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Understanding the morphodynamics of sediment waves in ancient deepwater CLTZs: are we missing something (super)critical?

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Sediment waves in modern deepwater channel-lobe transition zones are common geomorphological features, however they have not been widely identified at outcrop. Consequently, their process record and depositional architecture are poorly constrained. Several locations from an exhumed Permian fine-grained base-of-slope system (Unit B, Karoo Basin, South Africa) show exceptional preservation of distinctive lenticular sand-prone bedforms of which the architecture and facies characteristics are presented in detail. Due to their dimensions (0.5-3.5m thick, 20-100m long) and wave-like morphology, they are classified as sediment waves. The palaeogeographic location of both outcrops, and the lack of confining surfaces, support a channel-lobe transition zone setting.

Lenticular bedforms show clear steep (10-25°) sigmoidal internal truncation surfaces, which are unequally spaced (20-100m), dominantly upstream-facing, and always overlain by banded sandstone facies. The absence of bed splitting and recurring facies trends supports significant spatio-temporal energy fluctuations during a single flow, resulting in upstream bedform accretion. The limited evidence of reworking suggests a primary depositional control on the development of sediment wave morphology and their architecture indicates individual sediment wave beds accrete upstream, in which each swell initiates individually. These depositional processes do not correspond with known bedform development under supercritical conditions. Lateral switching of the flow core is invoked to explain the complex architecture and facies distributions.

The depositional architecture of these deep-water sediment waves highlights the importance of understanding the process response to the dynamic erosional and depositional relief present in channel-lobe transition zones, and that complicated bedform architectures can be produced from subcritical temporal flow fluctuations downstream of hydraulic jump arrays.