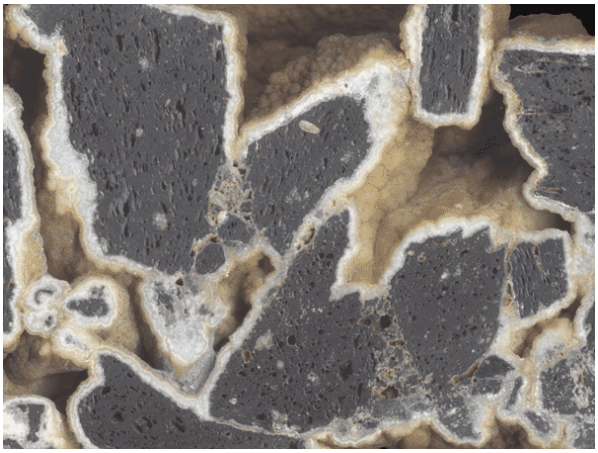
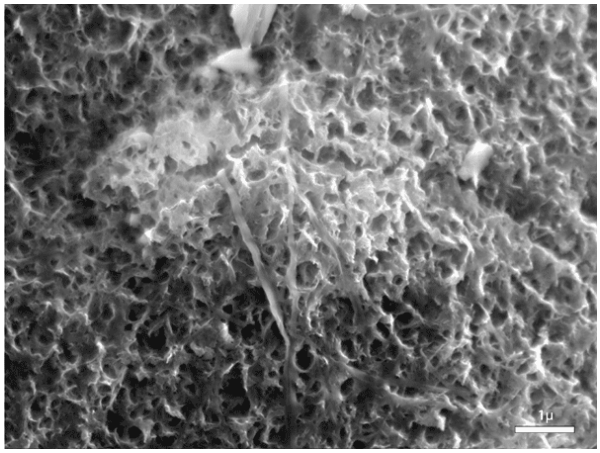
LIFE IN A MARS ANALOG: MICROBIAL ACTIVITY ASSOCIATED WITH CARBONATE CEMENTED LAVA BRECCIAS FROM NW SPITSBERGEN. H. E. F. Amundsen[1], A. Steele[2], M. Fogel[2] , J. Kihle[3], M. Schweizer[2], J. Toporski[2], A. H. Treiman[4], [1]Physics of Geological Processes, Univ. of Oslo, N-0316 Oslo, Norway <h.e.f.amundsen@fys.uio.no>, [2]Geophysical Laboratory, Carnegie Institution of Washington, Washington DC 20015, USA, [3]Institute for Energy Technology, N-2027 Kjeller, Norway, [4]Lunar and Planetary Institute, Houston TX 77058, USA

Introduction: Low-temperature carbonate deposits in volcanic centres on NW Spitsbergen (Norway) comprise carbonate globules near identical to those in ALH84001 [1] and represent a unique opportunity to examine water-rock interaction and possible microbial activity in a Mars analog environment. Field observations show that abundant magnesite and dolomite were deposited in lava conduits after eruption, likely in the presence of standing water. SEM-, fluorescence- and C,N isotope data indicate the presence of microbial activity within vesicular lava breccias in these conduits.

Methods: Lava breccias (Fig. 1a) were sampled from vertical lava conduits in the central part of the Sverrefjell volcano ca 400 m.a.s.l. Samples were slabbed or broken open and examined by optical microscopy and SEM. Acridine- and DAPI stains were applied in combination with UV- and blue (405 nm) light fluorescence to detect RNA/DNA. Handpicked carbonate- and lava fragments were analysed for $\delta^{13}C$ and $\delta^{15}N$ before and after leaching with 6N HCl.

Description: The ca 1 Ma Sverrefjell volcano is situated at 80°N and formed during a major glacial event. Exposed vertical lava conduits are typically filled with lava breccias cemented together by magnesite and dolomite carbonates. Carbonates are strongly zoned ranging from dolomite with minor calcite to an outer layer of magnesite. Abundant lava vesicles commonly show a greyish coating associated with small (100 µ) carbonate globules. SEM data shows the





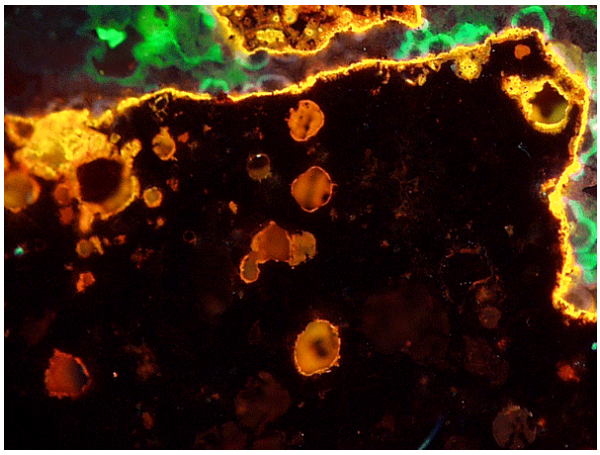


Figure 1: (a) Slabbed breccia with vesicular lava fragments covered by 2-3 mm thick magnesite-dolomite coating. (w.o.f. = 5 cm). (b) Filamentous and spongy carbon-rich layer on vesicle wall in lava clast (scale bar = 1µ). (c) Blue light (405 nm) fluorescence from slabbed breccia after staining with Acridine Orange (w.o.f. = ca 1 cm).

vesicle coatings to consist of a fibrous and spongy carbon-rich substance (Fig 1b). Similar material is also present at clast-carbonate interfaces. Breccia fragments were stained with DAPI and Acridine Orange and examined under both UV- and Blue light fluorescence. Both coated vesicles and lava-carbonate contacts showed strong fluorescence indicating specific staining of microbial RNA/DNA.

Handpicked fragments of carbonate coating and vesicular lava were analysed for $\delta^{13}C$ and $\delta^{15}N$ before and after leaching with 6N HCl. Lichen from the breccia outcrop was analysed for reference. Carbonate coating and unleached basalt show $\delta^{13}C$ values (PDB) between 1.0 and 1.5 (Fig. 2), organic carbon from leached basalt shows $\delta^{13}C$ between -11 and -13 and $\delta^{15}N$ around -4 to 1. Lichen carbon shows $\delta^{13}C$ between -22 and -26 and $\delta^{15}N$ between -8 and 1.

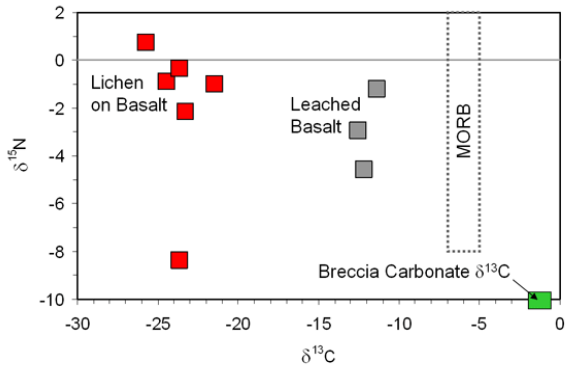


Figure 2: $\delta^{13}C$ (PDB) and $\delta^{15}N$ isotope data.

C isotope data shows that organic material present within the basalt vesilces is heavier than photosynthetically produced C and analysis oflichens in teh area suggest that little surface contamination haspenetrated the rock. This leads to the suggestion that the organicmaterial has another origin, this hypothesis will be expanded upon during presentation.

References: [1] Treiman A. H. et al. (2002) Earth Planet Sci. Lett., 204, 323-332.