



## The Geological record of environmental change

*Utah: Spring Canyon- sediment partitioning*

### Voice Over

In a few places lagunal sediments deposited behind a barrier island can be seen, as here at Spring Canyon, five kilometres to the west of Gentile Wash.

### John Howell

This coal and the overlying strata sit directly on top of a marine shoreface, and lie about 5 kilometres up dip from the shoreface parasequence that we walked through in Gentile Wash. I've come to this section to have a look at the non-marine expression of those shoreface parasequences, and we're in a broadly time equivalent package of sediment. What we see above the coal are a series of poorly exposed unbioturbated mudstones, and these pass up into a series of fairly well-bedded sandstones, and the beds dip at a very gentle angle towards the north-west. If we look closer up at the beds, we see that they are intensely current ripples, and I've just taken a paleocurrent reading, and the paleocurrents are going broadly towards the north-west. We interpret the succession of strata to be washover deposits deposited behind a barrier island system. To understand how a barrier island system such as this, and a pro-relational shoreface succession could be broadly time equivalent, we need to consider a dynamic model for parasequence evolution.

### Voice Over

To explain how in one place a shallowing up parasequence developed, but in another a time equivalent barrier and lagoon system occurred, let's consider what happened as the balance between relative sea level rise and sediment supply changes. When the sediment supply is greater than sea level rise, sediment is supplied to the shoreline by rivers, and spread along the coast by wave processes. The shoreline progrades because there is more sediment supplied than there is space available to accommodate it. When sea level rises at a greater rate than the rate of sediment supply, the shoreline changes from a land-attached beach to a barrier island lagoon system. The barrier system migrates in a landward direction because sediment is eroded on the seaward side of the barrier island, and deposited in a lagoon as washover or tidal deposits by a process of rollover. Nothing is left on the seaward side except for an erosional surface. Meanwhile a wedge of accommodation space has been created behind the barrier islands. This space is filled by fluvial and lagunal sediments. Eventually, once the rate of sea level rise slows, the lagoon fills with sediment. Once it is full, sediment is bypassed through the coastal plain to the shoreline, and a new parasequence starts to prograde. This sequence of events shows that the locus of deposition shifts according to the balance between rates of sea level rise and sediment supply. When sediment supply dominates, sediment bypasses the coastal plain and causes progradation of the foreshore and shoreface sediments. When rising sea level dominates, deposition takes place behind the barrier system that retreats backwards. This shift in the locus of deposition through time is called sediment partitioning. Another way of illustrating sediment partitioning is to examine the development of a parasequence through a number of time intervals.

During time intervals one, two and three, sea level rise dominates so that barrier island, lagoon and coastal plain sediments are deposited, but there is virtually no deposition offshore. As the rate of sediment supply starts to dominate, sediment bypasses the former areas of deposition and the shoreline progrades. When sea level rise dominates again, another barrier island, lagoon, coastal plain system develops. Let's recap how the location of areas of deposition and non-deposition change during the development of a parasequence.

Whilst the barrier island is migrating landward, accommodation is created in the coastal plain and fluvial sediments are deposited. At the same time little or nothing is deposited in the marine portion of the system, so a condensed section develops. When sediment supply dominates, the shoreface starts to prograde. All of the sediment bypasses the coastal plain and is now supplied to the marine system. Coal may continue to form in the coastal plain at this time. The system progrades until the next sea level rise creates space in the coastal plain and turns the shoreface into a barrier island again.