

Sequence Stratigraphic Analysis of Mixed, Reefal Carbonate and Siliciclastic Systems

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Carbonate reefs are often juxtaposed with off-reef, siliciclastic sediments and sequence stratigraphy provides the best methodology for correlating between the two disparate successions. A sequence analysis also allows the relationship between the carbonates and the siliciclastics to be understood in terms of base level change.

The main sequence stratigraphic surfaces associated with reefs are unconformable shoreline ravinements (SR-U), maximum regressive surfaces (MRS), maximum flooding surfaces (MFS) and slope onlap surfaces (SOS). Off-reef siliciclastics usually contain only MRSs and MFSs.

An SR-U within or capping a reefal succession correlates to an SOS on the reef flank and eventually to a facies contact between basinal carbonates and overlying siliciclastics. This facies contact is often misinterpreted as an MFS. The SR-U also correlates with an MRS which usually occurs near the top of the onlapping siliciclastic succession. An MFS can be traced from the reefal carbonates to near, or at, the top of the siliciclastic succession.

The conjoined reefal SR-U and the MRS high in the siliciclastics constitute a depositional sequence boundary. Such a boundary marks the start of transgression and approximates the start of base level rise. Transgression allows carbonate deposition to be reinitiated on the reef and shuts off the siliciclastic supply. If the previously deposited siliciclastic sediments filled most of the off-reef area, a prograding carbonate ramp builds from the reef across the former inter-reef basins, downlapping on the MFS. If not, reef growth resumes until the next base level fall exposes the reef and brings back siliciclastic sediments which continue to fill the off-reef basin.

Off-reef siliciclastic sediment can vary from deep water turbidites, through slope shales to shallow shelf sandstones, depending on the proximity of, and the rate of supply from, the siliciclastic source area. Regardless of the specific siliciclastic facies occurring in the off-reef area, the same types of sequence stratigraphic surfaces are present and their correlation allows the depositional history to be determined. In most situations, reef growth occurs during base level rise and is terminated during base level fall. The associated siliciclastic sediments are deposited almost entirely during base level fall and onlap the SOS on the carbonate slope. This sequence stratigraphic model is equivalent to Wilson's model of reciprocal sedimentation.