



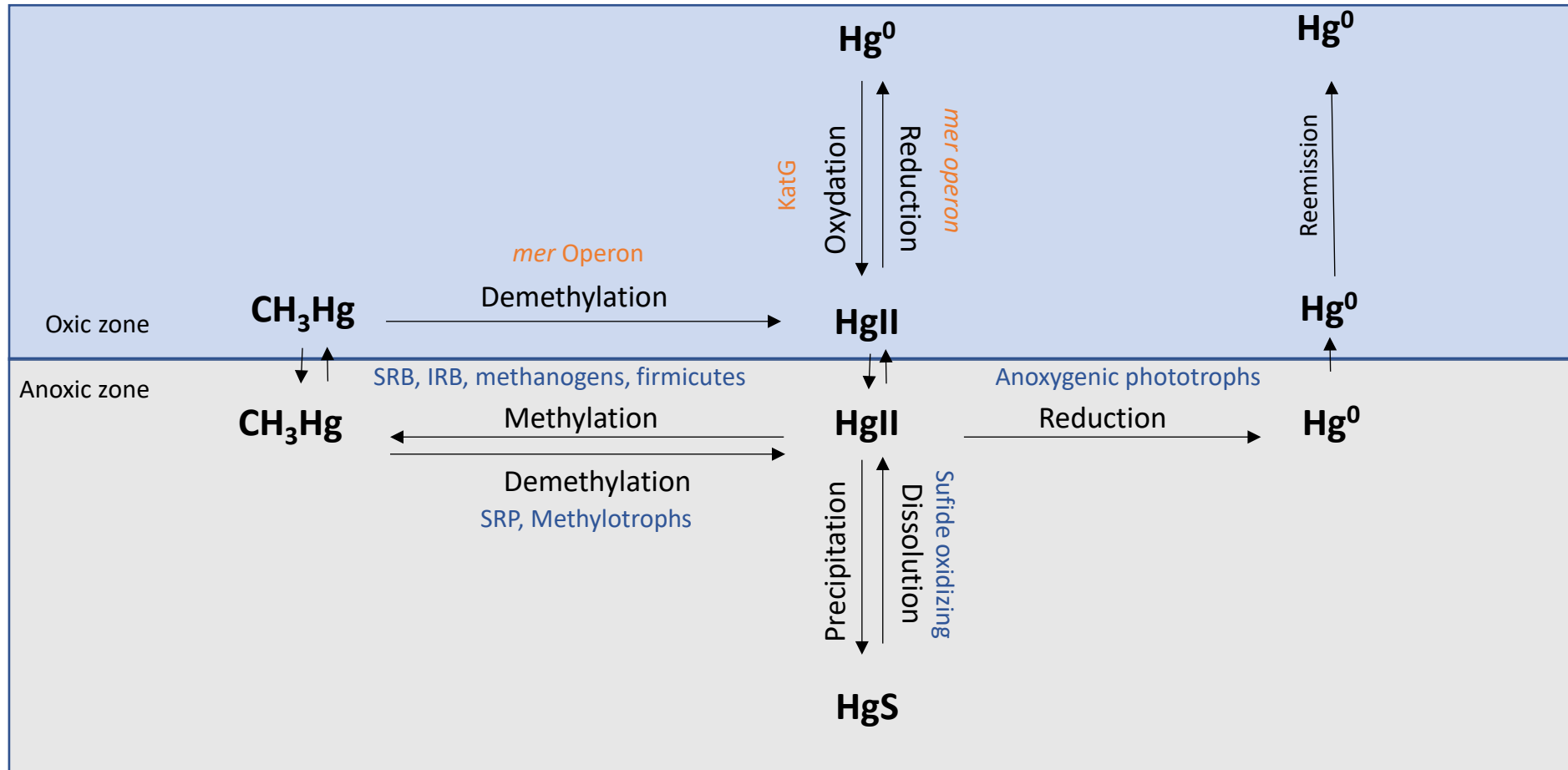
ICMGP 2024
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Marisol Goñi-Urriza

Microbial interactions between sulfate reducing bacteria and anoxygenic phototrophs affect Hg methylation

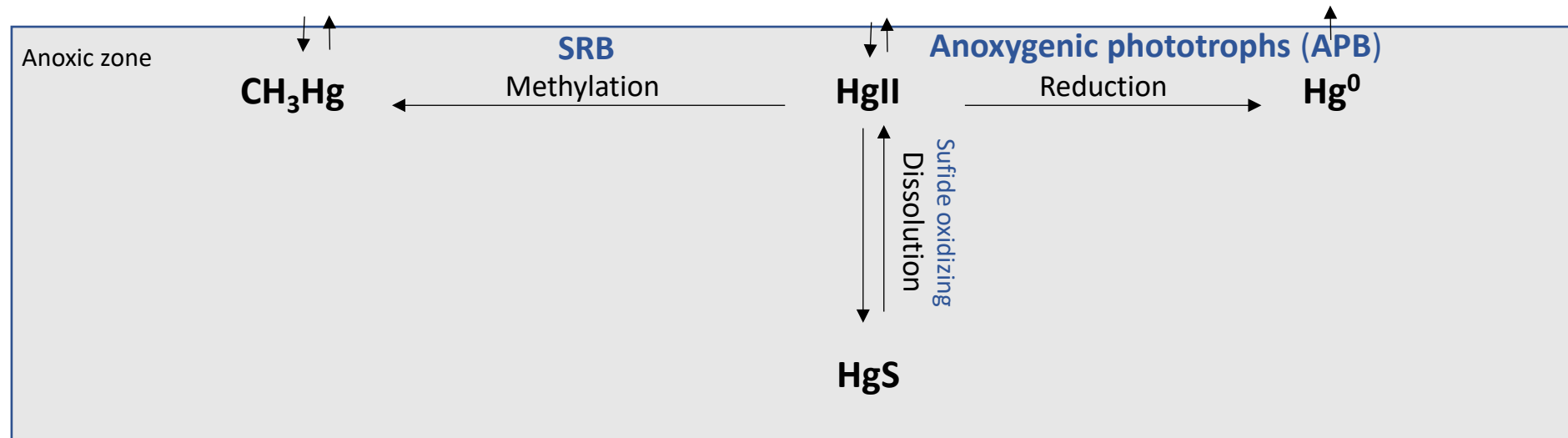
Diva Scuvée, Adrien Vigneron, Rémy Guyoneaud, Emmanuel Tessier, Claire Gassie, Jinping Xue, David Amouroux, Bahia Khalfaoui-Hassani and Marisol Goñi-Urriza

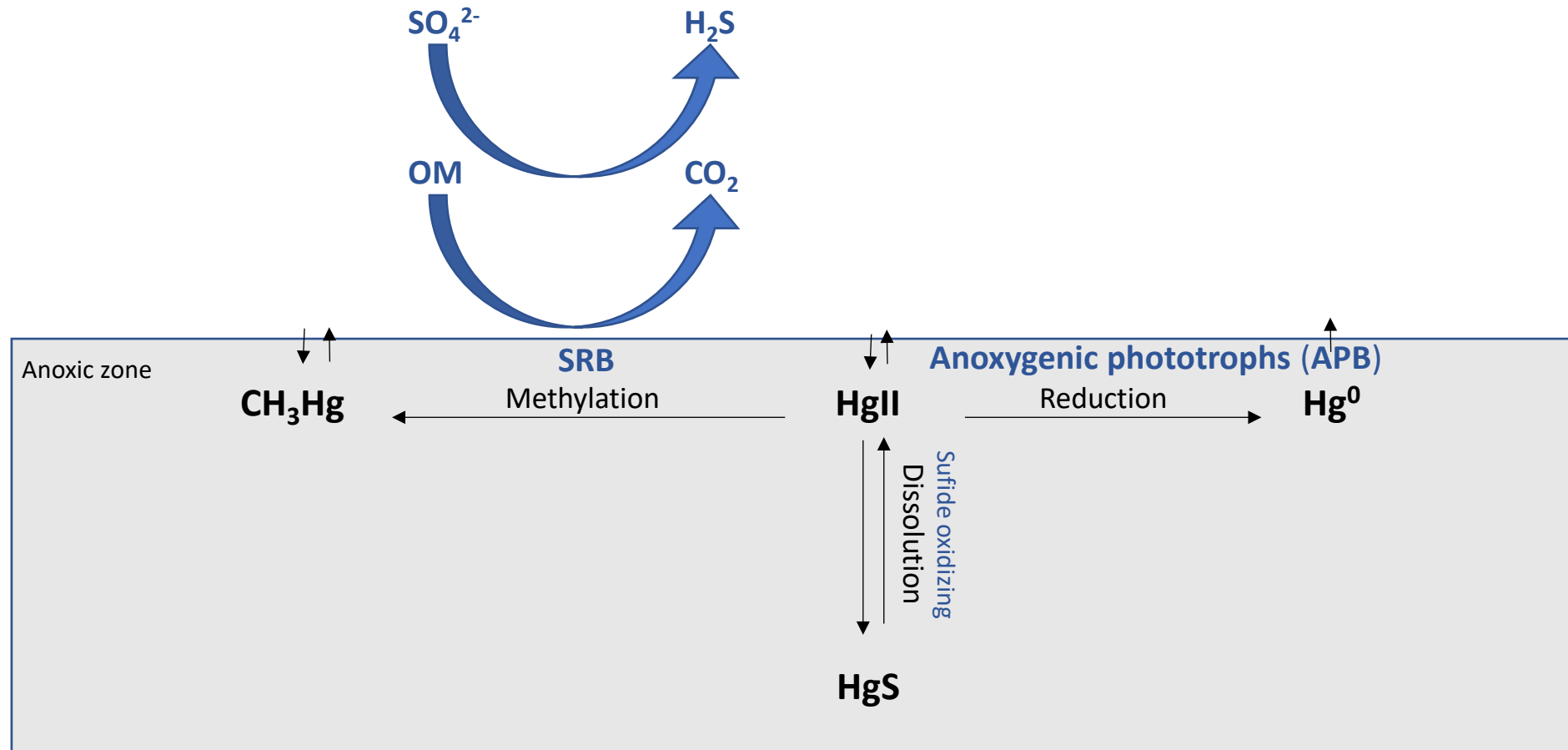


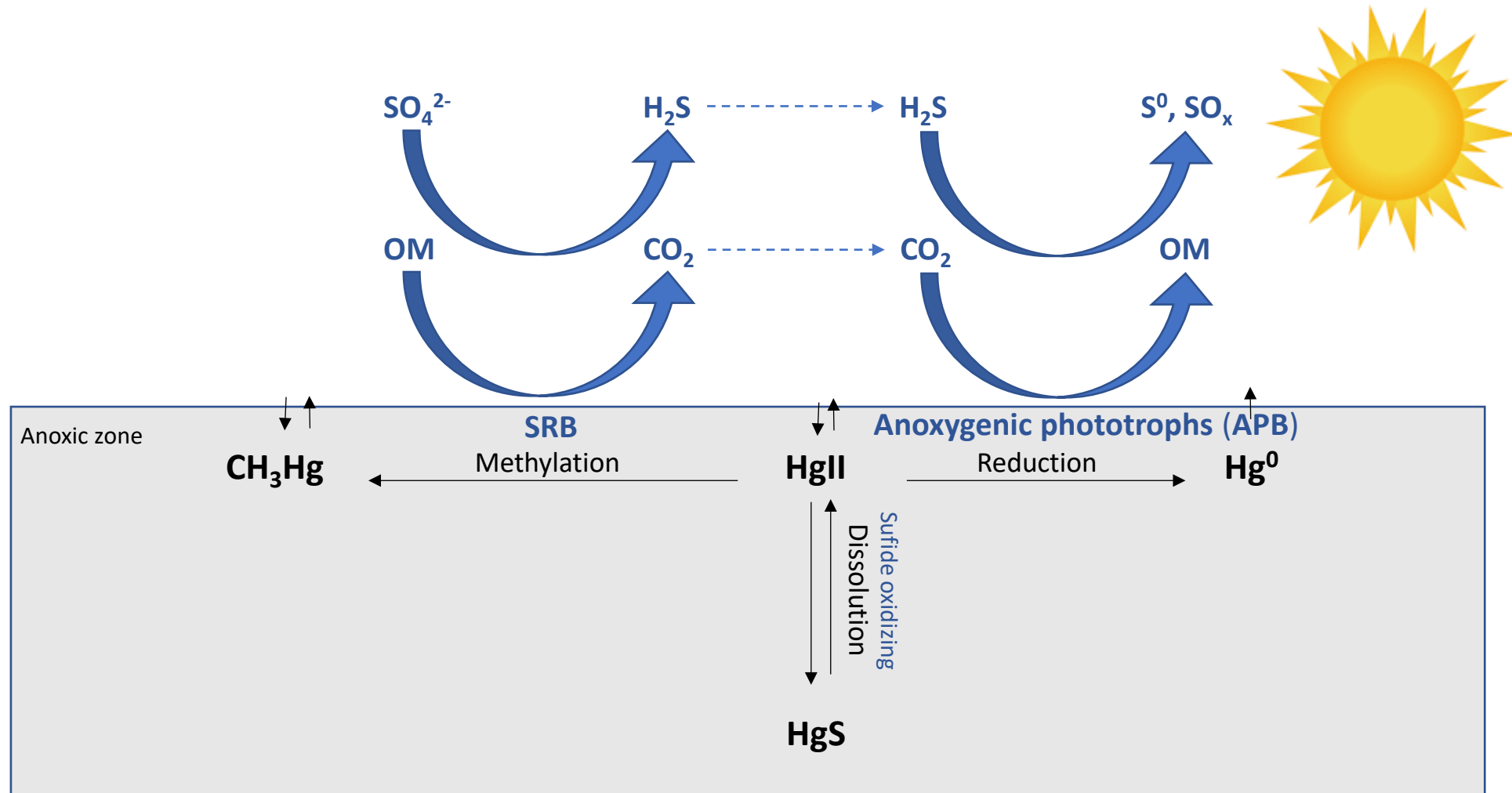


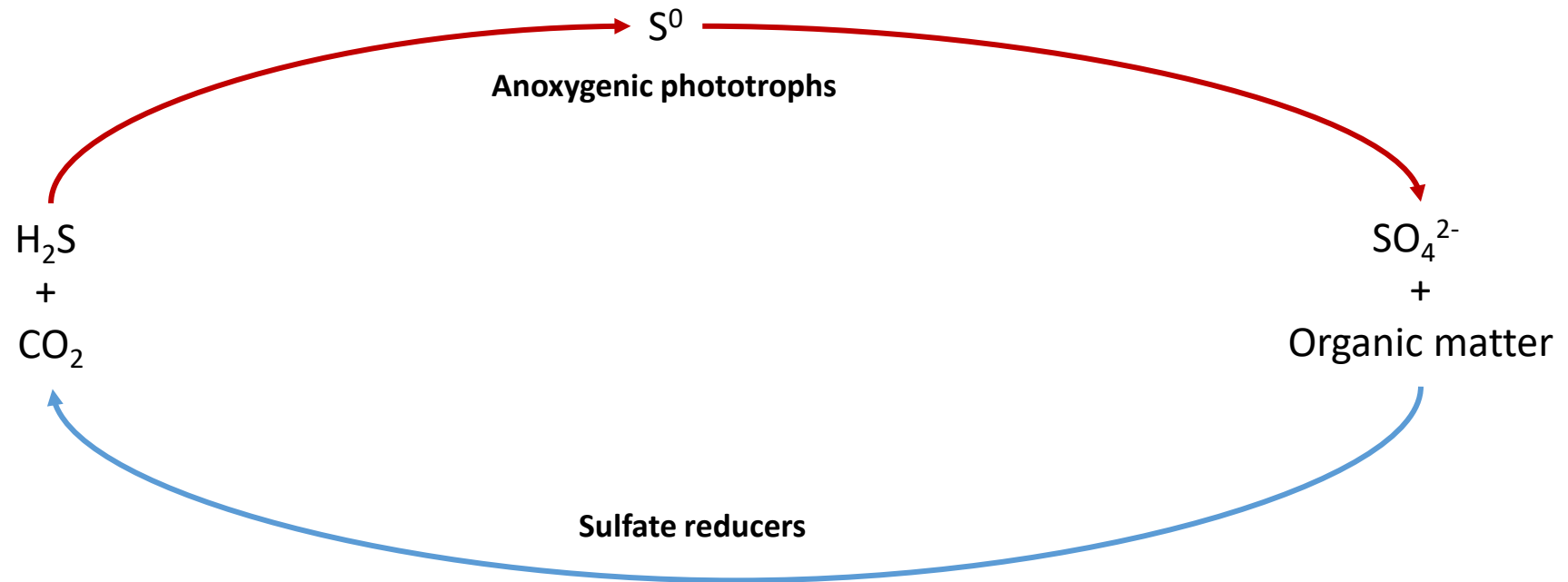
(Compeau and Bartha 1984, 1985; Gilmour et al. 1992; Smith et al. 1998; Barkay et al. 2003; Fleming et al. 2006; Kerin et al. 2006; Hamelin et al. 2011; Gilmour et al. 2013; Parkes et al, 2013; Grégoire and Poulain 2016)



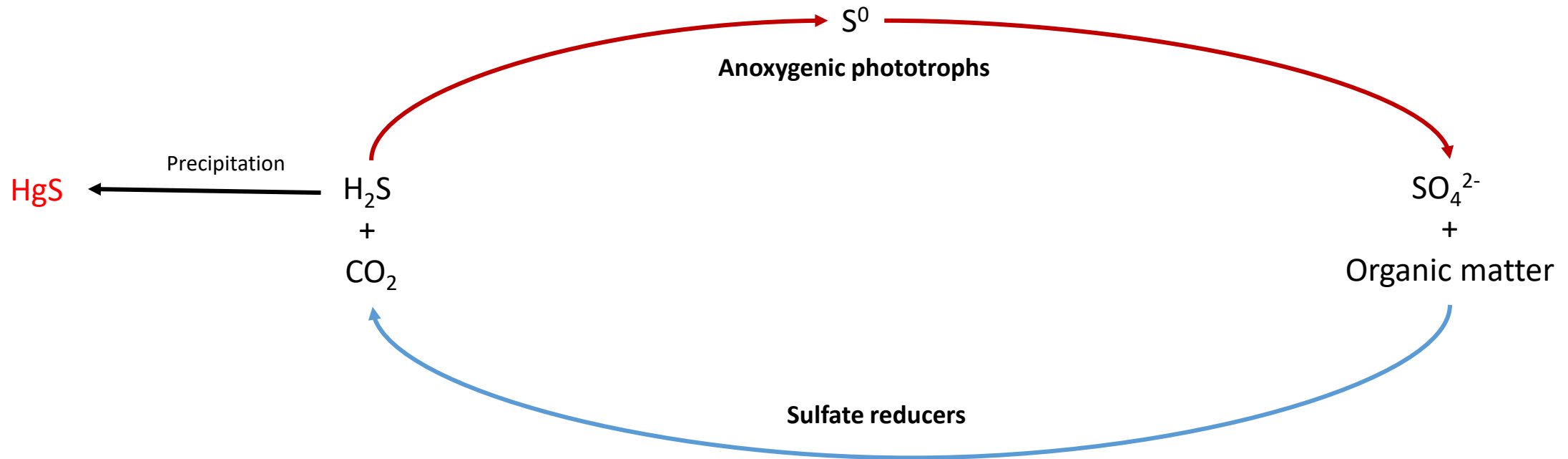








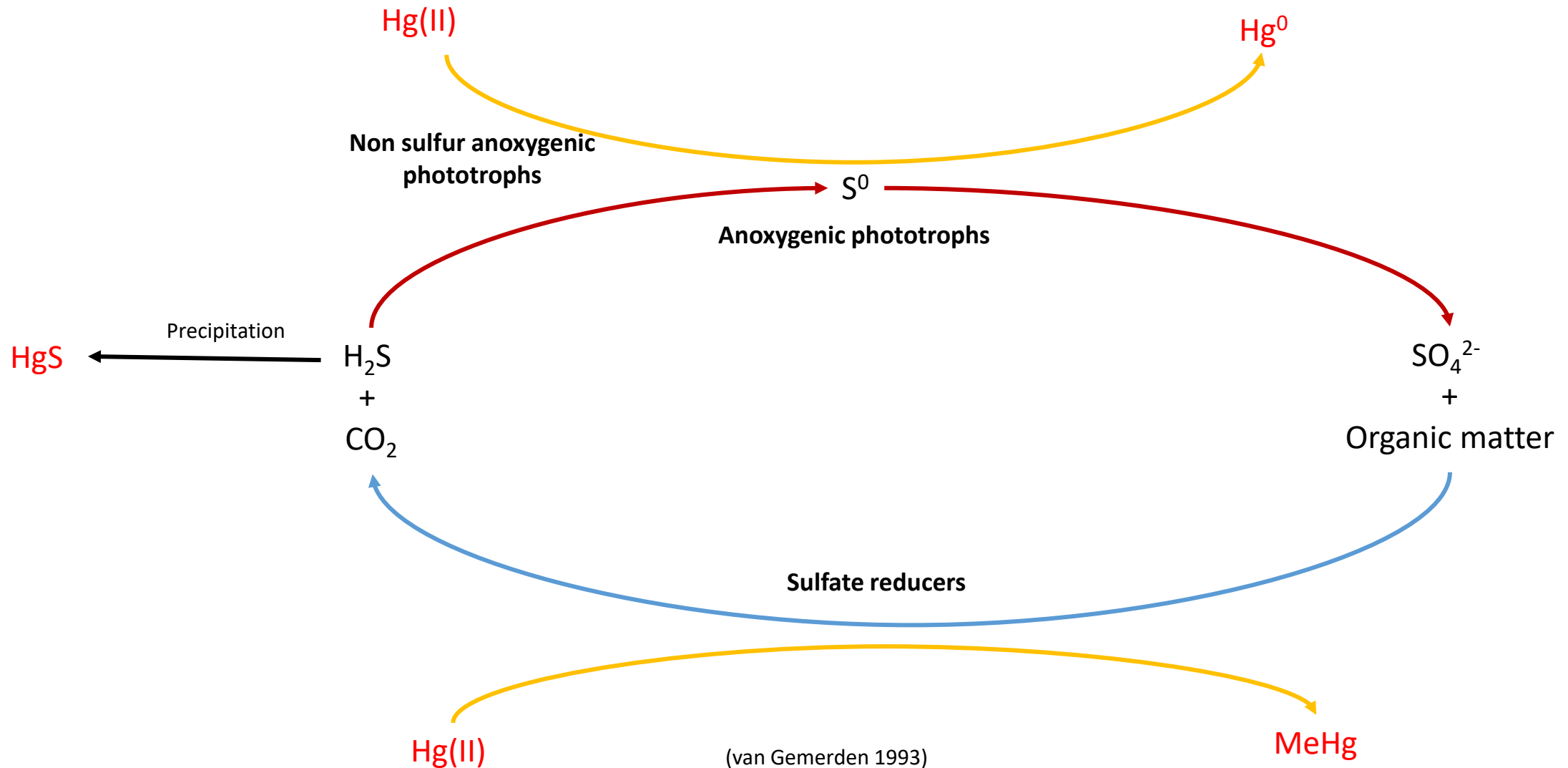
... and Mercury???

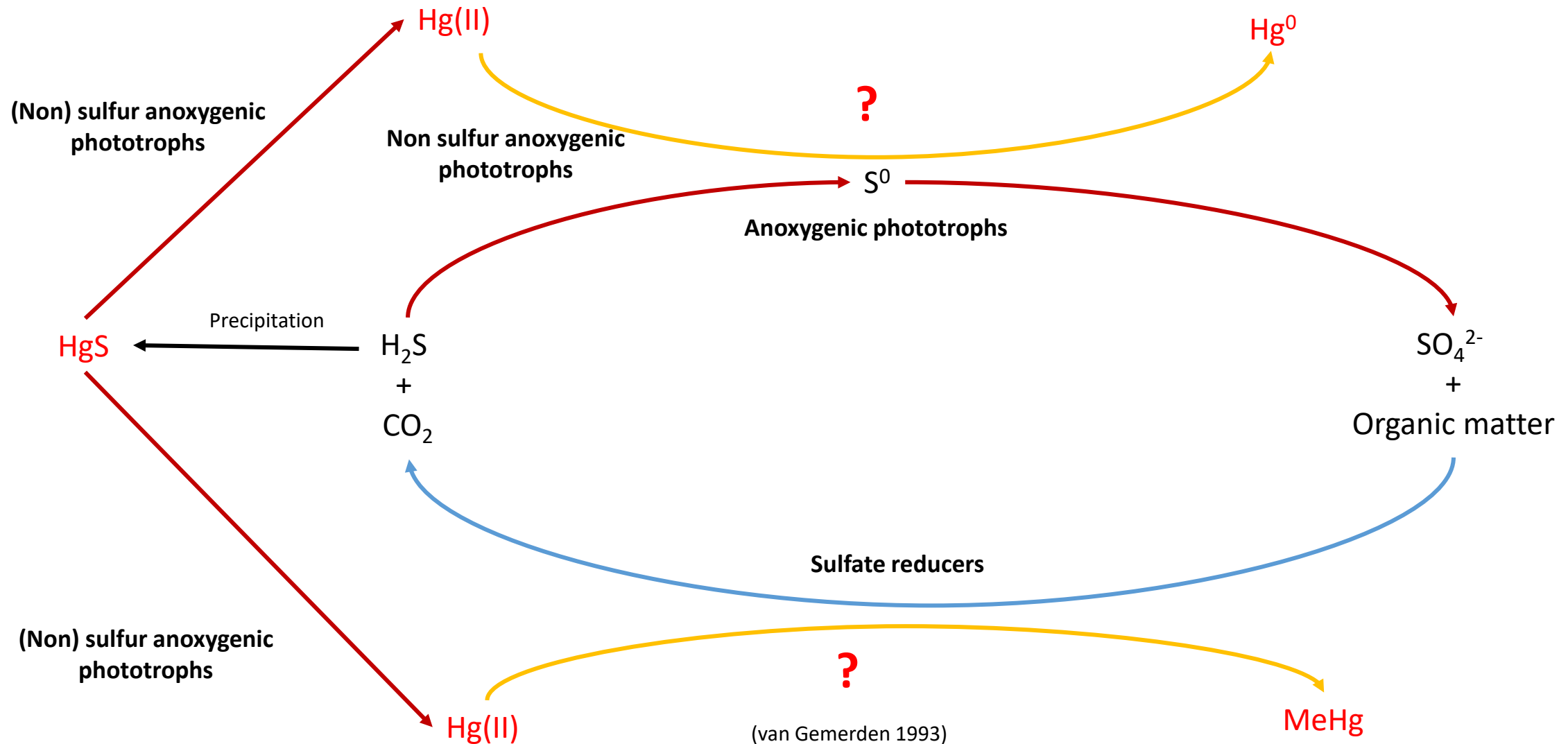


(van Gernerden 1993)

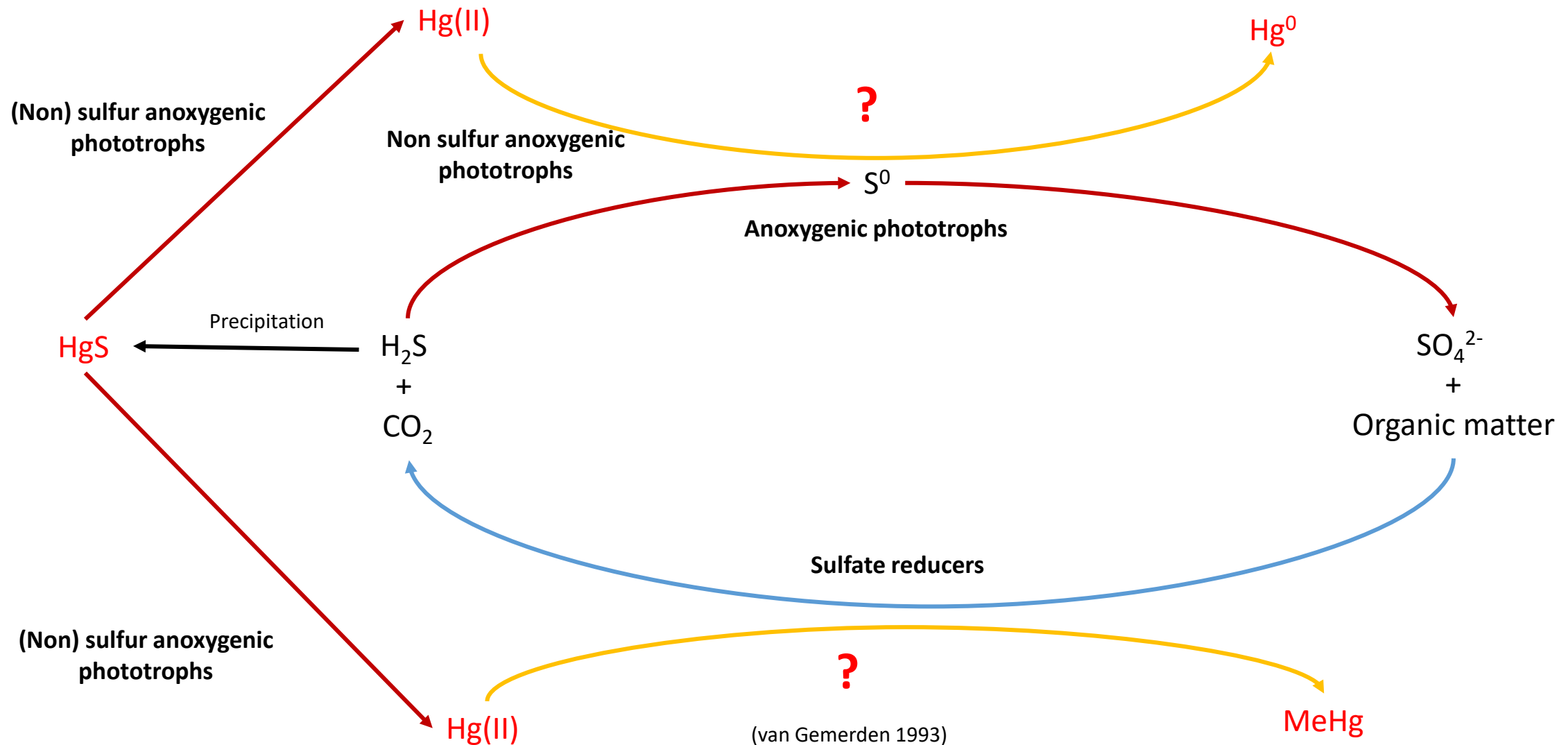


... and Mercury???






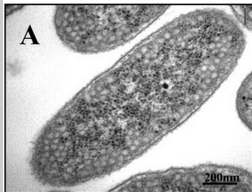
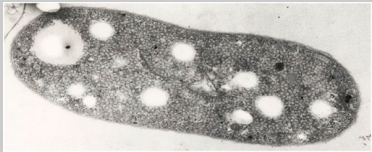





How metabolic interactions between SRB and APB affect mercury transformations?



	Sulfate reducer <i>Desulfobulbus propionicus</i> 1pr3
Sulfur metabolism	$\text{SO}_4^{2-} \rightarrow \text{H}_2\text{S}$
Carbon metabolism	Heterotrophe: <ul style="list-style-type: none">- Propionate \rightarrow Acetate- H₂ + CO₂ + Acetate- <i>Ethanol</i>- <i>Propanol</i>- <i>Pyruvate</i>- <i>Lactate</i>
Mercury metabolism	$\text{HgII} \rightarrow \text{CH}_3\text{Hg}$



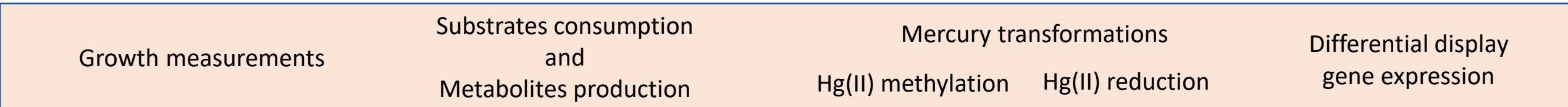
	 Sulfate reducer <i>Desulfobulbus propionicus</i> 1pr3	 Non sulfur anoxygenic phototroph <i>Rhodobacter capsulatus</i> SB1003	 Sulfur anoxygenic phototroph <i>Allochromatium vinosum</i> DSM 180
Sulfur metabolism	$\text{SO}_4^{2-} \rightarrow \text{H}_2\text{S}$	$\text{H}_2\text{S} \rightarrow \text{S}^0$ 	$\text{H}_2\text{S} \rightarrow \text{S}^0 \rightarrow \text{SO}_4^{2-}$ 
Carbon metabolism	Heterotrophe: - Propionate → Acetate - $\text{H}_2 + \text{CO}_2 + \text{Acetate}$ - Ethanol - Propanol - Pyruvate - Lactate	Myxotrophe: - Butyrate - Acetate - Propionate - Pyruvate  	Phototrophe: - Acetate - Propionate - Butyrate - Formate - Fumarate - Succinate - Pyruvate 
Mercury metabolism	$\text{HgII} \rightarrow \text{CH}_3\text{Hg}$	$\text{HgII} \rightarrow \text{Hg}^0$	Unknown



Axenic Growth			Co-culture growth		
<i>D. propionicus</i>	<i>R. capsulatus</i>	<i>A. vinosum</i>	<i>D. propionicus</i> + <i>R. capsulatus</i>	<i>D. propionicus</i> + <i>A. vinosum</i>	<i>D. propionicus</i> + <i>R. capsulatus</i> + <i>A. vinosum</i>



Axenic Growth			Co-culture growth		
<i>D. propionicus</i>	<i>R. capsulatus</i>	(<i>A. vinosum</i>)	<i>D. propionicus</i> + <i>R. capsulatus</i>	<i>D. propionicus</i> + <i>A. vinosum</i>	<i>D. propionicus</i> + <i>R. capsulatus</i> + <i>A. vinosum</i>



Single copy genes:

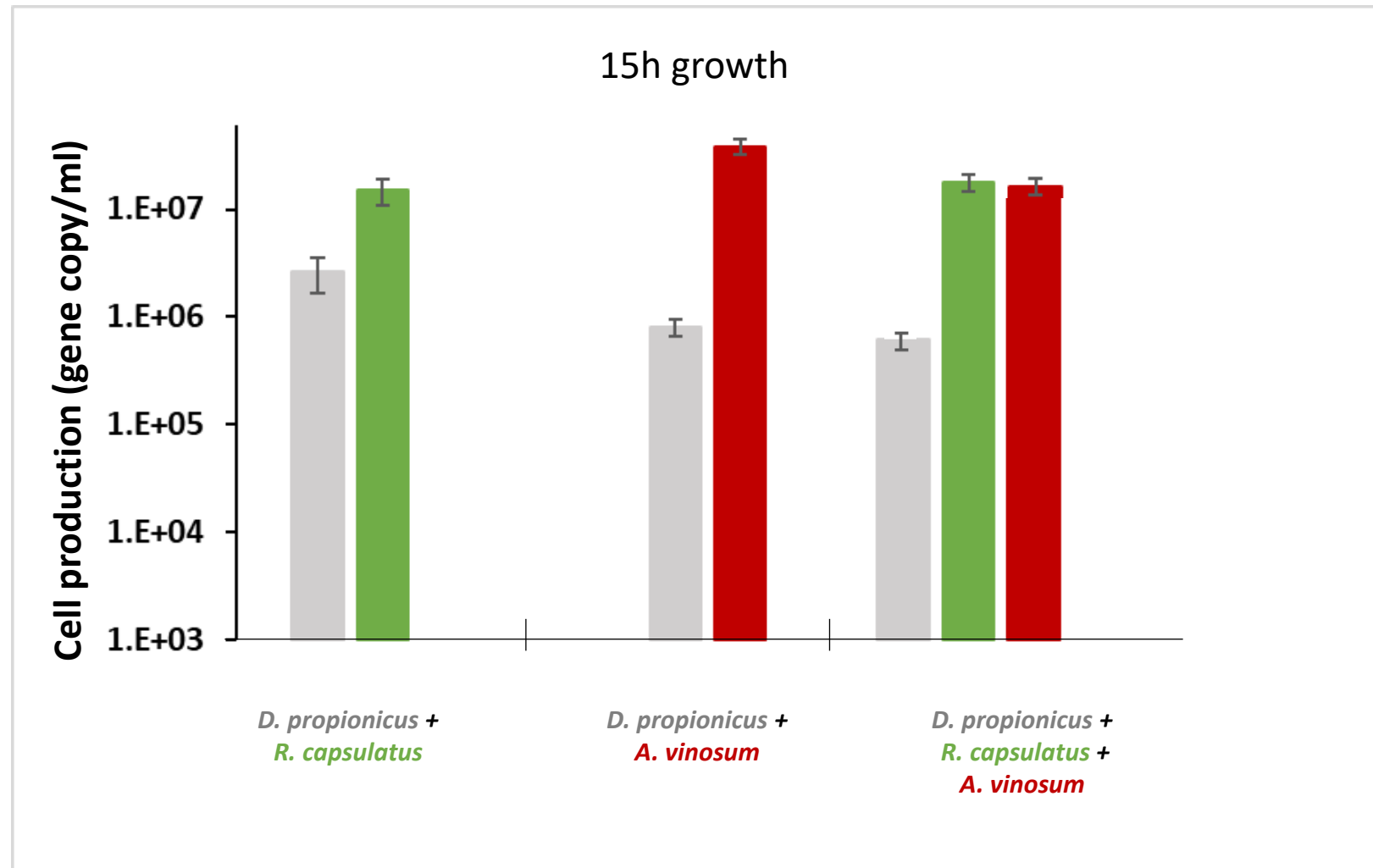
pufM → *A. vinosum* DSM180
(Photosynthesis)

ctrl → *R. capsulatus* SB1003
(Carotenoids synthesis)

dsrB → *D. propionicus* 1pr3
(Sulphate reduction)

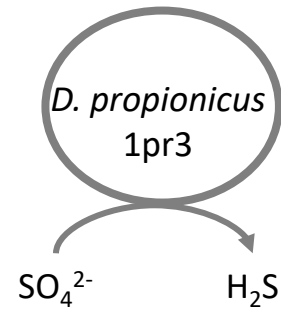
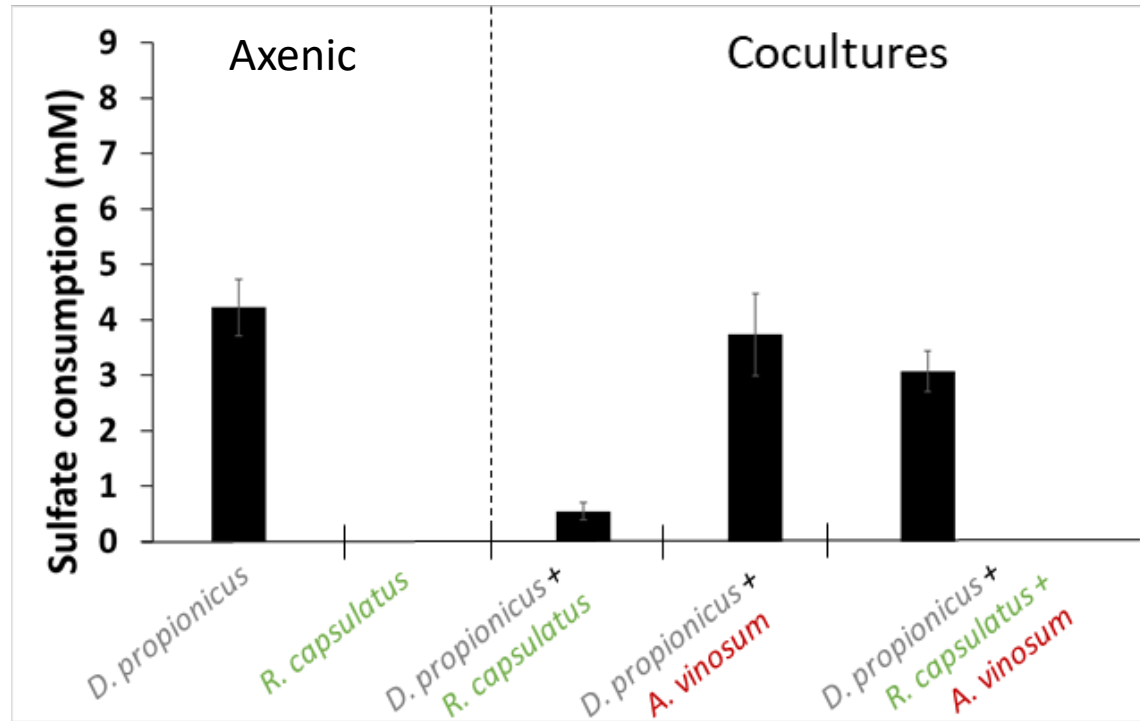


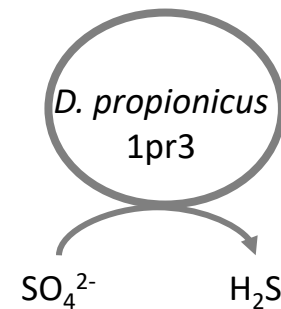
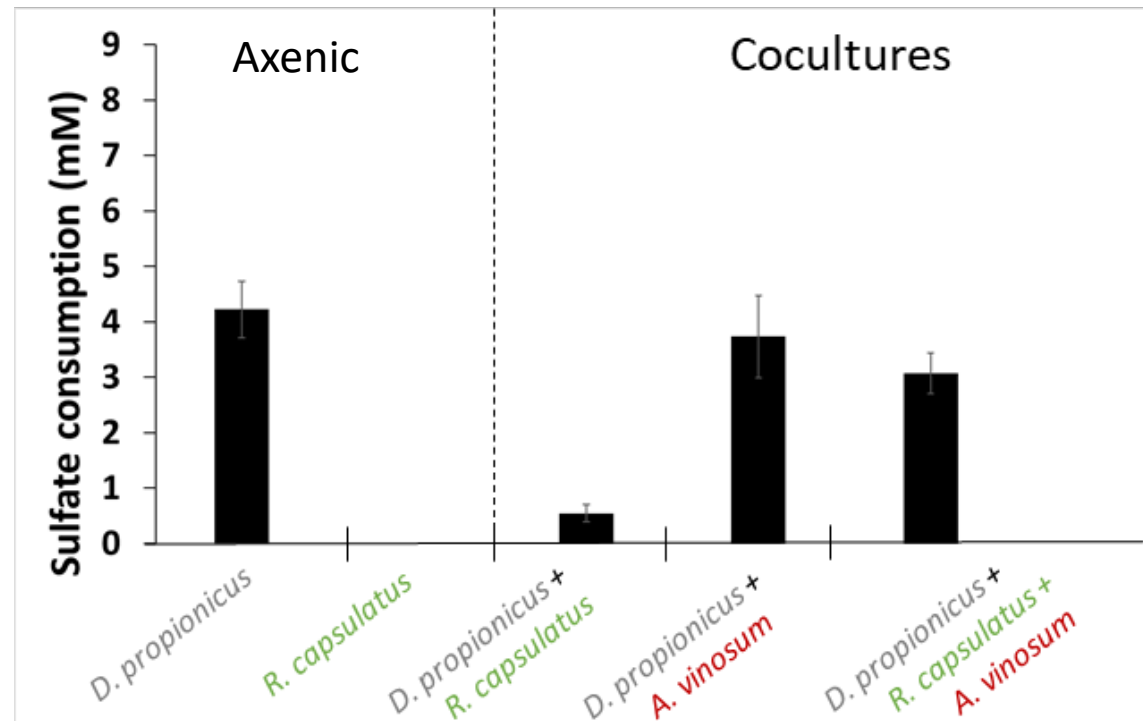
Common medium: adapted MM + Sulfate + propionate+ butyrate



→ All the strains grown!!



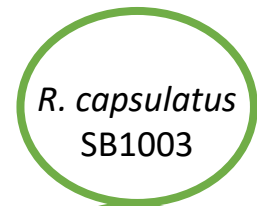
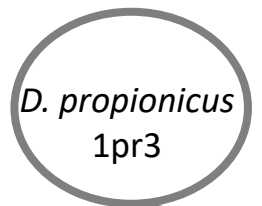
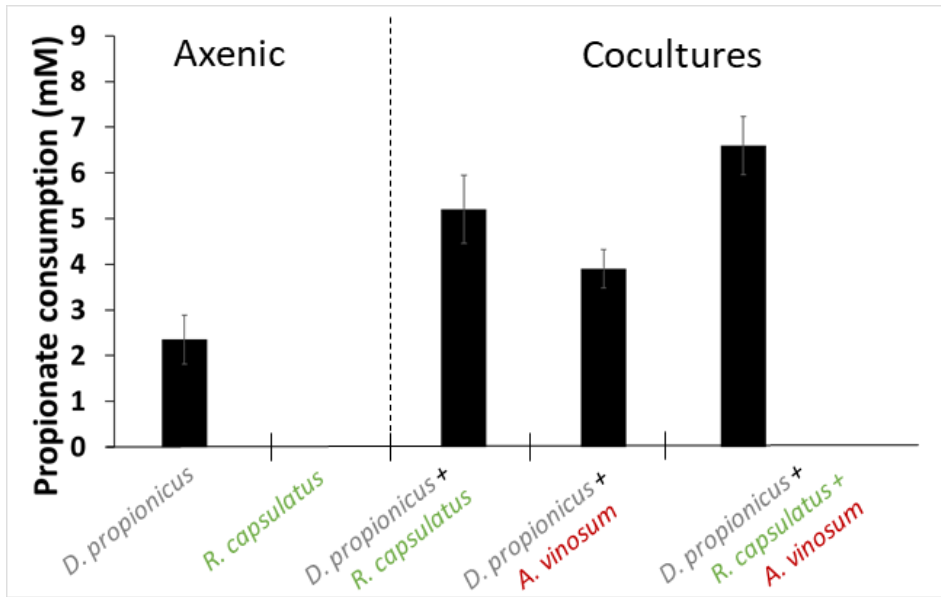




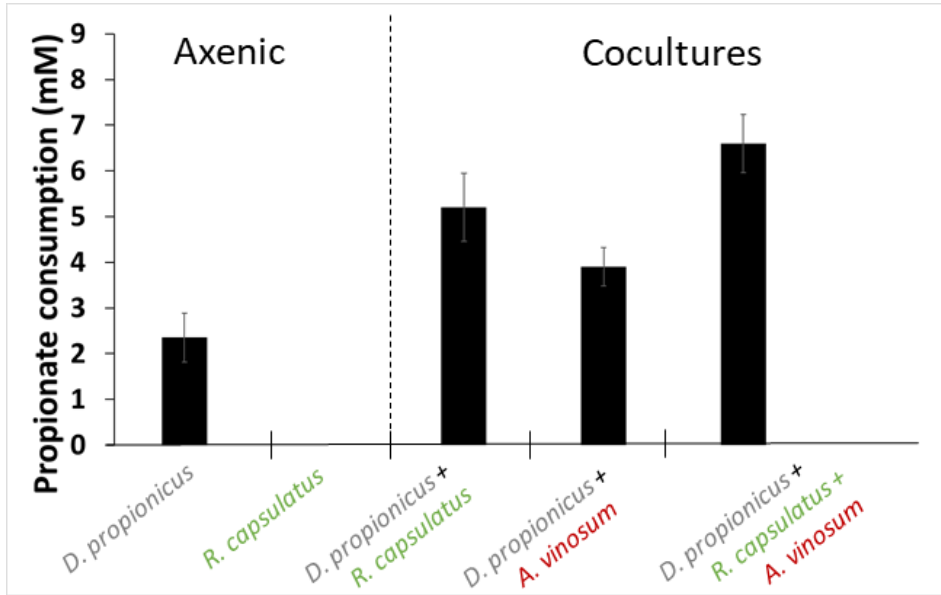
→ Gene expression of sulfate reduction genes NOT affected, neither by Hg(II) nor by anoxygenic phototrophs



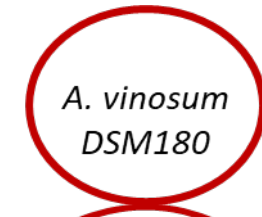
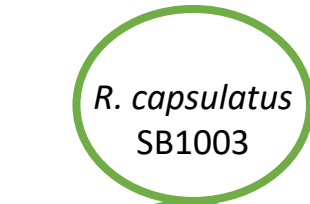
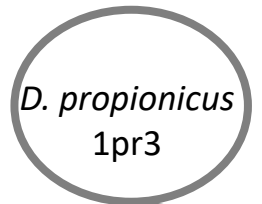
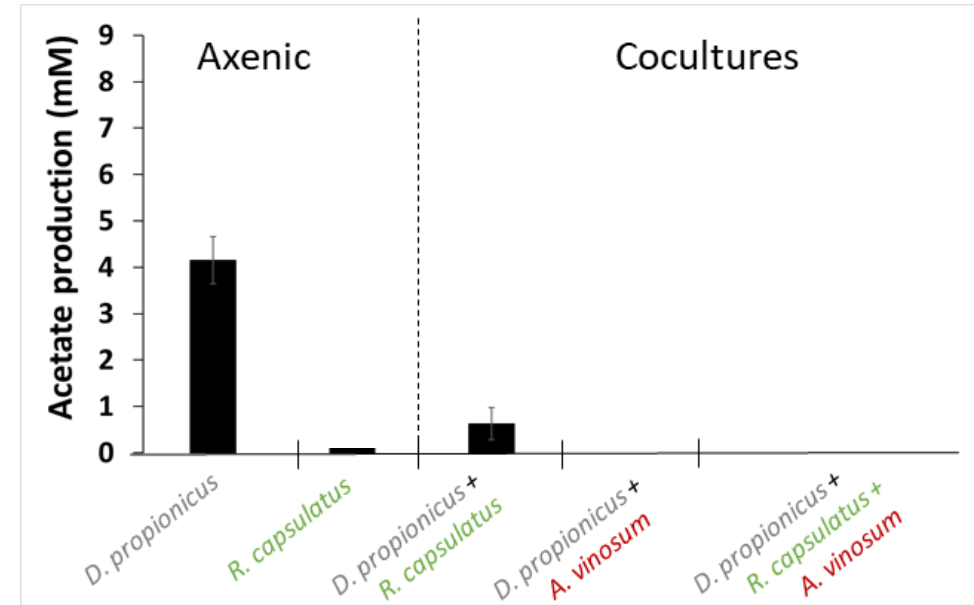
Propionate consumption



Propionate consumption



Acetate production



Propionate Acetate

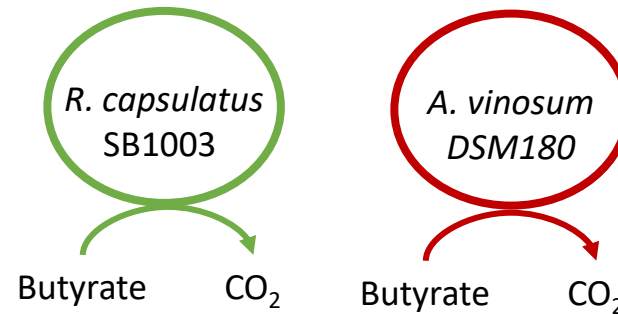
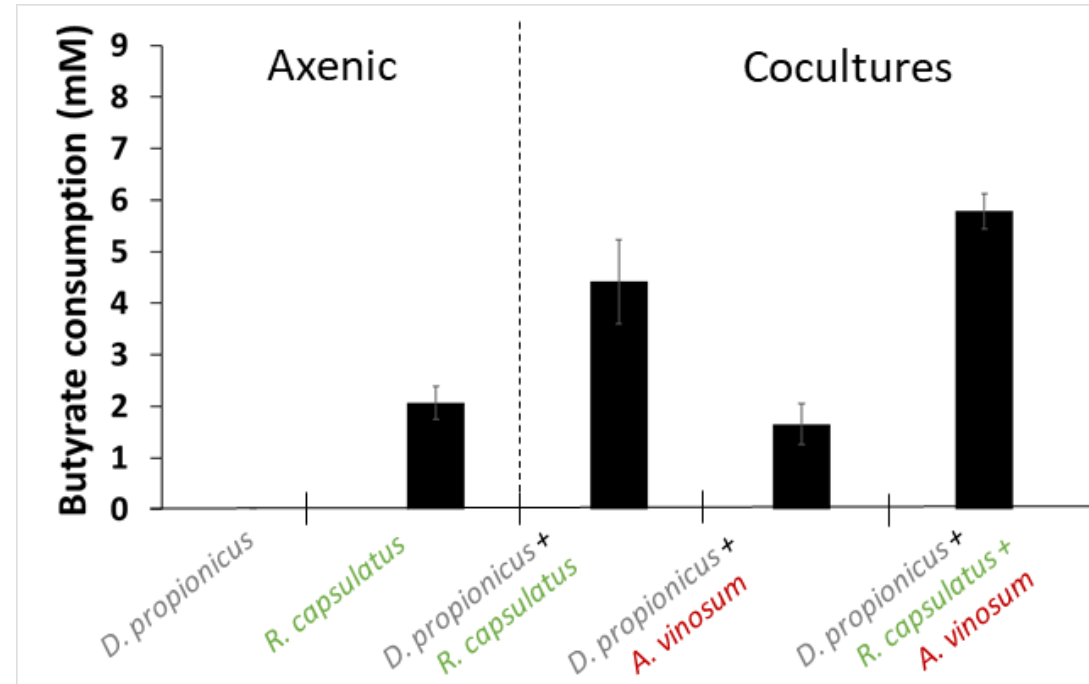
Propionate CO₂

Propionate CO₂

Acetate CO₂



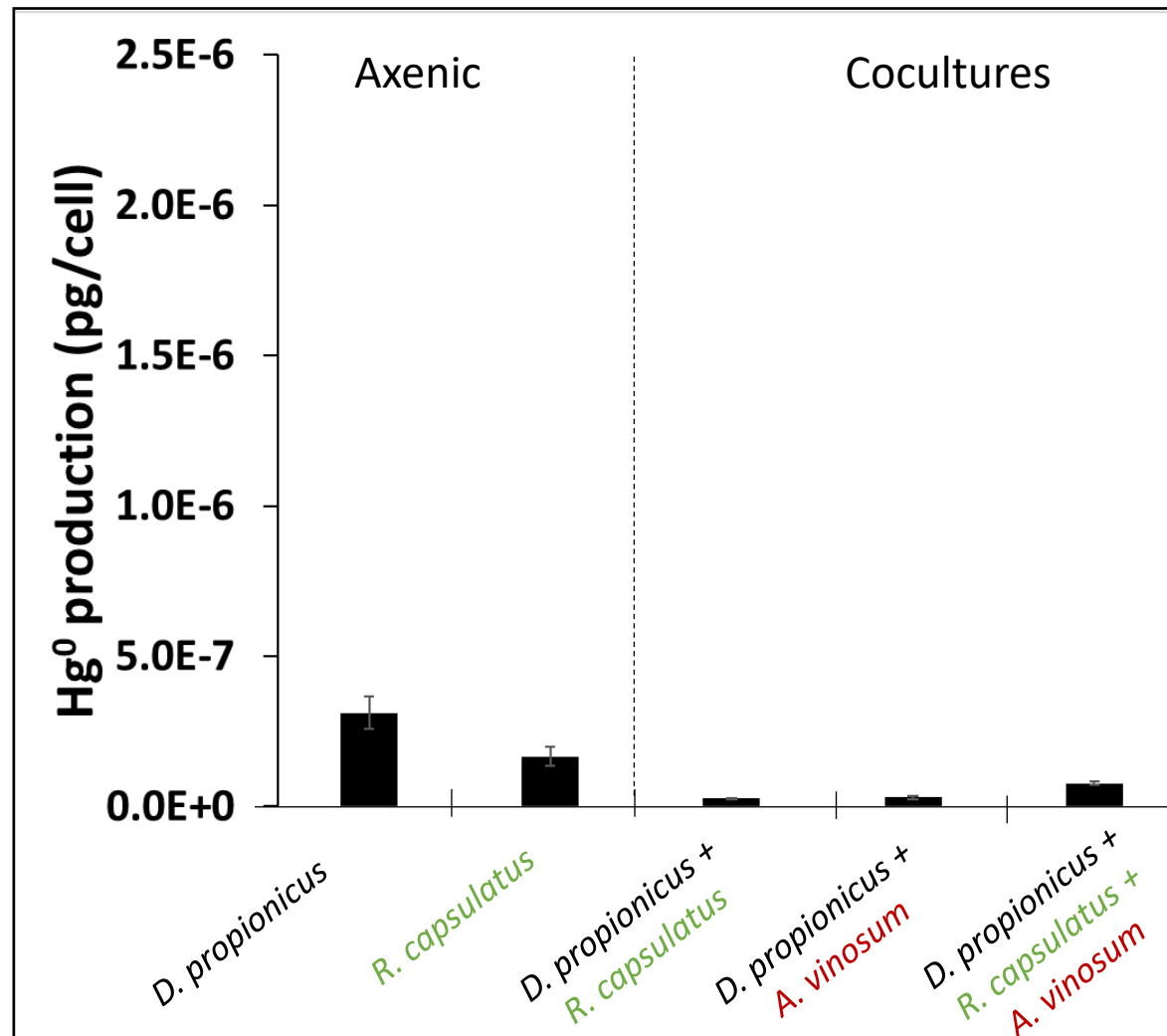
Butyrate consumption



How those metabolisms affect mercury transformations?

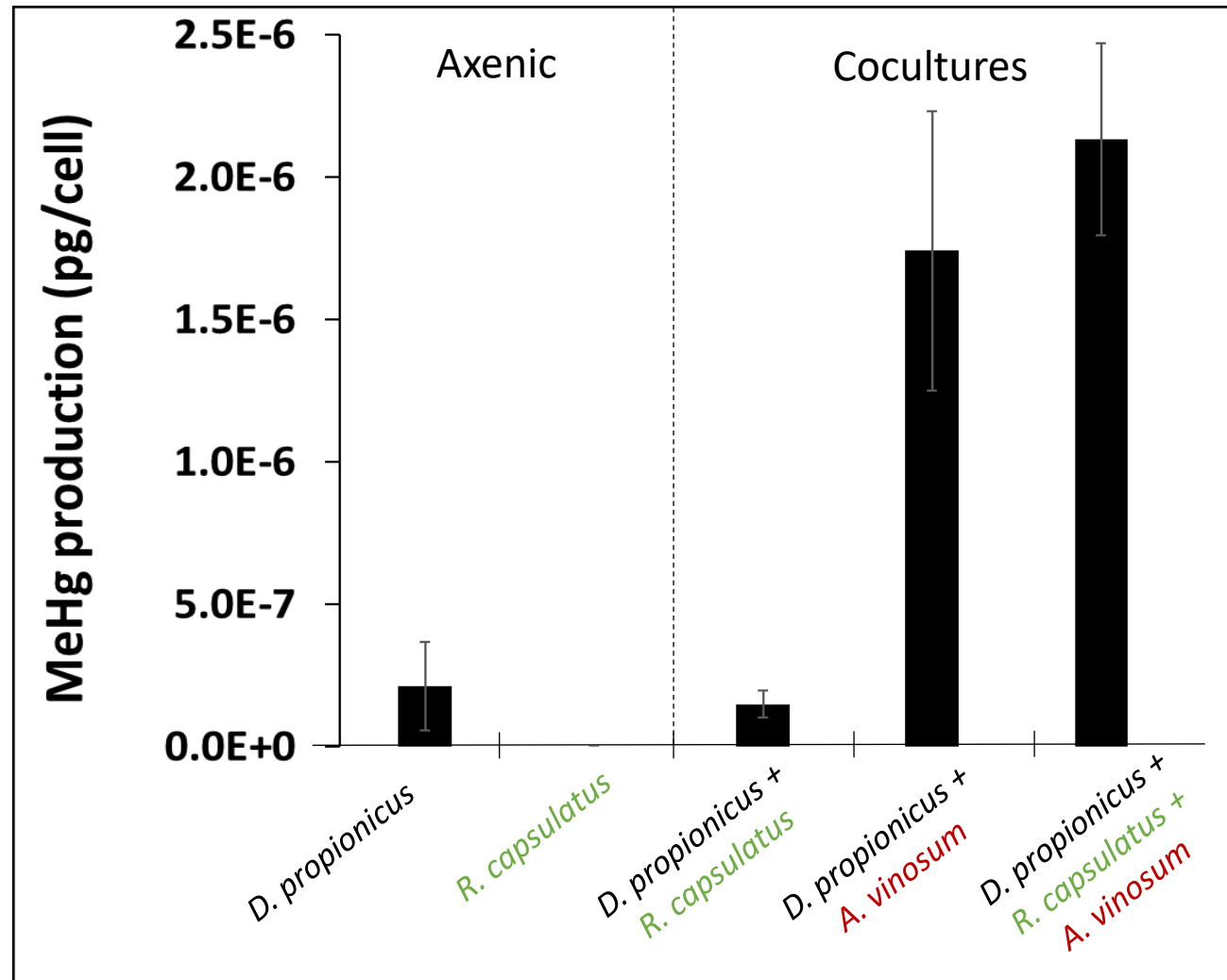


Common medium: Propionate+Butyrate+SO₄²⁻



➔ Inhibition of Hg(II) reduction in cocultures

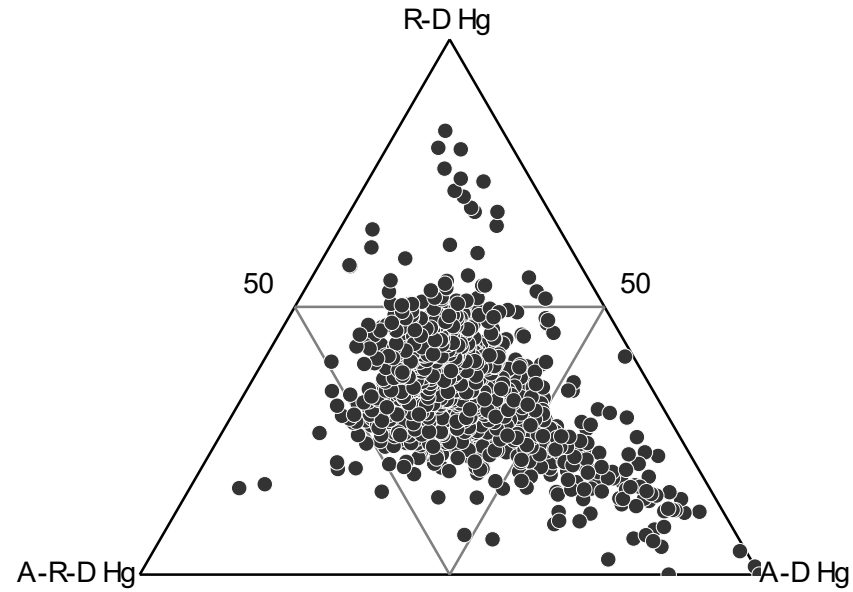




→ *D. propionicus* produces 10 times more MeHg in the presence of *A. vinosum*



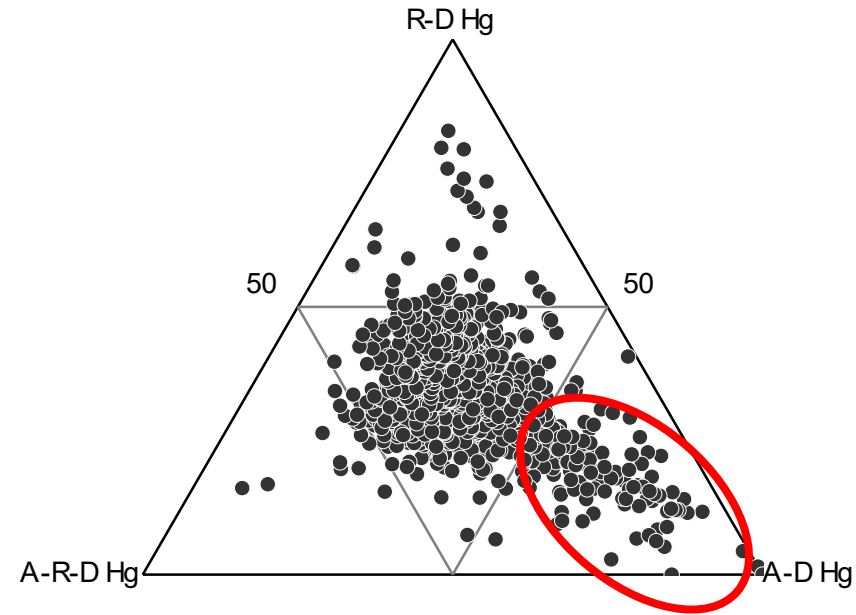
→ in co culture with phototrophs



Each dot: expression level of a *D. propionicus* gene



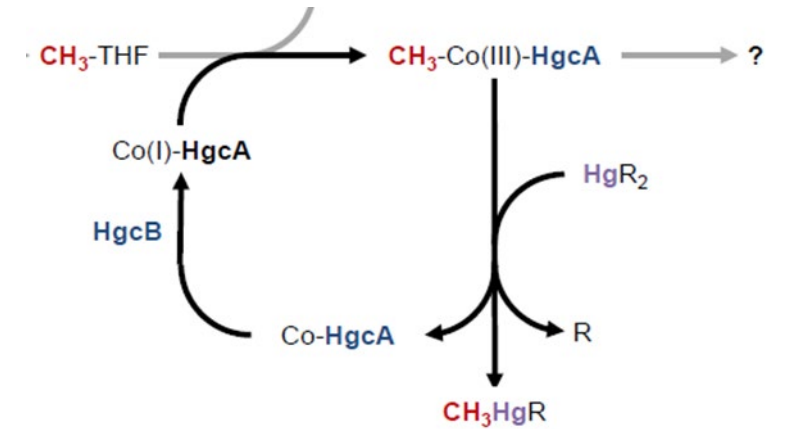
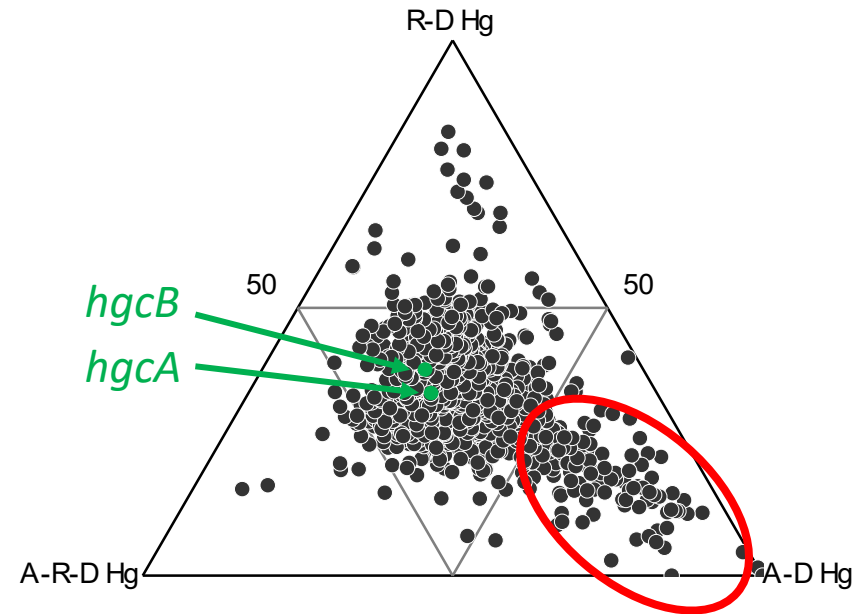
→ in co culture with phototrophs



→ *Allochromatium vinosum* induce the highest modification in expression pattern



→ in co culture with phototrophs



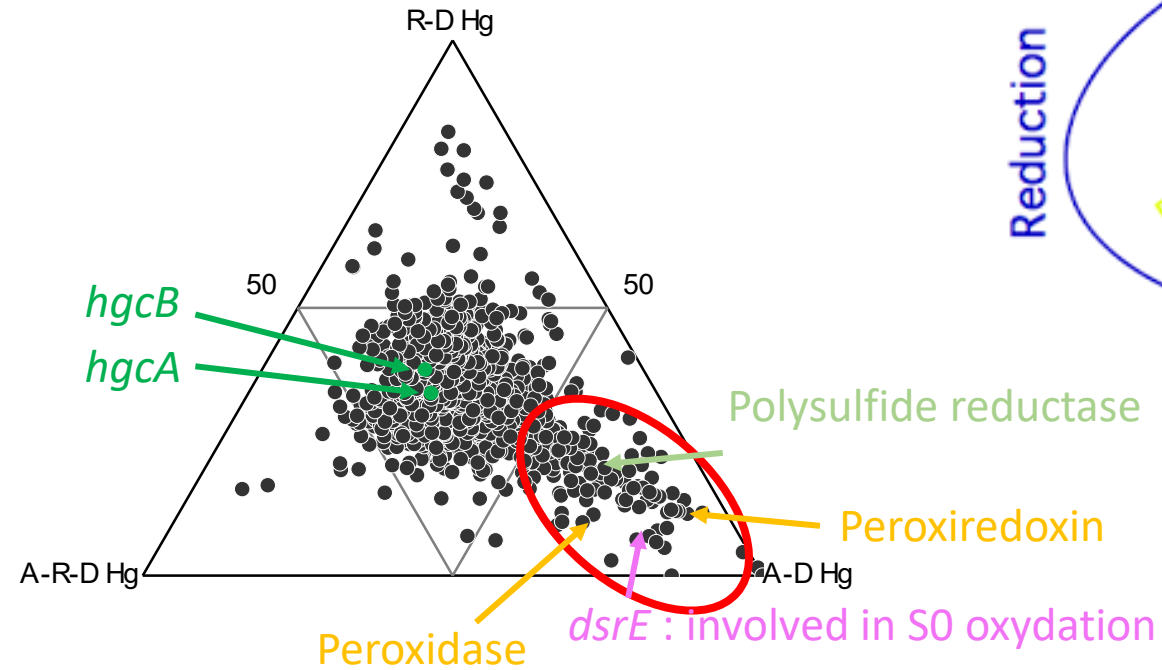
Parks et al., 2013

→ *Allochromatium vinosum* induce the highest modification in expression pattern

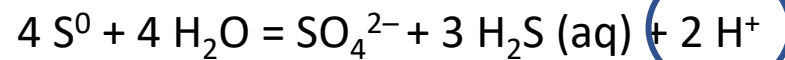
→ *hgcA* and *hgcB* genes expression is low and does NOT change in the presence of *A. vinosum*



→ in co culture with phototrophs



- *Allochromatium vinosum* induce the highest modification in expression pattern
- *hgcA* and *hgcB* genes expression is low and does NOT change in the presence of *A. vinosum*
- Disproportionation of S^0 induced in *D. propionicus*

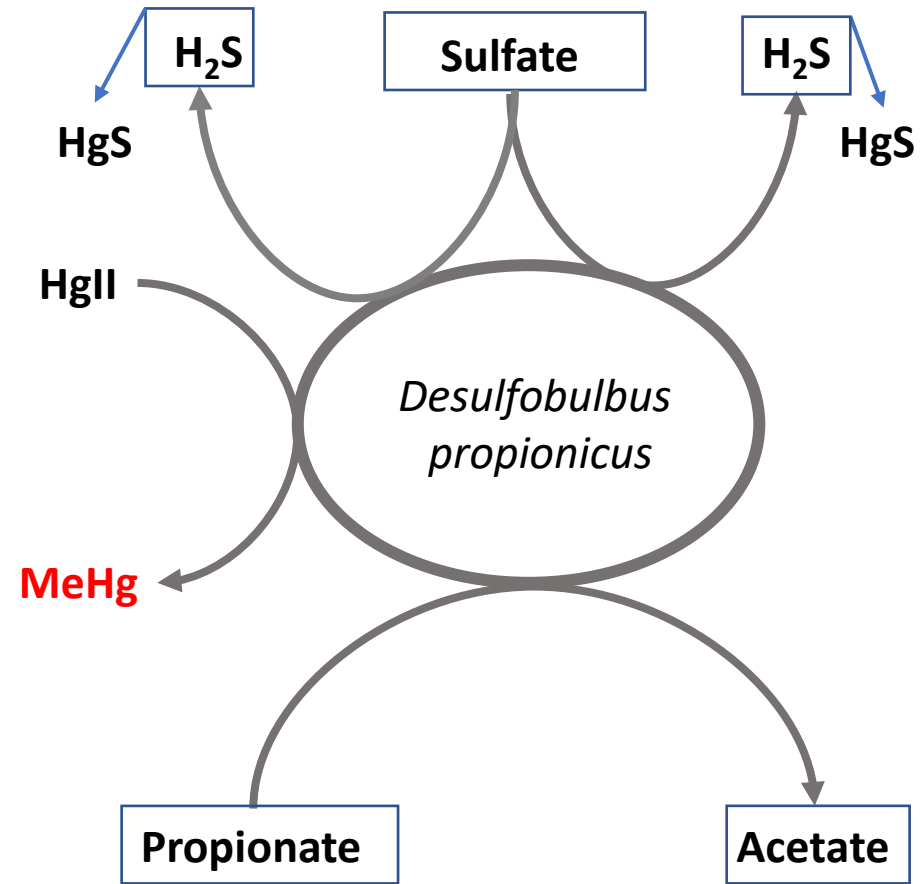


→ New energy source

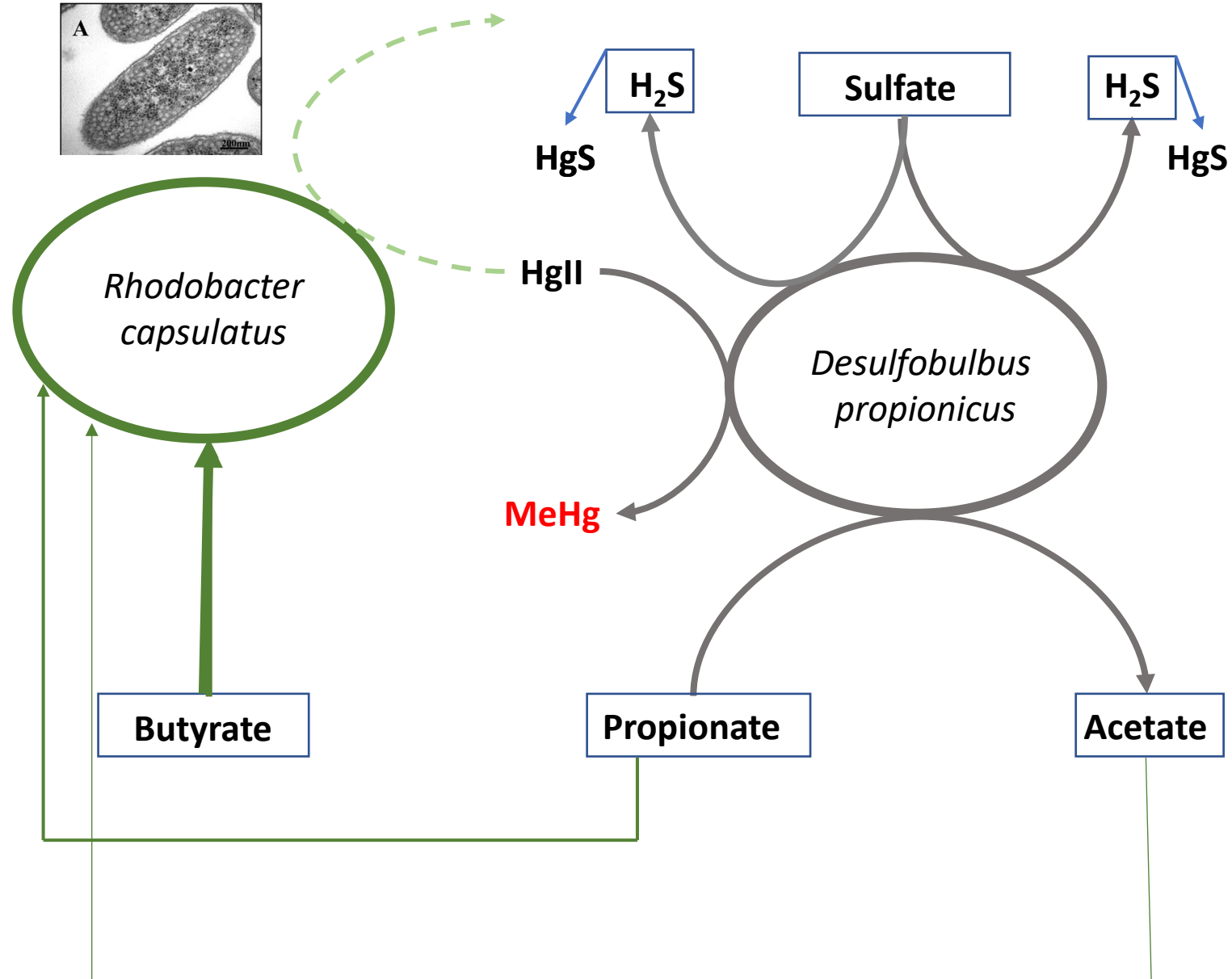
Each dot: expression level of a *D. propionicus* gene



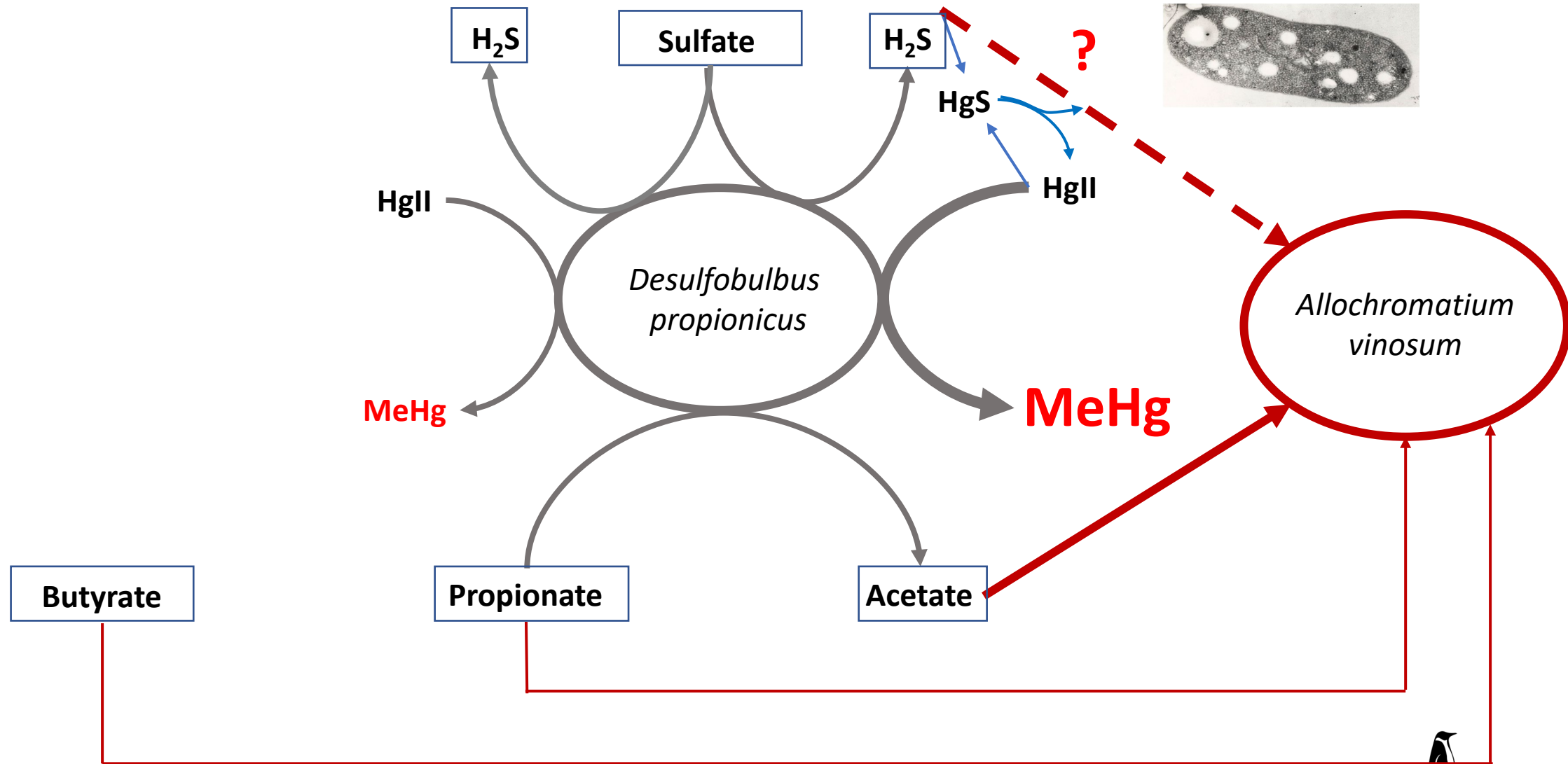
Model of metabolic functioning and mercury transformations in cocultures

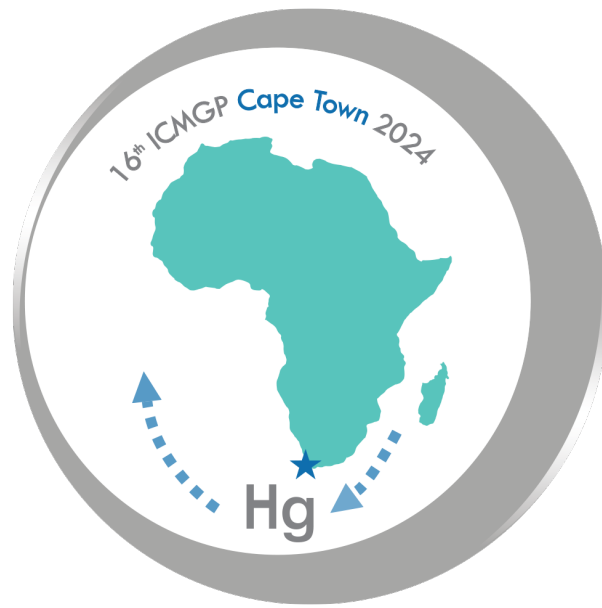


Model of metabolic functioning and mercury transformations in cocultures



Model of metabolic functioning and mercury transformations in cocultures





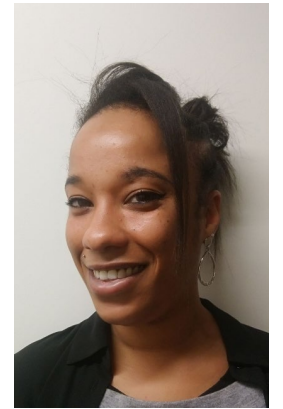
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Many thanks for your attention



Adrien Vigneron



Diva Scuvée

