



The Geological record of environmental change

Utah: Incision surfaces at Woodside Canyon

Voice Over

So far we have looked at evidence indicating rises in relative sea level. The key indicators are parasequences and flooding surfaces. Now let's examine the nature of surfaces across which relative sea level fell, starting at Woodside Canyon. Inside Woodside Canyon a large channelised unit incises into one of the parasequences. This incision surface can be traced around the canyon and defines a valley system over 3 kilometres wide. The white sandstone at the top of the shoreface has been eroded away. This could be due to a distributory channel as we saw in the panther or it may be related to relative sea level fall. To determine which of these is the case John will take a closer look at the facies that occur beneath and above the incision surface by climbing this alcove inside the canyon. He starts here at the flooding surface in the basinal setting we saw earlier, where hummocky cross-stratified lower shoreface sands are overlaying by offshore silts and shales.

John Howell

Above the offshore shales we quickly pass into these thin hummocky cross-stratified beds and we're into the offshore transition zone. These thicken upwards and fairly quickly we get into a series of amalgamated hummocky beds of a second lower shoreface. The interval from the flooding surface to here represents the start of the progradation of another parasequence. As we move up through these amalgamated hummocks of the lower part of the shoreface we come across this surface here. Above this surface we see a sharp change to medium-grained cross-stratified sandstones. This could be interpreted as a transition into the upper part of the shoreface, just as we saw at Gentile Wash. However, there is a lack of marine bioturbation and the sediments are slightly less well sorted and slightly coarser-grained. I'm now going to show you why the succession that starts here and goes up to the next 25 metres is not the upper part of shoreface, I'm going to show you what the significance of this surface actually is.

Above the trough cross-stratified sandstones we saw just down there we see a series of inter-bedded sandstones and mudstones, with generally larger scale cross-stratification. If we look up close at this cross-stratification we see these laminae here are actually draped by carbonaceous material which goes all the way down the front of the facet. We see similar things up here and some of this is actually wave ripple, but again the key operation is the drapes. We interpret this inter-bedded sand and mud package as tidal in origin, and that's significantly different from any of the shoreface material we've seen before.

If we move up the section we see that this package of tidal strata is overlaying by a thin about 50 centimetres mudstone interval. The muds we see in this are dark grey in colour and black any bioturbation. That's a significant contrast to the offshore mudstones we saw previously. Also within this interval a key piece of evidence is the presence of a very carbonaceous shale which is verging on being a coal.

This array of facies which we see from the trough cross-bedded sands into the tidal bar forms and the unbioturbated mudstones and the coals, we interpret to be the fill of an estuary. The incision surface we saw previously matches with the surface we saw down there. We are in the fill of an estuarine valley cut during sea level full, and this is significantly more complicated than the simple distributory channel we saw in the panther.

Looking across at the other side of the alcove we can see a broader view of the facies we've been just looking at in detail. The interval we're interested in goes from this incision surface we see cutting down here, to the base of the large, blocky sandstone above us. That interval is about 25 metres thick and we can see that it's comprised of a series of dipping inter-bedded sandstones and siltstones. There's about three or four separate packages which each comprise a unit of these dipping surfaces, and these surfaces are lateral accretion surfaces; they're deposited on the inside of a meandering tidal channel. The fact that we see three or four of them indicates that we see three or four stacked tidal channels. We're now going to go and have a look at the top of our valley fill succession and we're going to see what the nature of the overlying surface is.

At the top of our succession we see another interval of unbioturbated blue-grey mudstone. This tells us that our environment was fairly hostile to marine life and we're still in the estuary. Further evidence for this comes from the large scour surfaces we see here in these sandy facies and the presence of current wave ripples. Passing up we see a sandy mudstone above us that's intensely bioturbated. We can see a whole series of burrows in here, large, sand-filled, and typically unlined. Above this unit we see a blocky sandstone and we can just about make out some broad hummocky cross-stratification. These sandstones are deposited in an open marine environment in the lower part of the shoreface in all to get through about 15 or 20 metres. They sit directly on our estuarine mudstones and that tells us that again this is a flooding surface, and there's a rising sea level of about 15 or 20 metres, so this is a flooding surface, this is our valley fill and this represents the transition back to open marine conditions. The parasequence behind us can be seen to pass up to the white beach sandstones just behind me. The burrows we see here are of particular interest and very significant. The fact that they are relatively large, unlined, and filled with sand that's actually fallen down from the interval above, tells us that these muds underwent a series of compaction and partial lithification prior to the organism burrowing into the interval. This type of surface we call a glossy funghetti surface.

So if we sum up what we've seen, we can see that we walked up through the lower part of a shoreface, and then we passed very quickly into a series of fluvial sandstones. Those fluvial sandstones are overlain by a series of stacked laterally accreting tidal barforms, and after about 25 metres of such a succession the thing passed back into open marine conditions. We interpret this to be an incised valley cut during sea level fall and filled as an estuary during the subsequent sea level rise.