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How to link modern and ancient barrier island systems: Dimensional comparisons and updated sedimentary facies models

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Existing depositional and facies models for ancient barrier island systems are primarily based on modern observations. This approach overlooks processes tied to geologic time scales, such as multi-directional motion, erosion, and reworking, and their resulting expressions in preserved strata. We have investigated these and other challenges of linking modern and ancient barrier islands through outcrop studies and through data compilation from the rock record compared to modern barrier island dimensions. Results emphasize key depositional and preservation processes, and the dimensional differences between deposits formed over geologic versus modern time scales. For example, when comparing deposits from individual barrier islands, thickness measurement comparisons between modern and ancient examples do not vary systematically, suggesting that local accommodation and reworking dictate barrier island thickness preservation. A complementary outcrop study focusing on paralic strata from the Upper Cretaceous Straight Cliffs Formation in southern Utah (USA) is used to update models for barrier island motion and preservation to include geologic time-scale processes. Barrier island deposits are described using four facies associations (FA): backbarrier fill (FA1), lower and upper shoreface (FA2), proximal upper shoreface (FA3), and tidal channel facies (FA4). Three main architectural elements (barrier island shorefaces, shoreface-dominated inlet fill, and channel-dominated inlet fill) occur independently or in combination to create stacked barrier island deposits. Barrier island shorefaces record progradation, while shoreface-dominated inlet fill records lateral migration, and channel-dominated inlet fill records aggradation within the tidal inlet. Barrier islands are bound by lagoons or estuaries and are distinguished from other shoreface deposits by their internal facies and outcrop geometry, association with backbarrier facies, and position within transgressive successions. Tidal processes, in particular, tidal inlet migration and reworking of the upper shoreface, also distinguish barrier island successions. In sum, these datasets demonstrate that improved depositional and facies models must consider multidirectional island motion, ravinement, erosion, inlet migration, and reworking when describing processes and predicting barrier island dimensions.