Geophysical Research Abstracts
Vol. 12, EGU2010-6482, 2010
EGU General Assembly 2010

Genesis of a calciclastic slope-basin system: role of eutrophication, faulting, and sea level fall (Late Cenomanian, northern Israel)

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Late Cenomanian calciclastic (calcarenitic-calciruditic) sediments in the Galilee and Carmel regions of northern Israel represent a departure from the typical Middle Cretaceous pattern of mud-dominated lithofacies in this region. In the Yanuch Formation of the western Galilee, a steeply dipping calciclastic clinoform body, more than 100 meters thick, abruptly overlies a succession of limestones with thinly bedded, somewhat cross-laminated calcarenites. Farther to the S-SW, in the coeval Muhraqa Formation of the Carmel region, a sub-horizontally bedded calciclastic sheet, 25-30 meters in thickness, is composed of graded, massive, planar and rippled beds. This body abruptly overlies basinal pelagites and is associated with breccias and distorted bedding. These Late Cenomanian calciclastic bodies reflect parts of a unique depositional episode that took place in this region in the Late Cenomanian.

The Late Cenomanian calciclastic succession of northern Israel evolved in two stages: a stage of highstand ramp progradation, followed by a stage of forced regression with concomitant tectonic activity.

Ramp progradation is reflected by meter-scale cycles shallowing-upwards from basinal wackestones to shoreface calcarenites, and containing phosphatic grains, chert, and masses of pithonellid calcispheres (calcareous dinoflagellate cysts). These cycles aggraded only to storm-wave base, and did not equilibrate with sea-level, as a result of nutrient excess and eutrophication that slowed skeletal production by benthic organisms. This contributed to formation of a homoclinal carbonate ramp profile.

In the course of forced regression, tectonic activity on the E-W striking Yirka fault of the Galilee triggered transformation of the homoclinal ramp into an open shelf-margin with a steep-slope. Downfaulting to the south of this main fault, and block movements along secondary listric faults divided the slope into three small extensional basins and a single hangingwall synclinal basin. Base-level fall brought about extensive shelf-floor reworking above wave base, with formation of carbonate sands on the footwall shelf. These grains were swept off-shelf, accumulated on the slope and filled the intraslope basins. This calciclastic-clinoformic slope system extended at least six kilometers south of the shelf-margin bounding fault, forming the clinoformic top of the Yanuch Formation. Farther downslope, carbonate sand transport became channelized and the grains were ultimately deposited in the distal Carmel basin as a broad calciturbidite sheet interrupted by debrites and slumped mega-blocks.

The large volume of loose carbonate grains transported to the lower slope and basin are the consequence of several factors operating simultaneously. Faulting resulted in the formation of a structurally composite steep slope in the Galilee. Eutrophication inhibited biogenic growth of skeletal build-ups, and together with base-level fall favored mechanical erosion above wave base on the Galilean shelf. Submarine erosion/reworking of the shelf resulted in off-shelf grain dispersion, and transport to the slope and basin.

This system is fundamentally different from typical Tethyan high-productivity low-latitude carbonate systems, where sea level fall results in downslope shift of belts of skeletal carbonate production. In contrast, the response of the Galilean carbonate system to eutrophication and sea-level fall recalls the behavior of cool-water carbonate systems, and some siliciclastic systems. Structural control on the slope geometry generated features that can be found in siliciclastic shelf-margin deltas.