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The Stratigraphic Record of Large Scour-fills: An Outcrop Example of Seismic-scale Cyclic Steps?

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Channel-lobe transition zones are commonly observed at base-of-slope settings in submarine systems. From modern seabed datasets these areas contain a distinctive assemblage of erosional and depositional bedforms, which are related to sediment gravity flows passing from confined to unconfined conditions. One of these features are cyclic steps, which show the upstream migration of sediment waves and are related to hydraulic jumps that occur on the lee side of a bedform and re-acceleration on the stoss-side. It remains challenging to find these features in outcrop due to their long wavelength.

In a base-of-slope setting in Fan 3 of the Skoorsteenberg Formation, Tanqua depocentre, Karoo Basin, the fill of an erosion surface (1-1.5km long, 15-20 m deep) with clear downstream asymmetry is studied in detail. The sedimentary infill of this feature consists of basal interbedded sandstone and siltstone, while the main infill is medium-bedded, climbing-ripple dominated sandstones. This main infill consists of a distinct upstream stacking of beds and bedsets (backsets) separated by multiple internal m-scale erosion surfaces. This is in marked contrast to the facies and architecture of typical channel-fills in the same stratigraphic unit.

The feature is here interpreted as a scour-fill, with the architecture of the fill being the result of knickpoint migration at the upstream margin and backfilling on the downstream margin. A very similar erosional feature, located $\sim$1.8km downstream of the well-studied example, suggests that they share the same depositional history. The development of a composite basal erosion surface could explain their extensive km-scale downstream size. In this case the scour system did not result in the inception of a channel system. Instead the infill suggests an aggradational stage following a sediment bypass stage. The described case study shows a rare example of the preservation of large-scale upstream migrating scour features, here interpreted as cyclic steps, and provides an important insight into their facies and internal architecture.