# How is sediment transported through submarine channels and onto the lobe? New insights from integrated monitoring of an active channel

*Maarten S. Heijnen[1,2], Michael A. Clare[1], Matthieu J.B. Cartigny[3], Peter J. Talling[3], Sophie Hage[2], D. Gwyn Lintern[4], Cooper Stacey[4], Daniel R. Parsons[5], John E. Hughes Clarke[6], Stephen M. Hubbard[7], Joris T. Eggenhuisen[8]*

*[1]Marine Geosciences, National Oceanography Centre, European Way, Southampton, U.K.*
*[2]Ocean and Earth Sciences, National Oceanography Centre, University of Southampton, European Way, Southampton, U.K.*
*[3]Departments of Geography and Earth Sciences, University of Durham, South Rd, Durham, U. K.*
*[4]Natural Resources Canada, Geological Survey of Canada, Box 6000, 9860 West Saanich Road, Sidney BC, Canada.*
*[5]School of Environmental Sciences, University of Hull, U.K.*
*[6]Earth Sciences, Center for Coastal & Ocean Mapping, University of New Hampshire, 24 Colovos Road, Durham, U.S.A.*
*[7]University of Calgary, Department of Geoscience, Calgary, Alberta, Canada.*
*[8]Department of Earth Sciences, Utrecht University, Utrecht, The Netherlands*

Turbidity currents are submarine density flows that create the longest channels on our planet. Their deposits, are known to hold valuable archives of Earth's history (paleoclimate, paleoseismicity), and major hyrdrocarbon reserves. The currents themselves pose a hazard to important seafloor infrastructure (pipelines, cables), and can transport nutrients, pollutants, and (micro)plastics into the deep sea. Despite their importance, our understanding of submarine channels and lobes remains unclear. This is largely due to the lack of direct observations of active submarine channel-lobe systems from source to sink.

Here we present a unique first-ever integrated monitoring dataset comprising: i) detailed time-lapse seafloor surveys over a decade along the full-length of the active Bute Inlet submarine channel-lobe system, ii) direct measurements of turbidity currents at multiple locations down the system, and iii) discharge from the feeding river. We show that tens of flows occur yearly in the upstream domain of the channel. However, most turbidity currents do not contribute to lobe-building, and instead dissipate within the channel. In contrast to conventional models of channel erosion, bypass and deposition, we observe a pattern of alternating zones of erosion and deposition along the channel. These alternations are due to upstream migration of steep-faced knickpoints, reworking channel deposits and transporting sediment step-wise downstream towards the lobe. We, lastly, show that submarine lobes do not necessarily give a good representation of the upstream flow events and their triggers. This has important implications for how to interpret these deposits and their use in reconstructing Earth's history and geohazard assessments.