Marine carbonate sequences from foreland areas

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Abstrak (Abstract)

Thick wedges of siliciclastic sediment that characterize the proximal parts of foreland basins are typically used to decipher the tectonic evolution of these basins. Marine carbonate strata, however, are more common in many foreland basins than is generally expected and may provide a better record of relative sea level change than siliciclastic strata. In terms of their paleogeographic setting, carbonate facies may develop in the proximal foredeep on a variety of topographic highs, in the distal foreland area far from terrigenous influx, or across the entire foreland basin during tectonically quiescent stages of basin development. Thus, deformation patterns and differential subsidence across foreland areas dramatically affect carbonate platform morphology, facies patterns, and stratigraphic development.

Synorogenic foreland carbonate platforms typically have ramp profiles that mimic the flexural profile produced by tectonic loading. During active convergence and cratonward migration of an orogenic wedge, the flexural profile also migrates cratonward and synorogenic carbonate platforms typically onlap/backstep cratonward. The cratonward limit of onlap/backstepping is controlled largely by the rigidity of the foreland plate and eustatic sea level fluctuations during convergence. Basinward parts of some foreland carbonate platforms may be drowned *(sensu stricto)* during active convergence, especially if the underlying lithosphere has low digidity, if the orogenic wedge advances rapidly, or if an eustatic sea level rise occurs at the same time as migration of the flexural profile. True flexural drowning might occur most often when thermally immature lithosphere is loaded by an orogenic wedge.

In some foreland areas, complex patterns of synorogenic differential subsidence affect carbonate deposition hundreds of kilometers cratonward of the proximal foredeep. These patterns of differential subsidence reflect the response of preexisting basement structures across the foreland to tectonic loading along the plate margin and are not easily explained by

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simple flexural models. Quantitative subsidence analyses from these foreland areas suggest that differential subsidence in the distal foreland is temporally related to tectonic loading along the continental margin, but cratonward limits of the differential subsidence are beyond reasonable limits of flexurally produced subsidence. In addition, patterns of differential subsidence in the distal foreland to not have "normal" flexural wavelengths, amplitudes, or orientations with respect to the orogenic wedge and alternative tectonic models are necessary to explain the differential subsidence.

During periods of relative tectonic quiescence, when the foreland basin is near isostatic equilibrium, carbonate units may prograde concentrically from all sides of the basin. Tectonic subsidence may be essentially non-existent and accommodation is generated by sediment loading and eustatic sea level rise. Over time, the basin depocenter typically shifts cratonward, away from remnants of the former orogenic wedge. Cratonward migration of the depocenter probably reflects isostatic rebound of the former orogenic wedge as it is eroded. Sequence geometries and stacking patterns probably are controlled largely by eustatic fluctuations. Large lateral shifts in facies tracts occur because of the low depositional gradients and very low subsidence rates across the foreland. Platform profiles have very low dips and progradation rates of shoal water facies are high. Lowstand facies may have not be deposited because all available accommodation is filled with highstand carbonates that rapidly prograde or aggrade across the entire basin.

In contrast, some postorogenic foreland carbonate platforms may develop on high relief, fault-bounded uplifts that formed during previous stages of active convergence along the plate margin. If vertical displacement along the boundary faults of these uplifts is great enough, synorogenic siliciclastic sediments cannot completely fill adjacent depocenters. During subsequent postorogenic stages of basin evolution, these foreland uplifts act as pedestals for carbonate platform development. In addition, the boundary faults of the foreland uplifts may be reactivated long after active convergence and may localize later platform margins.