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The mid-Norwegian margin gas hydrate province: trace of slope stability and geo-hazard through time

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Gas hydrate is stable in marine sediments on many Arctic continental slopes under present temperature and pressure fields. Yet, changes in the physical conditions have been shown to trigger dissolution and emanation of methane into the ocean. Access to a huge database of 2D and 3D seismic records, covering the entire mid-Norwegian margin, now provide an exceptional opportunity to test the relationship between methane release and slope stability. On the mid-Norwegian margin wedges of thick glacigenic units were deposited during past glacial intervals and covers older sequences of fine-grained hemipelagic siliceous ooze. This stratigraphic architecture combined with subsidence, large amount of biogenic methane, deep thermogenic methane reservoirs and thermal processes, provide a natural laboratory where to study the development and dynamics of methane hydrates and other digenetic processes through Cenozoic time.

Gas hydrate bearing sediments are commonly detected in our seismic profiles by the presence of cross-cutting bottom simulating reflectors (BSR's). We also recognize the presence of a second, deeper BSR. This reflector has previously been interpreted as a fossil base of the gas hydrate stability zone caused by hydrate dissociation during postglacial sea level rise and increase bottom water temperature. Several submarine slides confine the spatial distribution of present day gas hydrates, whereas the occurrence of the second BSR is patchy and discontinuous, but appears to be detached from the mass wasting structures. This observation indicates the possible link between methane dissociation and migration from the deeper BSR to the present-day gas hydrate stability depth with ocean floor destabilization at different temporal scales. The presence of a diagenetic-related BSR deeper in the stratigraphical sequence may also suggest thermal gradient increase at depth, thus providing a complementary scenario for methane hydrates dynamics through time.