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The effects of differential compaction on shelf-edge trajectories and clinothem geometries

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Clinothems document the progradation of sedimentary strata. Their geometries allow us to define shelf-edge trajectories, which are widely used to infer temporal and spatial variations in relative sea-level, depositional environments, basinward sediment transfer, and paleobathymetric configurations. Typically, shelf-edge trajectory analysis is conducted on deeply buried successions, in which the primary stratigraphic architecture is modified by sediment compaction. Here, we present a novel clinothem reconstruction approach that applies decompaction while accounting explicitly for down-dip lithology variations. We show that preferential compaction of fine-grained foresets and bottomsets results in a basinward rotation of trajectories. In some cases, shelf-edge trajectories change from rising, normal regressive trajectories to apparently falling, forced regressive trajectories after compaction, leading to an erroneous sequence-stratigraphic interpretations and incorrect predictions for the timing and volume of sediment transfer to deep water. Furthermore, differential compaction steepens and vertically extends clinothems during burial, an observation in direct contrast to decompaction methods not accounting for dip-orientated lithology variations.