Imaging and Imagining Transitional Sedimentary Environments: A Paleogeographic Reconstruction of Northern Colombia

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Predicting reservoir presence and quality in frontier basins is a challenging task due to the scarcity of wells and seismic data. Northern Colombia's Caribbean offshore basin is no exception to the rule, as available seismic data are mainly restricted to regional 2D lines, and wells are mostly confined to the continental shelf. In addition, the tectonically active nature of this continental margin hinders the application of depositional models from the world's best known analogs such as the Gulf of Mexico and Brazil, developed on passive margins. To establish a working geologic framework for predicting Cenozoic reservoir distribution in the onshore Lower Magdalena and Guajira and offshore Caribbean (Sinu and Guajira) basins, we integrated onshore and offshore seismic, biostratigraphic, and geologic information onto a set of 5 paleogeographic maps spanning the late Oligocene through the early Pleistocene of northern Colombia. To cross-check the validity of intermediate versions of our maps, we resorted to seismic geomorphology analysis. This procedure allowed us to test whether features such as channels, chaotic, clinoform and lobate seismic geoforms were sitting on areas consistently mapped as paleo-canyons, debris flows, prograding deltas, areas of mass-transport complexes, etc. Moreover, tracking the migration of the shelf break on seismic data was particularly useful to constrain deep-water environments, and the wandering edges of paleo-deltas. Our maps reveal the design of the paleo-shoreline, shelf break and main emerged areas, and record the birth and evolution of ancient and modern river deltas. Furthermore, our maps help us understand the geologic history of basin infill due to sediment delivery by the Sinu, Atrato, Magdalena and Rancheria rivers, implicitly displaying reservoir fairways. The dynamic nature of this project facilitates the constant inclusion of new seismic and well data as they become available, testing the validity of our maps and improving their quality.