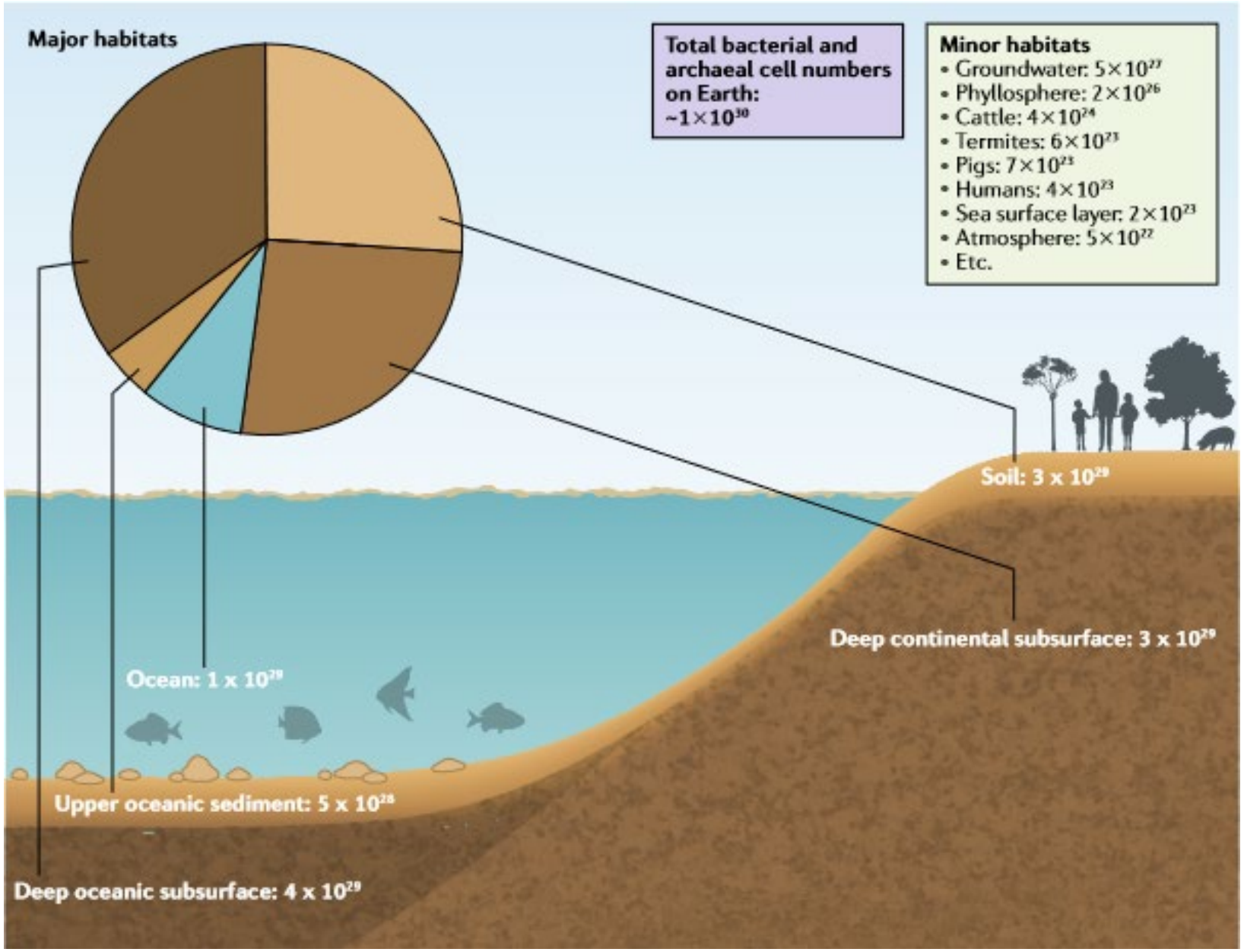
How 3D microscopy can help the biogeosciences

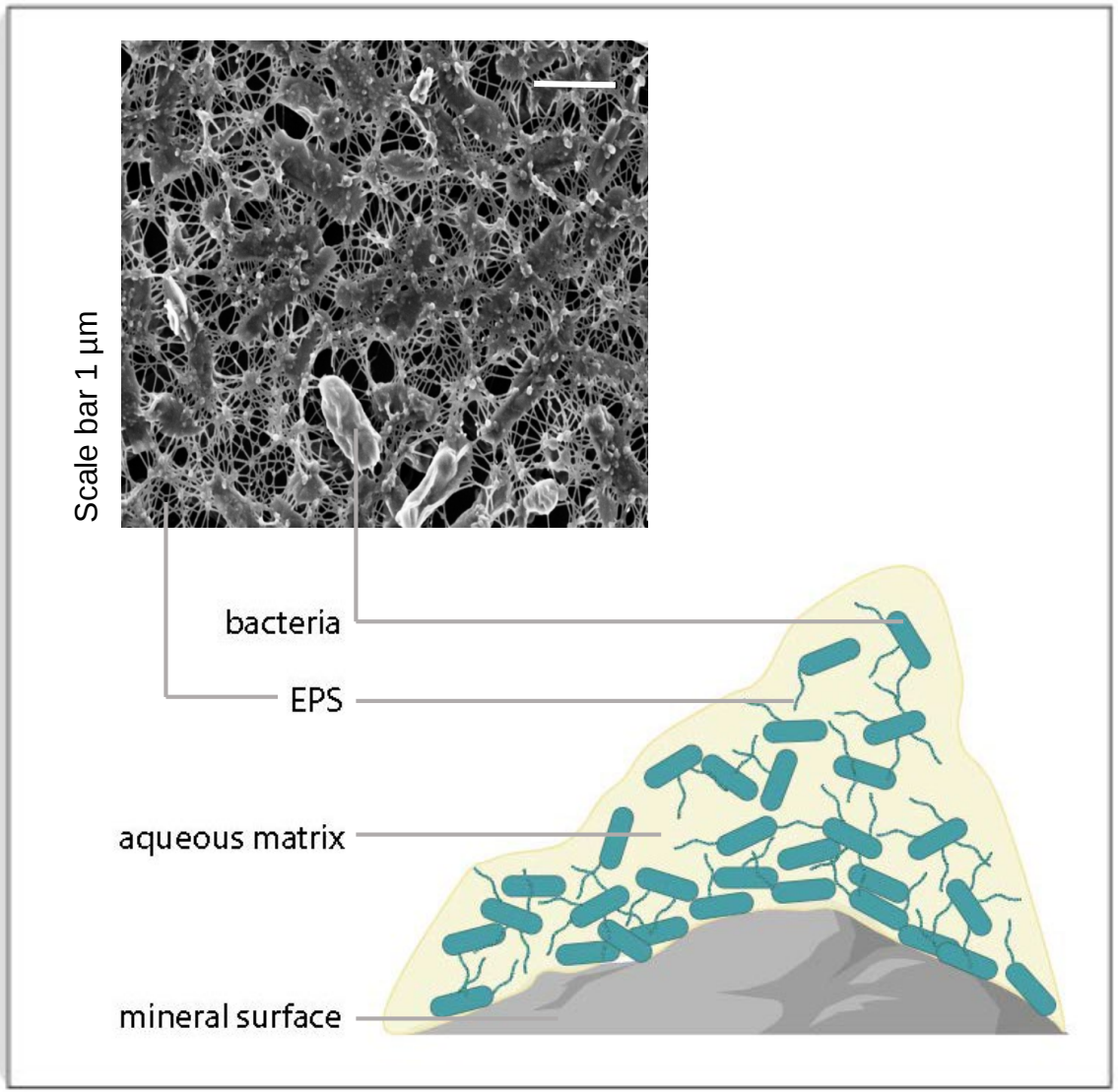
V. Rollot (rollot@ipgp.fr), E. Gérard, C. Dejean, C. Le Losq – IPGP, B. Ménez, J.M. Diaz – Scripps, F. Guyot – MNHN, A. Gélabert – CEREGE



Flemming and Wuertz, 2019

Biofilms are 3D gel-like structures

Biofilm on the rocks

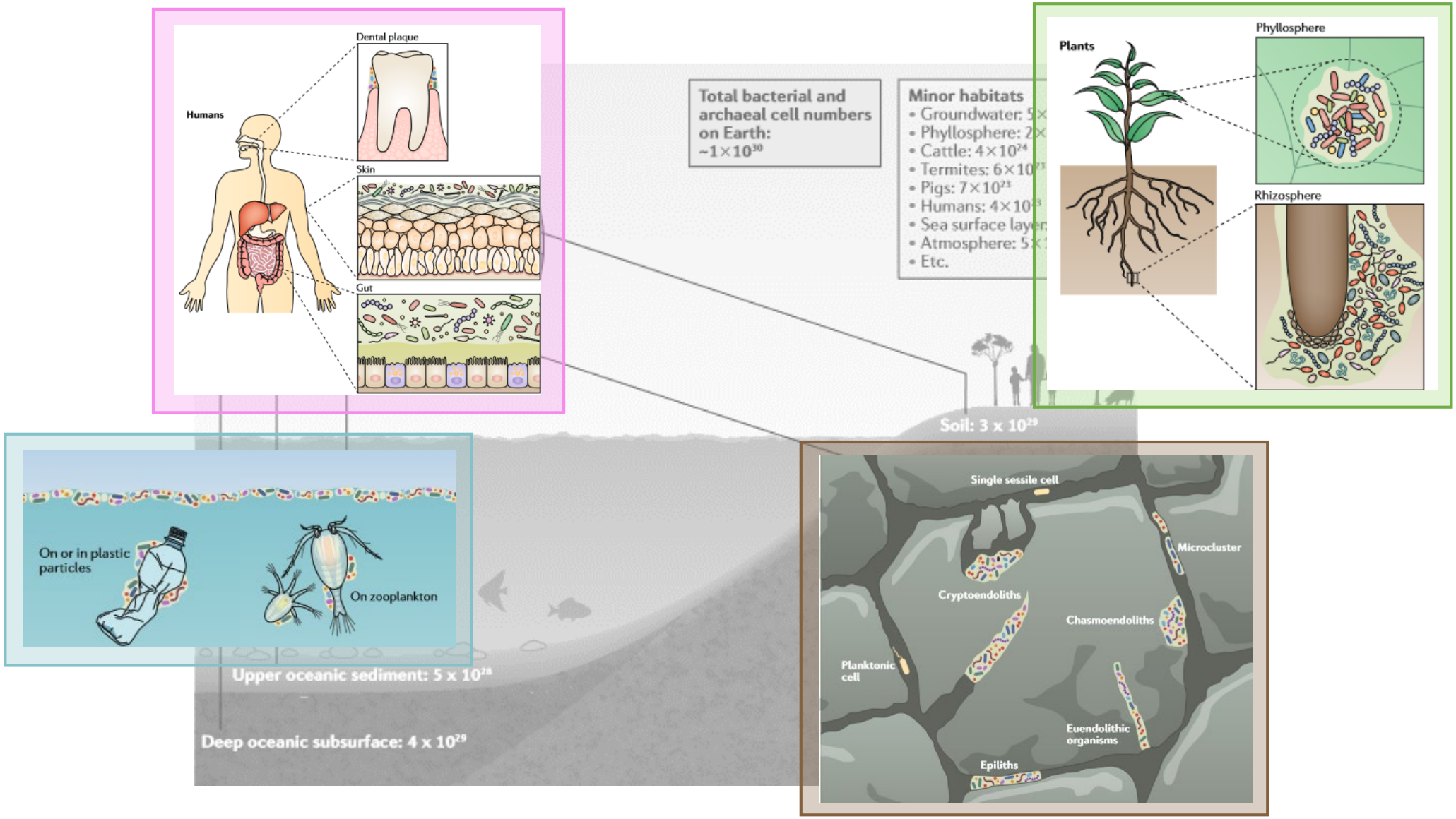


Hydrated

Low permeability

µenvironments

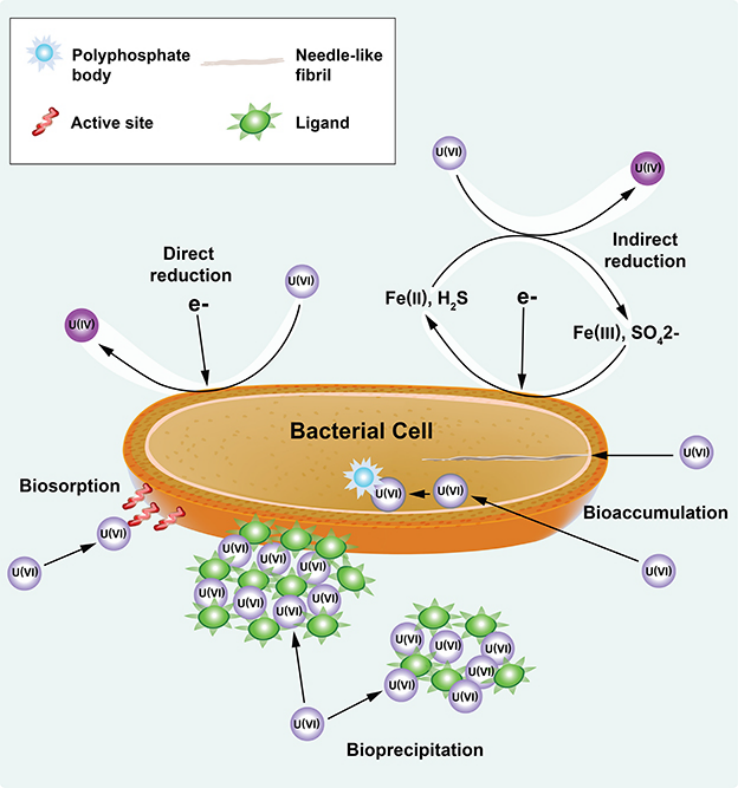
Photo: Wenatchee River, Washington
SEM image: ©T. Couasnon
Schema: created in BioRender



Adapted from Flemming and Wuertz, 2019

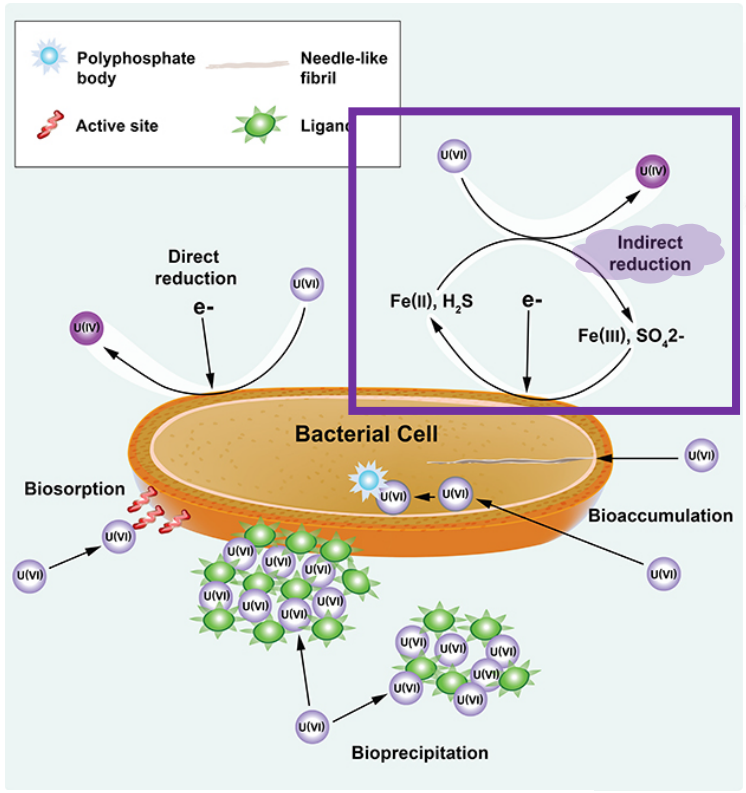
How do they interact with their environment? Especially with metals?
⇔ biogeochemical cycles

Microorganisms interact with metals



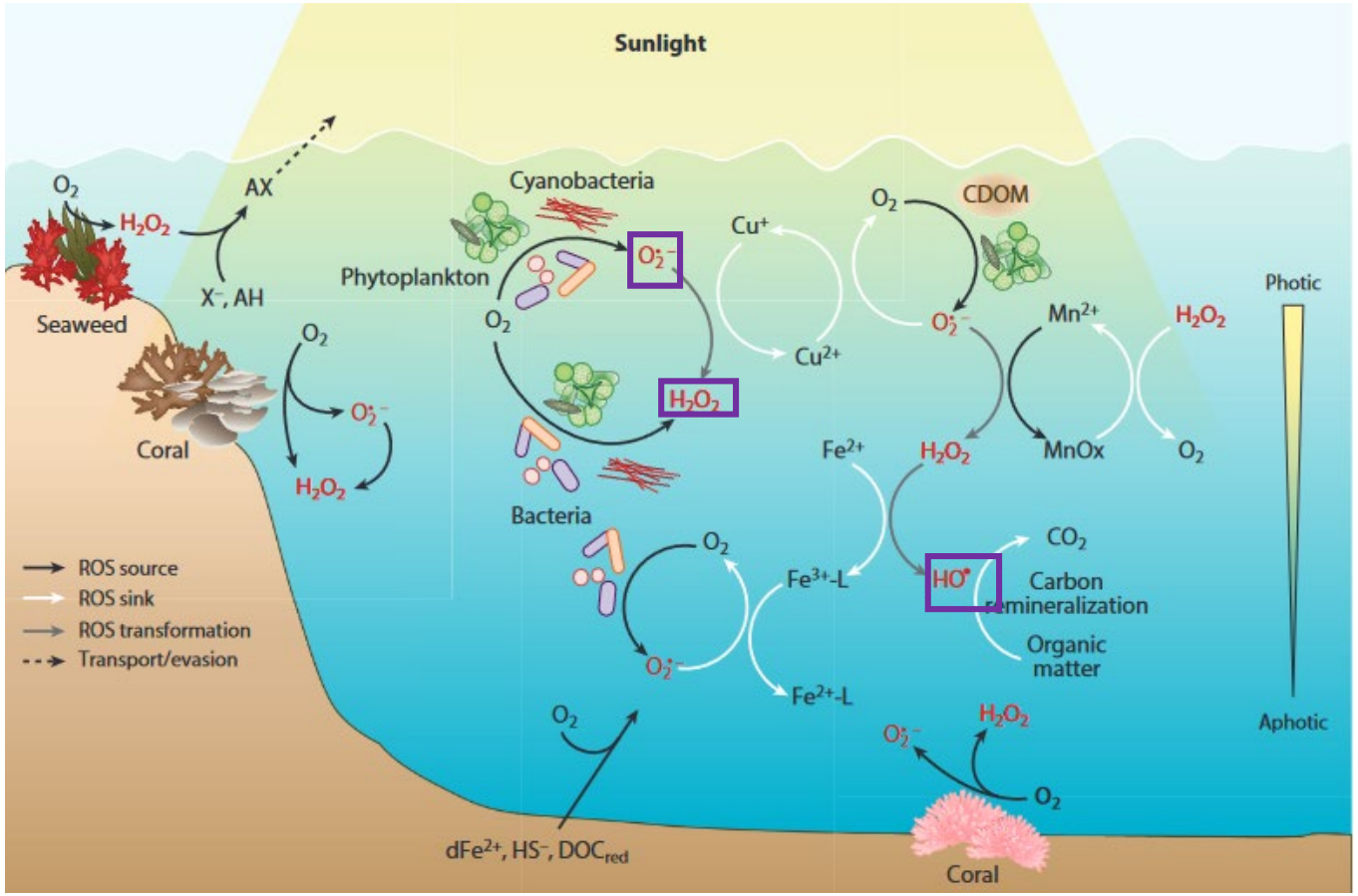
Renslow, 2017

The response to the metals under investigation is related to O_2



Renslow, 2017

redox

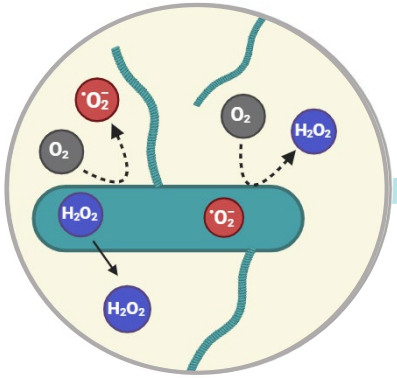


C. Hansel and J.M. Diaz, 2021
Learman et al, 2011

ROS: Reactive Oxygen Species = key but cryptic process

ROS in biofilms: a dual challenge

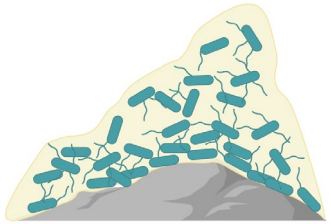
ROS



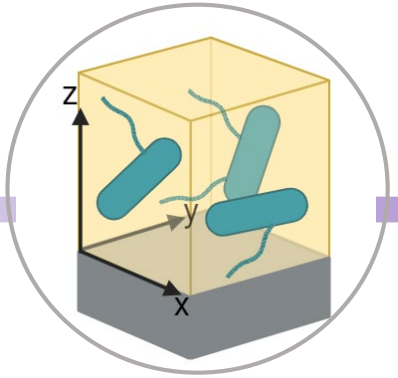
- Highly reactive
- Transient (µs-min)

→

- Spectro(photo)metry, chemi-luminescence, fluorescent probes, chromatography, genetic assay



Biofilms



- Hydrated
- 3D living structure

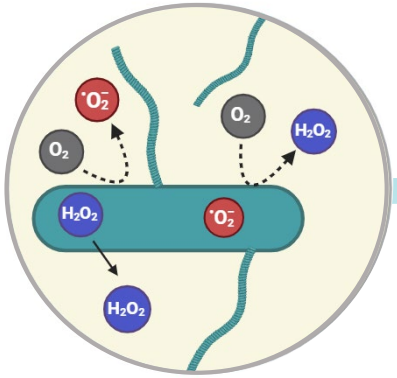
→

- Conventional imaging not suitable: TEM, SEM, light microscopy, 2D epifluorescence
- 3D imaging

created in BioRender

ROS in biofilms: a dual challenge

ROS



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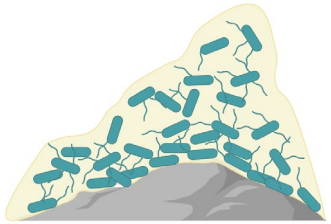
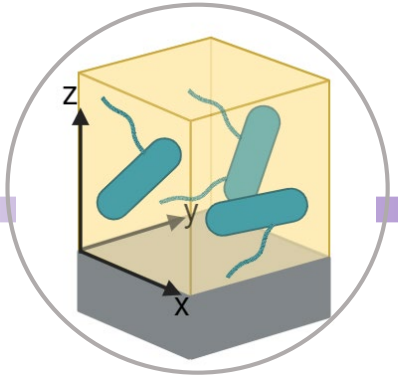


Confocal Laser Scanning Microscopy (CLSM)

Biofilms



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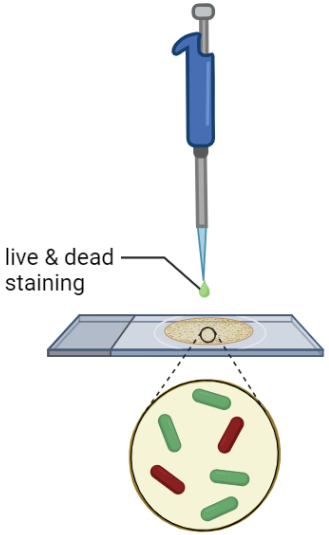
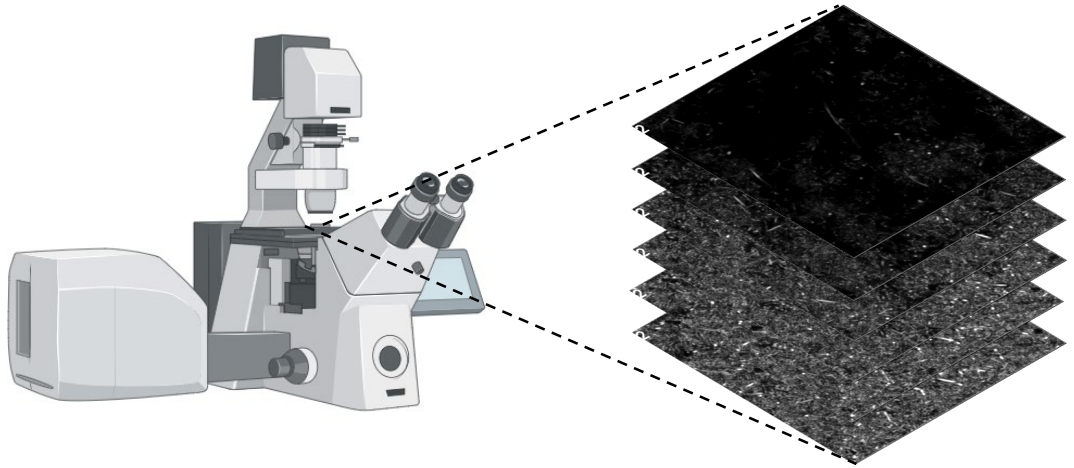
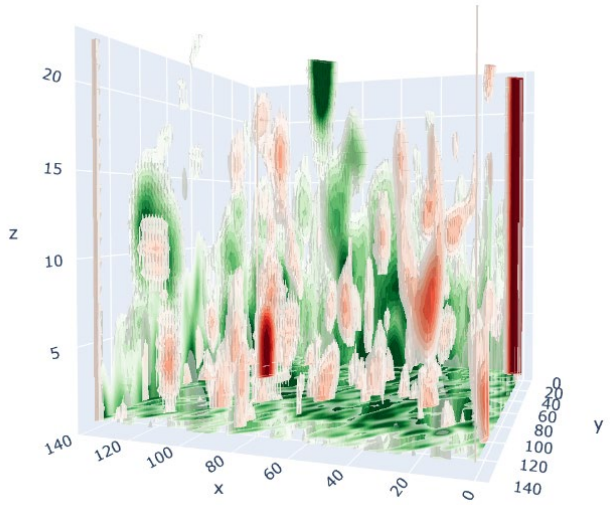
Confocal Laser Scanning Microscopy

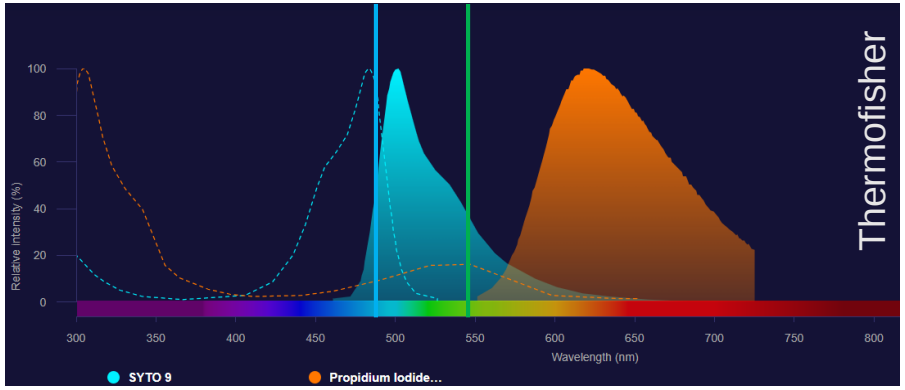
Staining | Imaging | Image analysis



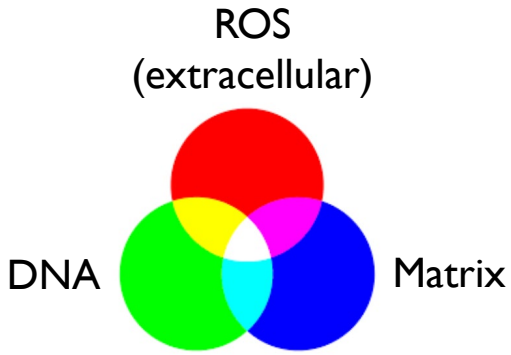


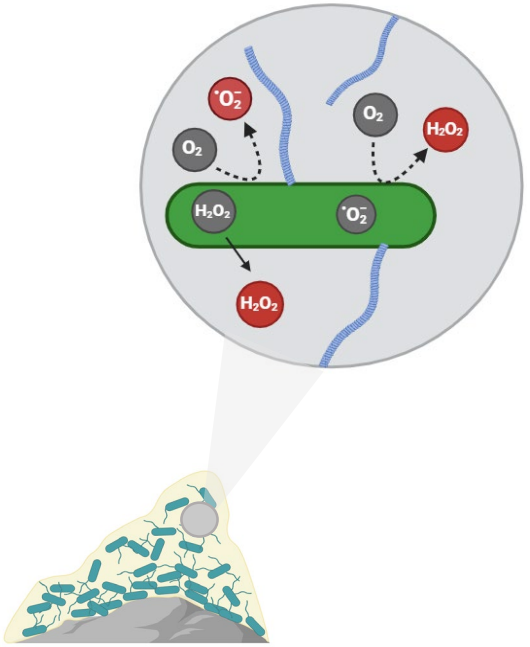


Blue Green lasers



Case study: ROS in biofilms





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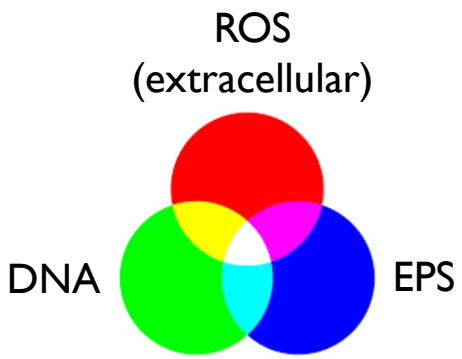

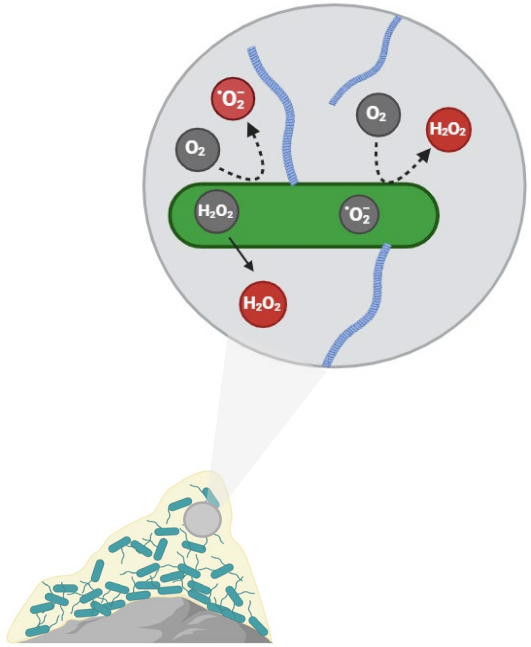

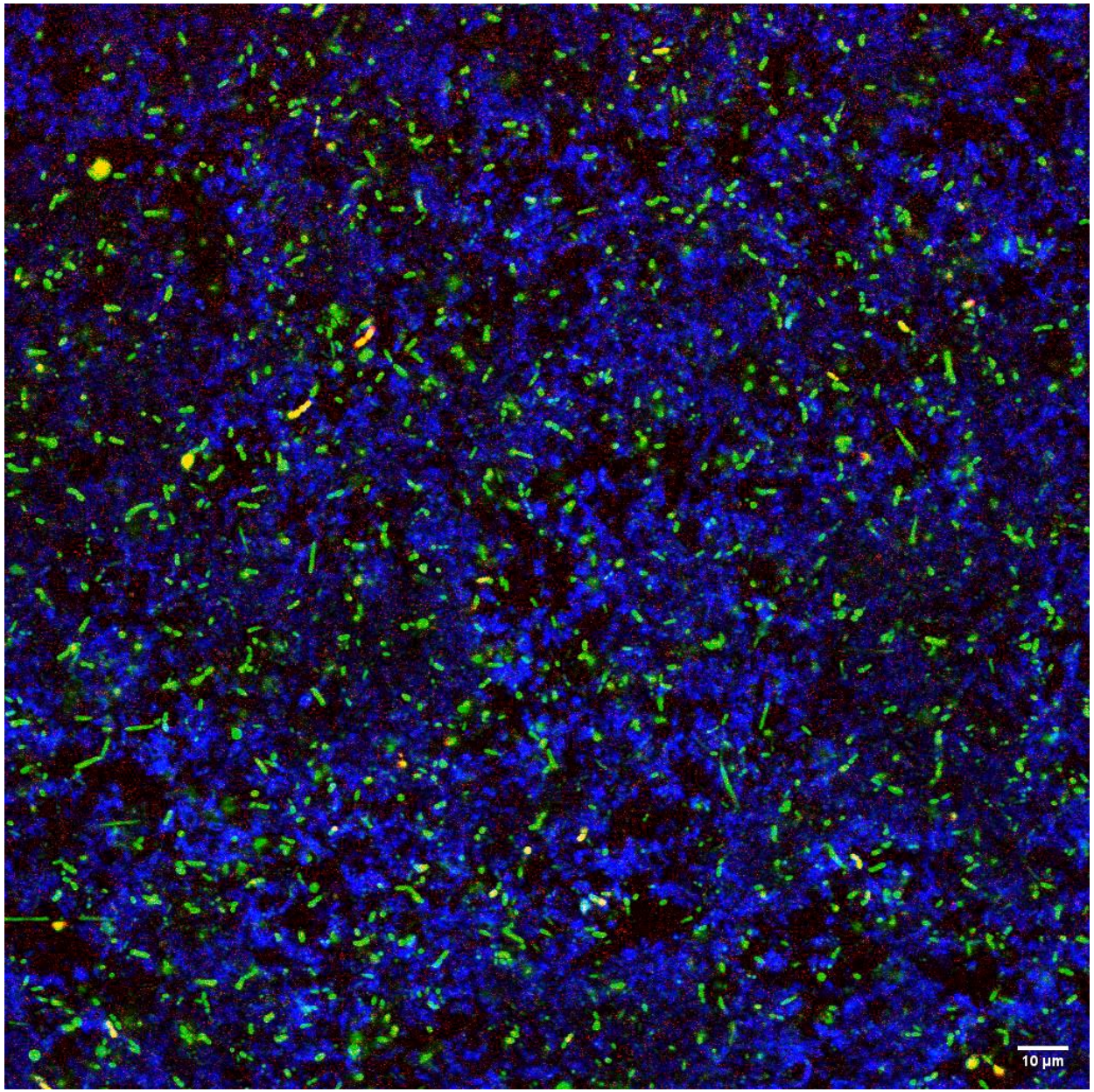

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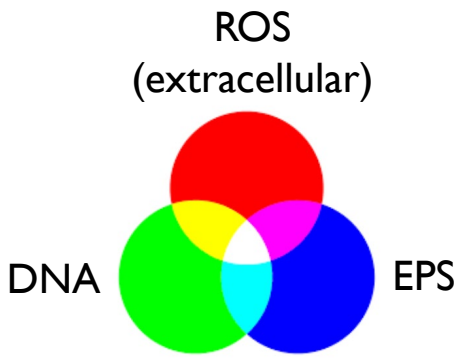
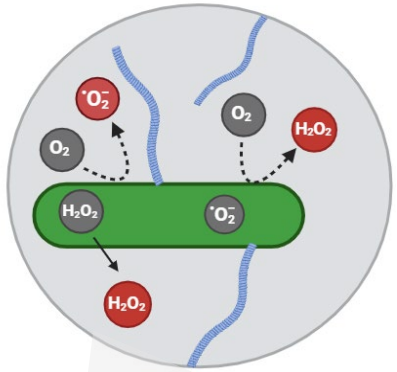
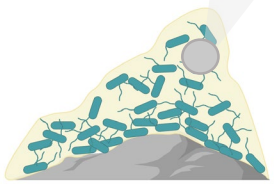
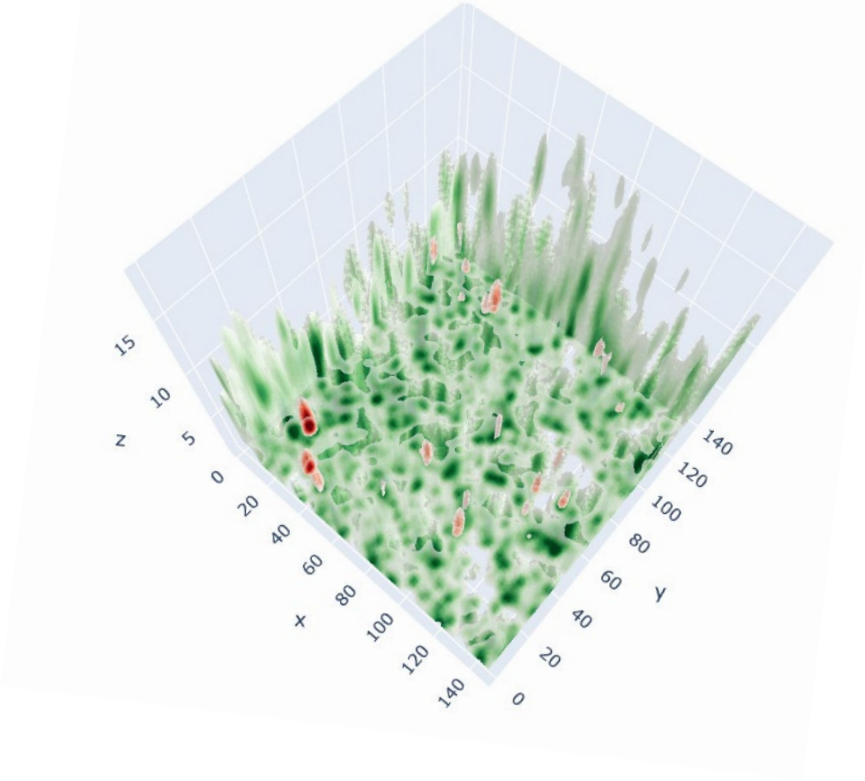
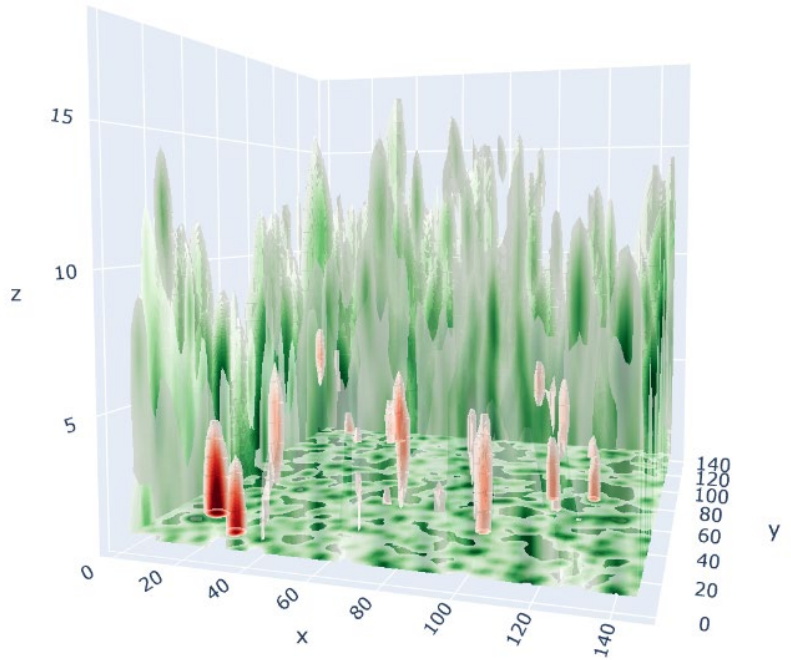






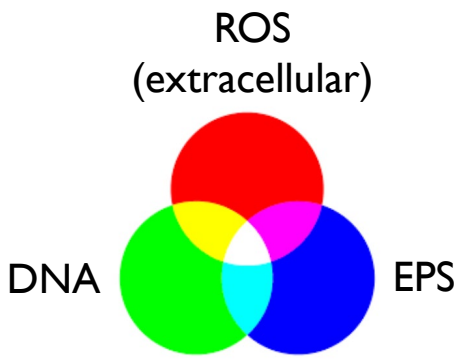


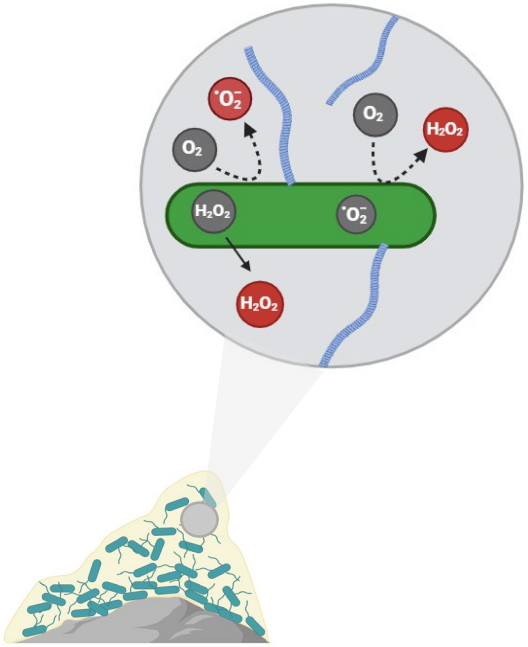


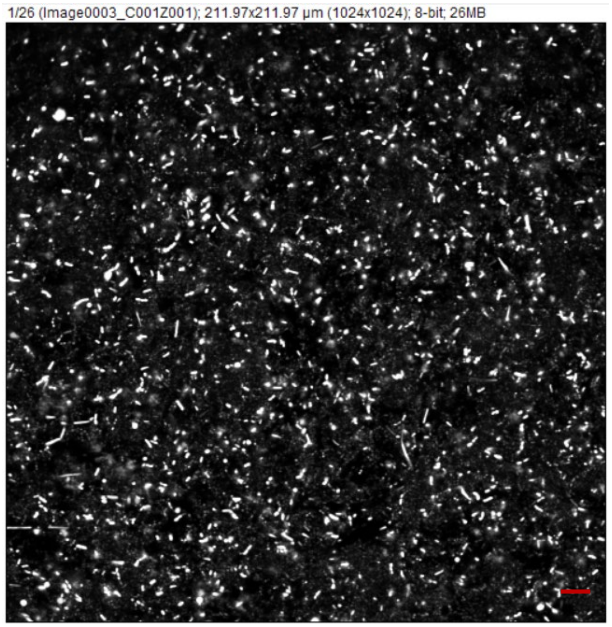
- Local ROS production
- Statistical analysis with machine learning
- Comparison with metal stressed biofilms

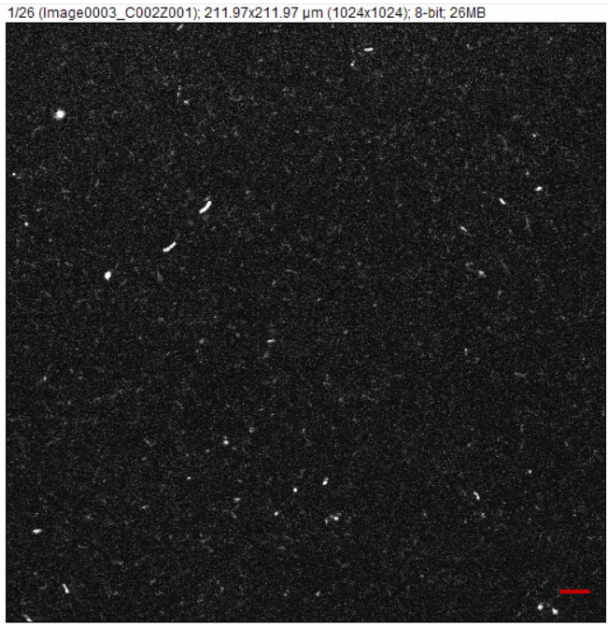
Thank you & bon appétit!

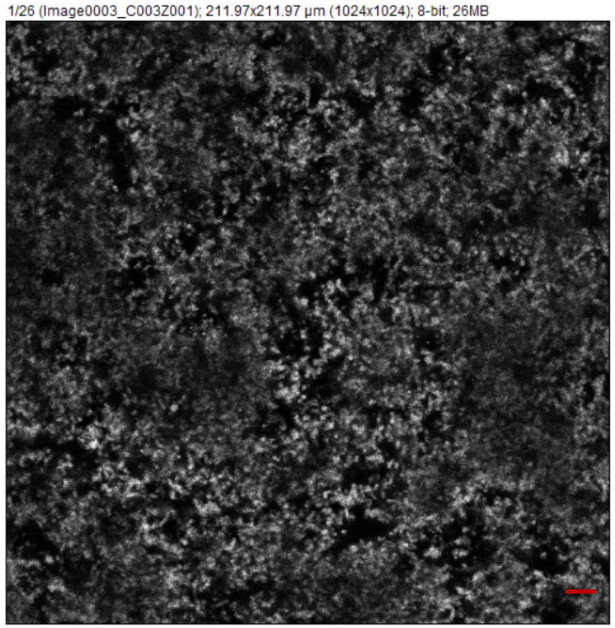
Case study: ROS in biofilms





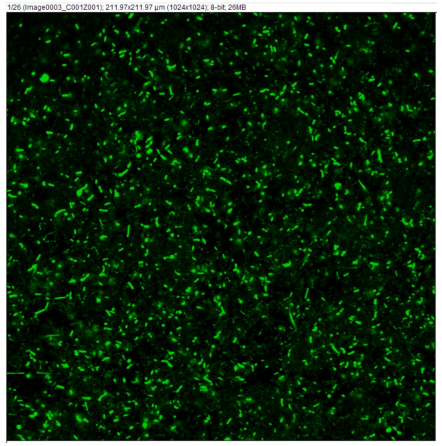




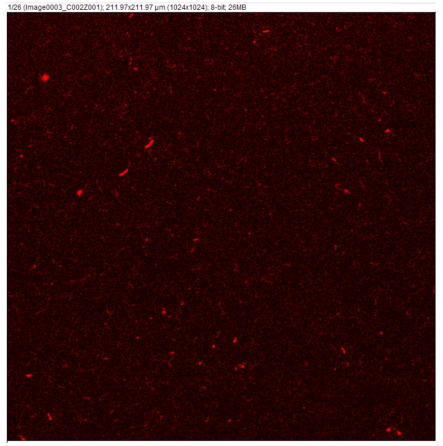


Scale bars 10 µm

DNA



ROS



EPS