The Drumheller Coal Zone, Lower Horseshoe Canyon Formation: Sedimentology and Sequence Stratigraphic Analysis for Coal Bed Methane (CBM) Exploration

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ABSTRACT

Renewed government interest in the coal-bed methane (CBM) potential of Alberta has led to geologic studies in targeted areas of the Plains and Foothill regions of Alberta. One of the favourable targets is the Drumheller Coal Zone (Lower Horseshoe Canyon Formation) of south central Alberta that has large reserves of coal present at an attractive (relatively shallow) depth. Detailed sedimentological and sequence stratigraphic analysis was done on continuous outcrop exposures of the Drumheller Coal Zone, and associated sediments, in the Willow Creek and Red Deer River valleys, along with subsurface analysis and correlation of 111 coal and oil/gas well logs. Much of this work used a multidisciplinary approach involving facies analysis of outcrops, well-log analysis and correlation, regional mapping, as well as comparisons with modern analogues.

Three major parasequences are recognized: A) a fluvial-estuarine sequence with tidal floodplains, coals and associated channel fills; B) a consistent, and laterally persistent, coarsening-upward estuarine sequence capped by a uniform coal seam; and, C) a fluvial-deltaic coastal plain succession, with multistory channel successions, wide fluvial floodplains and coals. The boundaries between the different stratigraphic parasequences are, in general, smooth and gradational. The exception is the contact between parasequences B and C, which is abrupt and shows marked changes across the boundary in facies associations and interpreted paleoenvironments.

The base of the fluvial-estuarine Parasequence A is interpreted to be associated with a maximum marine flooding event, followed by successive marine flooding events that become less extensive towards the northwest. The laterally persistent coarsening-upwards Parasequence B is thought to be a result of abundant sediment supply coupled with rapid fluvial progradation into the basin. Regional outcrop-subsurface correlation shows that this progradational event correlates with the Dorothy shoreline sands. Parasequence C, with its dominant fluvial character and coals, has a reduced marine influence.
The spatial distribution of the different parasequences fits a model, originally proposed by Shepheard and Hills (1970), of a depositional platform for the Horseshoe Canyon deltaic system within a marine-continental transition zone.

The regional correlation of the different coal seams within individual parasequences (i.e. not cross-cutting parasequence boundaries), and the number and distribution of coals is directly related to the origin of the facies tracts preserved within the different parasequences.

The present study shows that when a sequence stratigraphic analysis is tied to detailed facies and paleogeographic reconstructions, this provides a realistic framework for deciphering the 3-D architecture of individual coal seams within the Drumheller Coal Zone. Such a framework is useful for characterization of the coal-bed methane potential of the Alberta Plains.