

**Digital Geospatial Context for 3-D Source-to-Sink Models:
New Insights into the Classic Shelf to Basin System of the Guadalupe and
Delaware Mountains**

April 26 - May 1, 2012 Carlsbad, NM

Recent advances in stratigraphic and structural analysis of the Permian Guadalupian section of the Guadalupe and Delaware Mountains were the theme of SEPM's April 2012 "**Digital Geospatial Context for 3-D Source-to-Sink Models**" research conference. The conference, co-convened by Charlie Kerans and Jerome Bellian, sought to bring together researchers who have been active in this classic area over the last 15 years and highlight recent achievements. A significant effort was placed on bringing together those researchers with extensive expertise in the region to foster an active dialog on the status of current research and needs for future studies. A unique aspect of this effort was that many of this new generation of studies could be placed within the high-resolution geospatial framework of airborne lidar data that were acquired in 2009 by the RCRL group at the University of Texas at Austin, Jackson School of Geosciences Bureau of Economic Geology and Department of Geological Sciences.

Forty four scientists took part in the conference held in Carlsbad, NM, that ventured daily into the field to visit classic outcrop localities including the Dark, Walnut, Slaughter, Rattlesnake, Pine, and Shumard Canyon areas of the Guadalupe. Keynote talks were offered by Mitch Harris, Gregor Eberli, David Mohrig, and Mike Gardner. Harris provided a detailed review of the role of Guadalupian sedimentologic and stratigraphic research in our evolving view of the source-to-sink theme and carbonate sedimentology sensu lato. Gregor Eberli stimulated the group by drawing remarkable parallels between ongoing research on the sedimentology and marine geomorphology of the Bahamian slopes and examples from the Guadalupe. The theme of David Mohrig's presentation was the importance of understanding fundamentals of sediment supply and grain size in controlling styles of deposition and bypass in submarine channel systems. To do this he used slope profiles extracted from the LiDAR as the boundary conditions for a numerical model of turbidity currents. Model results suggest that: (1) turbidity currents moving down the steepest submarine slopes associated with the Capitan Formation should have always been net erosional; (2) turbidite deposition on the submarine slopes tied to the Cutoff and Bone Spring formations was from slow moving turbidity currents with extremely low suspended-sediment concentrations; and (3) filling of slope channels in the Brushy Canyon Formation was the product of selective deposition of the coarsest particles being transported into the basin. Gardner shared his views on source-to-sink correlations. This talk emphasized the completeness of the Permian system, where exceptional surface exposures, combined with abundant subsurface information, enable consideration of how the carbonate shelf interacts with sedimentation in the basin.

Field visits were the focus of the conference. Charlie Harman and Phil Resor set the stage for a thematic group of stops and presentations that highlighted integration of deposition and structural evolution of the Capitan-equivalent shelf and margin. Harman used the classic North Slaughter Wall as a backdrop to demonstrate the importance of syndepositional growth faulting and differential compaction over paleo-shelf margins in controlling stratigraphic patterns on the shelf. Resor illustrated the regional extent of syndepositional faults, their relationship to larger tectonic elements such as the Walnut Canyon Syncline and fault systems like the Ogle Cave system, and the numerical modeling basis for understanding these brittle failures within the outer shelf and margin. Dave Hunt, Toni Simo, and Giulio Casini carried this theme of syndepositional growth faulting on the shelf to another level by illustrating the step-wise evolution of a growth graben extending throughout most of the Yates Formation in the head of Rattlesnake Canyon. This work was a magnificent marriage of detailed stratigraphic, structural, and modeling work integrated with ground-based lidar to demonstrate the complex and pervasive impact of growth faulting on the “stable shelf”.

The importance of the work presented by Jason Rush on the north entrance wall of Walnut Canyon corroborated the aforementioned stops and went beyond the shelf perspective, showing how syndepositional faulting near the shelf margin can lead to large-scale collapse of outer-shelf and reef-margin strata. Ned Frost led the group through a detailed study of early-to-late fracture and fault development in the Tansill shelf and equivalent Capitan margin in the north wall of Dark Canyon. This exhaustive demonstration of the impact of fracturing on deposition, early- and late-diagenetic overprints, was another reminder that present and future studies of the Guadalupian carbonates must include an understanding of the synkinematic structural framework.

Field visits focusing on sedimentologic aspects of the Guadalupian section were led by Ted Playton and Jerome Bellian in the Pine-to-Smith Canyon area of the southern Guadalupes where sculpting mechanics of the lower-slope environment were discussed. Anjali Fernandez, David Mohrig, and Christine Rossen led the group through Shumard Canyon to basal Brushy Canyon outcrops to illustrate the internal architecture of channel fills and their relationship to grain-size and sediment supply.

Presentations in Carlsbad included summaries by the field trip leaders, in addition to presentations by Kerans on the latest understanding of the regional framework of the Guadalupes, by Art Saller on the role of differential compaction on controlling the depositional profile of the Capitan margin, by Bellian and Reyes on the lidar volume processing and interpretation and its impact on present and future data visualization and integration, and by Steve Bachtel and co-workers from Chevron and Tengizchevroil on the relationship between styles of margin fracturing and collapse observed in 3-D seismic at Tengiz field and

how this style of margin/slope deposition compared to that observed in the Guadalupian slopes.

The intensive 5-day combined field and lecture format of this conference served to amplify several themes -

- Syndepositional fracturing and faulting is a pervasive phenomenon throughout the Seven Rivers through Tansill shelf and time-equivalent Capitan margin and has fundamental implications for high-resolution stratigraphy as well as diagenesis across the carbonate portion of the system
- Slope processes and resultant stratigraphy in the carbonate section involves a combination of small-scale and catastrophic collapse that cannot be linearly related to eustacy. Though line-fed slope patterns dominate, a range of channel systems and collapse reentrants analogous to those observed in the Bahamian margins makes this a highly complex record.
- The history of slope deposition within the Delaware Basin Group provides critical information on the paleoclimate and tectonics of the broader Permian Basin system that is not well-recorded in the carbonate record. Deep-water base-level/energy regime patterns of initiation, growth and retreat (Gardner) provide a context for the phase of base-level not recorded by the platform top. The record of bypass and deposition within channel systems can now be read in terms of _____

Finally, during the course of the conference, we saw huge potential for group collaboration in placing various stratigraphic, mechanical, and diagenetic analyses into a unified geospatial context provided, in this case, by an extensive shared airborne lidar digital outcrop model. The geospatial referencing of our combined observations may lead to step changes in our understanding of the broader source-to-sink context of shelf-to-basin systems.