Carbonate Slope and Basin Deposits: A Review of Models, Worldwide Examples and their Relevance to the Western Canadian Sedimentary Basin

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Summary

As exploration in a sedimentary basin matures, it is often astounding to witness the number of new play concepts that continue to be generated and successfully developed. Often these new plays are actually old, almost forgotten ideas that come to light again due to new technologies, higher commodity prices, or simply the conviction of individuals to pursue them. One such play is carbonate slope and basin deposits. While these have long been recognized in the rock record and modern environments, surprisingly little has been done to consider these as exploration targets, particularly in the Devonian of the Western Canadian Sedimentary Basin.

Deep–water clastics have seen a substantial amount of research and exploration in the last 20+ years, but little attention has been given to their carbonate counter part. In spite of this, there are significant reserves discovered on a world wide basis in these reservoirs. Historically, slope and basin deposits have generally been used as proximity indicators for reefs or other large carbonate build-ups which are generally the target of exploration. To this end, the description of these deposits from an explorationists stand point is often over simplified. It is this that has spurred the authors to attempt to identify, describe and classify deep water carbonates in much the same way as deep water clastics have been in the last couple of decades. Additionally, an attempt to refine the existing depositional models and better define the context in which they appear was undertaken.

The first challenge is to correctly identify these deposits. The authors propose three major categories in which slope deposits can be found: debrites, slope calcarenties and mega talus blocks. Debrites or debris flows are likely the most common occurrence of carbonate slope deposits. They exhibit both channelized and sheet geometries and are made up of both slope and margin derived material and are thus very heterogeneous. Transport distances are generally short, and as such these deposits tend to be poorly sorted.

Slope calcarenites are most akin to clastic deep water deposits. They also exhibit channelized and sheet like geometries, and are made up of resedimented grains sourced from higher energy platform and margin environments. The mechanisms and hydraulic flow processes are similar to that of clastic turbidites and as such they have the potential to be carried and deposited further from

their original sediment source. The resultant deposits can show grading that can manifest themselves in much the same way as clastic turbidites, although observations suggest that there are narrower ranges for grains sizes likely due to sorting and winnowing at the time of original deposition.

Perhaps the most impressive of all of these deposits are the mega talus blocks. These are margin derived blocks that have catastrophically detached from the main margin and have tumbled into the slope environments flanking a reef. Their range in size can be from a few meters to hundreds of meters, depending on their original deposition and the mechanism(s) for failure. These perhaps make the most enticing exploration targets since they are large, carry similar reservoir properties to that of a carbonate reef margin, and have been defined seismically. *Note: a core display around these particular deposits will be given by the same authors focussing on the Devonian of Western Canada.*

Much difficulty can be encountered when trying to describing deep water carbonates in the subsurface because generally there is very little core data available. Additionally, some of these deposits can easily be interpreted incorrectly. One such example is the interpretation of large talus blocks as pinnacle reefs residing basinward of a carbonate reef margin: the log data would look very similar, as would overall seismic expression. Even core would look similar on a cursory overview. However, through integration of surface and subsurface rock data, seismic, and application of an appropriate model, the explorationist can correctly interpret these environments and begin to predict their presence and character.

On a worldwide basis, the economic significance of deep water carbonate deposits can not be understated with estimates of discovered recoverable resources exceeding 41 Billion BOE (C&C Reservoirs). More striking is that these discoveries are thus far located in only seven sedimentary basins, the largest of which is the Poza Rica field in the Tampico Embayment, Gulf of Mexico (Enos, 1977) which alone accounts for 32 Billion BOE. When deep water clastic reservoirs were in their exploration infancy, as deep water carbonates are today, their worldwide picture was very similar. A move to better understand these depositional environments and exploration perseverance could in time yield a picture similar to that of deep water clastics. Through linking old ideas with new exploration practices, and better understanding the rocks being drilled, these plays may prove very prolific in old and new exploration basins.

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