The control of sea-level changes on the sedimentary architecture of carbonate margins

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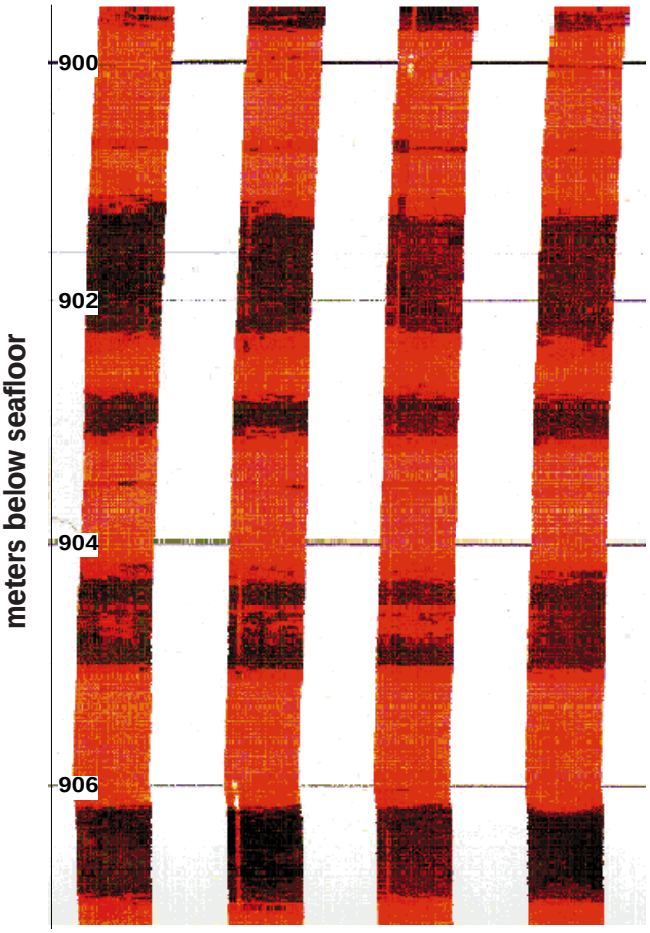
A major controversy has been raging within the geological community ever since scientists proposed the sequence stratigraphic concept, which postulates that each global sea-level change would create a characteristic sequence of sediments that could be found in all the sedimentary basins of the world. The Ocean Drilling Program has made it one of its priorities to address key questions surrounding sea level changes by drilling several transects across different continental margins. During ODP Leg 166 seven holes were drilled along two transects of the margin of Great Bahama Bank to extract the history of the last 25 million years of sea-level changes and solve the controversy surrounding the sequence stratigraphic concept [*Eberli et al.,* 1997]. Cores from these holes now corroborate that global sea level changes do, indeed, control the sedimentary architecture of this carbonate margin. Facies successions within the cores contain indications of sea-level changes on two different scales. First, there are high-frequency alternations between meter thick layers with platform-derived material and thin layers with more pelagic sediments (see figure). The duration of these alternations (20 - 40 k.y.) correlates to orbitally induced high-frequency sea level changes. Longer-term sea-level changes with durations of 0.5-2 m.y. are recorded in 17 Neogene seismic sequences that together build a sedimentary pile that is over 1300 m thick. In these sequences alternating high (up to 20 cm/k.y.) and low sedimentation rates (<2 cm/k.y.) record a long-term pattern of bank flooding with concomitant shedding to the slope, and periods of bank exposure with reduced shallow-water carbonate production, upper slope erosion and largely pelagic sedimentation. The ages of the 17 observed seismic sequence boundaries yield an excellent correlation between sites, documenting the age consistency of the sequence boundaries and chronostratigraphic significance of the seismic reflections. The ages of these sequences, in conjunction with data from other margins, will eventually solve the question about global synchroneity of (third-order) sea-level changes. Thus, Leg 166 drilling results provide a long-awaited data set towards verifying the sequence stratigraphic concept.



Formation MicroScanner electrical image of the borehole wall showing alternations of carbonate-rich (orange-red) and carbonate-poor (dark) layers in the slope sediments of Great Bahama Bank (ODP Site 1003, Leg 166). Carbonate-rich intervals are interpreted to reflect periods of high sea level while the dark intervals correspond to times of increased pelagic and siliciclastic input during sea-level lowstands.

Reference:
Eberli, G.P., P.K. Swart, M. Malone, et al., *Proc. ODP, Init. Repts., 166,* 1997.