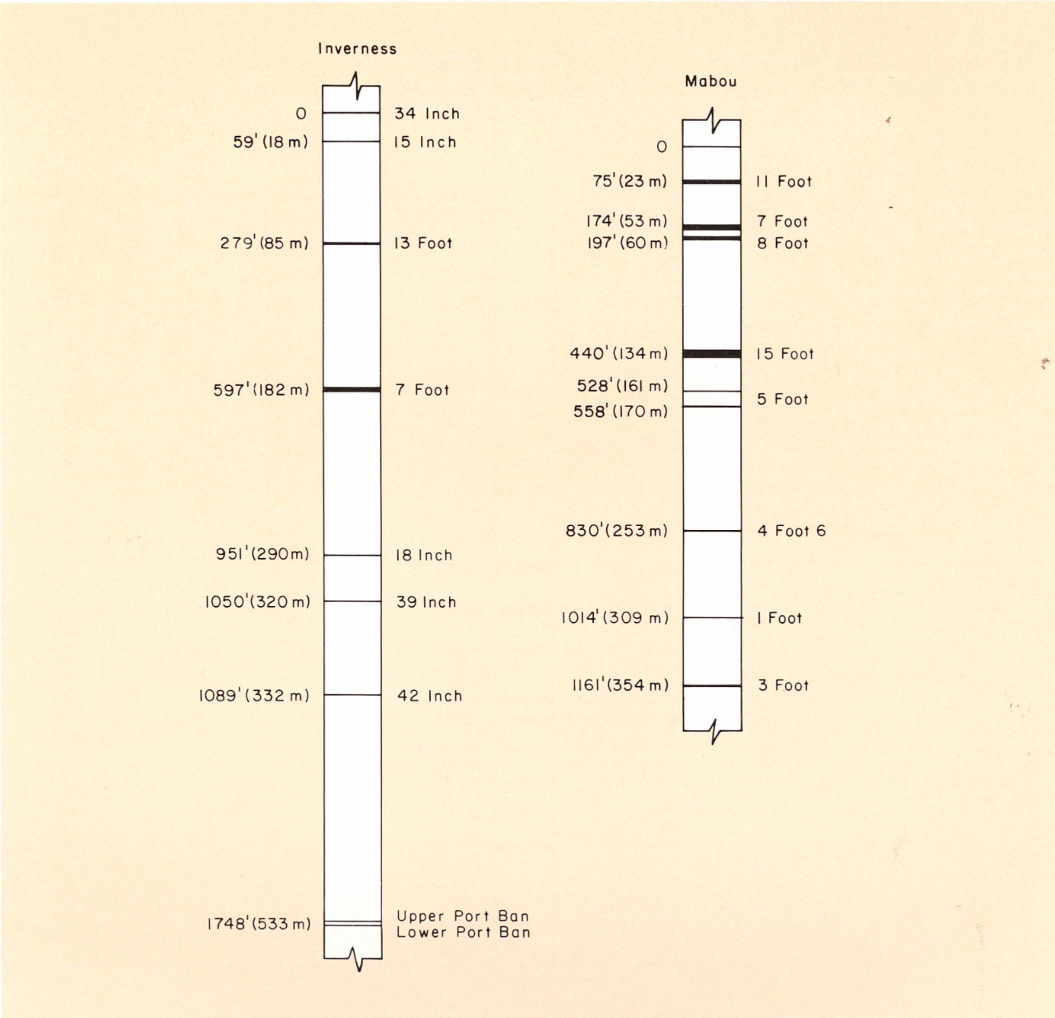


FIGURE 17. Stratigraphic columns of the Mabou and Inverness districts of the Mabou-Inverness coalfield (the major seams of the Inverness section overlie those of Mabou).

SYDNEY COALFIELD

The Sydney coalfield (Figure 18) contains the largest coal *reserve* in eastern Canada. The approximately two-thousand-metre-thick coal-bearing Morien Group underlies a roughly triangular area with an apex south of Sydney and a base off the south coast of Newfoundland. More than 98 percent of the coalfield is submarine although eleven of the thirteen known major coal seams (Figure 19) outcrop on land. Their geological settings are reasonably well known through surface exposure and underground workings. The only direct information available on their offshore geology comes from deep coal mines and the twenty wells drilled for petroleum and coal, and this data is largely limited to the area within 10 km of the Cape Breton coast. Geophysical techniques, primarily seismic surveying, have been used to define the geological structure of the greater part of the submarine basin.

The depositional environment is largely fluvial. The river systems had their headwaters in a mountainous upland whose present-day eroded remnants are represented by the crystalline rocks of the Forchu-East Bay structural blocks and the Cape Breton Highlands. Great volumes of coarse sandy sediments accumulated in a braided river environment, leaving 900 m or more of sediments in the eastern part of the basin where deposition was initiated and subsidence was greatest. The braidplain migrated steadily westward. As the stream gradients decreased, the rivers, now flowing over an extensive, possibly coastal, floodplain, took on the character of meandering streams with fewer major channels. These river channels were separated by broad marshy flats which became the locus for deposition of muds (overbank deposits) when the rivers flooded.

Early *clastic* deposition and a later initiation of major peat deposition occurred in the southeastern part of the basin. Significant peat accumulation began with the formation of the Tracy seam, the lowest mineable seam in the section. The progressive westward onlap of younger seams reflects the overall development of the Morien Group. The later seams (Harbour, Hub, and Point Aconi) are well developed over most of the basin. Throughout Morien time the centre of deposition remained in the easterly Donkin area where the seams attained their greatest thickness. The seams invariably deteriorated near the western basin margin where they split due to an influx of sediments from the highlands.

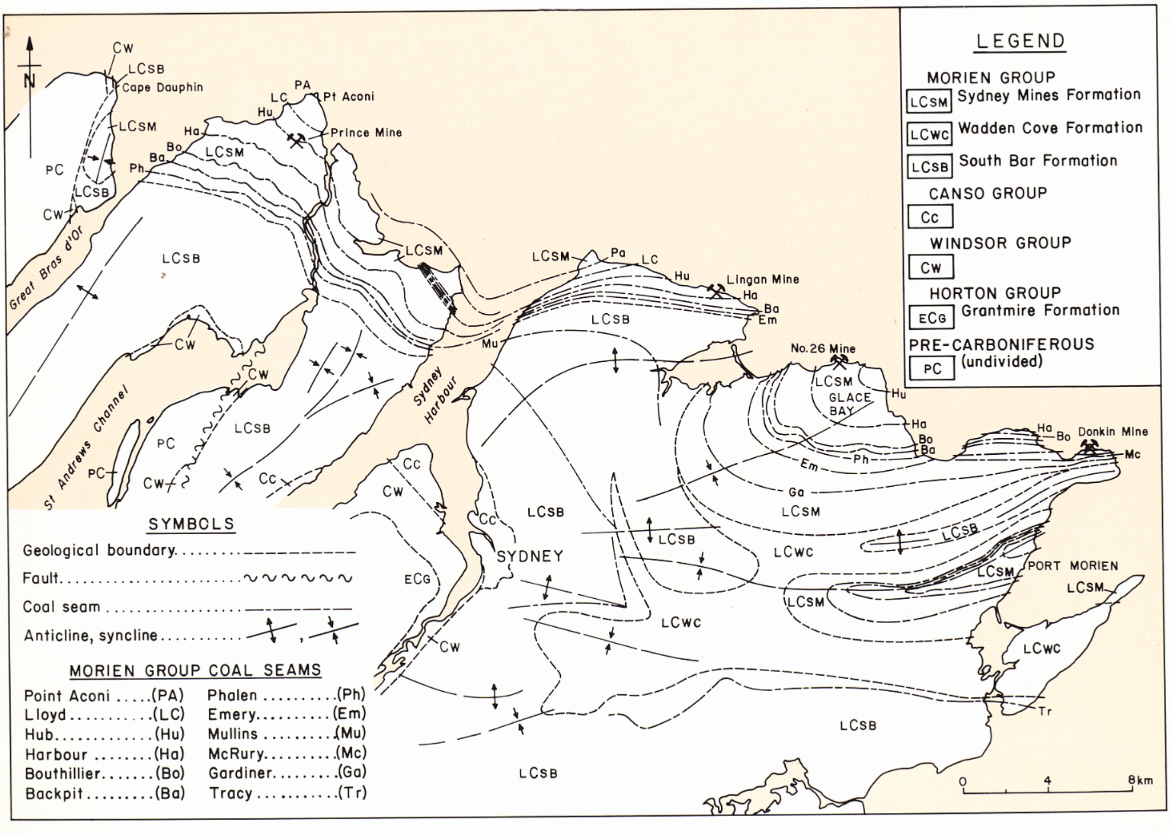


FIGURE 18. Geological map of the Sydney coalfield.

The major structural features of the Sydney coalfield are the bounding faults (the Mountain fault on the west and the Mira River – Bateston fault on the southeast) and the large-scale *folds* which define a broad structure known as the Sydney *synclinorium*. These northeast-trending folds closely reflect the underlying basement structure and probably represent draping and differential *compaction* of the sediments over the uplifted basement blocks (e.g., Coxheath Hills, Boisdale Hills).

The coal seams dip gently approximately 5° toward the deeper offshore basin centre except where affected by the northeast-trending open *flexures*. Even on the flanks of these folds, dips rarely exceed 15°. The fact that seams tend to be somewhat thicker in the synclines than over the anticlines suggests that these structures are at least in part contemporaneous with deposition of coal.

The rank of the Sydney coals varies considerably, increasing to the east and with depth. They are classified generally as high volatile A bituminous (Hacquebard 1983) but in places reach medium volatile bituminous.

All underground mining operations in the Sydney coalfield are managed by the Cape Breton Development Corporation; two surface operations and two coal-waste reclamation operations are conducted by other groups. At Point Aconi, Novaco Limited is in the final stages of an open-pit operation on the Sydney Main Harbour seam, while T. Brogan and Sons operates an open-pit mine on the Bonar (Lloyd Cove) seam. Selminco Inc. conducts two coal waste-bank reclamation projects in the coalfield.

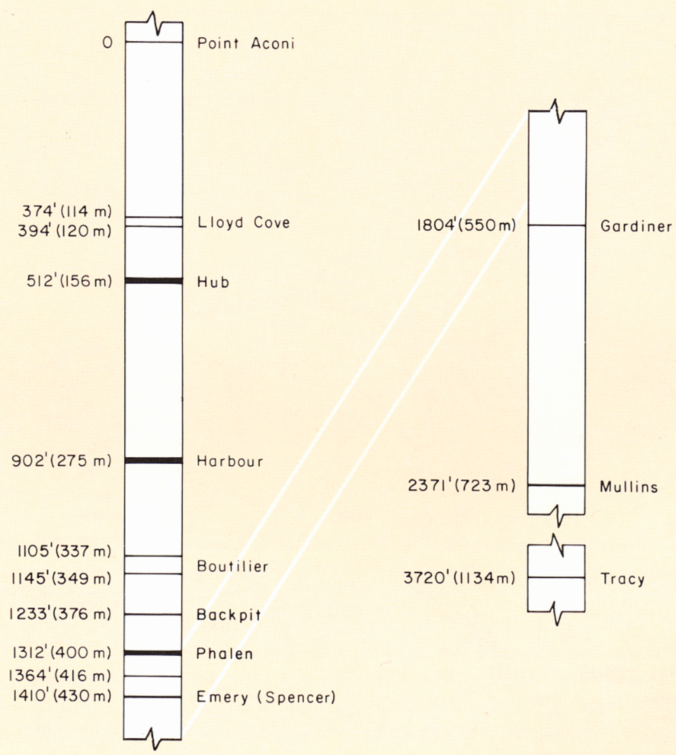
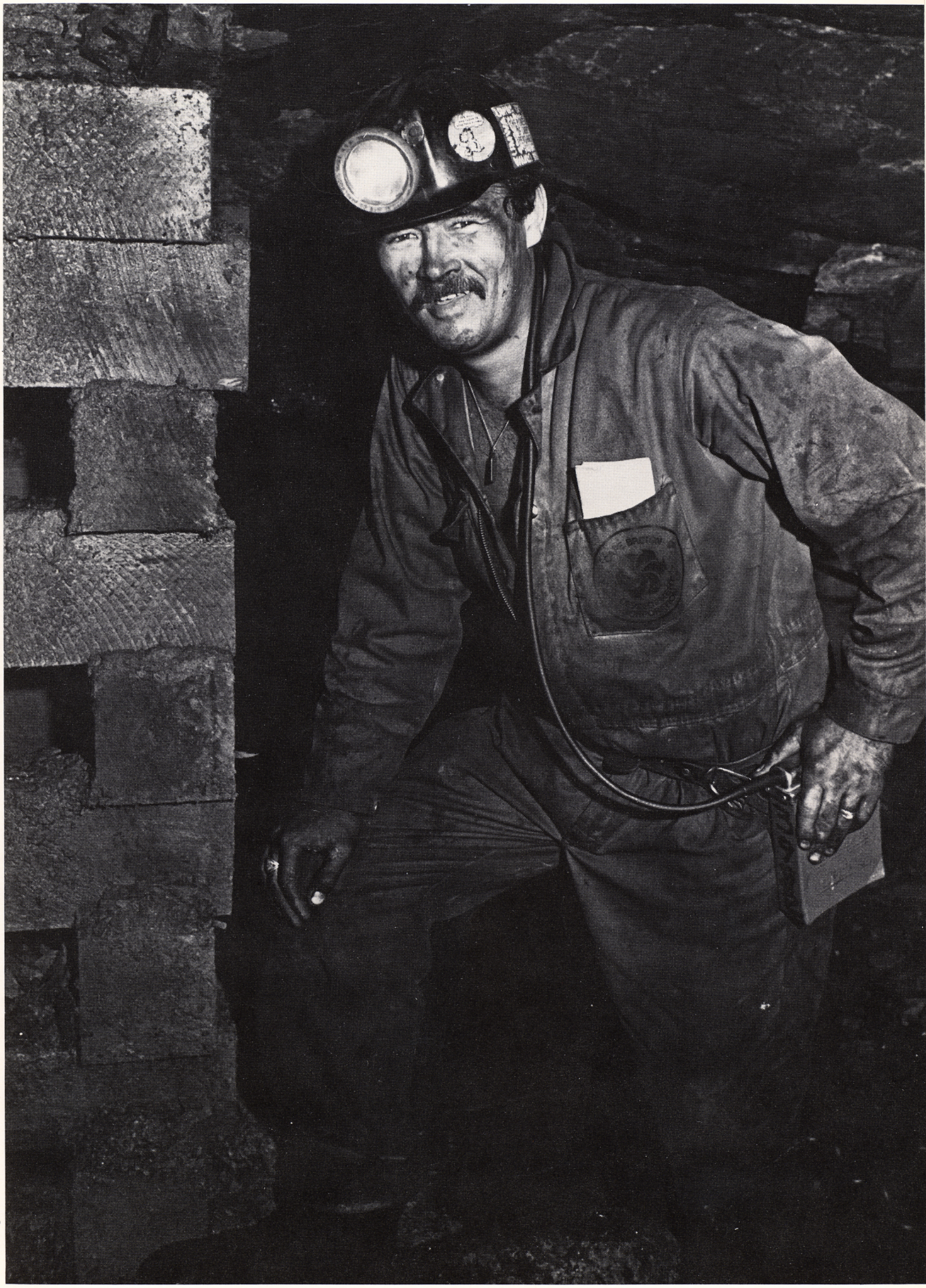


FIGURE 19. Idealized stratigraphic column of the Sydney coalfield showing major coal seams.



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