The Influence of Tectonic Evolution on Deep-Water Stratigraphic Architecture, Magallanes Basin, Chile

Romans, Brian W.[1]; Fildani, Andrea [1]; Hubbard, Stephen M.[2]; Covault, Jacob A.[1]; Graham, Stephan A.[3]; Fosdick, Julie C.[3] (1) Chevron Energy Technology Co., San Ramon, CA. (2) Department of Geoscience, University of Calgary, Calgary, AB, Canada. (3) Department of Geological & Environmental Sciences, Stanford University, Stanford, CA.

The impact of tectonic processes on the evolution of sedimentary basins and their stratigraphic architecture is significant. Patterns of uplift and subsidence in space and time influence fundamental boundary conditions of depositional systems, such as basin-margin relief, sediment supply, and dispersal. The fills of sedimentary basins contain robust records of such tectonic processes. The objective of this study is to combine an integrated analysis of provenance (e.g., detrital-zircon ages, sandstone composition, etc.) with high-resolution stratigraphy in order to assess the evolution of deep-water architecture within the context of mountain-building episodes and unroofing during basin development.

This analysis of the Cretaceous Magallanes Basin, Chile, provides constraints on depositional age, basin configuration, and source area, as well as insights into the evolution of ~4,000 m of stratigraphic architecture during ~20 m.y. of basin filling. A robust provenance database, integrated with well-studied stratigraphic architecture, provide the first comprehensive record of the northern Magallanes foreland basin succession. The stratigraphic succession consists of three deep-water formations capped by a deltaic/shallow-marine unit, reflecting distinct phases of deposition, each with a distinct stratigraphic architecture (i.e., lobes, leveed channels, progradational slope systems). The transition from unconfined slurry-bed prone deposits of the Punta Barrosa Formation to erosional and levee-confined conglomerate-filled channel complexes of the Cerro Toro Formation is marked by the appearance of pre-foreland Jurassic igneous rocks in the detrital zircon record. This unroofing signal indicates the general timing of thrust-sheet emplacement and, thus, corresponding changes to the basin, which include narrowing of the foredeep and introduction of abundant conglomeratic detritus. A subsequent transition from basin-axial channel-belt sedimentation to sandstone- and mass transport-dominated prograding slope systems of the Tres Pasos Formation is characterized by additional input of pre-foreland material suggesting continued denudation of existing thrust sheets. The integrative approach of this study bridges the gap between provenance analysis and purely high-resolution stratigraphy in order to build a robust model of basin-filling stratigraphic architecture for prediction in frontier sedimentary basins.