The geology of the Minto Salmon Harbour mine site and its high sulphur coals

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The Salmon Harbour mine, near Minto, central New Brunswick, excavates coal from the upper part of the Minto Formation of the Pictou Group (Pennsylvanian), the uppermost unit within the Maritimes Basin in this area. The stratigraphic succession is informally divided into seven units at the mine site. Unit 1 is the coal seam, a high volatile A bituminous grade of coal containing between 5 to 9 % sulphur. Unit 2, in outcrop, comprises organic rich shale that forms the roof rock to the coal. A laterally equivalent sandstone has recently also been identified in nearby boreholes. Units 3 and 5 contain numerous sandstone and mudstone couplets that exhibit ped-like fracturing. Unit 4 is a laterally extensive sandstone, locally conglomeratic with trough cross beds, rip-up clasts and climbing ripples. Bounding surfaces are variably oriented. Unit 6 is a laterally discontinuous lenticular sandstone that can truncate much of Unit 5. In plan view it maps as a sinuous body and

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internally has uniformly dipping bounding surfaces suggesting lateral accretion sets. Unit 7 is the present day overburden.

The outcropping Minto Formation is modelled as a poorly drained coal swamp that was gradually displaced by a fluvial system and associated floodplain. The sand-mudstone couplets likely represent sheetflood and overbank deposits that were subaerially exposed to subsequently form a palaeosol. The widely outcropping Unit 4 sandbody represents either extensive lateral migration of a small channel or a very large fluvial trunk channel, potentially with the variably dipping bounding surfaces defining growth-increments of a mid-channel barform. The Unit 6 sandbody represents a short lived meandering fluvial channel.

At the base of Unit 2, sulphur/carbon analyses indicate 3.1 wt% sulphur and 1.32 wt% carbon. Progressively lower values are recorded up-section. Higher levels of sulphur (6.47 wt%) and carbon (2.23 wt%) were detected immediately below the coal seam. Petrographic analyses have identified quartz as a blocky cement and kaolinite as a pore-filling vermiform clay phase in units 2 and 3. Unit 4 additionally has quartz forming 'dog tooth' quartz crystals enclosed by a later stage calcium carbonate cement (5–10%). Thin sections from sandstone immediately beneath the coal exhibit pyrite likely enclosing kaolinite but postdated by carbonate (late alkaline conditions).

The source of the sulphur in the coal and adjacent strata is debatable. Although sulphate from seawater would provide an abundant source of sulphur, no sedimentological evidence for marine influence is noted. Sulphate-enriched fluvial waters draining upstream outcrops of uplifted Mississippian Windsor Group salt would not likely have produced the acidic pore waters necessary to produce the early diagenetic suite that is identified. Instead it is proposed that, during burial, the strata acted as an aquifer-aquatard system. Sulphate-rich waters were derived from an aquifer system below the coal seam. Sulphate reduction, producing the various forms of pyrite, occurred during basin-wide dewatering along aquifers confined below the impermeable shale and mudstone aquatard above the coal.