AAPG HEDBERG CONFERENCE
"MICROBIAL CARBONATE RESERVOIR CHARACTERIZATION"
JUNE 4-8, 2012 – HOUSTON, TEXAS

Microbialite Bioherms in Great Salt Lake, Utah: Influence of Active Tectonics and Anthropogenic Effects

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Stromatolites and other morphologies of microbialite bioherms constitute some of the earliest evidence of life on Earth and were significant carbonate platform builders throughout most of the Precambrian. New geophysical and geological evidence from Great Salt Lake, Utah (GSL) reveals the world's largest living extent of microbial bioherms as well as tectonic and anthropogenic influences on an otherwise naturally-occurring population. A rock-filled causeway constructed across the lake during the late 1950's subdivided the GSL and the benthic stromatolite population, providing an ideal locale to examine environmental and anthropogenic controls on stromatolite distribution and survivability within a mid-latitude shallow marine environment. These controls may provide insight into understanding ancient stromatolite morphologies and assess whether these observed morphologies are related to evolution of the microorganisms or changing environmental conditions. We observe a variety of stromatolite morphologies in the GSL from giant ramified columnar forms (tens of meters in diameter and height) to smaller benthic forms (meters in diameter and height) (Figure 1) to widespread biofilms. While the larger columnar forms seem to be limited to a specific area of the lake, the benthic forms are pervasive in the shallower waters and appear to be controlled by depth-related factors such as light penetration and/or wave-base energy.

In the north part of GSL, where the salinity is at or near saturation, widespread die-off of stromatolites suggests that environmental conditions have exceeded the tolerance range of stromatolites and similar biogenic carbonates. In contrast, lower salinities in the southern part allow for continued stromatolite growth. High salinity in the south arm (15 – 18% salinity) likely promotes maintenance of stromatolite growth and limits competition.

The influence of tectonic controls on microbialite distribution throughout GSL is evidenced by the abrupt occurrence of stromatolites in areas of structural microtopographic highs. The relation between structural microtopographic highs associated with microbialite bioherms and corresponding onlapping sediments trapped in hanging wall lows is repeated in many of the surveyed transects and likely occurs throughout the lake. Some stromatolite growth appears very recent, occurring after Pleistocene Lake Bonneville, whereas in other areas, large ramified columnar stromatolites appear long-lived and keep pace with sediment accumulation. Results from this investigation place important constraints on the range of salinities and associated environmental conditions for microbial life in early Earth history and provide a field-scale analogue for recent discoveries of Cretaceous microbial carbonates in the South Atlantic.

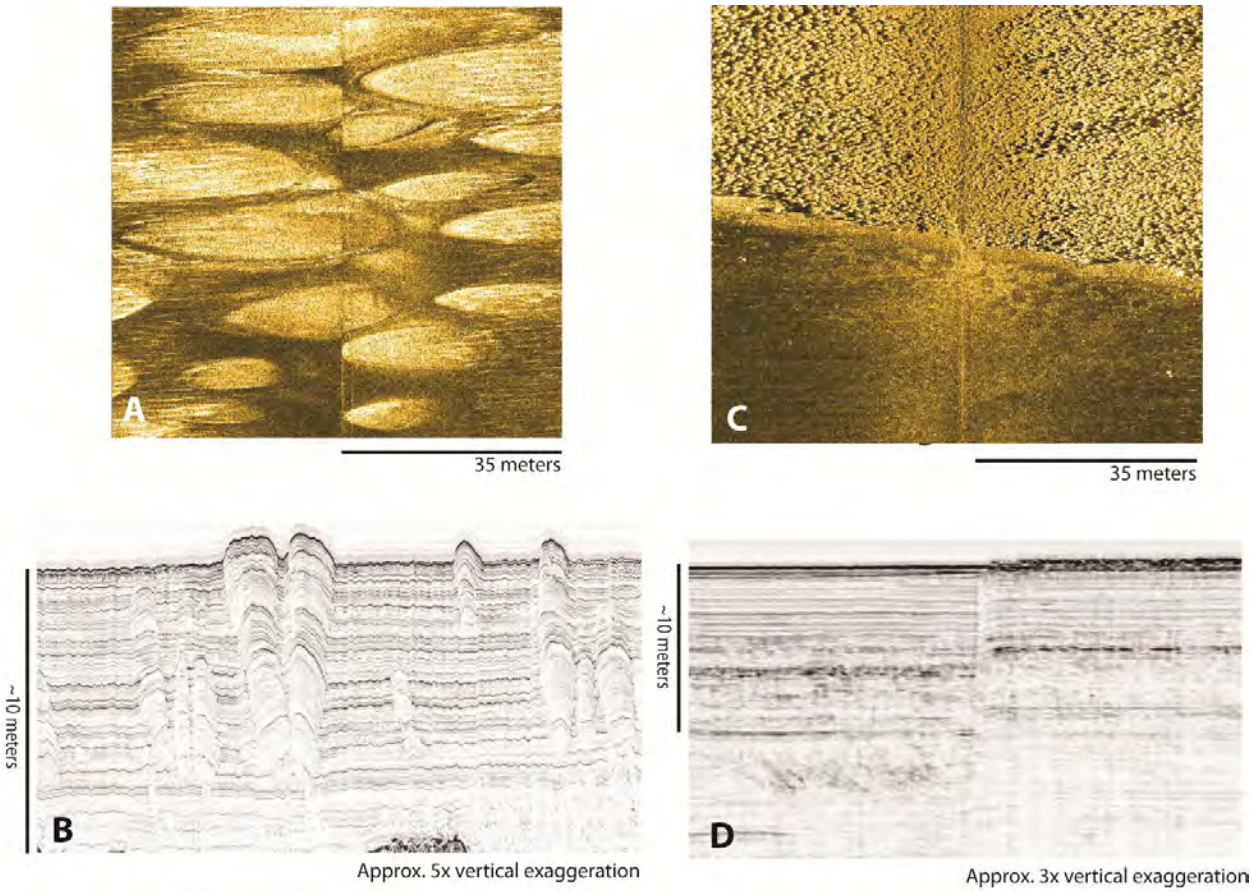

Figure 1. Ramified magastromatolites (A. Sidescan sonar image; B. CHIRP image) and benthic stromatolites (C. Sidescan sonar image of reef-like deposit; D. CHIRP image).