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Metallophilic extreme thermoacidophiles: potential biosignatures in the Venusian clouds

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M. W. Lomonosow

"Some ask if there are similar to us humans living on planets... If one we have a sourt that, ... that one should go have a swell".

"Некоторые живущие на кто про то з того же и на тах есть еры? Ежели редет для

Lomonosov, M.V., 1761a. The Imperial Academy Of Sciences

Petersburg Imperial Academy of

Metallophilic extreme thermoacidophiles Archaeal order Sulfolobales





- Metallosphaera sedula
- Metallosphaera hakonensis
- Sulfolobus acidocaldarius
- Sulfolobus metallicus
- Acidianus brierleyi
- Acidianus manzaensis

Thermophiles → growth at high temperatures – optimal between 65-75°C

Acidophiles \rightarrow growth at low pH – optimal between **1.0 – 3.0**

Metallophiles → utilize metals e.g. Fe, S for energetic needs & resistant to high metal concentrations in the environment Venera-D, Moscow, 2019



Metallosphaera sedula RESISTAN

Kölbl D., 2017; Milojevic T., 2019; Blazevic A., 2019

SoxL

CbsB

2Fe-2S

SoxN

G. Wheaton, 2015

NADH

QH.

b FoxC

4Fe-4S

FoxG

-> Uphill

FoxD

Downhill ←

FoxB

Cu_pa:

M. sedula cells grown on *wikersität* terrestrial mineral materials



Milojevic T., 2019

M. sedula cells grown on *wersität* terrestrial mineral materials



M. sedula cells on terrestrial materials wiversität



Venera-D, Moscow, 2019

Milojevic T., 2019

M. sedula cells on terrestrial minerals





Venera-D, Moscow, 2019

Blazevic A., 2019



Blazevic A., 2019

M. sedula cells on terrestrial minerals





Milojevic T., 2019

Venera-D, Moscow, 2019

Blazevic A., 2019

Biotransformation of the stony wivesität meteorite NWA 1172 by *M. sedula*



M. sedula grown on meteorite materials





Astromaterials for Venus???









universität wien

Conclusions/Future Outlook

 Cultivation of the metallophilic extreme thermoacidophiles on Venusian relevant astromaterials;

niversität

- The **aerosolization** of these microorganisms followed by the study of **metal-microbial interface** of the aerosolized samples.
- We propose to focus on metalloorganic signatures of the afore-mentioned chemolithotrophs, including nanoscale iron/ sulfur microbial interfaces and sulfur-bearing specific organic biomarkers (**thiophenes** from *Sulfolobus* quinons).
- Such investigations may provide a guiding point for **in-situ measurements** to analyze collected Venusian aerosol samples. Furthermore, the performed studies may pave the way to the efficient nanoanalytical spectroscopy of collected and returned samples captured in Venus clouds in order to assess their biogenicity.

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frontiers in Microbiology Extreme Microbiology 📀



Research Topic

Astrobiology At The Interface: Interactions Between **Biospheres, Geospheres, Hydrospheres And Atmospheres Under**

Planetary Conditions

