More References on Sediment transport, erosion and shedding in carbonate settings

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ABSTRACT: University Waddell Field, in northeast Crane County, West Texas, has yielded more than 19.5 million barrels of oil from Lower Devonian Thirtyone Formation deep water cherts and siliceous limestones. Oil production is on the decline, and current recovery represents only 30 percent of the original oil-in-place. The low recovery efficiency, despite 50 years of primary and secondary recovery (gas injection, waterflood) and a partially-completed 20-acre infill well pattern, chiefly reflects reservoir heterogeneity induced by complex facies relationships in a basinal turbidite channel/levee complex and submarine fan depositional setting. Analysis and interpretation of core and log data from University Waddell field permits subdivision of the approximately 900 ft thick Lower Devonian reservoir interval into four regionally mappable stratigraphic units that define three large-scale (>100 ft thick) distal-to-proximal successions. Major field production is from porous cherts and siliceous limestones in the lowermost sequence. Reservoir bodies are composed of silt-size to fine-grained, siliceous skeletal packstones/grainstones derived from the platform margin/slope and transported up to 50 mi basinward by turbidity currents. These porous, relatively well-sorted facies represent episodic, high-energy deposition in turbidite channel/levee to proximal submarine fan complexes. Mapping of individual facies bodies indicates lobate to channel-form geometries that generally trend north to northwest, parallel with the regional depositional axis. Reservoir facies grade laterally and are interbedded with nonporous facies that represent slow accumulation of mud-rich sediments in an overbank and distal submarine fan setting and background hemipelagic sedimentation. Although fault-induced compartmentalization occurs in updip Thirtyone Formation reservoirs, the role of faults and fractures is poorly defined for University Waddell Field. The complex anticlinal structure in the southern portion of the field requires 3-D seismic data to adequately resolve. Significant (50-100 ft vertical offset) normal and reverse faults are recognized from log correlation, although the current well spacing precludes mapping of these steeply dipping fault planes. Although open fractures are common in core, existing data are inadequate to determine their spacing and orientation. High-resolution resistivity image logs from future wells are essential for evaluating the influence of fractures on reservoir behavior. An estimated 17 million barrels of remaining mobile oil make this reservoir a significant target for enhanced recovery efforts. The highly heterogeneous facies-induced reservoir architecture accounts for many of the production anomalies, poor communication between injection wells and flanking producers, and undrained reservoir regions due to inadequate production completions and inefficient waterflood sweep. To access part of this remaining oil, nearly 40 recompletion opportunities were defined in existing production and injection wells. Five geologically targeted infill drilling locations were defined, the most favorable site coincides with an undrilled structural high.

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ABSTRACT: Fluxes of biogenic carbonates moving out of the euphotic zone and into deeper undersaturated waters of the North Pacific were estimated with free-drifting sediment traps. Short- duration (1 to 1.5 day) sampling at 100-2200 m points to a major involvement in the oceanic carbonate system by aragonitic pteropods. Pteropod fluxes through the base of the zone are almost large enough to balance the alkalinity budget for the Pacific Ocean. Dissolution experiments with freshly collected materials show that low pteropod abundance in long-duration collections results from dissolution subsequent to collection. Short-duration sampling showed significant increases in the ratio of calcitic foraminifera to aragonitic pteropods in undersaturated waters, indicating that calcite was preserved relative to aragonite. Approximately 90% of the aragonite flux is remineralized in the upper 2.2 km of the water column.-C.N.

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ABSTRACT: Karst morphology appears early, even during carbonate sediment deposition. Examples from modern to 125-ka-old sub-, inter- and supratidal sediments are given from the Bahamas (Atlantic Ocean) and from Tuamotuan atolls (southeastern Pacific Ocean), with mineralogical and hydrological analyses. Karstification is favoured by the aragonitic composition of bioclasts coming from the shallow marine bio-factory.

Lithification by aragonite cements appears as a rim around carbonate deposits and dissolution and non-cementation start at the same time on modern supratidal deposits (Andros micrite or atoll coral rudite) and provoke the formation of a central depression on small or large carbonate platforms. In fact, this early solution of the centre of platforms is closely related to the location of each of the studied examples on hurricane tracks. High-energy events, such as hurricanes and tsunamis, affect sediment transport but hurricanes also affect diagenesis as a result of the enormous volume of freshwater carried and discharged along their paths. This couple, lithification-solution, is localised at sea level and accompanies sea-level fluctuations along the eustatic curve. Because of the precise location of hurricane action all around the Earth, early karstification by aragonite solution, cementation and supratidal carbonate sediment accumulations (high-energy trails) act together on all the platforms and atolls located inside the Tropics (23 degrees 27') between roughly 5 degrees -10 degrees and 25 degrees on both hemispheres. However, early karstification acts alone on shallow carbonate platforms including atolls along the equatorial belt between 5 degrees -10 degrees N and 5 degrees -10 degrees S. These early steps of karstification are linked to the ocean-atmosphere interface due to the bathymetrical position of shallow carbonate platforms, including atolls. They lead to complex karstified emerged platforms, called high carbonate islands, where carbonate diagenesis, together with the development of bauxite- and/or a phosphate-rich cover and phreatic lens, will occur.

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ABSTRACT: This overview on event deposits is based on (1) a brief summary on denudation rates in regions of various relief and climate as derived from the suspended and bed loads of rivers, (2) the fractions of sand and mud present in the fills of various basins, and (3) the mechanisms controlling sediment remobilization. In continental settings, size and frequency of event deposits (debris flows on alluvial fans, avalanching on fan deltas and overbanking on floodplains) directly reflect erosional processes in the source areas and the ratio of denudation area/accumulation area. In marine environments, both sediment supply and the change in near-shore accommodation space largely control the nature of stratigraphic sequences. Under conditions of high sediment supply and low-frequency sea-level changes, the thick systems tracts tend to show only minor differences in the presence of event deposits, including tempestites. With decreasing sediment supply, event deposits are increasingly concentrated in the lowstand systems tract. As shown by a number of models (with differential subsidence or uplift of the basin margin), rapid relative sea-level fall accentuates both coastal and submarine sediment remobilization (rich in sand), particularly during the early lowstand phase, as well as delayed valley incision. The resulting submarine fans tend to be sand-dominated, whereas large fans fed by major rivers are dominated by turbidite muds. In regions of coastal uplift, valley incision persists longer than the lowstand period, and sea-level changes may cause "pulses of uplift" and phases of punctuated cliff erosion. Along carbonate buildups, lowstands of third-order or higher frequency sea-level changes are often recorded by coarse skeletal debris and megabreccias and/or, in the case of mixed systems, by siliciclastic turbidites. In rapidly closing foreland basins, high-frequency sea-level cycles only tend to affect both the proximal and distal basin margins, whereas third-order sea-level changes have a limited potential to directly control depositional sequences and event deposits close to the overthrust front. With high sediment supply, individual event deposits (such as debris flows, sandy and calcareous tempestites and turbidites) mostly form at intervals of tens to hundreds up to some thousands of years. Longer recurrence intervals occur in settings with low sediment supply or characterize very large mass flows and megaturbidites.

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ABSTRACT: This study develops a currents of removal methodology to examine and quantify the nature of physical transport processes affecting the formation of bioclastic deposits in the Cocos (Keeling) Islands, an Indian Ocean atoll. This approach is based on the hydraulic settling and threshold of entrainment characteristics of bioclastic deposits and measured current energy. Potential mobility (PM) analysis of 157 samples quantifies the proportion of deposits able to be transported in each geomorphic zone. Results show that under mean energy conditions wave-induced currents entrain and transport sediment within the atoll and show that transport of sediment is not solely reliant on storm energy conditions. Gradients of PM values are used to reconstruct sediment transport pathways from the reef flat (85-100% PM), through shallow passages (75-100% PM) to sand aprons (50-75% PM) and shallow (0-20% PM) and deep lagoon (0% PM). Comparison of settling velocity distributions of bed material and sediment retained in sediment trap experiments show that actual mobility levels correspond with PM estimates. Potential mobility analysis also identifies the immobile portions of deposits which increase lagoonward. Constituent analysis of immobile fractions and analysis of settling frequency distributions are used to differentiate the importance of physical and biological processes in the formation of deposits throughout Cocos and identify the role of each geomorphic zone in the transport system. The pattern of sediment is controlled by physical processes between the reef flat, the primary sediment production zone, with sediment transported through the shallow passage conduits to the sand aprons. The formation of shallow and deep lagoon deposits is controlled by autochthonous sediment production and storm deposition. Potential mobility analysis is a powerful tool enabling physical transport processes within bioclastic sedimentary environments to be quantified. The ability to examine an individual deposit's hydraulic behaviour and development also enables depositional processes to be examined at a much finer resolution than previously attempted using conventional textural approaches.

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ABSTRACT: The open-ocean carbonate slope N of Little Bahama Bank consists of a relatively steep (4o) upper slope at water depths of 200-900 m, and a more gentle (1-2o) lower slope at depths of 900-1300 + m. The upper slope is dissected by numerous, small, submarine canyons (50-150 m in relief) that act as a line source for the downslope transport of coarse-grained carbonate debris. The lower slope is devoid of any well-defined canyons but does contain numerous, small (1-5 m) hummocks of uncertain origin and numerous, large (5-40 m), patchily distributed, ahermatypic coral mounds. Sediments along the upper slope have prograded seawards during the Cainozoic as a slope-front-fill seismic facies of fine-grained peri-platform ooze. Surface sediments show lateral gradation of both grain size and carbonate mineralogy, with the fine fraction derived largely from the adjacent shallow-water platform. Where unlithified, sediments are heavily bioturbated and are locally undergoing dolomitization. Upper slope sediments are also 'conditioned' eustatically, resulting in vertical, cyclic sequences of diagenetically unstable (aragonite and magnesian calcite-rich) and stable (calcite-rich) carbonates that may explain the well-bedded nature of ancient peri-platform ooze sequences. Lower slope sediments have prograded seaward during the

Cainozoic as a chaotic-fill seismic facies of coarse-grained carbonate turbidites and debris flow deposits with subordinate amounts of peri-platform ooze. Coarse clasts are 'internally' derived from fine-grained upper slope sediments via incipient cementation, submarine sliding and the generation of sediment gravity flows. Gravity flows bypass the upper slope via a multitude of canyons and are deposited along the lower slope as a wedge-shaped apron of debris, parallel to the adjacent shelf edge, consisting of a complex spatial arrangement of localized turbidites and debris flow deposits. A carbonate apron model offers an alternative to the fan model for palaeoenvironmental analysis of ancient, open-ocean carbonate slope sequences. -A.W.H.

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