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DISSERTATION TITLE: *Dynamics and sedimentology of pockmarks*

Pockmarks are among the most spectacular and mysterious features of the seafloor. They are crater-like depressions ranging in size from less than a metre to hundreds of metres. Areas pocked by millions of these depressions are continuously discovered worldwide in the most diverse environments. A part of this PhD work deals with the origin and evolution of a pockmark field in the Barents Sea. It is proposed that the pockmarks formed at the end of the last glacial period near the edge of the retreating ice sheet. The removal of the weight of the ice and the rising seawater temperature in this period triggered the destabilisation of methane hydrates (ice-like substances containing gas molecules), which caused the release of free gas through the seafloor. Initial, shallow depressions formed where the gas was leaking, while over time pockmarks deepened due to the lack of sedimentation above the active seeps.

Despite the fact that the studied pockmarks in the Barents Sea appear virtually clear of recent sediments, no evidence is found of recent gas seepage. Similar results have been reported from other areas worldwide. Based on a long-term monitoring study of pockmarks in the Oslofjord, an explanation for the maintenance of pockmarks other than fluid seepage is given, combining water turbulence and biological activity. Reduced sedimentation rates in pockmarks are ascribed to suspended fine material kept in suspension more easily in the depressions than on the rest of the seafloor, and transported away before settling. The work also includes an analogue model study of the behaviour of marine currents in pockmarks. Experiments in a water tank provide evidence for an upwelling current that, in nature, would be sufficient to prevent the settling of particles up to the grain size of very fine sand. Enhanced turbulence as observed in the pockmark model, moreover, would support suspended fine material making it transportable even by a weak current.

Using a variety of techniques (litho- and biostratigraphy, seismic interpretation, radiocarbon dating, current and sediment flux measurements, experimental hydrodynamics), this PhD work seeks to improve knowledge on the origin, past and present activity, as well as long-term evolution of seabed pockmarks. This

knowledge is crucial for assessing the role of pockmarks as indicators of underlying hydrocarbon reservoirs, as geohazards, as players in climate change, and as habitats for marine organisms.