



**SAND: Sedimentary Analogs Database and Research Program
2017-2018 Phase I Research Proposal**

Dr. Lesli Wood, PI

Cost: \$45,000 per year

Products: Access to Legacy SANDatabase and
Access to Future SANDBOX Database under development,
Access to the new Analog Classification Tool (ACT) and Seismic Geomorph Plugins
Field Courses, Annual Meeting Dissemination of Research Results, Student graduates

This proposal for the **SAND Research Group at Colorado School of Mines** will define the “new” research plans and propose a way forward to continue the highly successful education-through-research program that has been supported by industry associates for 14 years.

Student researchers and young professionals have always been a major product of our research program. The work we do in basin evolution and fill, includes outcrop, subsurface, seismic and numerical and physical process modelling and reservoir modeling. Our work is deeply engaged in quantitative seismic geomorphological analysis of seismically-imaged depositional systems. Some of the major products of our past program include:

SAND – the legacy archive and database of our entire 14 year research program. This database includes 1000’s of instances of morphometrics, petrophysics and documents of clastic systems architecture and nature. In addition, the accompanying Knowledge Database includes hundreds of talks, posters, summary sheets, short courses and field trip notes, core descriptions, seismic horizons and interpretations, and streaming presentations from worldwide basin studies.

PETREL RIBBON AND LOBE PLUGINS – Our research group is engaged in development of downloadable plugins for mapping of geomorphic elements in 3D seismic data, and the collection and porting of these quantitative data into spreadsheets for statistical analysis and reservoir modeling. In addition, we integrate established geomorphologic equations in to these data collection tools that capture relationships between form and fill and form and process.

STUDENTS – we have graduated 45 young professionals in geosciences, all of whom have joined the energy industry.

NEW IDEAS – we have made significant advances in interpretation of and understanding of mass transport deposits, shelf sand reservoir systems, interpretation and recognition of the impact of mobile muds and mud volcanos on basin development, the influence of topography on deepwater sedimentation processes and resultant reservoir nature, and in Best Practices for modeling of tidally-influenced and other heterolithic reservoir systems.

RESEARCH THEMES 2017-2018

The three primary goals of our research program in clastic basins have not changed. These include:

- To provide quantitative data for risking, assessing and modeling clastic systems in basins worldwide.
- To provide new ideas in larger source-to-sink concepts along clastic margins.
- To educate the next generation of integrated earth scientists.

Quantitative Databases

Decades of work in areas that require dense morphometric data in clastic systems, such as reservoir modeling, risk analysis and reservoir rock volume assessments, has driven us to create such databases for ourselves and our members companies. The next 3 years of the SAND research program will be about redesign, improvement and ongoing population of ***the CSM SANDBOX, a new and improved clastic architectures and reservoir character database*** to assist members in risking clastic plays, calculating accurate volumetrics, designing drilling and production plans, and accurately constructing and conditioning reservoir models.

Some of the primary tasks toward this goal include:

1. Increased applicability of the SAND data archive toward conditioning reservoir models, through improved understanding of sampling efficiency and bias, and through enhanced understanding of how to build accurate training images.
2. Increased interaction with geophysicists toward understanding the geophysical attributes that characterize various seismic morphologies.
3. Ongoing data collection, including analogs for successful deepwater stratigraphic traps, mining of offshore reservoir performance data, more data on deepwater architectures and their habits, more work on predicting the relationship between architectural form and fill type.
4. New 2015 tools to enhance utility and increase company usage of the data in the existing SAND database. These include improved interfaces and parsing tools.

The Analog Classification Tool is a developed tool that will enable users to parse datasets by Depositional Systems (ie., deepwater, aeolian, delta, etc.), Sub-systems (ie., slope, abyssal plain, etc.) and desired architectural elements (ie., channel, lobe, sediment waves, distributary channels, etc.). This tool will continue to develop as we use the data search and develop increased understanding in the way users access the data in the SANDBOX. ACT V1 is currently running on the new SAND database.

Research Areas and Projects Underway

Focus in deepwater systems research will center on:

1. The interaction of structure and sedimentation in deepwater settings. In this area, our energies will be spent in
 - a. a worldwide assessment of sediment pathways and sediment structure interaction in **deepwater fold belts**,

- b. toward numerical modeling of **gravity sedimentation in complex topographies** and
 - c. the nature of **high net:gross deepwater fan systems in an unconfined to confined margin transition**. (Jackfork to Atoka transition (Penn.).
 - d. **Mega-canyon formation and fill**, offshore Suriname/Guyana.
- 2. Mass Transport processes, deposits and influences on basin fill. In this area our energies will be spent in
 - a. predicting the nature of accommodation space along the surface of MTDs and the **nature of healing phase top-fill turbidites**, as well as
 - b. continuing to examine the **sealing capacity of MTDs**, through unique outcrop, subsurface (core and logs) and seismic data sets.
 - c. Forces of formation, numerical understanding of compaction and dewater processes toward **a seismic and log-based predictive model of MTD lithology**.
 - d. **Clay type and amount variability in deepwater facies associations**.
- 3. Current- versus gravity-driven sedimentation in marine environments. In this area our energies will be spent in
 - a. The roll of large storm events in moving sediments into deepwater. This is a physical modeling study of the **influence of waves on extending storm-generated gravity flows across marine shelves and into deepwater settings**.
 - b. **Worldwide survey** of current-driven sedimentary deposits.
 - c. Seismic, log and core **recognition criteria for current-driven sedimentation deposits**.

Focus in shoreline and shallow marine systems research will center on:

- 1. Shelf sands. In this area, our energies will be spent in:
 - a. **Prediction of the distribution of sands on shelves**; sweet spots, basinward extent, etc.
 - b. Cryptic **current-driven erosional surfaces on marine shelves**
 - c. Deepwater clastic deposits in epi-continental seaways
- 2. Rift Basins. In this area, our energies will be spent in:
 - a. **Axial versus marginal drainages in rift basin margins**
 - b. **Seismic geomorphology of rift basin fills** including the Sag Phase.
 - c. Worldwide assessment hydrocarbon exploration and development in ancient rift basin systems.
 - d. Geographic focus **on the Rio Grande Rift of New Mexico as an analog for rift fill architecture**. Spatial and temporal variability in fill types.
- 3. Reservoir Modeling. In this area, our energies will be spent in:
 - a. **3D reservoir modeling of the Atoka (Penn) shelf and shelf edge deltaic architecture** from extremely well exposed quarries.
 - b. Low net:gross shelf sand reservoirs, and **controls on fracture nature in the Verde Field, north west San Juan Basin**.

Research Team

The team consists of

- Dr. Lesli J. Wood, Principle Investigator and Director of the Research Group,
- Dr. Mary Carr, clastics sedimentologist and reservoir modeling, assistant program manager
- Dr. Darrin Burton, Affiliated Research Faculty, outcrop and subsurface to geomodelling
- Andi Niess, Webmaster

In addition, the program will work with an average of 10-12 graduate students any one time.

Returns

We typically hold two annual meetings in the year. The Spring SAND meeting is focused on Deepwater Systems and the Fall SAND meeting is focused on Fluvial-Deltaic-Shallow Marine Systems. These meetings typically include core workshops and field courses held in conjunction with a day of formal talks. In addition, **we spend at least two days with each company in return for their membership, looking at company data, teaching courses or doing general consulting on the topics of choice.** Finally, **year around access to the SANDatabase is provided each member.**

Budget

Each company is asked to provide \$45,000 a year to support the ongoing research program.

Contracts will be mailed out once a year, as requested by the member company.

Contracts can be done for single year or multi-year, whatever the member company desires.