

EGU21-16596

<https://doi.org/10.5194/egusphere-egu21-16596>

EGU General Assembly 2021

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A field-scale laboratory to study particulate transport from river source to marine sink: Bute Inlet (Canada)

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It is often assumed that particles produced on land (e.g., sediment, pollutants and organic matter) are transported through watersheds to a terminal sediment sink at the seashore. However, terrestrial particles can continue their journey offshore via submarine channels, accumulating in abyssal plains of the oceans. Offshore sediment transport processes are key controls on the burial of organic carbon and the distribution of benthic food, yet they are challenging to study due to the difficulty of capturing usually short duration events within large-scale systems at great ocean depths. Fjords are sufficiently small scale to enable their submarine channel systems to be studied from river source to terminal sink on seafloor fans. Bute Inlet is an up to 650 m deep fjord in British Columbia, Canada. The Homathko and Southgate rivers both feed Bute Inlet with freshwater and terrestrial sediment. A large landslide occurred on 28th November 2020, which caused a Glacial-Lake Outburst Flood (GLOF) which breached a moraine-dam and transported huge volumes of material through the Southgate valley and into Bute Inlet. The impact of this recent event on the submarine system in Bute is, for now, poorly constrained but ongoing work is exploring the impact of this major event on the Inlet. Bute Inlet is one of the most studied fjords worldwide, with a range of offshore campaigns that have been conducted during the last seventy years, providing an unprecedented background dataset and thus opportunity to explore what impact a large magnitude, low frequency terrestrial event had on the submarine system. This presentation will provide an overview of the past research conducted on the Bute submarine channel system, under more usual river discharge conditions and compare this background context to the recent GLOF event.

Previous studies have revealed that the floor of the Inlet is characterized by a 40 km long

submarine channel formed by submarine avalanches of sediment (turbidity currents) that can be up to 30 m thick and reach velocities of up to 6.5 m/s. Based on time-lapse bathymetric mapping over 10 years, the evolution of this channel is known to be controlled by the fast (100 to 450 m/yr) upstream migration of 5 to 30 m high steps (called knickpoints) in the channel floor. Sediment cores reveal that the channel floor and proximal lobe are dominated by sand and up to 3 % of total organic carbon in the form of young woody debris. Research in Bute Inlet has thus allowed submarine flow processes, seafloor morphology and deposits to be linked in unprecedented detail. Using those past results as a baseline, new data collected after the GLOF will be crucial for testing the impact of high-magnitude catastrophic events on a marine system and the ultimate sink for the terrestrial material. Understanding what impact the GLOF had on the usual seafloor processes has direct implications for the preservation of benthic communities living in the fjord and for the global carbon cycle.