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Reconciliation of Measurement Differences Observed from Seismic, Well Logs, and VSP

The reconciliation of measurement differences between seismic and well-log derived data is a critical issue in exploration. Both data sets contain "apparent ground truth" information, but neither is free from errors. Because well logs can be considered as in-situ measurements and seismics are considered as surface sensing measurements, the major physical differences between the two are: (1) the volume of rocks the data represent, and (2) the presence of wave propagation effects for the seismic method.

The conventional method of reconciliation is through the use of the synthetic seismogram. The geophysicist simulates the seismic signature of the given earth model defined by sonic and density logs, and attempts to match the synthetic with the seismic trace. In practice, the character and travel-time of the events from the seismic trace usually do not match those from synthetic seismograms. In addition to the physical differences between the measurements, the mismatch can be attributed to: (1) one-dimensional model used to generate the synthetic seismogram, (2) use of an approximate solution to the wave equations in synthetic seismogram calculation, and (3) inability to simulate seismic processing effects in the synthetic seismogram generation.

Some of the reconciliation methods show that (1) free surface multiples and interbed multiples remaining on seismic data can be identified by using VSP-processed data; (2) observations that seismic times are longer than integrated sonic times are reconciled by determining and comprehending multiples, Q, and dispersion factors; and (3) full waveform offset-dependent modeling is essential to comprehend and understand VSP, seismic, and integrated sonic-log derived differences.

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Continental Shelf Sediment Transport, Northeastern South Carolina

Analysis of 128 bottom grab samples, fathometer traces, and published bathymetric charts imply that active sediment transport affecting bottom sediment texture, composition, and bathymetric features is limited to within 4.5 km of the shore along the coast between Myrtle Beach and Georgetown, South Carolina. Five sedimentary provinces were differentiated using a combination of sediment particle size distribution, quartz sand shape analysis, percent carbonate, water depth, and ocean bottom topography. Throughout the area, bottom deposits clearly show a logical facies relation to geomorphic features. Most of the bottom features and sediments appear to be Pleistocene deposits provided by the ancestral Pee Dee River.

The area of active sediment transport and deposition has higher percentages of silt, carbonate, and uniform fine-sand size. No relation is seen between these sediments and the ancestral Pee Dee River. The inner-shelf Pleistocene features retain both their physiographic expression and sediment types and are different from present nearshore deposits. It is concluded that sparse bottom sediment transport is currently taking place on the inner continental shelf beyond 4.5 km from shore in the area studied.

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Porosity Evolution in Salem Limestone (Mississippian) of South-Central Indiana

The Salem Limestone (Valmeyeran) is represented in Monroe and northern Lawrence Counties, Indiana, by a complex assemblage of bioclastic packstone-grainstones capped by dolomitic rocks. Modal analysis indicates intervals where porosity exceeds 20%. However, the evolution of this porosity is not well documented. Optical and cathodoluminescence petrography reveal primary porosity in coarse echinoderm-bryozoan and diverse-fauna grainstones. In the porous zones, cement occurs as (1) fibrous to sparry cement filling intragranular areas (foraminifer chambers and fenestrate bryozoan zooecia), (2) isopachous crusts on the exterior of polycrystalline and coated grains, (3) syntaxial rims on uncoated echinoderm grains, and (4) rudimentary syntaxial cement on "bald spots" where grain coats have been spalled by compaction. Porosity in analagous bioclastic grainstones composed of uncoated echinoderm fragments is thoroughly occluded with syntaxial cement.

Cathodoluminescence reveals that rudimentary cement under spalled grain coats postdates the earliest cements on uncoated grains. From oldest to youngest, luminescence zonation for well-developed syntaxial rims progresses from nonluminescent, through dully luminescent, through brightly luminescent, to dully luminescent. The rudimentary syntaxial cement under spalled coats is commonly brightly luminescent.

Tightly cemented, fine-grained, bioclastic packstone-grainstones overlie these porous intervals, apparently serving as aquacludes that prevented more thorough cementation. Secondary porosity also is common in the Salem Limestone and occurs as gastropod molds, vugs, and solution-enlarged fractures.

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Depositional Facies Mosaics and Their Time Lines in Lower Ordovician Carbonates of Central Appalachians

A comparative sedimentology and facies stratigraphy study of the Lower Ordovician carbonate of the central Appalachians (Beekmantown Group and equivalents) has been carried out. Our approach used subfacies (rock record of subenvironments) as the basic units of section measurement. We differentiated related sets of subfacies into larger facies units (rock record of environments). Facies were then correlated from section to section using fossils and lithostratigraphy to make a 3-dimensional facies mosaic. Within this mosaic, time lines were constructed using onlap-offlap tongues and cyclic sequences. These time lines cut across facies boundaries. Using this approach, we have established that the lower 600 m of the Lower Ordovician carbonate sequence is made up of 4 main facies: (1) cyclic laminite facies composed of a package of shoaling-upward shelf lagoon-peritidal cycles, (2) thin-bedded grainstone facies deposited in a shelf lagoon, (3) *Renalcis* bioherm facies recording a shelf lagoon patch-reef environment, and (4) *Epiphyton* bioherm facies recording a shelf-edge reef system. The distribution of these facies along time lines across the strike of the central Appalachians is markedly zoned. *Epiphyton* bioherm facies dominate the eastern margin while cyclic laminite facies dominate the western margin, with thin-bedded grainstone and *Renalcis* bioherm facies making up the central belt. This zonation of facies is a typical shallow carbonate shelf system with fringing reefs along the eastern, seaward margin and tidal flats along the western, landward margin. Vertical distribution of these facies across strike records 3 major sea level changes during deposition of the lower 600 m of this extensive Lower Ordovician carbonate shelf.

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Mesozoic (Early Cretaceous) Radiolarians from Northwest Atlantic, DSDP Hole 534A

Lower Cretaceous to Middle Jurassic (Albian to Callovian) deep-sea sediments recovered from DSDP Hole 534A (28°20.6′N, 75°22.8′W, water depth 4,976 m) in the Blake-Bahama basin represent the oldest oceanic sediments in the northwestern Atlantic Ocean. The presence of radiolarians was recognized by shipboard scientists from cores 46-127 at subbottom depths 950-1,635 m.

The occurrence of radiolarians (all of Early Cretaceous age) was actually limited to the sediments of Blake Bahara Formation, cores 51, and 69 through 82. Judging from the faunal composition, core 51 apparently belongs to the *Eucyrtis tenuis* Zone of Barremian age, whereas cores 69 through 82 are probably assignable to the *Sethocapsa trachyostraca* Zone of Valanginian age. Similar radiolarian assemblages have been reported from the submarine deposits of several North Pacific DSDP sites as well as outcrop sections from Japan, suggesting a wide geographic distribution of co-eval marine sediments.

The majority of radiolarian specimens observed during the investigation had their siliceous skeletons replaced by pyrite, which indicates the reducing condition of sediments during the initial diagenesis of the organic remains.