Integrating Outcrop Data to Define Regional and Reservoir-Scale Patterns in Prograding Shelf-Slope-Basin Systems, Sobrarbe Formation, Spain

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Strata from prograding shelf-slope-basin clinoforms are oil and gas reservoirs in many parts of the world including West Siberia Basin, northwest slope of Australia, and North Slope of Alaska. The Eocene Sobrarbe Formation of the Ainsa Basin, southern Pyrenees, Spain, is an excellent outcrop analog for these systems. The Sobrarbe Formation contains several condensed-section bounded clinoforms that are greater than 200 meters in relief. They record the progradation of a linked shelf-slope-basin system. Stratal units and bounding surfaces within one condensed-section bounded stratigraphic cycle (Cycle 2) can be walked from the fluvial system all the way out to the basin floor. This relationship is interpreted to document coeval deposition across the physiographic profile.

Laterally extensive outcrops of Cycle 2 are used to quantitatively describe reservoir architecture and sedimentary processes in coeval strata from six physiographically distinct areas: (1) fluvial, (2) shelf, (3) shelf edge, (4) slope, (5) base-of-slope, and (6) basin. Fluvial strata are ~50% sandstone and are composed of channels, crevasse splays, and overbank strata. Shelf strata are ~60% sandstone and are composed of marine shale, distributary mouth bars, and distributary channels. Shelf-edge strata are ~75% sandstone and are composed of distributary channels, river-mouth bars, and marine shale. Slope strata are ~40% sandstone and are composed of mudstone sheets, levees, and submarine channels. Proximal base-of-slope strata are ~20% sandstone and are composed of sandy submarine-fan strata consisting of amalgamated submarine channels, and turbidite lobes. Basin floor strata are ~20% sandstone and are composed of turbidite lobes and mudstone sheets.

A quantitative comparison of the data reveals the following. First, ~50% of the sandstone in the entire depositional cycle is located in a narrow area around the shelf edge. Second, maximum grain size decreases from gravel in fluvial strata to fine-grained sand on the basin floor. Third, the diversity of reservoir elements and facies decreases from the fluvial system to the basin floor. Fourth, each physiographic position is distinguishable in terms of net to gross, grain-size distribution, reservoir-element associations, and facies associations.