AGU 100 FALL MEETING
Washington, D.C. | 10–14 Dec 2018

OS13C-1502: The dominant control on submarine channel evolution revealed by new high-resolution time-lapse bathymetry

Monday, 10 December 2018
13:40 - 18:00
Walter E Washington Convention Center - Hall A-C (Poster Hall)

Submarine flows called turbidity currents form spectacular seafloor channels, whose scale rivals rivers on land. These underwater channels are much less well understood, however. Turbidity currents pose a hazard to important seafloor infrastructure, and their associated deposits form archives of Earth's history and major hydrocarbon reservoirs. Therefore, understanding how submarine channels form and develop is important. We present the most detailed timelapse monitoring yet for any submarine channel, which provides new insights into the controls on channel evolution. We analyse a decade of repeat seafloor surveys from a river-fed submarine channel in Bute Inlet, British Columbia, Canada. Past studies suggested that meander bend erosion, levee deposition, or trains of scours control submarine channel growth. We show for the first time that exceptionally rapid (100-400 m/year) upstream migration of 5 -30 m-high knickpoints can dominate submarine channel development over the entire length of the system. Sediment volumes eroded and deposited during knickpoint migration significantly exceeds that supplied by the inputting rivers, and that associated with outer-bank erosion at meander bends. Knickpoints are a well-known feature in rivers where they are caused by external factors, such as tectonic uplift, bedrock layers, or base-level change; however, they are not regarded as a dominant morphodynamic process, since they migrate upstream at much slower rates. We compare the evolution of the submarine channel with that of the inputting rivers to reveal a very different behaviour. While secondary flow primarily controls river bend migration, we find that knickpoints formed by internal processes are the dominant control on the morphologic evolution of the submarine channel; capable of completely altering channel geometry, initiating channels and controlling meander-bend growth. Knickpoints also exert a major control on the preservation potential of individual events and may strongly control sediment delivery to the terminal lobe. Similar knickpoints have been identified in many submarine channels worldwide; hence we suggest that they are of global importance.

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