BIOSTRATIGRAPHIC SIGNATURE OF SEQUENCE BOUNDARIES, MAXIMUM FLOODING SURFACES, CONDENSED SECTIONS, AND DEPOSITIONAL SYSTEMS TRACTS -- with examples from the Gulf of Mexico Plio-Pleistocene

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The primary horizons utilized in sequence stratigraphic analysis are the sequence boundary, and the maximum flooding surface which occurs within the condensed section in areas of low sediment accumulation rates. These regionally correlative surfaces can be identified on seismic reflection profiles, on wireline logs, in stratigraphic sections, and from checklists of fossil abundance and diversity. Both surfaces are time-transgressive but nevertheless can be used as correlation horizons for partitioning depositional cycles into discrete phases of relative sea-level rise and fall. Sediments deposited during rising and falling phases of sea-level form depositional systems tracts that consist of all correlative deposits of lowstand, of transgressive or of highstand phases of relative sea level.

The sequence boundary is an unconformity formed during relative lowering of and during lowstand of sea level. The unconformity correlates into basinal areas of continuous sedimentation where the age of the unconformity is determined biostratigraphically. The unconformity surface is usually recognized because of erosional truncation of underlying strata and the onlap of overlying strata of the next sequence. The sequence boundary may be represented by a marked shift in biofacies assemblages from deeper below to shallower above. It may be marked also by an increase in reworked or displaced fossils, and by a decrease in both fossil abundance and diversity due to rapid accumulation of sediment in the shallow water, high-energy environments associated with the erosional unconformity.

The maximum flooding surface is defined by, and can be identified by, the most landward onlap of marine strata immediately below the progradational unit with downlapping onto the flooding surface. The precise age of this surface will vary along any basin margin because of the interplay of sediment supply and accommodation space. Away from the locus of major input of sediment this surface is a clay-rich condensed section formed by slow accumulation of sediment. This interval is often represented by significant increase in fossil abundance and by the deepest-water biofacies assemblage of the transgressive-regressive cycle. Despite their lateral variabilities, the seismic, lithologic and biostratigraphic signatures of the condensed section and of the associated maximum flooding surface are generally the most easily recognized and precisely dated regional correlative surfaces.

Within the axis of the depocenter, the highstand systems tract typically consists of forestepping coarsening-upward cycles deposited above the maximum flooding surface and below the sequence boundary. Fossil assemblages of the highstand systems tract reflect shallowing upward neritic conditions, with intervals in which faunal abundance decreases upwards. Transgressive systems tracts are backstepping coarsening-upward cycles deposited above the regional transgressive surface and below the maximum flooding surface. Fossil assemblages in transgressive systems tracts show deepening-upward biofacies and an increase in faunal abundance upward. Lowstand systems tracts are most significant seaward of the shelf-edge, and consist of depositional thicks with low fossil abundance. These lowstand systems tracts are separated by highly fossiliferous condensed sections containing the distal aspects of the transgressive and highstand systems tracts.

Identification of each sequence boundary and its correlative conformity, and of each maximum flooding surface is achieved by careful recognition of patterns of stratal terminations, by correlation of those stratal surfaces of discontinuity with measured sections or wireline logs, and by biostratigraphic correlation between these sections and logs. If the discontinuity surfaces correlate throughout the depositional basin or subbasin, they should be considered sequence boundaries and maximum flooding surfaces. If the surfaces are limited to local areas and are not coeval, they are probably local discontinuities associated with local structural events or with autocyclic shifting of sediment accumulation.