EaES 350 Laboratory 10: Seismic and sequence stratigraphy

You are interviewing for a job at Shell in Houston, Texas. The interview procedure includes the infamous "assessment center" that consists of a number of complex assignments that have to be carried out within a few hours time. This is supposed to mimic the hectic nature of working in the petroleum industry, where rapid decision making based on limited data is business-as-usual. The main assignment aims at testing your knowledge of sedimentary geology in general, as well as your ability to carry out a quick analysis of various kinds of data relevant to hydrocarbon exploration and production.

Your task is to analyze newly collected geophysical data from the Gulf of Mexico. You are dealing with high-resolution seismic, covering the uppermost ~100 m of offshore strata on the continental shelf and upper slope off East Texas. You receive a fully processed but uninterpreted, dip-oriented seismic section from this area; this section covers deposits that can be related primarily to the Brazos River. In addition, you have access to the outcomes of laboratory experiments that aimed at simulating similar types of strata under controlled conditions.

In the seismic section, identify the two major unconformities and label the reflection terminations "toplap" and "onlap" wherever you can identify them. For recognition of these features, revisit Fig. 22.3 from your textbook. This seismic section contains a spectacular example of an "unconformity and correlative conformity"; point it out and explain its mode of origin. Do you notice any striking disturbances when you trace reflectors from updip to downdip? Finally, be aware of the fact that the lowermost, continuous reflector is a so-called "multiple" that should be ignored in the stratigraphic interpretation.

A physical experiment was carried out to study large-scale stratigraphic patterns on passive margins, like the Gulf Coast, in relation to relative sea-level changes. The experiment was carried out at the Faculty of Earth Sciences, Utrecht University (The Netherlands), and aimed specifically at gaining a better understanding of the stratigraphy offshore East Texas. The experimental design consisted of a long and narrow feeder system that enters a wide, gently sloping area that represents the coastal plain and/or shelf, giving way downdip to a steep continental slope. Water and sediment is constantly supplied through the feeder system and base-level variations mimic sea-level changes with a shoreline below the shelf break during lowstand and relatively close to the feeder system during highstand.

A dip-oriented lacquer peel was made at the end of the experiment in order to study the stratigraphy. The stratified sands represent deposits that accumulated during the experiment; underlying massive sands are part of the basement that was built in the flume prior to the experiment. Make a sketch of the peel that includes the experimental equivalents to unconformities and reflection terminations as you identified in the seismic section. This experiment consisted of one base-level cycle, beginning and ending at highstand, and the cycle was highly asymmetric (i.e., rates of base-level rise and fall were very different). Infer from the stratigraphy what the base-level (relative sea-level) curve looked like.

Based on the information from the experiment, attempt to interpret the depositional history for the area covered by the seismic section.