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Selective erosion by gravity flows in the deep-sea Lofoten Basin, Norwegian Sea

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Deposits from gravity flows form a substantial part of the Lofoten Basin stratigraphy, a deep-water basin offshore Norway. This includes glacigenic debris flows from the shelf edge/upper slope, sandy turbidites from canyon – channel systems and debris flow deposits from submarine landslides. Little is, however, known about the properties of the gravity flows and their interaction with the sea floor sediments. We present newly acquired deep-towed side-scan sonar data co-registered with sub-bottom profiles showing small and large-scale irregularities of the sea floor in two areas relatively recently affected by gravity flows. The first area is located at about 2700 m water depth and is part of the distal Andøya Slide. Here, three several km wide and about 25 m thick lensoid and acoustically transparent deposits with a slightly irregular relief are inferred to represent debris flow deposits from submarine landslides originating from the nearby continental slope. The seafloor both below the debris flows and between and not affected by the debris flows is irregular due to closed seafloor depressions. They occur randomly and with a variety of forms up to 1 km across, 500 m wide and some meters deep. The second area is the Lofoten Basin Channel near its termination at about 3200 m water depth, beyond which laterally extensive sheets of normal graded sand interbedded with thinner mud layers occur. Sea floor depressions appear in several morphological forms on the channel flanks. The largest is more than 1 km long, up to 250 m wide, some meters deep has its longest axis parallel to the flow direction. It becomes less distinct in the down-flow direction. Other features in this area include densely spaced longitudinal features. In both areas the irregular sea floor morphology is inferred to be flute marks (or scours) formed by erosive gravity flows. Erosion of channel flanks by turbidity currents is well known from other studies but is not commonly described from the most distal channel settings as shown here. In the deepest part of the Lofoten Basin at least some of the flows overtopped and were erosive to the termination of the channel implying that the transition from erosion to deposition forming the sheets of sand occurred over a very short distance. The occurrence of flute marks in the area of the distal Andøya Slide indicates passage of spatially extensive and unconfined turbidity currents possibly associated with the slide event. The flows were accelerating or steadily flowing resulting in erosion and little or no deposition in part of the eastern Lofoten Basin.

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