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Ice-free summers predominant in the late Miocene central Arctic Ocean - New insights from a proxy-modeling approach

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During Polarstern Expedition PS87/2014, we discovered multiple submarine landslides over a distance of >350 km along Lomonosov Ridge between about 81°N and 84°N (Stein, 2015). The load and erosional behaviour of an extended ice sheet/shelf that probably occurred during major Quaternary glaciations, may have caused physical conditions that triggered these landslides and major down-slope transport of sediments at this part of Lomonosov Ridge (Stein et al., 2016 and further references therein).

The removal of younger sediments from steep headwalls has led to exhumation of Miocene to early Quaternary sediments close to the seafloor, allowing the retrieval of such old sediments by gravity coring and multi-proxy studies of theses sediments. Within one of these studies (Stein et al., 2016), we used for the first time the sea-ice biomarker IP25 (for background of approach see Belt et al., 2007; Müller et al., 2009, 2011) together with alkenone-based sea-surface temperatures (SST) to reconstruct upper Miocene Arctic Ocean sea-ice and SST conditions. The presence of IP25 as proxy for spring sea-ice cover and alkenone-based relatively warm summer SST of >4 °C support a seasonal sea-ice cover with an ice-free summer season being dominant during (most of) the late Miocene central Arctic Ocean. A comparison of our proxy data with Miocene climate simulations seems to favour either relatively high late Miocene atmospheric CO_2 concentrations and/or an overly weak sensitivity of the model to simulate the magnitude of high-latitude warming in a warmer than modern climate.

References:

Belt, S.T., Massé, G., Rowland, S.J., Poulin, M., Michel, and C., LeBlanc, B., 2007. A novel chemical fossil of palaeo sea ice: IP25, Organic Geochemistry 38, 16–27.

Müller, J., Massé, G., Stein, R., and Belt, S., 2009. Extreme variations in sea ice cover for Fram Strait during the past 30 ka. Nature Geoscience, DOI: 10.1038/NGEO665.

Müller, J., Wagner, A., Fahl, K., Stein, R., Prange, M., and Lohmann, G., 2011. Towards quantitative sea ice reconstructions in the northern North Atlantic: A combined biomarker and numerical modelling approach. Earth Planetary Science Letters 306, 137-148.

Stein, R. (Ed.), 2015. The Expedition PS87 of the Research Vessel Polarstern to the Arctic Ocean in 2014, Reports on Polar and Marine Research 688, Bremerhaven, Alfred Wegener Institute for Polar and Marine Research, 273 pp (http://epic.awi.de/37728/1/BzPM_0688_2015.pdf).

Stein, R., K. Fahl, Schreck, M., Knorr, G., Niessen, F., Forwick, M., Gebhardt, C., Jensen, L., Kaminski, M., Kopf, A., Matthiessen, J., Jokat, W., Lohmann, G. and the PS87 Geoscience Party, 2016. Ice-free summers in the late Miocene central Arctic Ocean - New insights from proxy/model reconstruction. Nature Communications, revised version under review.