shoal grades laterally into black, thin-bedded (8 to 12 cycles per meter), carbonate mudstone.

Part of the length of the boundary between the *Immanitas* bed and the overlying volcaniclastic rocks has been intruded by diorite. This intrusion resulted in the neomorphism of even the mudstone fillings in the rudists to coarse-grained equant calcite. For this reason, the extent of packstone versus grainstone is difficult to ascertain.

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Energy Dissipation over Salt Marsh and Its Effect on Estuarine Sediment Transport and Tidal Dynamics

Sand transport in a salt marsh estuary near Sapelo Island, Georgia, is in a net seaward direction. Bed forms migrate seaward at rates that vary with both their wave height and the tidal amplitude, and they maintain an ebb orientation through both the ebb and flood portions of the tidal cycle. Analysis of the energy flux through the estuary delineates the close interrelation between sand transport and hydrodynamics. The average rate of tidal-energy dissipation over the entire estuary–salt marsh system was determined from the difference in energy flux at the seaward and headward ends of the estuary. Estimates of the energy-dissipation rate within the estuary proper were obtained from measurements of bottom shear stress recorded at intervals over a tidal cycle. Comparison of these energy-dissipation rates indicates that the rate of energy loss in the total estuary–salt marsh system is several orders of magnitude larger than within the estuary proper. Most of the tidal energy loss is due to frictional dissipation around the *Spartina* grass in the marsh.

An important result of this is the "storage" of water at high tide in the marsh creating a large phase lag in the ebb flow between the headward and seaward ends of the estuary. The resulting large ebb-water slope (pressure gradient) induces ebb currents and bottom frictional forces which dominate over the flood phase. This result is directly reflected in the ebb-dominated bed-form geometry and sand transport.

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North Sea Exploration

The North Sea covers parts of the intracratonic Northwest European basin. Exploration efforts in onshore parts of this basin peaked in the 1950s and 1960s and resulted in the proving of ultimate recoverable reserves of 2.4×10^9 bbl of oil and 110 Tcf of gas.

Exploration in the North Sea began in the early 1960s. Ultimate technically recoverable reserves in established offshore accumulations are estimated to amount to 24×10^9 bbl of oil and 90 Tcf of gas.

The gas province of the southern North Sea forms a direct extension of the onshore Permian gas play. Onshore oil plays do not extend into the offshore.

The prolific oil and gas province of the central and northern North Sea is closely tied to the Mesozoic North Sea rift. Reservoirs range in age from Devonian to early Tertiary. Upper Jurassic kerogenous shales are the principal source rocks; in large parts of the Viking and Central grabens the source shales reached maturity during the Tertiary by which time the North Sea rift had become inactive and was replaced by regional subsidence which led to the development of the Cenozoic North Sea basin.

Most of the hydrocarbon reserves in the Viking and Central grabens is contained in structural traps. High reserve concentrations in relatively small areas are related to the availability of abundant, mature source rocks, the blanket development of reservoirs, and the close spacing of trap-providing structures. Many of the known oil accumulations are contained in overpressured reservoirs. Long-range migration is apparently of little significance in the oil habitat of the North Sea.