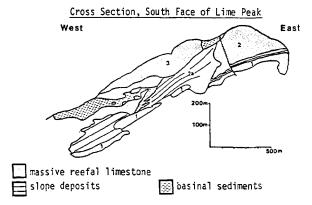
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Lime Peak—An Upper Triassic Reef Complex in Yukon

Upper Triassic carbonates in the Whitehorse trough, Yukon, are lenticular bodies surrounded by Triassic graywacke and volcanic-clast conglomerate derived from an arc to the west. The carbonates at Lime Peak are unusually well exposed. They show multiple stages of reef growth and a complete facies zonation from massive reefal limestone to offlapping slope and basin.

The massive reefal limestones have variable lithology from peloidal mudstones to organic framestones containing spongiomorphs, tabulozoans, and calcareous sponges, with lesser contributions from corals, brachiopods, mollusks, algae, and echinoderms.



Slope deposits are alternations of thick beds of reef-derived debris with thinner beds containing attached spongiomorphs, thick-shelled pelecypods, large gastropods, and corals which colonized the debris beds.

Basinal sediments include thin-bedded limestones and shales consisting of muddy layers rich in sponge spicules and organic matter and graded packstones containing thin-shelled bivalves and skeletal debris.

The stages of growth were (1) initial development of lensoid masses each about 25 m thick (1 on sketch), (2) growth of a much larger reefal mass about 150 m thick (2 on sketch) which shed an apron of debris to the west (2a on sketch), and (3) development of a second thick buildup (3 on sketch) on the underlying forereef debris (2a) as the whole system prograded to the west.

The Lime Peak reef complex is not typical of other Triassic buildups in North America which are generally low-relief, thin accumulations (less than 10 m thick) dominated by corals and spongiomorphs. The buildups at Lime Peak are much thicker, and tabuloazons and sponges are more important builders than corals.

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Sedimentologic and Stratigraphic Interpretation of Sand Bodies in a Tidal Embayment

A depositional model for intertidal sand bodies indicative of tidal embayments was developed from 20 vibracores and 25 can cores taken at St. Helena Sound, South Carolina. This V-shaped embayment located 35 km south of Charleston, South Carolina, has a tidal range of 2.0 to 2.8 m.

The intertidal shoals are formed and reworked by opposing tidal currents. Ebb currents usually exceed 100 cm/sec in the deep adjacent channels and produce the long linear features on the

shoals. Flood currents rarely exceed 75 cm/sec and are dominant across the broad seaward sand flats.

The range of sedimentary features gradually changes from a dominance of physical sedimentary structures on the exposed seaward sand flats to a dominance of biogenic sedimentary structures on the protected sand flats. The distribution of each feature is controlled by their relative position on the sand flats to maximum wave energy. Where biogenic sedimentary structures are abundant, protection from wave energy is afforded by the shoal crest. Laterally the shoals grade into ebb channels or lower subtidal mixed sand and mud flats.

The shoals display a coarsening-upward sequence of wavybedded to flaser-bedded clays and sands overlain by clean wellsorted, cross-bedded to burrowed sands. The sands are composed of fine to very fine subangular quartz grains.

The depositional history of the intertidal sand bodies indicates a vertical buildup of sediments and subsequent lateral accretion. Subtidal sand bodies were first deposited on preexisting bay-fill muds. With a decline in sea-level rise, an increase in vertical deposition occurred, producing incipient intertidal bars. As the bars became fully emergent, increasing wave energy and tidal currents reworked the shoals into their present shape. Continued sand deposition occurred as lateral accretion and infilled adjacent channels.

The shoals are up to 10 m thick and cover an area of 1 to 4 km<sup>2</sup>. They extend 3 to 5 km seaward and are as much as 1 to 2 km in width. Because most of the shoals are subtidal to intertidal, preservation potential is high. As the embayment fills, prograding salt marshes will eventually cap the sand bodies.

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Niobrara Formation (Upper Cretaceous), Eastern North Dakota

The Niobrara Formation (Upper Cretaceous) has recently gained attention as a shallow, low-permeability reservoir for natural gas. Understanding its distribution and the conditions under which it was deposited will contribute to its evaluation as a source of hydrocarbons in this region.

On the basis of outcrop sections and cores in northeastern North Dakota, the Niobrara Formation is approximately 64 m thick and can be divided into two subequal units. The lower 31-m unit is medium dark gray and medium olive-gray, laminated calcareous shale with "white specks" (fecal pellets), comminuted fish remains, *Lingula*, and thin fine-grained sand stringers near the base. The upper 33-m unit is light-gray to light olive-gray, shaly chalk containing abundant "white specks", with a thin (5 m) very light gray, bioturbated chalk at its base. Sediments are bioturbated at the top of the lower unit and the base of the upper unit.

The main controls of sediment character are rates of calcareous plankton productivity and aerobic versus anaerobic bottom conditions. The Niobrara represents, from bottom to top, the following sequence of environments: (1) low productivity anaerobic conditions; (2) low productivity aerobic conditions; (3) high productivity aerobic conditions; and (4) high productivity anaerobic conditions

Over the eastern half of North Dakota, the Niobrara ranges in thickness from less than 17 m to greater than 75 m. Alternating thinning and thickening bands trend northwest-southeast and suggest structural control of deposition.

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