TYPES AND HIERARCHY OF STRATIGRAPHIC CYCLES

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Four types of stratigraphic cycles of more than 10.000 years duration are recognizabe within the stratigraphic record. They are (i) Continental Encroachment Cycles, (ii) Major Transgressive Regressive Facies Cycles, (iii) Sequence Cycles and (iv) Parasequence Cycles.

(i) **Continental Encroachment** cycles are defined on the basis of the relative extent to which the continents are covered by sedimentary rocks at the time of deposition. These cycles have a duration of greater than 50 My and are defined as *first order*. There are two major continental encroachment cycles in the phanerozoic. One extends from the latest Proterozoic to the basal Triassic, and the more recent extends from the basal Triassic to the present. First order cycles are produced by tectono-eustatic sea level changes corresponding to changes in ocean basin volume induced by continental break-up and aggregation. The bases of continental encroachment cycles are regional onlap surface that are associated with maximum basinward shifts of coastal onlap. The maximum marine transgressions within the continental encroachment cycles occur at the base of the *Ordovician* in the older cycle and near the base of the *middle Cretaceous Turonian* age in the upper cycle. The peak Turonian transgression of the youngest cycle is commonly characterized on seismic data by a major downlap surface that separates the backstepping transgressive phase of the encroachment cycle from the forestepping regressive phase. Seismic examples illustrate the similarity of continental encroachment cycles on several different continents. The youngest continental encroachment cycle is represented by *the smoothed long term sea-level curve* on the Haq et al. (1987) chart.

(ii) **Major Transgressive Regressive Facies** cycles are defined on the basis of changes in the average shoreline position and are the building blocks of the continental encroachment cycles. The time duration of the major transgressive regressive facies cycles typically range from 3 My to 50 My. They are defined as *second order*. These cycles are believed to be the result of changes in the rate of regional tectonic subsidence and/or changes in the rate of global tectono-eustacy. Tectono-eustacy changes are believe to be caused by major changes in the rates of sea-floor spreading, which cause the size of the ocean basin change. The second order transgressive regressive facies cycles that are caused by tectono-eustasy are shown as variations on *the long term eustasy curve* of Haq et al (1987).

(iii) **Sequence** cycles are identified on the basis of changes in shelfal accommodation and are the building blocks of the major transgressive regressive facies cycles. They are composed of *lowstand, transgressive* and *highstand systems tracts*. These cycles are typically *third order (* 0.5- 3 My), but may be higher order during particular ages or certain phases of the third order sequence cycle. Third order sequence cycles are shown as the *short term eustasy curve* on the Haq et al. (1987) chart.

(iv) **Parasequence** cycles are shallowing upward intervals bounded by surfaces of abrupt deepening or their correlative surfaces within the non marine environment. They may be periodic or episodic. Periodic parasequences are believed to be caused by Milankovitch orbital cycles and episodic parasequences by autocyclic or local tectonic processes. These cycles range from *fourth to sixth order* (0.01- 0.5 My). Parasequences are the building blocks of the systems tracts.
The paper describes this new classification with special emphasis on the first order cycle type. The similarity of continental encroachment cycles in various areas of the world is illustrated by regional seismic lines.

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R.S.L.

SEA LEVEL CHANGES

LONG TERM

SMOOTH LONG TERM

LONG TERM

SHORT TERM

SMOOTH SHORT TERM

SHORT TERM

TIME DURATION

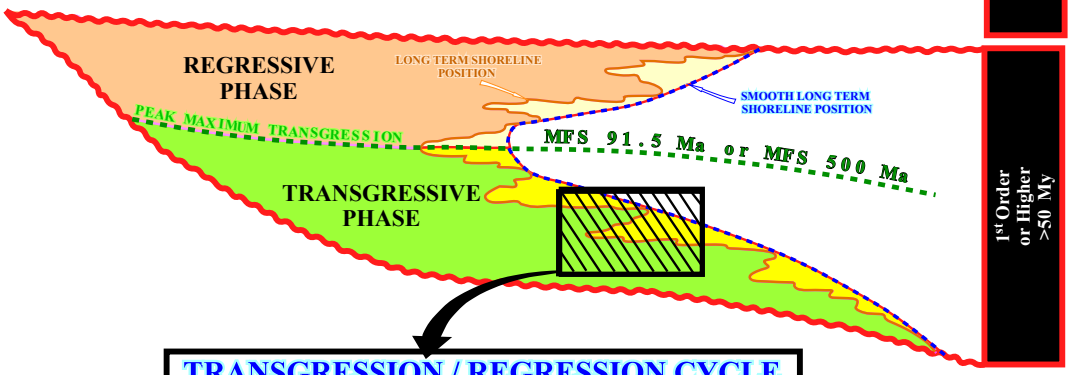
EVENTS

MAJOR CHANGES IN SHORELINE POSITION

CHANGES IN SHELFAL ACCOMMODATION

CONTINENTAL ENCROACHMENT CYCLE

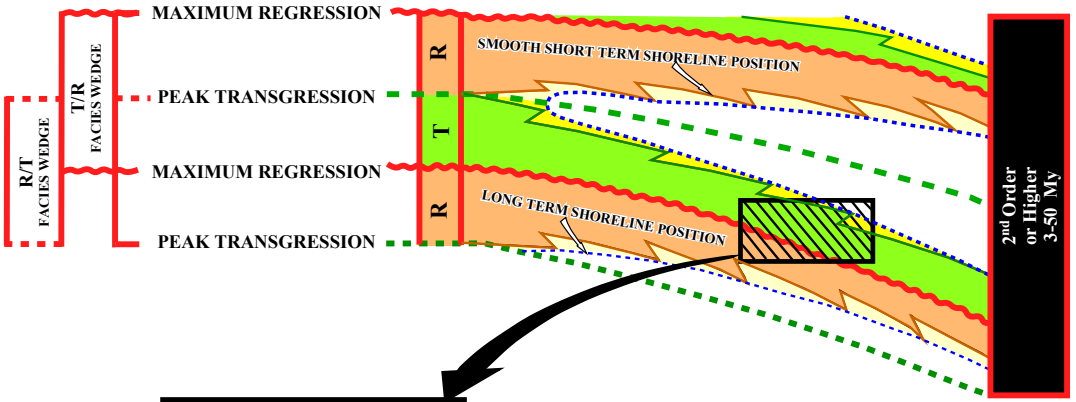
SUPERCONTINEN BREAK-UPS



1st Order or Higher >50 My

TRANSGRESSION / REGRESSION CYCLE

CHANGES IN RATE OF TECTONIC SUBSIDENCE

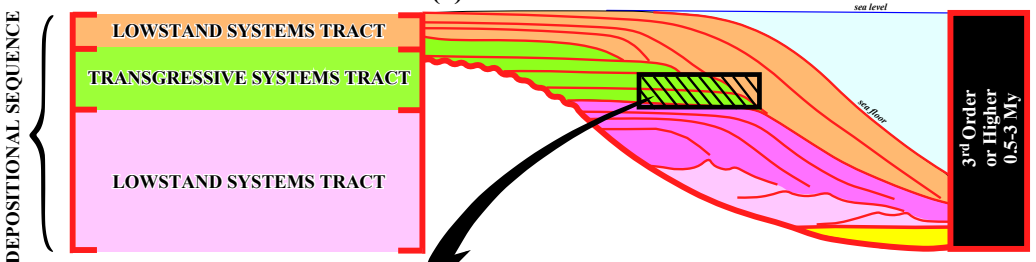


2nd Order or Higher 3-50 My

SEQUENCE CYCLE

GLACIO-EUSTASY

(?)

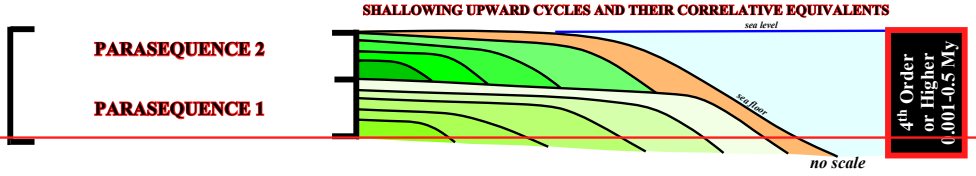


3rd Order or Higher 0.5-3 My

PARASEQUENCE CYCLE (PERIODIC)

GLACIO-EUSTASY

(?)



4th Order or Higher .001-0.5 My