I maintain a broad research interest in basin evolution under varying tectonic and climatic conditions, with specific focus on marine sedimentary processes and architecture of marine sedimentary deposits at various scales. I am also interested in interaction of sediments with biosphere. In my research, I use clastic sedimentary deposits as a record of past tectonic and climatic conditions, and I aspire to use study of sedimentary deposits as a tool to predict near-future surface processes. In my doctoral and postdoctoral research, I have studied sedimentary records from active and passive margins, and I have used a broad range of data including seismic data, well log, core, and outcrops. Prior to joining my current position of postdoctoral fellow, I have worked as a professional in the energy industry, where I studied several petroleum-rich sedimentary basins, focusing predominantly on seismic stratigraphy, geomodelling, seismic attribute analysis and seismic imaging.

Master' Research:

Relative time of igneous intrusion and major deformation events in Eastern Ghats Mobile Belt: By extensive field mapping and study of microstructures, I concluded that intrusive Koraput Alkaline Complex was pre-tectonic with respect to the major deformation events recorded in high-grade metamorphic rocks of Eastern Ghats (Gondwana Research, 2005).

Doctoral Research:

Quaternary stratigraphy of New Jersey shelf: I studied a Late Pleistocene sediment wedge on the outer New Jersey shelf using high resolution seismic (CHIRP), core, and C^{14} age data, and interpreted that the sediment wedge represents a series of forced regressive deltaic lobes supplied by the Pleistocene equivalent of the Hudson River system (Marine Geology 2013). Detailed analysis of seismic refection characters within the sediment wedge in New Jersey lead to identification of several clinothems that can be tied to the latest Pleistocene sea-level variations. The forced-regressive deltaic deposits prograded across the outer shelf and reached the shelf-edge at (or slightly prior to) last glacial maximum.
Source to Sink Study of Tyee Forearc Basin, Oregon: I undertook a source to sink study of the Tyee Basin succession, which is an Eocene (greenhouse climate) forearc fill exposed in Coast Range of Oregon. The results of this study (Global and Planetary Change, 2013) describes a relatively undeformed ancient forearc fill in its entirety. The basin-scale depositional model for Tyee Forearc Basin, constructed by spatially integrating extensive outcrop data and well data, shows two distinct stages of evolution and related the variability in the turbidite deposits in this area with the changing geometry of the basin-margin clinoforms. The basin-scale depositional model also showed the effect of initial basin topography on the shelf-edge trajectory. The conceptual depositional model was supported by a numerical model (geometrical model) of clinoform progradation over a basement topographic feature, which verified that the observed variation in clinoform height and clinoform trajectory was consistent with build-up of a sediment wedge under moderate subsidence, high sediment supply, and low amplitude sea-level variation (last two typical of greenhouse climate).

Current Research:

As a postdoctoral fellow at The Institute for Geophysics, UT Austin, I am working in a collaborative project known as *Genesis of Methane Hydrate in Coarse-Grained Systems: Northern Gulf of Mexico Slope* (GOM^2), funded by US Department of Energy (DOE). I study the architecture of Quaternary marine clastic deposits that host the gas hydrate and build numerical models to simulate the petroleum system associated with the hydrate accumulations. In continuation of my doctoral studies I am working on the forearc systems in northwestern USA, and studying Quaternary coastal stratigraphy using CHIRP seismic data. Some highlights of my ongoing research are provided below.
Mechanism of biogenic methane entrapment contributing to high saturation of Gas hydrate: By studying the petroleum system associated with a recently drilled gas hydrate accumulation in Gulf of Mexico, I am trying to develop a model for gas hydrate formation in high saturation from microbial methane that does not exclusively

rely on methane recycling at the base of hydrate stability zone (BHSZ) (Under review – AAPG Bulletin). Supported by subsurface observations, this model suggests that high saturation of gas hydrate could be reached by sustained free gas migration into a segment of reservoir while it is in the hydrate stability zone. To test the validity of such model of hydrate enrichment I am building a series of 2D numerical models in PetroMod software for simulating burial history, microbial methane generation, and hydrate formation in the study area.

Variability in supercritical bedforms: Numerical and experimental results and observations at or near modern sea floor suggest that upper flow regime bedforms could be more common in rock record than previously thought. However, work on ancient record of upper flow regime bedforms are few. Using 3D seismic data, I am studying a supercritical bedform field formed at a channel-lobe transition at the base of continental slope in northern Gulf of Mexico. I am describing the inception, subsequent evolution, and the burial of a supercritical bedform field and quantifying the observed variation in character of supercritical bedforms. I am working to relate such variations with changing depositional conditions using simple numerical modeling techniques.

Forearc Basin deposits: In continuation to my doctoral work, I am participating in a collaborative study of forearc stratigraphy in Oregon, based on field data and geochemical data. At present, I am studying a series of Slope-channel deposits in Eocene Tyee Forearc Basin that show considerable variability in sand-bed thickness, degree of basal erosion, and dimension of the channel elements. I am analyzing field data on slope channel deposits, including outcrop measurements and photogrammetry, which shows that the variation in characters might be related to the position of these channels (i.e., upper continental slope vs. lower continental slope).

Gravitational deformation of gas hydrate bearing channel-levee system in Gulf of Mexico: I completed a detailed stratigraphic analysis of the reservoir that hosts the hydrate accumulation in the Green Canyon area (block 955) in the northern Gulf of Mexico (AAPG Bulletin, 2020) and identified it as the relatively clay-free silty levee deposits bounding a Pleistocene submarine channel. The silty levees flanking the bypassing channel show evidence of gravitational failure (AAPG Bulletin, in press). There are few examples of such levee failures in other localities in Gulf of Mexico, but the exact mechanism of such gravitational failure is not well understood. I am attempting to establish a quantitative geomechanical framework to understand the failure mechanism.

Future Research Plans:

Looking forward**,** I want to maintain a broad research interest in basin evolution, clastic depositional processes, and sedimentary records, and I would like to combine field-based studies with seismic stratigraphy, numerical modeling, and potentially, experimental stratigraphy. However, in near term, I would like to focus on four specific areas of research.

1. **Quaternary fluvial and coastal systems:**

I plan to devote significant effort in studying Quaternary fluvial and coastal depositional systems and their response to change in climatic conditions. I am interested in working on response of coastal-to shelf-edge depositional systems to sea level rise, both from measurements in present-day systems and from ancient records, where significant sea level rise has been concluded (such as PETM). I plan to pursue funding opportunities from national and local governments.

2. **Marine gas hydrate systems and microbial methane storage:**

Marine gas hydrate systems are a major component of global carbon cycle, and a potential future energy source. Marine gas hydrate reservoirs might also have potential in carbon sequestration (carbon dioxide storage). Understanding mode of formation and mode of occurrence of gas hydrate in marine sediments, and the physical properties of unperturbed and perturbed hydrate reservoirs is essential in developing gas hydrate as a natural resource. As part of GOM^2 project (collaborative project with DOE, BOEM,USGS, UT, and several other universities as partners), I am studying the nature and behavior of gas hydrate in deepwater clastic reservoirs and I plan to continue my study of hydrate systems using subsurface data (publicly available 3D seismic data). I foresee collaborative research in the field of marine gas hydrates and polar gas hydrates, and

I would like to pursue funding opportunities from state agencies. I plan to expand the scope of my current research in marine gas hydrate systems to include the geochemical processes related to deep biosphere. The current understanding of the maximum depth of microbial methanogenesis is limited, but importance of such understanding is well-recognized not only for gas hydrate systems, but also in context of recently discovered substantial biogenic gas prospects.

3. **Turbidite depositional processes and architecture of turbidite deposits:**

Turbidity currents and other submarine gravity flows constitute the volumetrically most important sediment transport process on earth and sedimentary strata deposited by turbidity currents have been recorded in numerous localities worldwide. Societal importance of such deposits is well recognized, for example, as important hydrocarbon reservoirs and as record of ancient earthquakes. However, understanding of the flow behavior of turbidity currents and the processes that affect the deposition of turbidites are still incompletely understood. Although recent observations from long-term direct monitoring of turbidity currents provided insight into sediment concentration, velocity, and net deposition of large number of turbidity current events, these observations are not always easily usable to understand observations from outcrops and subsurface records, such as, ancient slope channel deposits seen in seismic data in continental slope and beyond, in passive margin settings.

I want to continue my research on architecture of turbidite channel levee systems based on outcrop and subsurface data. I am particularly interested in studying and modeling stacking pattern in submarine channel deposits resulting from migration and aggradation/erosion. For near future, I plan to use field data from Tyee Basin (Oregon) and publicly released seismic data (e.g., deep water Gulf of Mexico).

I plan to build on my current research on bedforms generated by supercritical turbidity currents. In addition to documentation of upper flow-regime bedform fields from subsurface data, I want to pursue more sophisticated numerical modeling techniques to understand the range of transport conditions under which upper flow regime bedforms are preserved in marine sedimentary records. For documentation of upper flow regime bedforms in deepwater sedimentary records I plan to use publicly available deepwater 3D seismic data from Gulf of Mexico. I am also seeking collaboration with the energy industry, which might provide access to additional data and expertise.

4. **Stratigraphy of active margin system:**

I would like to work on configuration forearc basin-fills in context of the nature of subduction, building on my outcrop-based work in Tyee Basin. Tyee Forearc succession, which being a relatively undeformed forearc-fill, provides unique opportunity in understanding the stratigraphy of forearc deposits. I am planning to start a long-term collaborative research project on stratigraphy and tectonics of this active margin based on outcrop measurements, geochemical data, and geochronology.