The regulating function of discharge of turbidity currents by submarine canyons and channels

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Long-lived (> 1000s years) leveed submarine channels are common in submarine fans. The flow discharge of turbidity currents flowing inside the channel is required to be nearly constant for stabilizing submarine channel development; however, the cause of this steadiness of turbidity currents is unknown. Here we propose a possibility that self-accelerating process of turbidity currents inside submarine canyons and channels derive steadiness of flow volume rate of turbidity currents on the basis of numerical experiments. Turbidity currents occur at upstream ends of submarine canyons, and they grow up to large volumetric scales through the self-accelerating process in which flows increase their density by erosion of basal sediments. Our numerical experiments that used a model of turbidity currents considering conservation of turbulent kinetic energy revealed that there is a limit for currents to grow up because the increase of suspended sediments expenses turbulent kinetic energy in the currents. This limit of flow growth is related not to the initial sediment discharge but to geomorphological properties of submarine canyons. As a result, diversity in flow discharge of turbidity currents becomes smaller downcurrent, implying that the flow steadiness at the downstream end of submarine canyons can be attained by this effect. In addition to this effect, the overspilling process of turbidity currents in leveed channels has effect of negative feedback to the height of the submarine levees, which can also regulates flow discharge of currents.

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