Sticking together: Inter-species aggregation of bacteria isolated from iron snow is controlled by chemical signaling

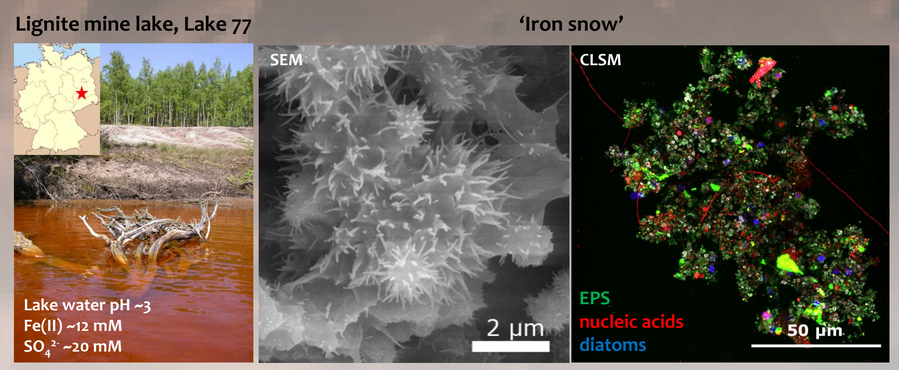
Jiro F. Mori[1], Nico Ueberschaar[2], Shipeng Lu[1,3], Rebecca E. Cooper[1], Georg Pohnert[2], Kirsten Küsel[1,3]

[1]*Aquatic Geomicrobiology, Institute of Ecology, Friedrich-Schiller University Jena, Germany*
[2]*Institute of Inorganic and Analytical Chemistry, Friedrich-Schiller University Jena, Germany*
[3]*The German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Germany*

Background

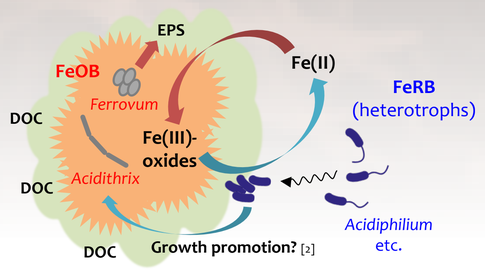
Mixed organic and inorganic pelagic aggregates (marine/lake snow) which form in the water column are considered local hot spots for microbial interactions. However, the exact mechanisms for their interactions is not well characterized due to the high microbial and chemical complexity.

Interestingly, Iron-rich pelagic aggregates ('**iron snow**') found in acidic mine lake are formed and colonized by small dominant groups of Fe(II)-oxidizing bacteria (FeOB) and Fe(III)-reducing bacteria (FeRB), thus providing a simplified model to study mechanisms of interaction and communication among key bacterial players within pelagic aggregates.



Research objective

Detection and identification of **infochemicals** that signify potential chemical communication between FeOB & FeRB within the iron snow.



Active FeOB/FeRB in iron snow [1]

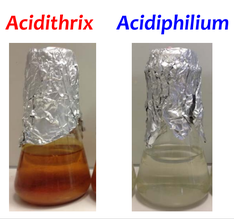
Bacterial species	Relative abundance (%, qPCR)
FeOB	**38.9**
Acidithrix	19.7
Ferrovum	19.2
FeRB	**14.0**
Acidiphilium	10.1
Albidiferax	3.3
Geobacter	0.6

Isolation of Bacteria

Sampling of lake water

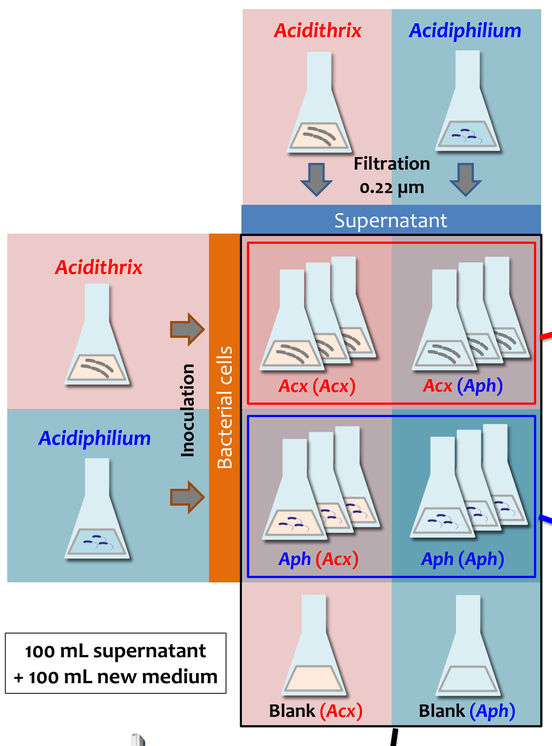
Closest isolate relative	Identity %
FeOB	
Acidithrix ferrooxidans PY-F3	100
FeRB	
Acidiphilium cryptum JF-5	99

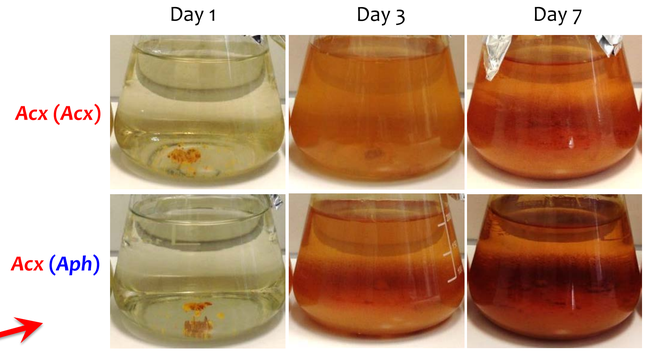
Acidithrix *Acidiphilium*

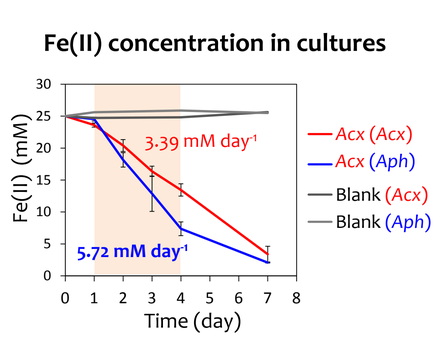


APPW+YE medium (pH 2.5)
25 mM $FeSO_4$
0.2 g/L Yeast extract

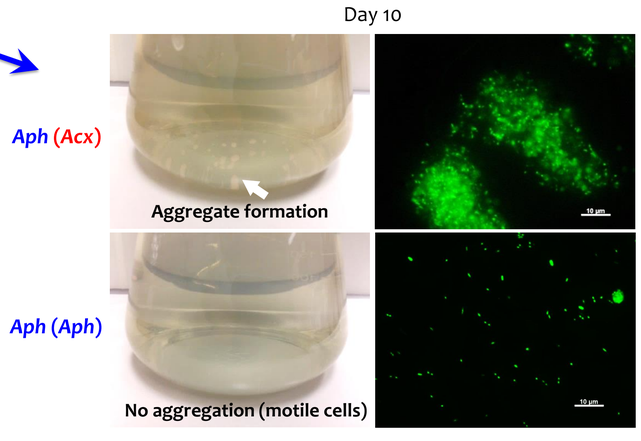
Supernatant exchange assay





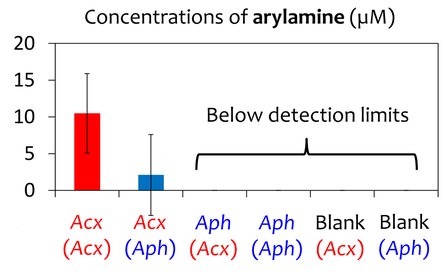


Rates of Fe-oxidation by *Acidithrix* were accelerated in presence of *Acidiphilium* supernatant.



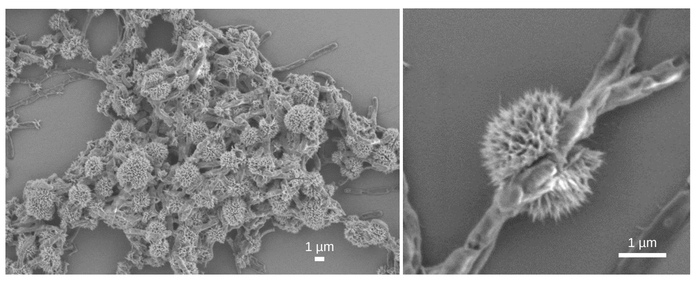
***Acidiphilium* cells formed aggregates in presence of *Acidithrix* supernatant.**

GC/MS analysis

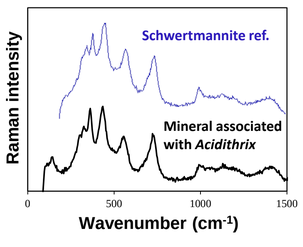


arylamine : a possible cell consolidation signal molecule for gram negative bacterium which suppress cell motility

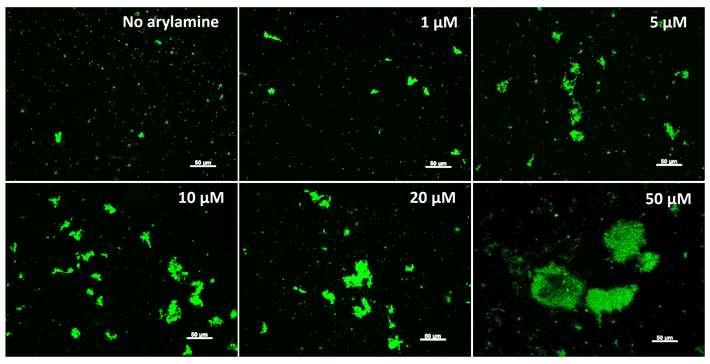
Aggregation of *Acidithrix*



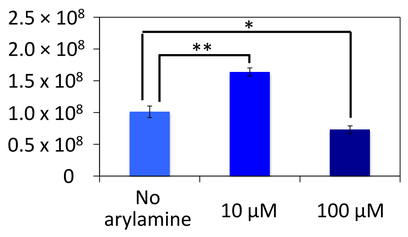
***Acidithrix* formed aggregates in association with Fe-oxide (Schwertmannite) [3]**



Effect of arylamine on *Acidiphilium*

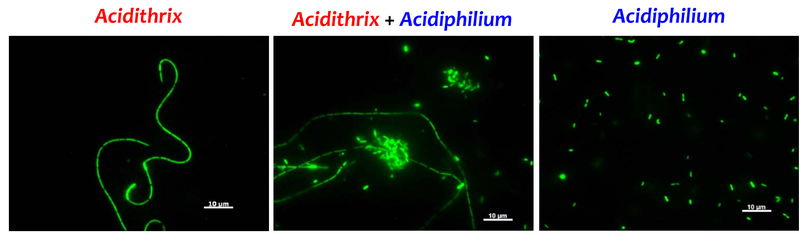


Bacterial 16S rRNA gene copy numbers ml^{-1}
(day 6, n=9)



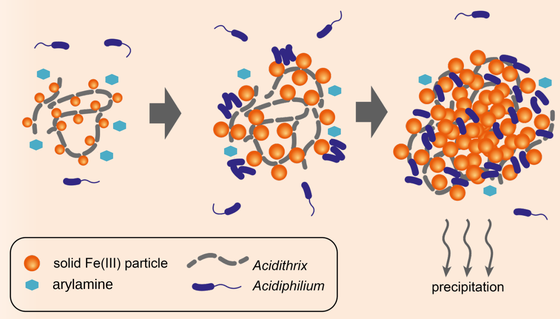
5-20 µM arylamine induced cell aggregation and faster growth of *Acidiphilium*.

Co-culture experiment



***Acidiphilium* cells formed aggregates in association with *Acidithrix* in co-culture.**

Summary



- ***Acidithrix* (FeOB) rapidly forms iron-rich aggregates and plays a central role in iron snow formation.**
- **Metabolites of *Acidiphilium* (FeRB) accelerates growth and Fe(II) oxidation of *Acidithrix*.**
- **Not only the shuttling of resources, but an active control by chemical signals shapes the association of the iron snow consortia and their behavior.**

References

[1] Lu, S. et al., *Applied and Environmental Microbiology* (2013)
[2] Liu, H. et al., *Archives of Microbiology* (2011)
[3] Mori, J. F. et al., *Microbiology* (2016)

Acknowledgements

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