Department Travels... 2015-2016

The Rice Earth Science department is frequently on the move, exploring both familiar and foreign locations, seeking to uncover natural mysteries hidden all across the globe.

Destination Lake Baikal: in search of the "ideal" modern shelf-edge delta

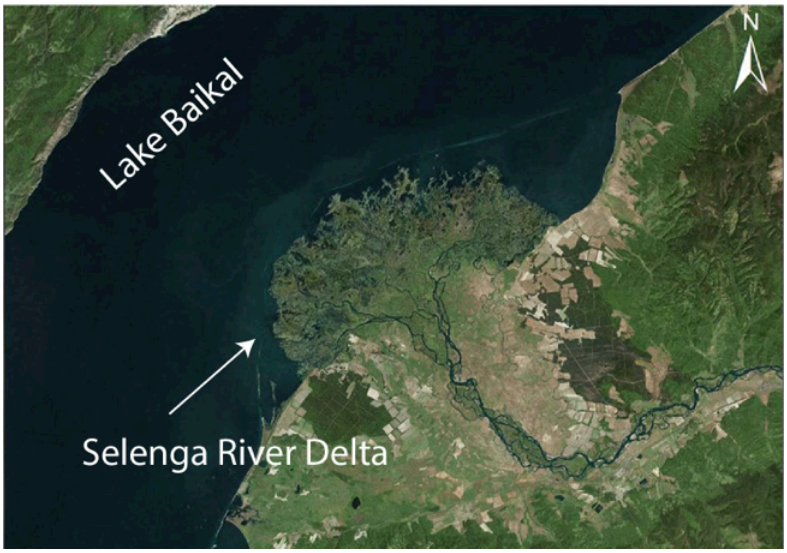
by Tian Dong and Jeffrey Nittrouer

After a 2-day long journey that started at Rice University and ended in the heart of Siberia, Professor Jeff Nittrouer and his graduate student Tian Dong finally reach their destination: a camp on the Selenga delta located along the southeastern shore of Lake Baikal; this will be home for the next month. Behind them lies the late July summer heat in humid Houston. Before them lies a great mission: to locate and survey the ideal modern shelf-edge delta, specifically the Selenge River delta, which flows into the world's largest and deepest freshwater lake.

Formed by a half-graben styled intracontinental rift that initiated 25 million years ago, Lake Baikal – the oldest lake in the world – extends over 600 km in length with an average width of 60 km and possesses a maximum depth in excess of 1.6 km. These dimensions render Lake Baikal the largest volume of unfrozen surface freshwater in the world, and the Selenga River is its biggest contributor of sediment and water. Covering ~ 560 km^2, the modern Selenga River delta is one of the largest freshwater deltas in the world.

Other than its impressive size, what else makes this system so special to make it worth crossing two continents and the Pacific Ocean to investigate scientifically? It turns out that the Selenga River delta is positioned along the deep-water margin of Lake Baikal, qualifying it as a rare modern shelf-edge delta system. Flooding of continental shelves all around the world as a result of sea-level highstand has pushed most if not all of modern marine deltas landward, sometimes several hundred kilometers from the continental slope. Therefore, due to its basin margin position, the Selenga delta represents an ideal system to study sediment dispersal processes that transfer mass directly from the delta topset to deep-water depositional environments.

The objective of this particular Russian-American collaborative field expedition is to investigate the hydrological and sediment transport dynamics of the bifurcating channel network on the Selenga delta's topset. Field work includes sampling sediment from the channel bed and bankline and surveying channel bathymetry from major and minor distributary channels. In terms of the results of this campaign, field data indicated a downstream fining of sediment, ranging from predominantly gravel and sand near the delta apex, to silt and very fine sand at the delta-lake interface; in fact, median grain size drops by three orders of magnitude over a relatively short topset distance (~ 35 km). Subsequent work back at Rice University includes developing an analytical framework to explain the downstream fining and elimination of gravel from the delta dispersal system. The analyses of hydrological data suggest that a significant spatial decline in boundary shear stress arises as water is partitioned within the bifurcating channel network.



Satellite image of the Selenga River delta and Lake Baikal. Covering 560 km^2, the Selenga delta is one of the largest freshwater delta in the world.

The Rice Sedimentology Group aims to produce future collaborative scientific expeditions to inform about the dynamics of the Selenga delta and Baikal, and this research will be used to advance geoscience and foster effective policymaking to preserve the Selenga system for its people. In fact, the next trip is already being planned: a winter expedition intended to shoot ground penetrating radar (GPR) in order to reveal the internal stratigraphic architecture of the delta. Why winter? Because the delta and lake are frozen solid, thus sampling via a snow mobile-drawn GPR unit will be extremely effective for covering the entire delta, from topset to foreset. Only this time, Professor Nittrouer and graduate student Dong will dream of the warmer weather back home in Houston.

In addition to the scientific work, this international collaboration has provided incredible cultural experiences by way of interacting with Russian scientists, tasting local cuisine, and exploring the beautiful landscape of rural Siberia. The local people, Buryatians, are descendants of the Mongols and have called the shores of Lake Baikal home for many centuries. Through fishing and farming, the Buryat communities have thrived on the natural resources gifted from Lake Baikal. To the indigenous people, the smell smoked Omul (fish) soup, sound of traditional Mongol music and dance, and love of horses are all traditions that are as integral as the Selenga River. For earth scientists, it is critical to continue studies about the natural development and processes that build this beautiful deltaic system, with an eye toward understanding the broader geological significance of the Selenga system.

The native people to Lake Baikal, Buryatians, wearing traditional dresses and singing to welcome the expedition team. Photo by Tian Dong.

TURKEY

Right: Geological Map of Istanbul Zone, Turkey. Photo by Jeffrey Piccirillo.

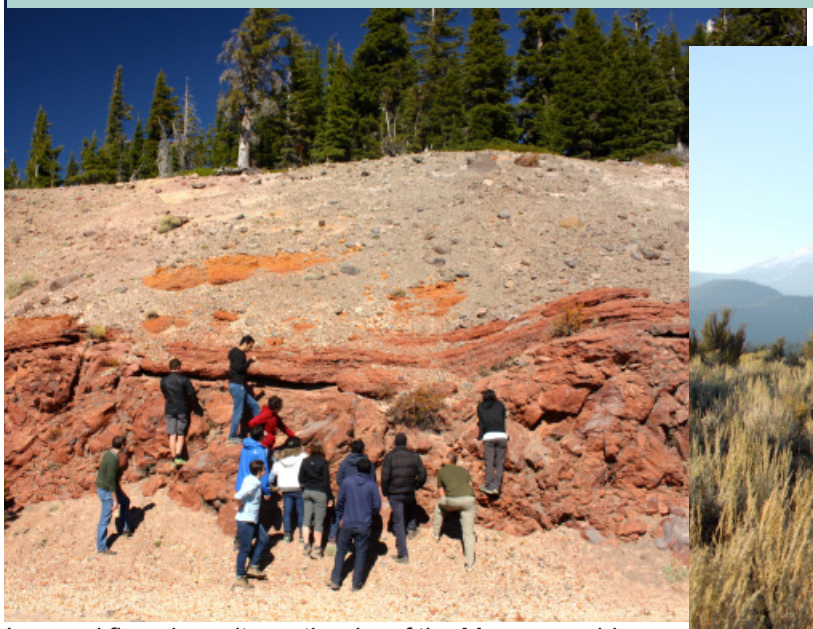
Left: Pankaj Khanna and Nur Koyuncu examining the Late Cretaceous serpentinite during the Department Type Locale Field Trip 2015, in Turkey. Photo by Jeffrey Piccirillo.

Ecolgite with garnet from the Tiburon Peninsula, CA. Photo by Cin Ty Lee

Earth Chemistry and Materials (ESCI 322) field trip to northern California. Photo by Hehe Jiang.

CALIFORNIA

WASHINGTON



Layered flow deposits on the rim of the Mazama caldera. Photo by Thomas Giachetti.

Physical Volcanology (ESCI 429) field trip to Southern Washington. Photo by Thomas Giachetti.

IRELAND

Advanced Topics in Basin Sedimentology and Stratigraphy (ESCI 546). Photo by Tian Dong.

Large fold within the Ross Formation. Photo by Tian Dong.

CENTRAL TEXAS

One billion year old serpentinite, as seen on an undergraduate-organized field trip. Photo by Cin Ty Lee.

MORE ADVENTURES AWAIT IN 2017!