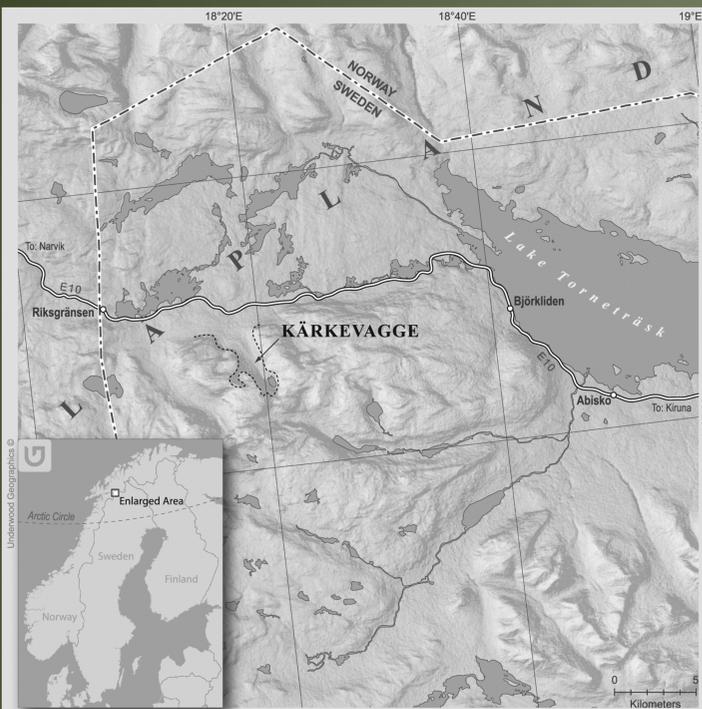


# Anaerobic Culturing Experiments of Sulfate Crusts, Fe/Mn Skins, and Aluminum Glazes from Kärkevagge, Swedish Lapland

Rebecca L. Mickol<sup>1</sup> and Cassandra L. Marnocha<sup>1</sup>

<sup>1</sup>Arkansas Center for Space and Planetary Sciences, University of Arkansas; rmickol@uark.edu

## BACKGROUND



**Figure 1.** Location of Kärkevagge, Sweden.

- Rock coatings may serve as microbial “safe havens” on Mars [1, 2]
- Kärkevagge is a glacially-eroded U-shaped valley in Swedish Lapland (Fig. 1)
- Three coating types used are sulfate crusts (jarosite, gypsum), Fe/Mn films (goethite, hematite) (Fig. 2), and aluminum glazes (basaluminite and alunite) [3]
- Samples collected summers 2010, 2012

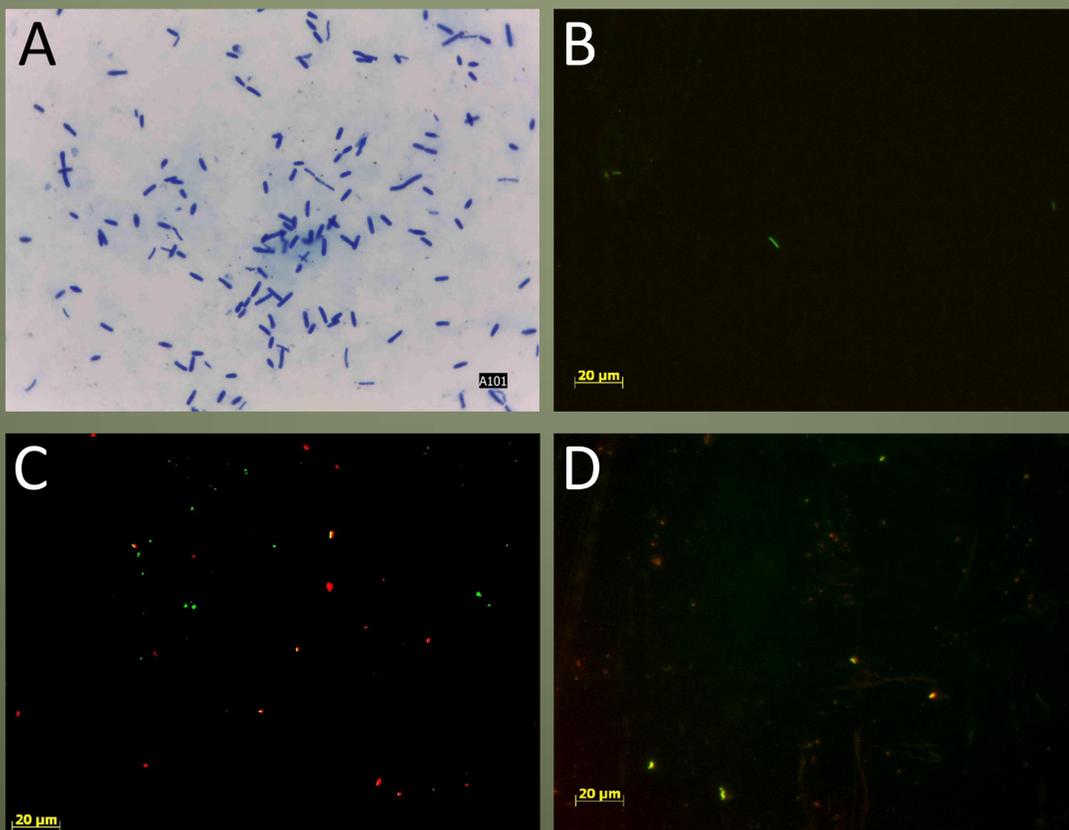


**Figure 2.** Fe/Mn film from Kärkevagge, Sweden.

## METHODS

- Eleven samples from all coating types, with two replicates per sample per medium
- Two types of anaerobic culture media prepared [4] with 10 mL of medium per tube
- Tubes sterilized via autoclave with samples added anaerobically
- Sterile 2.5% sodium sulfide ( $\text{Na}_2\text{S}$ ) added and tubes pressurized with 200 kPa of  $\text{H}_2$  gas
- Controls prepared as above with varying  $\text{Na}_2\text{S}$  and  $\text{H}_2$  gas for each coating type: Tube A,  $\text{Na}_2\text{S}$ ,  $\text{H}_2$ ; Tube B,  $\text{Na}_2\text{S}$ , no  $\text{H}_2$ ; Tube C,  $\text{Na}_2\text{S}$ ,  $\text{H}_2$ ; Tube D, no  $\text{Na}_2\text{S}$ , no  $\text{H}_2$
- Aliquots of 0.5 mL transferred to new medium after 5 months
- Tubes analyzed via gas chromatography, methylene blue staining (Fig. 3A), and fluorescent microscopy (Figs. 3B-D, 4)

## RESULTS



**Figure 3.** A. Bacteria from Fe/Mn film in anaerobic culture medium, mag. = 1000x. B. Live/dead stain of bacteria sampled from jarosite crust in anaerobic culture medium, mag. = 400x. C, D. Bacteria from Fe/Mn film, mag. = 400x.

## Rock Coating

Aluminum glaze

Jarosite crust (1)

Jarosite crust (2)

Jarosite crust (2\*)

Fe/Mn film (1)

Fe/Mn film (2\*)

## Cells/mL

$2.4 \times 10^9$

$6.0 \times 10^9$

$8.8 \times 10^8$

$5.2 \times 10^8$

$8.9 \times 10^8$

$2.0 \times 10^9$

**Figure 4.** Total number of cells/mL for coating types. Counts averaged over 10 random samples. Asterisks denote samples from transferred medium. Numbers denote replicates.

## DISCUSSION/CONCLUSIONS

- Complements study of microbial diversity in rock coatings in Kärkevagge, Sweden
- Survival under anaerobic conditions raises potential as Martian biosignatures
- Lack of methane detection does not rule out methanogen presence
- Sequencing analyses reveal presence of anaerobic bacteria, including sulfate-reducing bacteria and methanotrophs (Marnocha and Dixon, LPSC XLIV, #1566)

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## References

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