Jane Stammer is currently a Ph.D. student at The Colorado School of Mines. Her research focuses on the fractionation of minerals and textures in deep-water turbidite deposits. Her adviser is Dr. David Pyles.

Scientific Problem and Importance

Outcrop and subsurface studies document that submarine fan systems consist of channels and lobes that compensationally stack. Additionally, studies show that individual lobes have a thick axis and strata thin and become finer-grained toward the lateral and distal margins. No studies document how texture and mineralogy, which affects reservoir quality, changes laterally and longitudinally in these deposits. Through outcrop and experimental studies, this project will address the following fundamental questions related to reservoir quality in deep-water turbidite systems: How do mineralogy and texture change longitudinally and laterally in submarine fans? Are these changes related to hydrodynamic fractionation? Are the changes systematic? How do turbidity currents fractionate minerals of different size, shape, and density? How does fractionation affect reservoir quality?

Submarine fans are common reservoirs and comprise a large proportion of petroleum targets off the Gulf Coast of the U.S. Primary porosity and permeability, the main components in reservoir quality, are related to textural properties such as sorting, grain size, and grain shape, whereas secondary porosity and permeability are related to mineralogical properties such as alteration of feldspars to clay. Understanding textural and mineralogical variability and their impacts on reservoir quality is therefore critical.

Research methods and objectives

The proposed questions will be addressed by two methods of research: 1) field-based outcrop measurements of deep-water lobe strata within the Cretaceous Point Loma Formation, San Diego, California, and 2) scaled, physical experimentation using a deep-water tank.

Lobes are depositional features found in deep marine basins associated with non-channelized flows. Previous research conducted on the Point Loma Formation has identified four lobe complexes that expose strata from proximal, medial, and distal locations. The strata are well-exposed, have exceptional lateral continuity (5+ kms), and the outcrop is nearly perpendicular to paleocurrent direction. Individual beds and larger lobe elements will be mapped and sampled at the cm-scale, from axis to margin within proximal, medial, and distal locations in order to document how mineralogy and texture varies longitudinally and laterally.

The following parameters will be documented along the profiles: bed thickness, facies, primary, and secondary sedimentary structures, mineral composition, sorting, grain size, and grain shape. Standard petrography and QEMSCAN, which is an automated scanning electron microscope (SEM) system, will be used to accurately measure percentages of minerals, grain size distributions, and grain shape. Additionally, ICP-MS whole rock geochemical data will be used to relate changes and trends in geochemistry to changes in mineralogy produced by hydrodynamic fractionation.

The experimental portion of this research will take place in a 6x4x2 m tank at Tulane University. The experiment will test the effects of particle density and particle shape on flow behavior and characteristics of turbidity current deposits in 3-dimensions. To do this, two sets of experiments will be run. First, to test particle density, spherical beads of two of more densities with the same grain size distribution will be mixed. Second, to test particle shape, spherical and crushed silica of the same grain size distribution will be mixed. After each experiment, samples collected from all areas of the deposit will be analyzed to see how turbidity currents hydrodynamically fractionate particles based on these two parameters. Analyses and measurements taken during each run include particle size distribution using an LPSA, grain density, and shape distributions using QEMSCAN, and flow velocity and flow turbulence using acoustic Doppler instrumentation.