Sediment stacking patterns in coal measure sequences: examples from the Permian Bowen Basin

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Data compiled from some 32,000 coal exploration bore hole records were used to demonstrate the inter-relationship between the distribution patterns of thick coal seams, their splitting patterns and thick interburden relative to depositional environment, basement structure and fluctuating base levels (ACARP Supermodel 2000 Project). Four major coal 'superseams' occur within a southerly thinning terrestrial clastic wedge that can be correlated along a 250 km subcrop of the Moranbah and German Creek Coal Measures on the western limb of the Bowen Basin, Queensland. Seams split and merge along strike, but areas of thick, >10 m merged seams in the northern alluvial environment tend to occur over areas of stable basement domains interpreted from regional gravity.

In the alluvial palaeo-environments, splitting is complex and lateral variation in interburden thickness is high. Split traces form sinuous and arcuate patterns reflecting their origins from meandering channels and lobate overbank splays. Sandstone depositional style in the fluvial environment is commonly a composite of accretionary splays and channel-fills that range from 1 m to 55 m or more thick and up to 3 km wide; some with mapped lengths in excess of 15 km and oriented north-south. Locally, thick sandstone packages filled accommodation space created by progressive differential compaction of underlying peat layers. Successive clastic packages predominantly display an offset-stacking pattern both laterally and up stratigraphic section. Vertical stacking of thick (>40 m) multi-storied sandstone bodies is more isolated but occurs in locations that are underlain by sequences characterised by the thickest coal seams. Verticals stacking of thinner sandstones and thinner coals also occurs and is interpreted as tectonically controlled subsidence off the margins of stable basement platforms.

In the paralic palaeo-environments average coal seam thickness reduces to <5 m with less complex splitting and more constant interburden thicknesses. Split traces form relatively straight, northeast trending lines paralleling the palaeo-shoreline. Interburden distribution patterns consistently show long, straight, NE-trending belts of multi-storey, amalgamated sandstone units that stack and 'on lap' progressively up section. Thicker (>20 m), but narrow (<1 km) and sinuous distributary channels occur that can bifurcate around finer grained interbedded siltstones or traverse lobate amalgamated sandstone mouth bars. The seaward margin of these sandstones are often reworked by longshore drift into cleaner, more quartzose sandstone bars that trend southwest. Sediments accommodated within the inter-burdens show clear pattern of successive interburden units stacking toward the north and northeast in response to punctuated sea level transgressions culminating with the deposition of the marine derived Macmillan Formation.

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