Sedimentology and High-resolution Stratigraphy of a Muddy Ramp: Cardium Formation (Turonian-Coniacian), Southern Alberta

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Abstract

Interest in the Cardium Formation has traditionally centered on large hydrocarbon reserves hosted by shallow marine sandstone and conglomerate facies. As result, muddy facies, which comprise the bulk of the formation, have been neglected. Detailed stratigraphic and sedimentological investigation of the Cardium Formation between Twp. 26 in Alberta and Twp. 29N in northern Montana reveals a stratigraphic organization of much greater complexity than has previously been appreciated.

Our analysis is based on detailed correlation of over 800 geophysical well logs, combined with 12 outcrop and 12 core logs. Most of the major allostratigraphic bounding surfaces, established by Plint et al. (1986) further to the north, can be traced to southern Alberta. The succession between the E1 and E4 surfaces is typified by very continuous, parallel flooding surfaces. Overlying, mudstone-dominated rocks between the E4 and E7 surfaces are typified by complex, very gently dipping clinoforms. Clinoforms appear to radiate from a point source, and lap out to the east and south.

The change from parallel to clinoform stratal surfaces may reflect a change in water depth. If water is relatively shallow and the sea-floor lies above effective wave base, sediment transport by combined flows will result in very efficient transport of benthic sediment across a planar sea floor, forming parallel stratigraphic surfaces.

If water depth is somewhat greater and benthic sediment transport less efficient, sediment may be less efficiently transported away from river mouths, and low-angle submarine clinoform stratification may result. The dip of clinothems to the east and south is consistent with northern-hemisphere geostrophic circulation, but may also reflect the influence of persistent along-shelf currents (?wind-forced or thermohaline) directed along-shore to the SE. In this respect, the muddy clinoforms may be comparable to those observed in the Adriatic and east China seas (Cattanaeo et al. 2007; Liu et al., 2007).

Cores show that, nearest the apex of the clinoforms, sediment is a heterogeneous mixture of mud and very fine sand, passing distally into silty mudstone over ~100 km. The presence of both sand and mud suggests that mud may have been transported as bedload in the form of flocs and pellets with a hydraulic behavior similar to fine sand. Examination of core reveals

starved ripples of silt, indicating the influence of currents or waves. Additional microscopic observation of thin sections will be carried out to determine the presence of mud pellets and possible bedforms composed of pelleted mud.

References

Cattanaeo et al. 2007, Continental Shelf Research, 27: 506-525.

Liu et al. 2007, Geomorphology, 85: 208-224.

Plint et al., 1986, Bulletin of Canadian Petroleum Geology, 34: 213-225.