



The Geological record of environmental change

Utah: 'The Panther tongue'

Caption: Prof. Steve Flint, Earth Sciences, Liverpool

John has presented a model for the development of parasequences in wave dominated delta systems, and these form the majority of the Book Cliff stratigraphy. Now, as we look at the Helper Face, if we come down to the lowermost sandstone body, that's called the 'panther tongue' and even from here we can see some different characteristics in that unit. First of all, we see some low angle surfaces that dip through the body; and secondly, we can demonstrate that this unit thins out to shale, so that's different to what we've seen in the wave dominated systems, and I'm going to go and investigate those differences further.

Voice Over

Steve is heading north to look in more detail at the panther tongue, which is exposed by Highway 6, near the entrance to Gentile Wash.

Steve Flint

Well from this distance we can see that the base of the unit is a series of sandstones and siltstones, thinly-bedded, so that's rather similar. As we go up the succession the siltstone percentage decreases; the sandstones become more amalgamated and it does therefore show a coarsening upward trend; that's similar. The top of it, at least from here, appears to be flat, and we'd suspect a parasequence boundary, so that fits as well. The final check is to look at the details of the sedimentary structures to see if they are similar or different. We can now examine the sedimentary structures in order to interpret process and compare that with the wave dominated delta parasequences that we saw earlier. The bedding here is parallel and we see sandstones of 20-30 centimetres, interbedded with siltstones and fine-grain sandstones, so that's somewhat similar to the Gentile Wash section. However there are some crucial differences. These sandstones contain only this parallel lamination, they don't contain the hummocky cross-stratification that we saw develop so strongly in the wave dominated deltas. So there are some similarities, some differences. From the sedimentary structures we would interpret the dominant process here as being one of deposition from unidirectional currents, rather than storm waves, so that's the difference. The characteristics that are similar though indicate that this probably was developed as a parasequence, but the processes are somewhat different. We'd interpret the environment as that then of a river-dominated delta, rather than a wave-dominated delta. We know that river-dominated deltas tend to exhibit more complex lateral geometries than lateral changes in facieses. The good thing about the Book Cliff section is the exposures allow us to investigate that three-dimensional variability in the geometry of the delta. I've been tracing the panther tongue for five kilometres along canyon walls in a depositional strike orientation to the position behind me. When we look over at the panther we see very similar characteristics to Gentile Wash: thin-bedded at the base, thicker-bedded at the top so a coarsening upwards succession capped by a marine-flowing surface forming the parasequence boundary. We'll continue tracing the unit around through this side canyon to this position in front of me here, and here's a perfect exposure with which to characterise that thick-bedded upper unit. We see that the 15 metre upper section of the panther is now rather massive bedded, a sharp break and then the lower unit behind the trees is the thin-bedded panther that we saw before. Now John's standing on the upper panther parasequence boundary and I'm going to ask him to describe some of the details he sees up there. Hello John, can you hear me?

John Howell

Yes, I can hear you, Steve.

Steve Flint

Can you give me some indication as to the characteristics of that surface; I'm seeing it as a parasequence bandwidth from down here.

John Howell

Apparently bandwidth, I would agree with your interpretation there but I would say that, you know, in a similar way to the other parasequence band as we've seen it, it's flat, and very laterally extensive.

Steve Flint

OK, now the unit that you're standing on looks different to the panther we've seen before. I wonder if there's any way you can give me some of the detailed character of that unit?

John Howell

I think I can probably manage something like that.

OK Steve, well the upper bit is certainly very different. It's massive, it contains some feint, soft sediment deformation, it's about fine to medium grained.

Steve Flint

OK, do you see any of the panther features that we saw at Gentile Wash, like the trough cross-bedding, the upper-face plain bedding, and the marine biturbation – over?

John Howell

There's some evidence of the marine biturbation but a lot less, and most of the sedimentary structures, certainly all of the bedding we saw, is pretty much missing from where I am.

Steve Flint

From here, as you come down, it seems rather similar for another few metres until you get to an overhang, and that looks like an important surface.

John Howell

This surface here.

Steve Flint

That's the one, right where your feet are.

John Howell

OK, I'll check that out.

OK, well this surface represents a transition from the massive and the faintly clay-laminated stuff that we saw above into the sort of 10-20 centimetre scale bedded material we saw in the panther back at the Gentile Wash section.

Steve Flint

Well, if I link that observation with the larger scale geometry of the surface that I'm seeing, it suggests to me that it must be an erosive surface and the unit above looks like it might be some sort of channel deposit.

John Howell

I'd say this was an incision surface at the base of a big channelised unit.

Steve Flint

So, to wrap up on the panther tongue, we've developed several lines of evidence: the detailed process interpretations of Gentile Wash suggest a deposition from unidirectional currents; mapping of the panther tongue around these canyons shows us a series of seaward-dipping clinaforms, and an overall low-bay geometry. All of this is consistent with being a river-dominated delta. However, here we've seen an additional feature; we've seen a major erosion surface, and that erosion surface was overlain by a major massive sandstone body. So although there's increased lateral variability in these river-dominated deltas, they're capped by parasequence boundaries and therefore we can apply parasequence concepts to river-dominated systems as well as wave-dominated systems.