

# Sedimentary Characteristics of a Mixed Siliciclastic-Carbonate System and their Controlling Factors in a Rifted Lacustrine Basin: A Case Study from the Oligocene Dongying Depression, Bohai Bay Basin, China

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## Abstract

Mixed siliciclastic-carbonate sediments were well-developed in the northeast Dongying Depression in the Bohai Bay Basin, China during the First Member of the Oligocene Shahejie Formation. In sequence stratigraphic framework, the First Member contains a transgressive systems tract (TST) and a high-stand systems tract (HST), and the mixed deposits are mainly formed in the HST. Based on detailed core description and microscopic observation, the facies associations, depositional environment and formation mechanisms of this mixed system have been analyzed. Various lithofacies types can be grouped into three facies associations: the siliciclastic sandy beach-bar, the mixed siliciclastic-bioclastic-oolitic shoal and the bioclastic-oolitic shoal. Paleogeography analysis reveals that the study area is located near the northeast margin of the Dongying Depression with bulges to the north and to the east. The types of facies associations indicate they were all deposited in foreshore to shoreface above fair-weather wave base in the HST. In most mixed systems, the siliciclastic-prone deposits are found in the proximal area while carbonate-prone deposits in the distal area. However, the system studied herein shows the opposite situation, as pure carbonates deposited near the toe of the bulges while siliciclastic-prone sediments in the distal part. Coexistence of compositional and

strata mixing occurs. The bed-scale compositional mixing alternates with either siliciclastic beds or carbonates to form stratigraphic-scale strata mixing. Multiple sedimentary cross-sections of wells suggest both lake-level change and siliciclastic supply control spatial distribution and strata mixing of this mixed system. The bulges near the study area did not supply siliciclastic materials during HST, and in situ oolitic and bioclastic packstone-grainstone were deposited in the north and east area. When the lake-level decreased, the siliciclastic materials inputted from south to the study area and mixing started. In sequence stratigraphic framework, one sedimentary cycle equals to one parasequence set with carbonates and mixed sediments in the lower part while siliciclastic sediments in the upper part. The compositional mixing and local compositional heterogeneity are further controlled by local physiography and hydrodynamics. The study area is located near the northern faulted margin of a rifted depression with abundant small faults developed. The sedimentary facies suggest the lake-level is quite low, hence local physiography and wave movements are critical for compositional differences. As a result, unique compositions of mixed sediments are found adjacently, such as shells with empty cavity in siliciclasts, shells filled with siliciclasts in both siliciclasts and carbonates, and shells filled with siliciclasts while the intergranular space are empty.