Sediment Routing and 3D Stratigraphic Architecture in the Patagonian Foreland Basin: Implications for Andean Tectonics and Flat-Slab Subduction

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ABSTRACT

The Patagonian foreland basin of southern Argentina is broken by large basement blocks related to phases of thick-skinned shortening, potentially triggered by flat-slab subduction. An integrated understanding of the cratonward migration of foreland deformation and the resultant stratigraphic response remains elusive. The Cretaceous-lower Paleogene succession of the Chubut Province provides a nearly continuous stratigraphic record from the Andean foothills to the Atlantic Ocean. This locality presents a unique opportunity to define the 3D stacking patterns and sediment routing evolution that result from structural partitioning of a foreland basin, on a continental scale ranging from source to sink. Although the exact timing and mechanisms of Patagonian foreland deformation are poorly defined, two contractional phases are currently recognized (Late Cretaceous and Neogene), with a possible intervening Paleogene extensional phase. This study emphasizes the unclear transition from early Andean contractional to extensional tectonic regimes through a sedimentological investigation of the Cretaceous-lower Paleogene stratigraphic record. Despite excellent accessible outcrops, these clastic deposits have been utilized on a limited basis to constrain the timing of syndepositional uplifts. Few geochronologic studies exist, resulting in a weakly-supported chronostratigraphic framework for this succession. Furthermore, the depositional systems and sediment routing patterns of Late Cretaceous-early Paleogene age are incompletely described.

This project is motivated by three key questions: Q1: How did sediment routing (source-to-sink) systems across central Patagonia evolve in response to thick-skinned basement uplift? Q2: Did deformation advance cratonward (eastward) in an asynchronous but systematic pattern in response to changing slab dynamics? Q3: What are the 3D stacking patterns formed during periods of flat-slab subduction? To address these questions, I have developed an integrated regional approach, involving four main themes: (1) A 3D network of measured sections will be used to create detailed paleogeographic reconstructions to demonstrate the onset of basementinvolved uplift and the resultant basin-scale stratigraphic responses. (2) Provenance analyses including detrital zircon U-Pb geochronology, paleocurrent measurements, and sedimentary petrography will support the reconstruction of sediment routing pathways and sediment sources. Geochronologic data will also be acquired to refine the chronostratigraphic framework of the Late Cretaceous-lower Paleogene succession. (3) Drone photography /photogrammetry will facilitate the identification of sequence stratigraphic surfaces and the geometry of architectural elements for robust depositional system interpretation, quantification, and correlation. (4) Compilation and integration of a database of published U-Pb and Ar/Ar depositional ages, thermochronologic data, measured sections, and previously recognized syntectonic strata will aid the determination of irregular vs. systematic advance of thick-skinned shortening during early Andean orogenesis. I believe an integrated regional approach is necessary to demonstrate the timing and pace of early Andean shortening, proposed extensional relaxation, and associated shifts in provenance, depositional systems, and

basin evolution. The results of this study will refine our understanding of partitioned foreland systems such as the Laramide province of the Cretaceous Western Interior Basin, USA and the Sierras Pampeanas of central Argentina.