COAL FACIES AND PALAEOENVIRONMENTS OF THE MIDDLE EOCENE TO EARLY OLIGOCENE BOWMANS AND LOCHIEL DEPOSITS, NORTHERN ST. VINCENT BASIN, SOUTH AUSTRALIA

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ABSTRACT

The Middle Eocene to Early Oligocene Bowmans and Lochiel Coal Deposits of the northern St. Vincent Basin, South Australia, have been studied to elucidate their depositional environments. These coals occur within predominantly fluvio-lacustrine transgressive system tract sequences that formed during the initial phase of basin infill.

Eight genetically distinct, mostly vitrinite-dominated coal types were recognised and four facies were defined in line with varying levels of biomechanical degradation and changes in precursor organic matter. Facies I coals form thick, commonly wood-rich piles and are characterised by high terrestrial lipinitic contents, low gelification, elevated concentrations of gymnosperm and angiosperm biomarkers, and a quartziferous mineralogy. Primarily autochthonous accumulation in mixed angiosperm-gymnosperm forest swamps is inferred. Facies II coals tend to be laterally extensive and are distinguished by low wood contents with abundant groundmass telovitrinite, high tissue preservation, a mixed terrestrial-aquatic lipinitic assemblage, low levels of plant-derived terpenoids and a kaolinitic mineralogy. Autochthonous accumulation under elevated groundwater conditions from water-tolerant species in subaquatic marshlands is postulated. Facies III coals are highly gelified, have relatively low terrestrial terpenoid contents, exhibit some saprolitic characteristics and contain abundant mineral matter. Typically thin with limited lateral consistency, these coals are products of the accumulation of fine allochthonous and aquatic organic matter in an open water environment. Facies IV coals have an erratic distribution and comprise physically altered, friable and macrinite-dominated lithotypes. They are interpreted to be products of weathering and peat combustion, respectively.

The aforementioned facies are unevenly distributed and their stratigraphic succession highlights evolutionary changes in local palaeoenvironments. Within individual seams the transition from subaquatic to topogenous forest swamps and ultimately ombrogenous conditions is most common. However, over the coal sequence as a whole, conditions evolved from exclusively terrestrial through mixed terrestrial and subaquatic to open water. Also detected were multiple rapid reversals of the water table, especially higher in the sequence, and cyclic patterns reflecting a brief basal subaquatic phase prior to the onset of sustained terrestrial conditions. These patterns suggest a fluctuating, although progressively rising, water table and, and a balance between accommodation and accumulation.

Peat in the Lochiel Deposit accumulated within a restricted fault-bound sub-basin strongly influenced by local tectonics and a fluctuating hydrological regime, resulting in diverse, well-banded coals, a relatively fixed depocentre, and a well-defined facies succession. In contrast, xix
extensive peat accumulation within inter-channel floodplain settings is interpreted for the Bownans Deposit. Here more stable groundwater conditions and astro-sedimentological mechanisms controlled the peat characteristics, giving rise to low facies diversity, a weakly developed facies succession, and variable seam thickness and extent. Assorted marine indicators suggest a slightly more distal setting for the Lochiel Deposit.