Recent References on the Origin and Distribution of Peloids

Aalto, K. R. and Dill, R. F., 1996, Late Pleistocene stratigraphy of a carbonate platform margin, Exumas, Bahamas in Sedimentary Geology, v. 103, p. 129-143.

AB: Detailed field studies of the southern Exuma Cays on the eastern margin of the Great Bahama Bank show a complex history of late Pleistocene island construction. Pleistocene rocks include island core eolianites, overlain at island margins by fossil patch reefs and reef sands, which in turn are overlain by, and/or grade laterally into, talus breccia cones derived from the erosion of island core eolianite at paleo-seacliffs situated at approximately 5-6 m above present mean high tide. Laminated pedogenic calcrete widely caps Pleistocene rocks. Minor zones of penetrative subsurface calcretization, developed in association with root growth, occur along permeable horizons, including: contacts between talus units or crossbed sets, along tension joints, and (possibly) at the Pleistocene reef-eolianite contact. Among Pleistocene eolianite samples studied in thin-section, the relative proportions of ooids-intraclasts+grapestones-skeletal grains-peloids are approximately 48:39:6:7. Marginal to the Exuma Sound and on the Brigantine Cays, a greater proportion of ooids have peloidal nuclei and cortices with numerous laminae, which may reflect ooid derivation from shelf margin and broad platform interior regions that were characterized by high wave energy during ooid formation. Between these two areas, ooids are more commonly superficial and have cortices with few laminae and nuclei composed of subrounded micrite or pelmicrite intraclasts. Such ooid nuclei are most likely derived from storm erosion of partially cemented seafloor muds. Some skeletal-rich eolianite in this region may reflect local sediment input from platform margin reefs, or may be part of an older(?) stratigraphic unit.

Brennan, S. T., 1996, Heterogeneities of a low permeability exhumed petroleum reservoir, El Abra Formation, Sierra el Abra, NE Mexico in: American Association of Petroleum Geologists 1996 annual convention, p. 18.

AB: Characterization of heterogeneities in low permeability petroleum reservoirs is typically problematic, mostly due to the lack of research on three dimensional reservoir analogs. In the Sierra el Abra of northeastern Mexico there is an exhumed petroleum reservoir exposing Mid-Cretaceous Abra Limestone. This unit is the reservoir for the famous Golden Lane fields of Northeast Mexico. This study focused on three-dimensional exposures in one quarry of the Sierra el Abra, allowing analysis of a stratigraphic thickness of fifty meters differentially oil stained restricted platform limestone. Preliminary petrograph observations of fluid inclusions indicate that clear UV-fluorescent petroleum, brown non-fluorescent petroleum and gas condensate were present in the reservoir. The fluid inclusion observations coupled with the pervasive staining in outcrop indicate that the reservoir was once charged with petroleum. Based on permeability analyses, permeability is virtually non-existent (less than 0.001 millidarcy) for all units of the shoaling upward packages which constitute the reservoir. However, porosity analyses indicate that there is stratigraphic control on the heterogeneity of the reservoir system. Within the shoaling upward packages, the

peloidal phases have the highest porosities. Based on field observations, the peloid rich units had the darkest oil staining of all units within the quarry. Therefore, microporosity within the peloids was the major conduit for the charging of this reservoir. This exposed reservoir analog provides relevant data for the recognition of heterogeneities within reservoirs as well as understanding of low permeability reservoirs and their production potential.

Cairns, D. J., 1990, Sedimentologic and diagenetic evolution of an ooid-grapestone shoal complex within the Caicos Bank interior, Turks and Caicos islands, British West Indies, [Master's thesis]: University of Calgary. Calgary, AB, Canada, 198p.

AB: Holocene carbonate sediments, recovered in vibracores from an ooid - grapestone shoal complex within the interior of the Calcos Bank, comprise a shallowing-upward sequence that coarsens upwards, rests disconformably on Pleistocene bedrock and is capped locally by a subaerial exposure surface. Nine Holocene facies are recognized and have been grouped into four facies associations. Penecontemporaneous cementation of Holocene sediment has produced cemented layers and patches at the surface and in the subsurface. Three types of cemented zones are recognized: (1) subsurface-cemented layers and patches within buried sediment usually associated with burrows, root tubules and encrusting worm tubes; (2) beachrock exposed on the surface of emergent shoals; and (3) submarine-cemented patches on shoal margins in association with modern sponge colonies. Pleistocene coated grainstones were deposited and cemented within agitated marine shoals during an interglacial sea level highstand. Subsequent subaerial exposure of these rocks during a glacial sea level lowstand fostered; neomorphism of phreatic aragonite cement to low-magnesian calcite, erosion, leaching and the development of a caliche crust. Flooding of the Caicos Bank, following a gradual relative rise in sea level, initiated Holocene sedimentation and burial of bed rock with the deposition of the carbonate mud and peloid facies associations. The carbonate mud facies association was deposited within a semi-restricted, shallow water, low energy bank interior or lagoon environment protected to the south by a shoal complex. A low energy, stabilized normal marine subtidal bank interior environment influenced by low sedimentation rates is proposed for the peloid facies association. Vertical aggradation, favourable cross-bank circulation patterns and antecedent topography combined to promote conditions favourable to shoal development and deposition of the overlying oolitic facies association. Well sorted polished ooids and moderately sorted micritized pellets, peloids and dull unpolished ooids were deposited on shoal crests and within tidal channels separating shoals respectively. Subtidal marine hardground development in burrowed Thalassia grass stabilized inter-shoal and shoal flank areas, formed discontinuous patches and laterally extensive subsurface-cemented layers. Multiple occurrences of subsurface-cemented layers and patches are common at or near facies boundaries in the peloid and oolitic facies associations. Submarine hardground development may be the result of relatively longer time available for pore fluid migration and cement precipitation in stabilized environments dominated by low rates of sedimentation. Grapestone grains, produced within an expansive subtidal sediment source area located to the east of the shoal complex, were piled during storms at the eastern end of the study area where they were reworked, sorted and transported westward by longshore currents along shoal crests. Deposition of the grapestone facies association in this manner promoted further shallowing, subaerial exposure, shoal coalescence and lateral growth of the shoal complex. Widespread formation of beachrock near shoal crests was facilitated by precipitation of acicular aragonite cement from sea water by evaporation and CO (sub 2) degassing in the intertidal zone. Subaerial exposure of beachrock in supratidal settings promoted dissolution of metastable aragonite cement and precipitation of low-magnesian calcite in the vadose zone. Hardground development during deposition of this unit was constrained by relatively rapid rates of sediment accumulation. Discontinuous spicule-rich submarine-cemented patches are presently forming within the lagoon north of the shoal complex in response to the binding activity of living sponges. These submarine-cemented patches grow and coalesce as a result of the accretion of encrusting floral and faunal assemblages.

Chafetz, H. S., 1986, Marine peloids; a product of bacterially induced precipitation of calcite, Journal of Sedimentary Petrology, v. 56, p. 812-817

Coniglio, M. and N. P. James, Algal origin of peloids, peloidal intraclasts, and structure grumeleuse in Paleozoic Limestones; evidence from Cow Head Group, western Newfoundland in: 1984 AAPG annual convention, AAPG Bulletin v. 68; p. 464-465.

Conti, E. P., 1987, The evolution of a carbonate bank in the Caicos Islands, British West Indies, [Master's thesis]: Duke University. Durham, NC, United States, 185p.

AB: Mangrove Cay is a Holocene carbonate bank consisting of intensely bioturbated peloidal grainstone and packstone sediment partially overlain by intertidal to supratidal peat and mud. Approximately one half of the bank is an intertidal shoal barren of vegetation. The shoal is characterized by mounds of sediment expelled from burrows of the ghost shrimp Callianassa and a seaward fringe of the coralline red alga Goniolithon. Bank sediment is dominated by hardened cryptocrystalline peloids and oolitically coated peloids. The origin of the peloids was determined by evaluating the extent of microboring in various grain types. Using this approach, the peloids were interpreted to be derived primarily from fecal pellets. This is further supported by the presence of a large population of pellet producing organisms within Mangrove Cay sediment. Since fecal pellets are formed from the aggregation of mud by organisms, mud has dominated sediment input to the bank. Mangrove Cay has evolved through a complex interaction of sea level fluctuations, sediment transport by tide and storm generated currents,and sediment trapping, binding, and production by organisms indigenous to the bank. Late Pleistocene sea level oscillations resulted in an irregular topograph of lithified dune ridges and channels along the northern margin of the Caicos Platform. Tide and wind driven currents initiated by Holocene flooding of the platform flowed off the leeward margin of the platform in the vicinity of Mangrove Cay. Fine grained sediment carried by these currents during and immediately following storms accumulated in the lee of the emergent, Pleistocene dune ridge which forms the "backbone" of Mangrove Cay. A seaward barrier created by beach ridge accretion on adjacent dune ridges enhanced tidal current flow around Mangrove Cay and promoted colonization by Goniolithon.

Further restriction of the bank interior owing to the wave and current bafflng and sediment binding abilities of the algae allowed establishment of red mangroves and eventual development of a mangrove swamp. An organic-rich supratidal cap is expected to form over the entire bank sequence of grainstone and packstone. Comparison with other modern carbonate banks and analysis of regional geomorphology suggest that Mangrove Cay may be one of .

Eren, M., 1998, Origin of peloids in Pennsylvanian Atoka carbonates, Eddy County, New Mexico. Giornale di Geologia. 60, Serie 3A; Istituto di Geologia e Paleontologia. Bologna, Italy p. 197-204.

AB: Peloids in Atoka Pennsylvanian carbonates are dominant in the bank margin facies which characterizes the seaward margins of the algal banks and relatively high energy environment. These peloids are moderate to well sorted, spherical to elliptical shaped small micritic grains having average sizes of 60-120 mu m. The peloids are commonly surrounded by more crystalline cement rims made of former Mg-calcite. SEM analysis reveals that peloids are composed of equal size calcite crystals with 4-10 mu m sizes. Atoka peloids were initially precipitated within bacterial clumps. Later on, most or some peloids were removed from their original places and trapped in open-space areas of algal grainstone and boundstone or in laminated layers and geopetal textures as bottom infillings. Finally, the peloids were subjected to a paramorphic recrystallization.

Everts-Arnout, J. W., and Reijmer, J. G., 1995, Clinoform composition and margin geometries of a Lower Cretaceous carbonate platform (Vercors, SE France) in Palaeogeography, Palaeoclimatology, Palaeoecology, v. 119, p. 19-33.

AB: The concept of sequence-stratigraphy uses the stratal geometries at the margins of carbonate platforms to define depositional sequences and systems tracts. The aim of this study was to research if prograding, purely aggrading and retrograding phases of a Cretaceous carbonate platform showed differences in the composition and facies type of the slope sediments. The Vercors Plateau in SE France provides excellent outcrops to study this relationship. Continuous exposure of the platform-to-basin transition allowed direct examination of the margin geometries. Five successions were measured and sampled in great detail. Samples were thin-sectioned and point-counted, using point-count groups characterizing palaeoenvironments along the platform-to-basin transect. The composition logs as well as the numerical analysis of the point-count data, both show a clear relationship between grain composition and stratal geometry. The prograding and purely aggrading intervals are similar in composition, as they are both relatively coarse grained, and enriched in platform biota and limeclasts. Retreating units are relatively fine grained and rich in basinal grains (small benthic foraminifers, sponge spicules), non-carbonate grains and embedding material. These observations suggest that the retreating intervals represent incipient drownings of the platform. However, rather than distinctly separated groups the different phases of platform development form a continuous range of variation between high platform input and high basinal input. Compared to the prograding units the purely aggrading intervals are relatively rich in peloids, which may be suggestive of relatively low-energy conditions on the platform during aggradation. The compositional analysis also revealed significant variation in the frequency of ooids, but these variations showed no relationship with the progradation, aggradation or retreat of the platform.

Jimenez, M.J., Molina, J. M., Nieto, F., Nieto L., Ruiz-Ortiz, P. A., 1998, Glauconite and phosphate peloids in Mesozoic carbonate sediments (eastern Subbetic Zone, Betic Cordilleras, SE Spain), Clay Minerals, v. 33, p. 547-559.

AB: Glauconite and Ca phosphate peloids occur in Jurassic and Cretaceous bioclastic carbonate rocks from pelagic swell sequences of the Algayat-Crevillente Unit (Subbetic Zone). The size and morphology of the peloids are controlled by the bioclasts. The glauconite in both stratigraphic positions is K rich (>0.69 atoms p.f.u.) and shows well-defined 10 Aa lattice fringes. Poorly crystalline areas with a composition of Fe-smectite are found within the peloids, indicating the nature of the glauconitic precursor. This precursor would be formed in the shielded microenvironments of the bioclast and later transformed to glauconite by equilibration of peloids with sea water that culminated with the crystallization of a phosphatic phase. The greater presence of smectite areas in the Jurassic peloids and the lower K contents (0.69-0.81) of these glauconites, compared with the Cretaceous glauconites (0.81-0.89) can be explained by the calcitic early diagenetic cementation which stopped the process of glauconitization.

Macintyre, I. G., 1983, Submarine cements; the peloidal question in: AAPG annual convention with divisions, AAPG Bulletin v. 67, p.508.

Marshall, J. F., 1983, Submarine cementation in a high-energy platform reef; One Tree Reef, southern Great Barrier Reef in Journal of Sedimentary Petrology, v. 53; p. 1133-1149

AB: Three major framework facies (algal pavement, coral heads, and branching corals) show varying degrees of cementation. The widest distribution and greatest variety of submarine cements occur within those facies or subfacies that have extensive encrustation by coralline algae; these are found beneath the windward margin and within the patch reef drilled. Both Mg calcite and aragonite cements exhibit diverse fabrics and textures. Mg calcite in the dominant cement and is present as both an interskeletal and intraskeletal infill, whereas aragonite cement is exclusively intraskeletal. Interskeletal cements are only developed within those facies capable of trapping significant quantities of fine-grained internal sediment. Lithified crusts, with either a laminated or columnar morphology, are a prominent cavity infill within many of the reef framework facies. Organic influence during formation. Peloids, which are the major component of the lithified crusts as well as many other cavity infillings, are a particular form of Mg calcite micrite and have nucleated within the interstitial waters of the reef. Microcrystalline rim cements around the peloids have often cemented them into a coherent mass that resembles detrital lime mudstones.--Modified journal abstract.

Moraes, M. F. B., Rodriguez, M, R, Rodrigues, J. J. G., Duraes, E., 1998, Stratigraphy and reservoir characteristics of the Albian limestones in Santos Basin, Brazil in: AAPG international conference and exhibition, AAPG Bulletin v. 82, p. 1945-

AB: The Albian carbonates of Santos basin exceed 1,000m in thickness. Three tectono-sedimentary episodes were recognized in this carbonate package: a) the lowermost one overlies conformably the Aptian evaporites, defining a very gentle ramp; b) the intermediate one is strongly influenced by the halokinesis; c) in the last episode, less affected by salt movement, a broad shallow carbonate shelf was established. The first episode is seismically characterized by parallel reflectors, as a result of a weak salt movement and strong thermal subsidence. The depositional morphology is interpreted as a low energy gentle ramp, represented dominantly by fine-grained limestones. The intermediate episode, is characterized by truncations and onlaps related to the morphology generated by halokinesis. A progressive shallowing is marked by the passage from deep-water facies at the base to oncolitic/oolitic facies at the top. In the last episode, an agradational pattern was established, and a broad shallow carbonate shelf was installed. Seismically, this episode is characterized by more continuous and high amplitudes reflections. The depositional pattern is the typical shoaling-upward cycles, composed at the base by peloidal-oncolitic wackestones/packstones and at the top by high energy grainstones, formed by ooids and associated oncolites and peloids. These cycles reflect sea-level oscillations driven by climatic changes. As a result of a regional deep burial (more than 4,500m), the fine-grained and the mud-bearing rocks were strongly compacted (physical and chemical compaction), resulting in very tight rocks. On the other hand, the grainstones/packstones, because of their strength, were less compacted with part of their original porosity preserved; modification on their original permo-porosity features were dictated mostly by the meteoric diagenesis. At present, four Albian carbonate zones were recognized in the Santos basin. Stratigraphically these zones show lateral continuity and a high vertical compartmentalization. The reservoirs are formed by the higher energy facies, at the upper part of shoaling-upward cycles. The reservoirs are formed by oolitic/oncolitic grainstones and associated packstones, with a minor amount of peloids. Their quality depends largely on the diagenetic history. The upper zone was submitted to an intense meteoric activity, which obliterated the original intergranular porosity through grain dissolution and generation of micropores, resulting in a porous but poorly permeable reservoir (less than 1mD). In the other zones, the meteoric diagenesis are much less dramatic, which allowed the preservation of intergranular porosity, producing a domain of macropores, with high permeability values (up to 1,000mD). The general seismic attributes of the Albian carbonates allow the recognition and mapping of the porous reservoirs through seismic velocity and amplitude maps.

Peryt, T.(ed.), 1983, Coated Grains, Springer-Verlag, Berlin,655p.

Sneh, A., Friedman, G. M., 1984, Spit complexes along the eastern coast of the Gulf of Suez in Sedimentary Geology, v. 39; Pages 211-226.

AB: North to South longshore transport of well-sorted ooids in the northern part of the Gulf of Suez and of well-sorted quartz-feldspar particles, peloids and ooids in the southern part, results in the build up of hook-shaped spits. These spits protect coastal lagoons which become a trap for terrigenous mud. First seasonally flooded sabkhas are formed, and eventually true supratidal sabkhas develop. Contemporaneously, spits are further developed seaward at the rate of several tens of meters during an active season.

Sun, S. Q., Wright, V. P., 1989, Peloidal fabrics in Upper Jurassic reefal limestones, Weald Basin, southern England, Sedimentary Geology, v. 65, p. 165-181.

Valladares, A. S., del-Rey, D. B., Castro, J. A., 1998, Carbonate reservoir rocks from the Bahamas continental margin in: AAPG international conference and exhibition; abstracts, AAPG Bulletin, v. 82, p. 1977.

AB: Carbonate reservoirs have porosity formed in low to moderate energy environment with episodic high-energy environment close to platform reaching turbulent stage in slope areas. Porosity is intramicritic occluded by mudstone with peloids or mosaic of idotopic and xenotopic dolomite in shallow water (Jurassic, Lower Cretaceous) or occluded by micrite in deep waters. Reef derived rocks have biomicritic and intrabiomicritic porosity. This porosity was not occluded but was affected by recrystallization. Some diagenetic processes worsened porosity. The main processes are calcite deposition in basinal and slope rocks and dolomitization in platforms. Less important processes are related to deposition of gypsum, anhydrite, barite, pyrite and spatic calcite. Compaction affected porosity twice: once during the deposition in the original basin and the second during tectonic stacking by thrusting. At 2700 m a break of porosity is observed in all sequences. The diagenetic processes that enhance porosity are mainly fracturing and recrystallization. Bellow porosity break fracturing creates reservoir, which are related to productive horizons. Paleokarst and leaching, since the eogenesis, also affected a large volume of rocks. Idiotopic dolomitization improves intercrystalline porosity. The classification of reservoirs considers sedimentation environment and diagenetic processes. We divided carbonate section in three periods. The reservoir characteristics in each period are: Oxfordian, Kimmerigdian. The paleobasin had no more than 100 m water depth. Because of compaction and low fracturing a part of this section have no reservoir horizons. On the other hand, Lower Kimmergdian carbonates have several reservoir horizons thanks to intense fracturing and karst. This is a productive section in Boca de Jaruco oil field. Tithonian, Neocomian. The basin at this moment had two main environments carbonate platform and deep-water basin. Carbonate platform sediments presents porosity in dolomite and carbonates. In some levels porosity was destroyed by intense dolomitization. Different types of rocks represent slope sediments, which have variable porosity. In bathyal sediments reservoirs are due to the fracturing and karst with high values of porosity and permeability. This is the productive section in Varadero, Boca de Jaruco, and Puerto Escondido oil fields, as well as the new discovery Cupey. Aptian, Maestrichtian. The paleobasin at this time is similar to the previous except the breakdown of the platform. The sediments in the channels are mainly bathyal represented by deepwater carbonates and marls. This section is seal prone because of the low level of fracturing. Platform sediments are less dolomitized emerging reefal bodies with high porosity. Slope sediments improve reservoir characteristic toward Upper Cretaceous. Basinal carbonate section of this period still has several reservoir levels due to fracturing and leaching. This section produces in several oil fields.

Vera, J. A., Molina, J. M., 1998, Shallowing-upward cycles in pelagic troughs (Upper Jurassic, Subbetic, southern Spain) in Sedimentary Geology v. 119, p. 103-121

AB: Abundant calcareous tempestites with chert and hummocky cross-stratification (HCS) occur in Upper Jurassic successions (Milanos Formation) of the Subbetic (Betic Cordillera, southern Spain). These calcareous tempestite beds are calcisiltites and very fine calcarenites with peloids and bioclasts, and have thicknesses between 25 and 75 cm. Beds show symmetrical wave ripple lamination near the top, and are usually capped with wave ripples. According to palaeogeographic reconstructions, these strata were deposited in a subsiding trough in the pelagic domain of the Southern Iberian Continental Margin, which was the northwestern-most border of the Tethys. Calcisiltite and calcarenite beds deposited in this pelagic trough form small-scale to large-scale shallowing-upward cycles. Shallowing-upward cycles with calcareous tempestites in the lower part and oolitic limestone beds in the upper part, have also been recognized in some sectors of the Subbetic pelagic basin. The large-scale cycle occurs in the upper part of the Jarropa Radiolarite Formation, which directly underlies upper Oxfordian, Kimmeridgian and Tithonian strata of the Milanos Formation. Two types of large-scale shallowing-upward cycles have been recognized, according to the presence or absence of thick units of oolitic limestone with large-scale cross-stratification. The water depth during deposition ranged from below, but near, storm wave base at the base of the large-scale cycles to very shallow carbonate platform at the top.