Dynamic and Timing of the Yermak/Hinlopen Slide, Arctic Ocean

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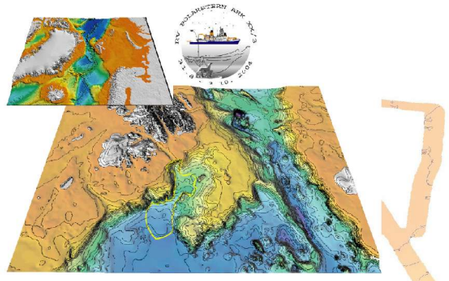
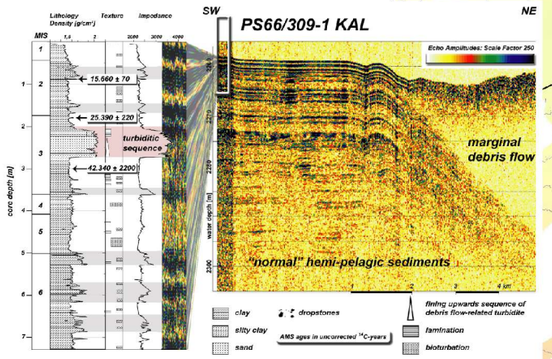
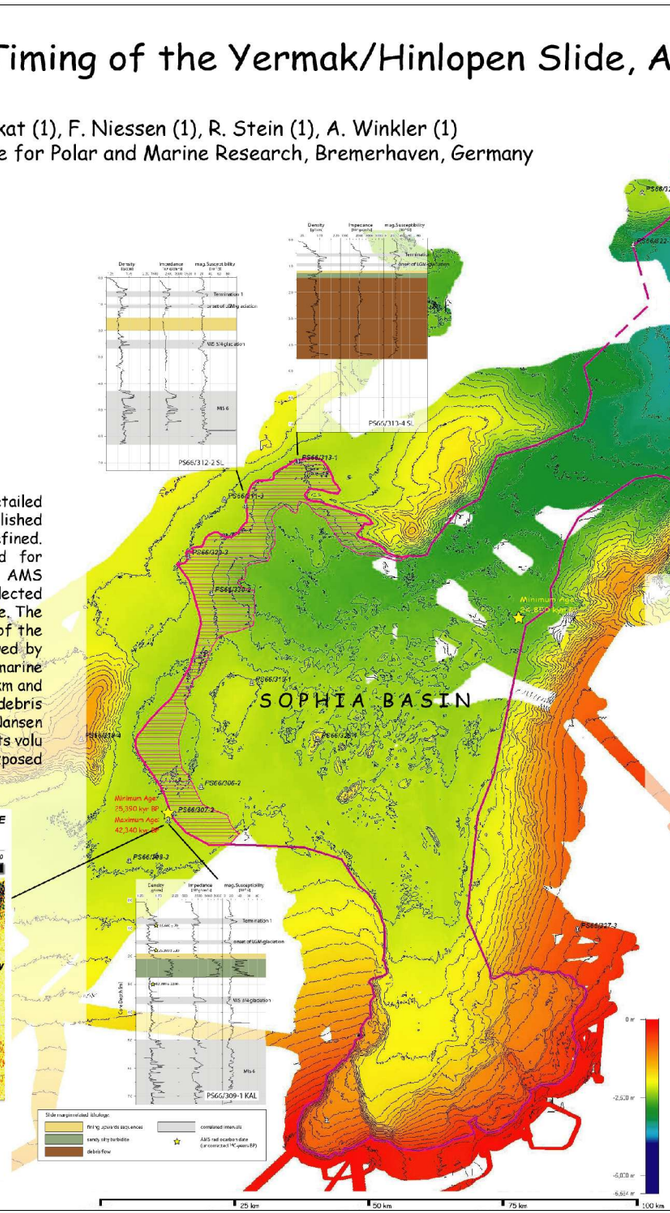
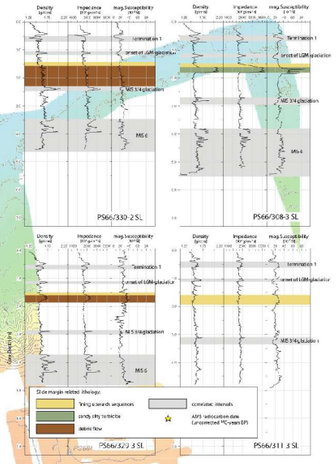


Abstract
Based on integrated interpretation of acoustic (PARASOUND), detailed bathymetric and seismic data of the shelf north of Spitsbergen, the published extend of the submarine Yermak Slide (Cherkis et al., 1999) has been refined. Key profiles across the margins of the slide have been sampled for sedimentological characterisation and dating of the submarine slide. AMS radiocarbon dating on shells of N. Pachyderma sin. of carefully selected key-cores allowed a solid characterisation of the age of the Yermak Slide. The data gives evidence of one large scale failure event at the termination of the Hinlopen cross shelf trough during MIS 3. This first event was followed by repeated minor events. The submarine megaslide developed into a submarine debris avalanche with tens of megablocks reaching extensions of up to 5 km and a relief of more than 300 m above the surrounding debris. The slide's debris rushed into the semi-enclosed Sophia Basin and finally funneled out into Nansen Basin. First calculations on the slide's area of more than 10.000 km^2 and its volu me of app. 2.400 km^3 puts the Yermak Slide among the largest exposed submarine slides worldwide.







The synthesis of already existing AWI data (bathymetry, PARASOUND, seismic) reached a comprehensive level and has been the basis for expedition ARK-XX/3 (31.08. - 03.10. 2004) with research icebreaker "Polarstern" and RV "Jan Mayen" (30.09.-14.10. 2004) to the target area north of Spitsbergen. During ARK-XX/3 additional detailed bathymetric and shallow acoustic (PARASOUND) data have been acquired on key profiles as well as 36 sediment cores – 18 gravity cores recovered on key locations and key transects of the Yermak Slide area. Core-logging as well as opening of cores and first sampling has directly been performed after recovery aboard RV "Polarstern". Accomplished sedimentological investigation of selected cores include geochemical bulk parameter, physical properties, magnetic susceptibility and x-ray radiography. Dating of microfossils from key cores with highest priority has been accomplished. Ongoing sedimentological investigation include stable isotopes of Neogloboquadrina. pachyderma sin. and XRF scanning of selected cores.

Results

The slide extend of the Yermak Slide has been revised. It extends further west within Sophia Basin than has previously been reported by Cherkis et al. (1999). The Yermak Slide funnelled out into Nansen Basin between Polarstern Seamount and the adjacent shelf north of Nordaustlandet. The overall extent is not known yet since extensive information of its distal part do not exist. Thus the total area affected by the slide might well exceed 10.000 km^2. The slide developed a consistent marginal facies within the Sophia Basin. Its marginal turbidite has been successfully cored through resulting in hemipelagic glacio-marine sediments on top and beneath the slide related turbiditic sequence. Application of the giant kastenlot ensured the recovery of enough datable microfossils. A large field of giant mega blocks characterise the inner slide debris within Sophia Basin. Individual blocks reach extensions of more than 4 km while standing up to 300 m above the surrounding debris. surrounding debris.
The integrated interpretation of geophysical and core data allows a preliminary slide summary: The slide consists of one major event dated back into MIS 3 repeatedly followed by minor events visible as debris flows in topographic lows on the main debris body. The sediment evacuation of the first main event was acomplished within several stages. As a consequence, compressional and extensional features are present in the sediments of the Sophia Basin. The sedimentological characterisation of the submarine landslide includes development of debris flows, turbidites and a debris avalanche with a number of mega blocks reaching extensions of more than 4 km and a relief of more than 300 m. The timing around 30 kyr BP coincides with the transition of the Kapp Ekholm Interstadial into Glaciation G of Svalbard (Mangerud et al., 1998) and the built-up phase of the Svalbard-Barents-Sea-Ice-Sheet. Thus, the slide occurred during falling sea level, increasing ice volume and a period of presumably increasing glacio-tectonic activity. Geometry and internal physical appearance point to a tectonically induced partial shelf collapse.

Acknowledgement

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References

Cherkis, N. Z., Max, M. D., Vogt, P. R., Crane, K., Midthassel, A., Sundvor, E., (1999): Large-scale mass wasting on the north Spitsbergen continental margin, Arctic Ocean. Geo-Marine Letters 19, 131-142.
"Leirdal, G. (1997): Senkvartär utvikling av kontinentalmarginen nord for Svalbard, M.S.thesis university of Oslo, 1997.
Mangerud, J., Dokken, T., Hebbeln, D., Heggen, B., Ingolfsson, O., Landvik, J. Y., Mejdahl, V., Svendsen, J. I., Vorren, T. O. (1998). "Fluctuations of the Svalbard-Barents Sea ice sheet during the last 150 000 years." Quaternary Science Reviews 17: 11-42.
Stein, R. (Ed.), (2005): Scientific Cruise Report of the Arctic Expedition ARK-XX/3 of RV "Polarstern" in 2004: Fram Strait, Yermak Plateau and East Greenland Continental Margin, Reports on Polar and Marine Research, 517, pp. 193.
Vanneste, M., Mienert, J., Bünz, S. The Hinlopen Slide: A Giant, Submarine Slope Failure on the Northern Svalbard Margin, Arctic Ocean, Earth and Planetary Science Letters (in press).
Winkelmann, D., Jokat, W., Niessen, F., Stein, R., Winkler, A.(2006). Age and extent of the Yermak Slide north of Spitsbergen, Arctic Ocean, Geochemistry Geophysics Geosystems (in press).

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Stein, R. (Ed.), (2005): Scientific Cruise Report of the Arctic Expedition ARK-XX/3 of RV "Polarstern" in 2004: Fram Strait, Yermak Plateau and East Greenland Continental Margin, Reports on Polar and Marine Research, 517, pp. 193.

Vanneste, M., Mienert, J., Bünz, S. (2006), The Hinlopen Slide: A Giant, Submarine Slope Failure on the Northern Svalbard Margin, Arctic Ocean, Earth and Planetary Science Letters (in press).

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