Symposium to the Doctoral Defense of Thomas Dobbeleers
University of Antwerp (Jan Dries) , January 25, 2018

Short version

Driving microbial metabolisms for granular sludge stability and exopolymers recovery

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Primary acknowledgement:

Lorena Guimarães

Nina Gubser

Opportunity

BNR granular sludge from used to useful resources

Low atmospheric impact

N_xO_y N_2

Low footprint

Used water

COD

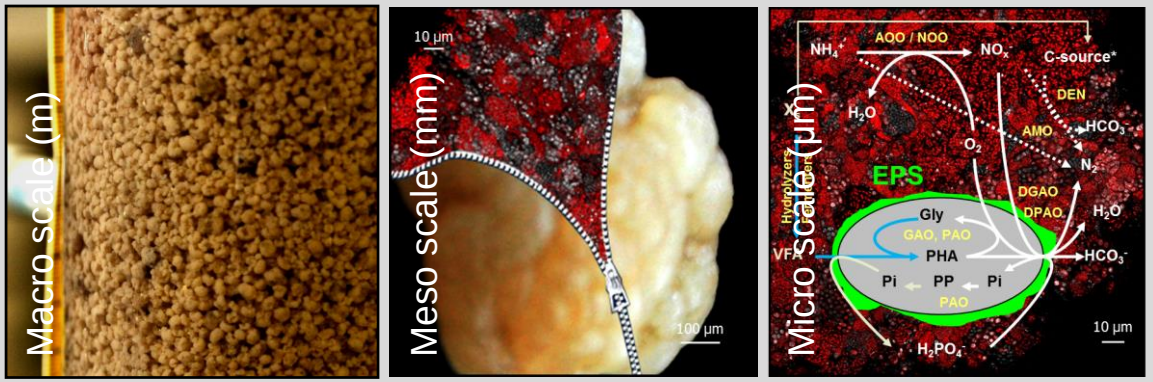
N

P

High-rate BNR granular sludge

Multi-species granular biofilms

Systems microbiology



Clean water

Low energy expense

(O_2)

A/O or A2O

PHA **EPS** PP ↓N/P

Chemical resource recovery

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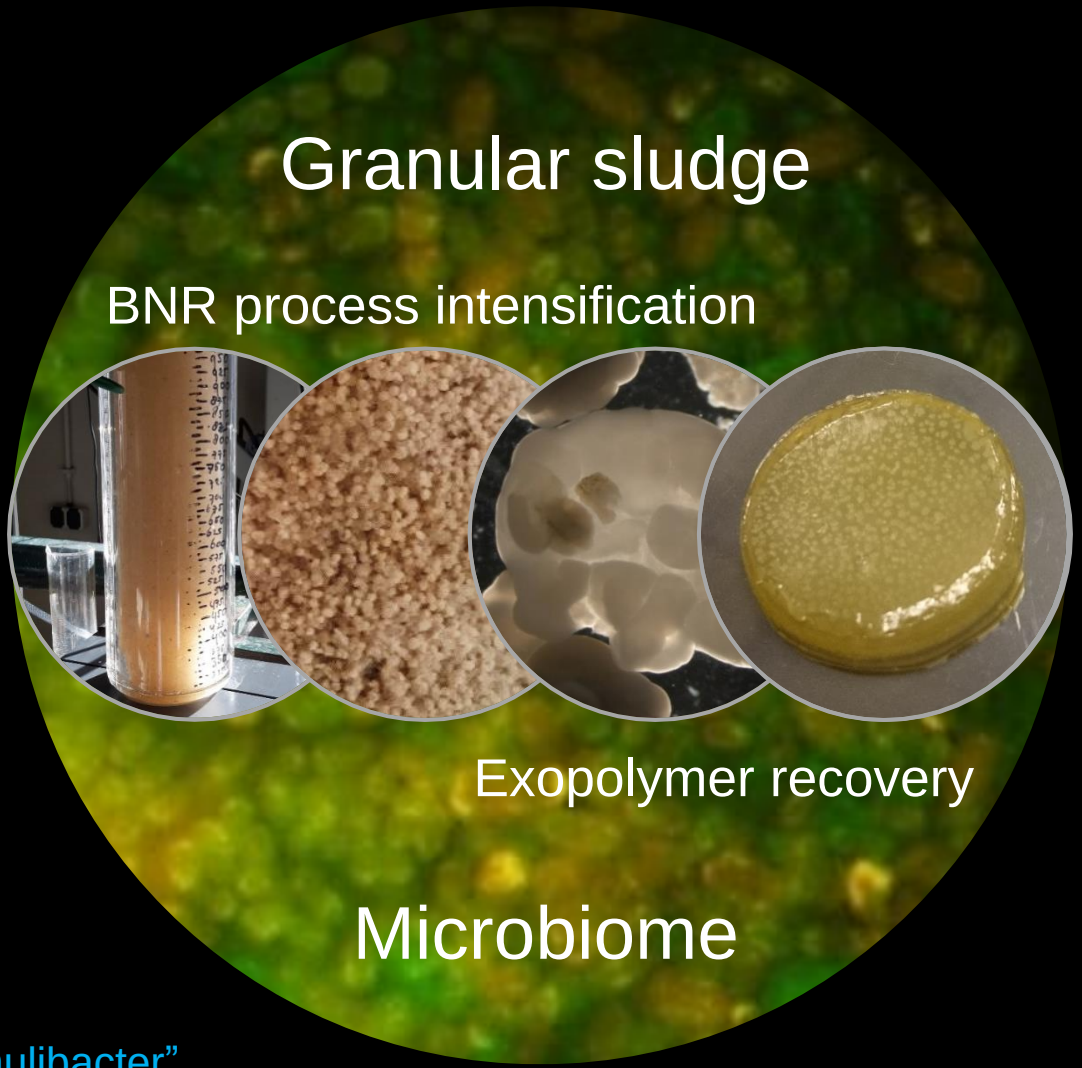
Weissbrodt and Guimarães, *et al.* (2016) *IWA LET*

Research focus

Can selection for polyphosphate-accumulating organisms (PAOs*) drive granules stabilization and exopolymer formation?



* here "*Ca*. Accumulibacter"

Weissbrodt and Guimarães, *et al.* (2017) *IWA Biofilms*

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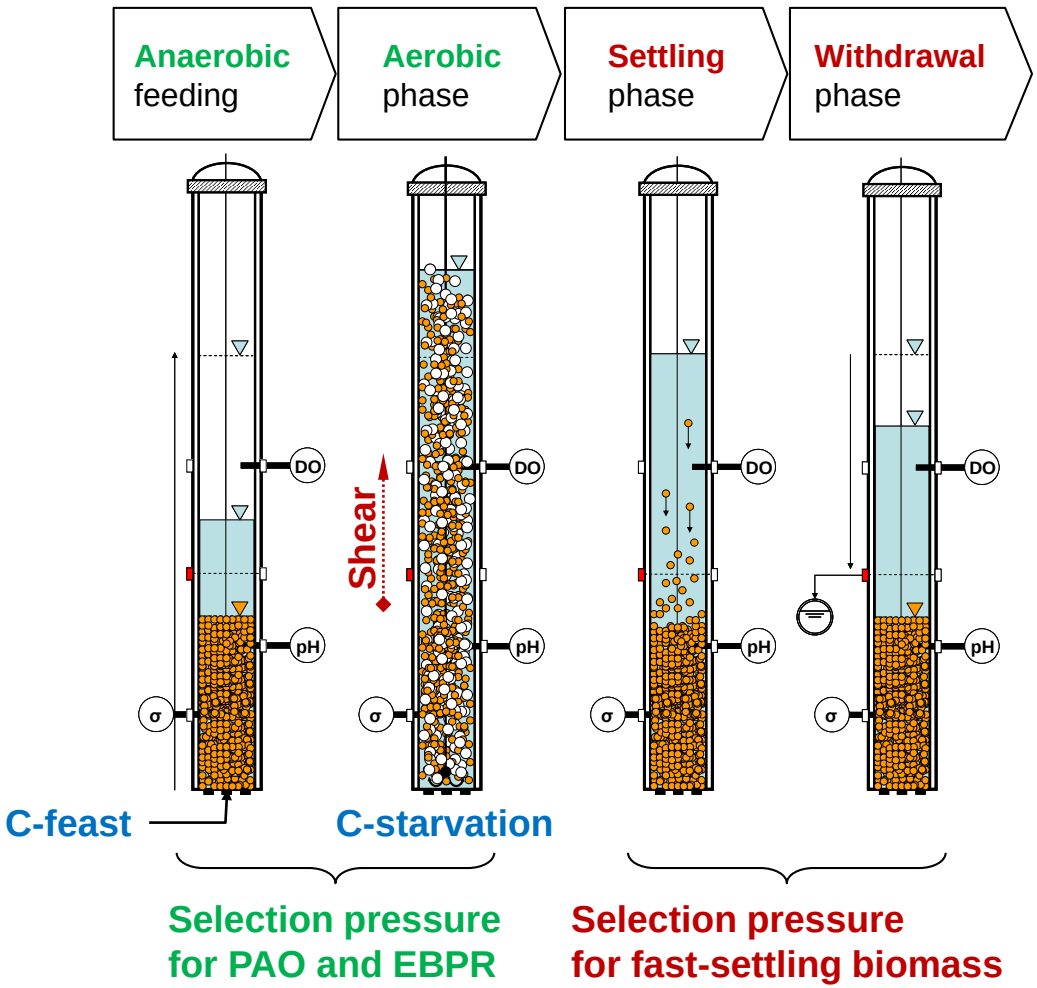
Granulation principles

Typical physical model for experimental investigations



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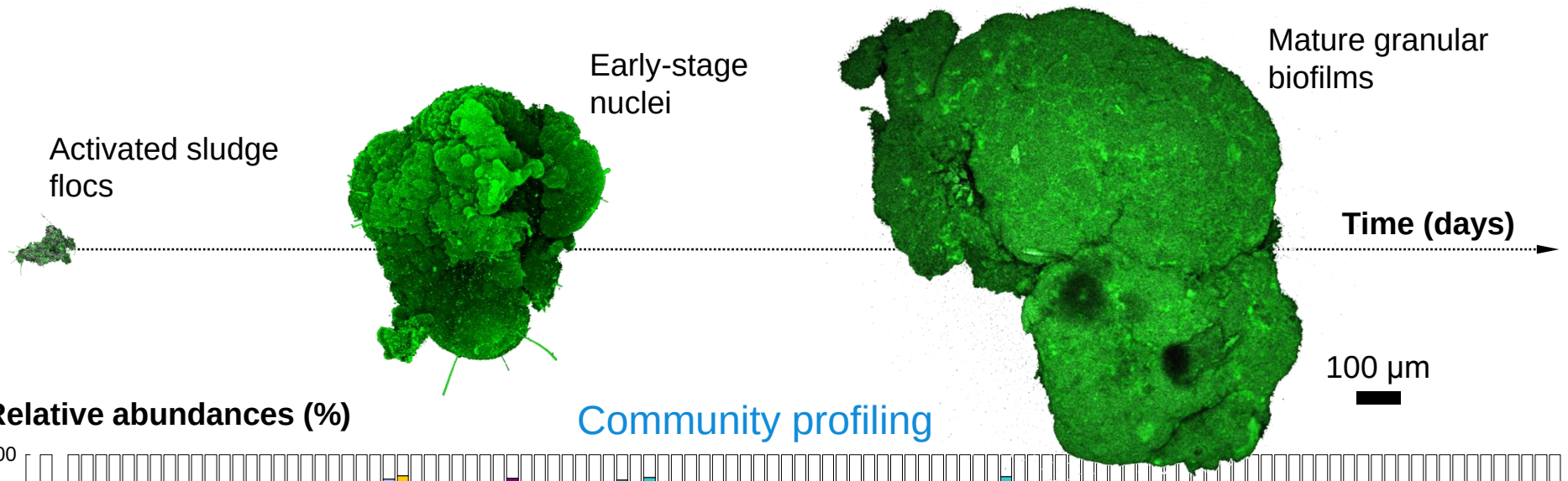
Weissbrodt *et al*. (2014) *Water Res.*

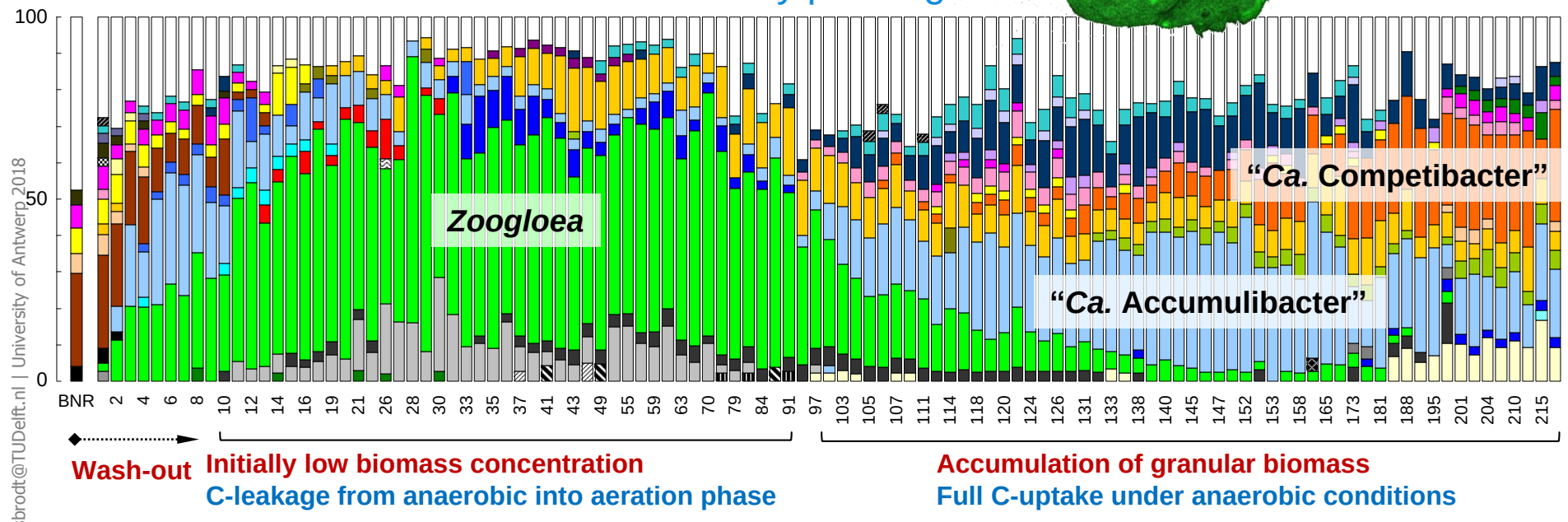
Selection under washout dynamics

Meso- and micro-scale insights



Relative abundances (%)

Community profiling



Wash-out

Initially low biomass concentration
C-leakage from anaerobic into aeration phase

Accumulation of granular biomass
Full C-uptake under anaerobic conditions

C N P removal → C removal → C N removal → C N P removal → C N (P) removal

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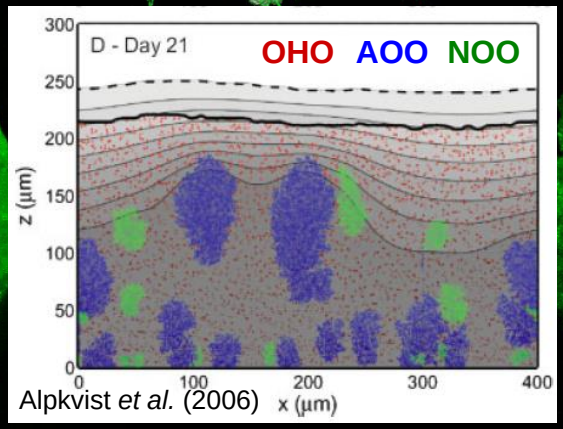
Impact of microorganisms on biofilm structures

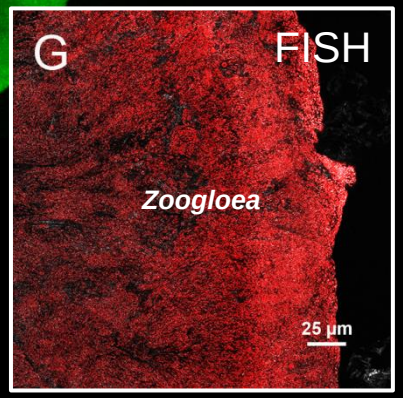
Microbial physiologies impact meso-scale architectures

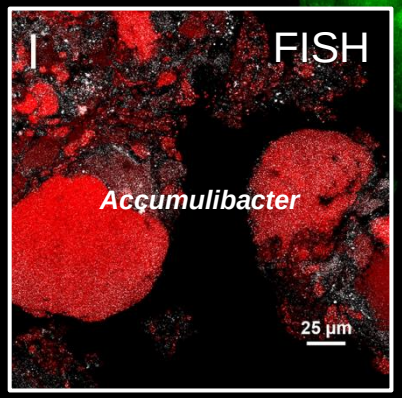
Homogeneous cell distribution

Heterogenous cell distribution



Alpkvist *et al.* (2006)





Dominated by:

Fast-growing *Zoogloea*

Dominated by:

Slower-growing
"*Ca.* Accumulibacter"
"*Ca.* Competibacter"

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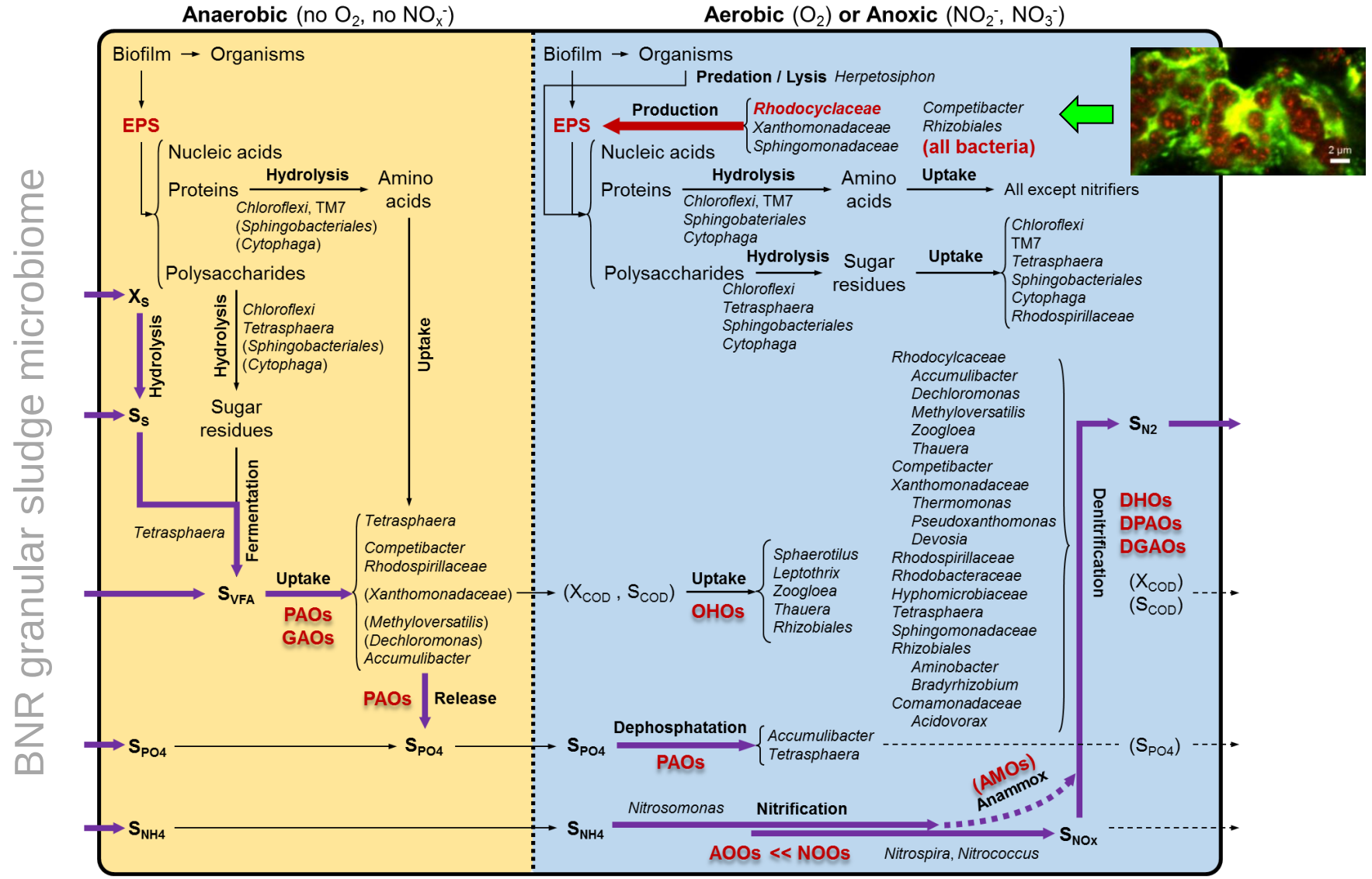
Conceptual model of BNR granular sludge microbiome

Rhodocyclaceae members are potential key producers of EPS



Modified from Weissbrodt *et al.* (2014) *FEMS Microbiol. Ecol.* 88: 579-95

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Take-home and outlook

Selection for PAOs drives granules stability, process robustness, biorefinery

1. Conditions of PAO selection can trigger robust granulation and exopolymer formation.
2. Exopolymers remain dark macromolecular matter: reliable characterization methods are needed.
3. Biosynthetic signatures of "*Ca.* Accumulibacter" were revealed: this remains dark biomolecular matter.
4. Benefits of selecting for PAOs in granular sludge are 4-fold: EBPR, P-recovery, granule stability, exopolymers valorization.

How to transition from bench to application?

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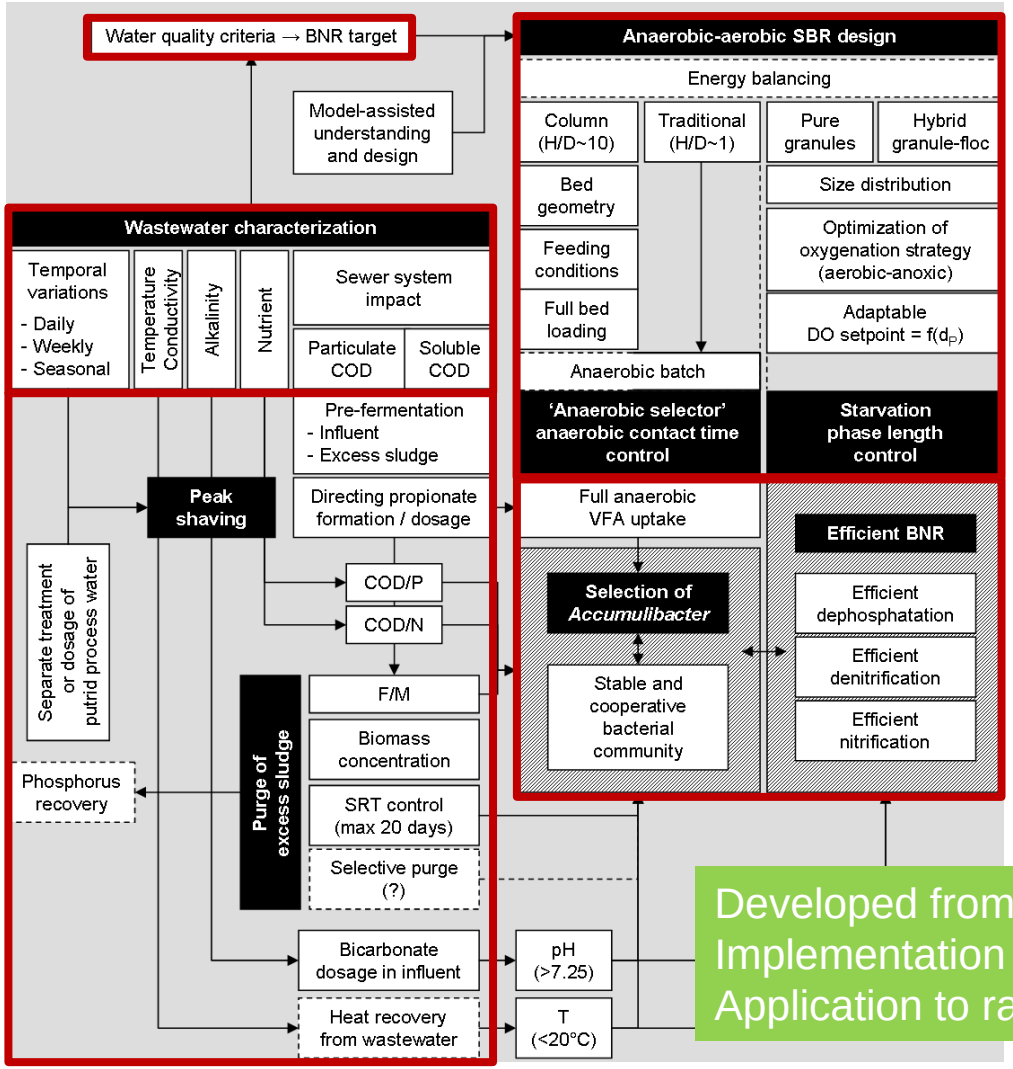
Outlook

Implementation to engineering practice (from municipal to industrial)

Effluent quality criteria

Wastewater characterization

SRT management and peak shaving



Anaerobic-aerobic SBR design

Use SBR flexibility for managing selection and BNR

Developed from bench-scale data
Implementation at pilot scale
Application to range of wastewaters

Weissbrodt (2013) *EPFL PhD Thesis no. 5641* DOI

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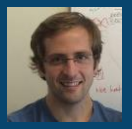
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