Sedimentary organic matter variations in the Chukchi Borderland over the last 155 kyr

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Knowledge on past variability of sedimentary organic carbon in the Arctic Ocean is important to assess natural carbon cycling and transport processes related to global climate changes. However, the late Pleistocene oceanographic history of the Arctic is still poorly understood. In the present study we show sedimentary records of total organic carbon (TOC, δ13C), $CaCO_3$, benthic foraminiferal δ18O, molecular markers (BIT index) and the coarse grain size fraction from a piston core recovered from the northern Northwind Ridge in the far western Arctic Ocean, a region potentially sensitively responding to past variability in surface current regimes and sedimentary processes such as coastal erosion. An age model based on oxygen stratigraphy, radiocarbon dating and lithological constraints suggests that the piston core records paleoenvironmental changes of the last 155 kyr.

TOC shows orbital-scaleincreases and decreases that can be respectively correlated to the waxing and waning of large ice sheets dominating the Eurasian Arctic, suggesting advection of fine suspended matter derived from glacial erosion to the Northwind Ridge

by eastward flowing intermediate water and/or surface water and sea ice during cold episodes of the last two glacia linterglacial cycles. At millennial scales, increases in TOC might correlate to a suite of Dansgaard-Oeschger Stadials between 120 and 45 ka before present (BP) indicating a possible response to abrupt northern hemispheric temperature changes. Between 70 and 45 ka BP, closures and openings of the Bering Strait could have additionally influenced TOC variability. $CaCO_3$ content tends to anti-correlate with TOC on both orbital and millennial time scales, which we interpret in terms of enhanced sediment advection from the carbonate rich Canadian Arctic via an extended Beaufort Gyre during warm periods of the last two glacial-interglacial cycles and increased organic carbon advection from the Siberian Arctic during cold periods when the Beaufort Gyre contracted.

Exploring fractionation models for some martian primary magmas

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The martian surface is mainly composed of tholeiitic basalts [1] as well as some alkaline compositions and sediments derived from basalts. Two hypotheses have been proposed to explain the compositions of martian basalts: 1) melting of martian mantle under various conditions, forming primary magmas with diverse compositions [2], or 2) fractional crystallization of primary magmas, resulting in the various basaltic compositions [3]. On the Earth, the Moon, and the asteroid 4 Vesta, primary magmas are scarce, indicating that most magmas fractionated during ascent. This model should also be applicable for Mars.

We conducted hundreds of fractional crystallization calculations for four different martian primary magmas: 1) Humphrey, 2) Fastball, 3) Yamato-980459, and 4) nakhlite parental melts, using MELTS and pMELTS [4]. Previously, all calculations and experiments have been isobaric. Our results are the first calculations conducted on martian magmas under polybaric conditions. In addition, we investigated isobaric and polybaric calculations at various oxygen fugacities, water contents, and P-T paths for each primary magma. Our study shows that polybaric fractionation of primary magmas (except Y-98) leads to the formation of alkaline compositions if most of the crystallization occurs at high pressures but forms subalkaline compositions if magma undergoes fractionation during rapid ascent.

In addition to examining martian primary magma evolution, we investigated formation of three specific martian alkaline rock compositions: 1) Backstay, 2) Jake Matijevic, and 3) nakhlite intercumulus glass. Backstay and the nakhlite intercumulus glass compositions can be formed through fractional crystallization of tholeiitic primary magmas, with or without water, and with a primary magma held at high pressures. Jake Matijevic [5] likely formed from a metasomatized alkali-rich melt. Our results suggest that alkaline magmas on Mars are formed similarly as on Earth and may be more common than suggested by orbital surveys for alkaline rocks.

[1] McSween *et al*. (2009) *Science, 324*, 736- 739. [2] Baratoux *et al*. (2011) *Nature, 472,* 338–341. [3] McSween *et al*., (2006) *J. Geophys. Res. 111*, E09S91. [4] Ghiorso and Sack (1995) *Contrib. Min. and Pet., 119,* 197-212 [5] Stolper *et al*. (2013) LPSC XLIV, Abstract #1685.

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