

Elucidating mercury sources and exposure pathways to bivalves using mercury stable isotopes

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Oak Ridge National Laboratory, United States



ESS
Environmental
System Science

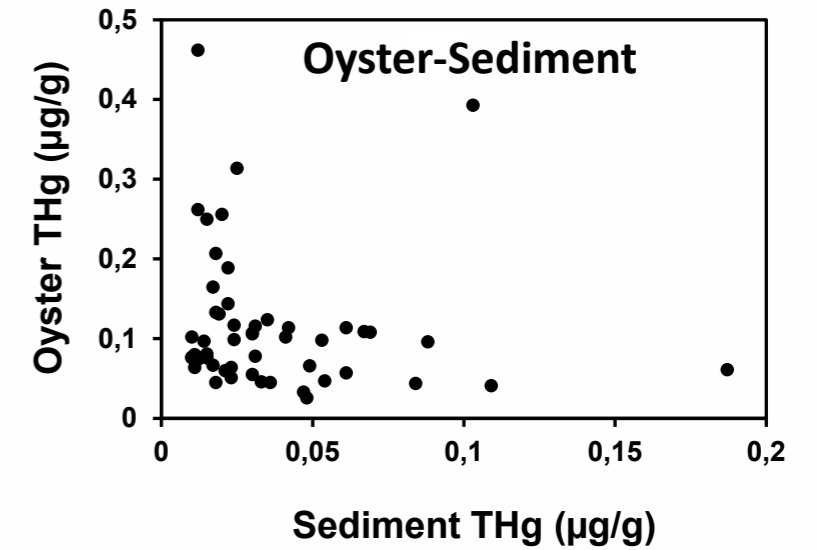
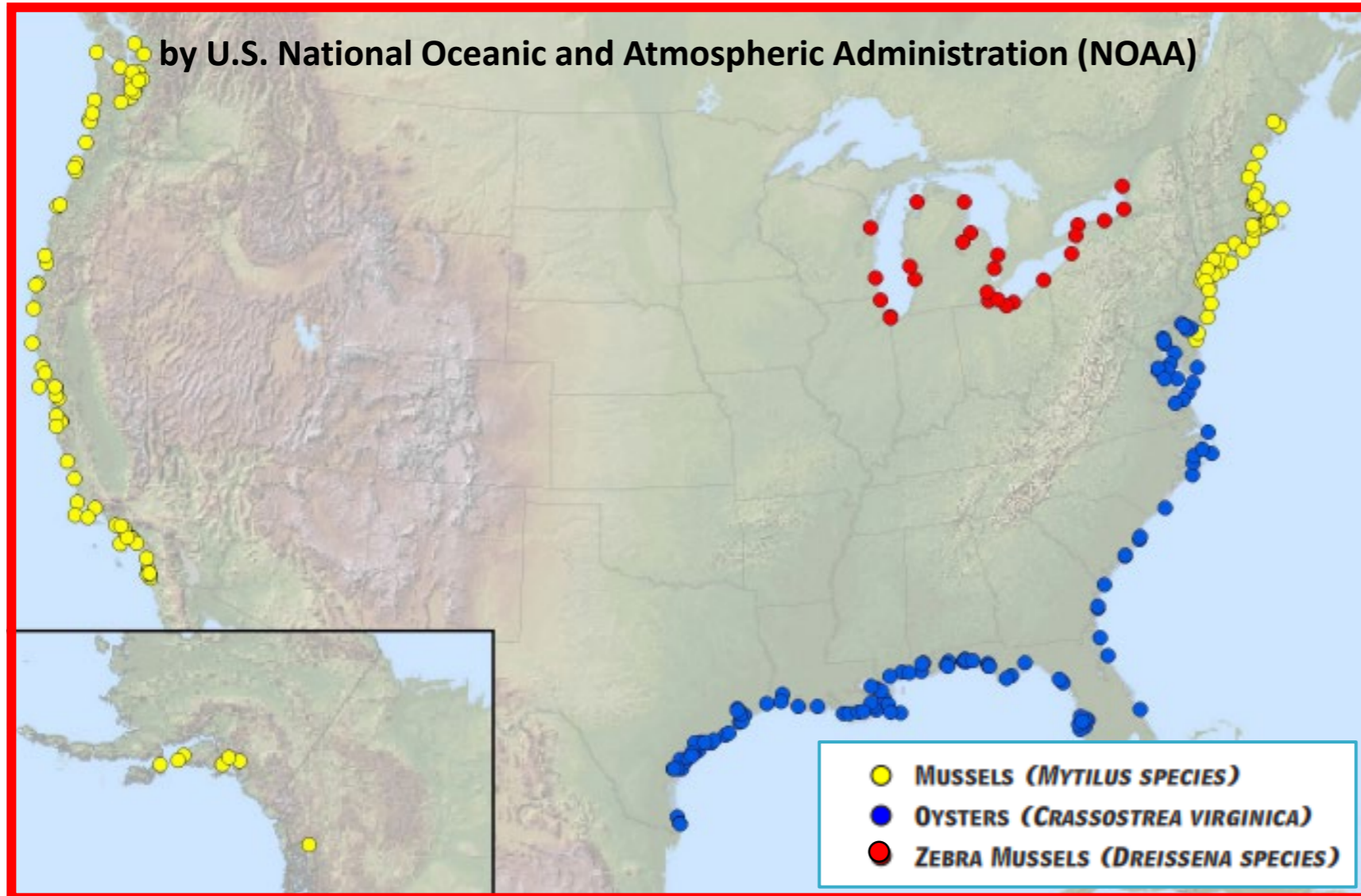


POSTECH

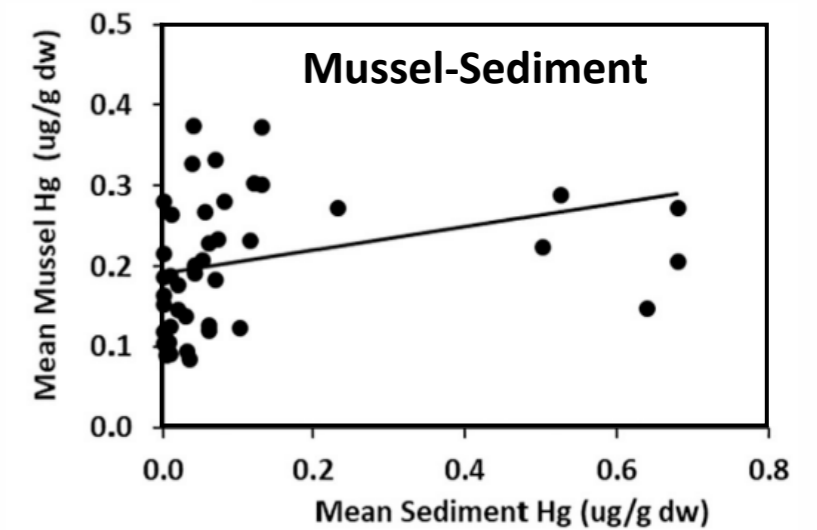
POHANG UNIVERSITY OF SCIENCE AND TECHNOLOGY



Mussel Watch Program

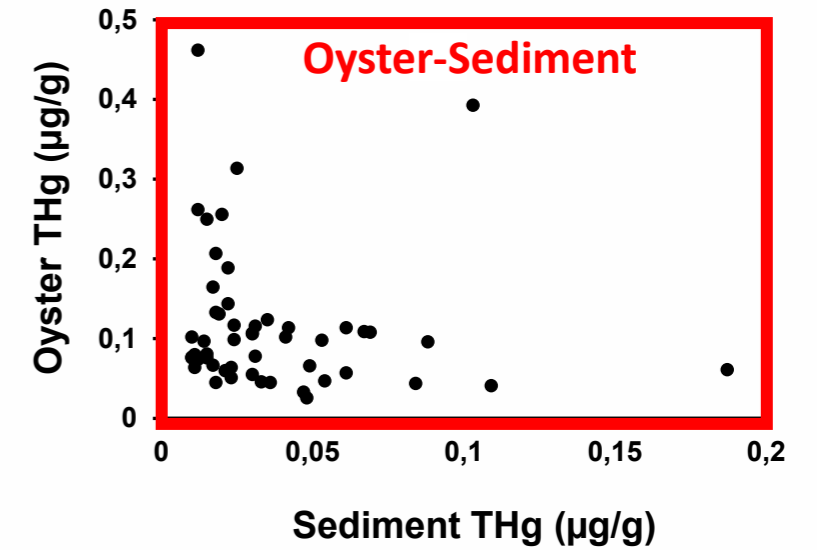


(Apeti et al., 2012)

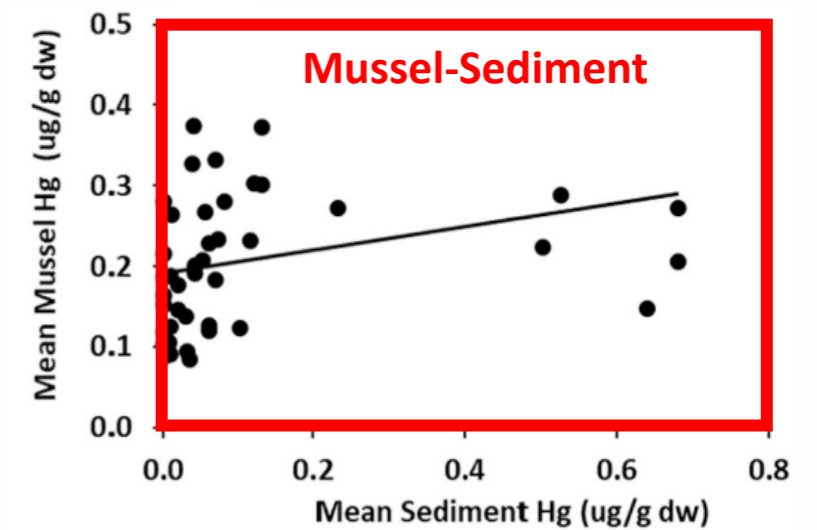


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Mussel Watch Program

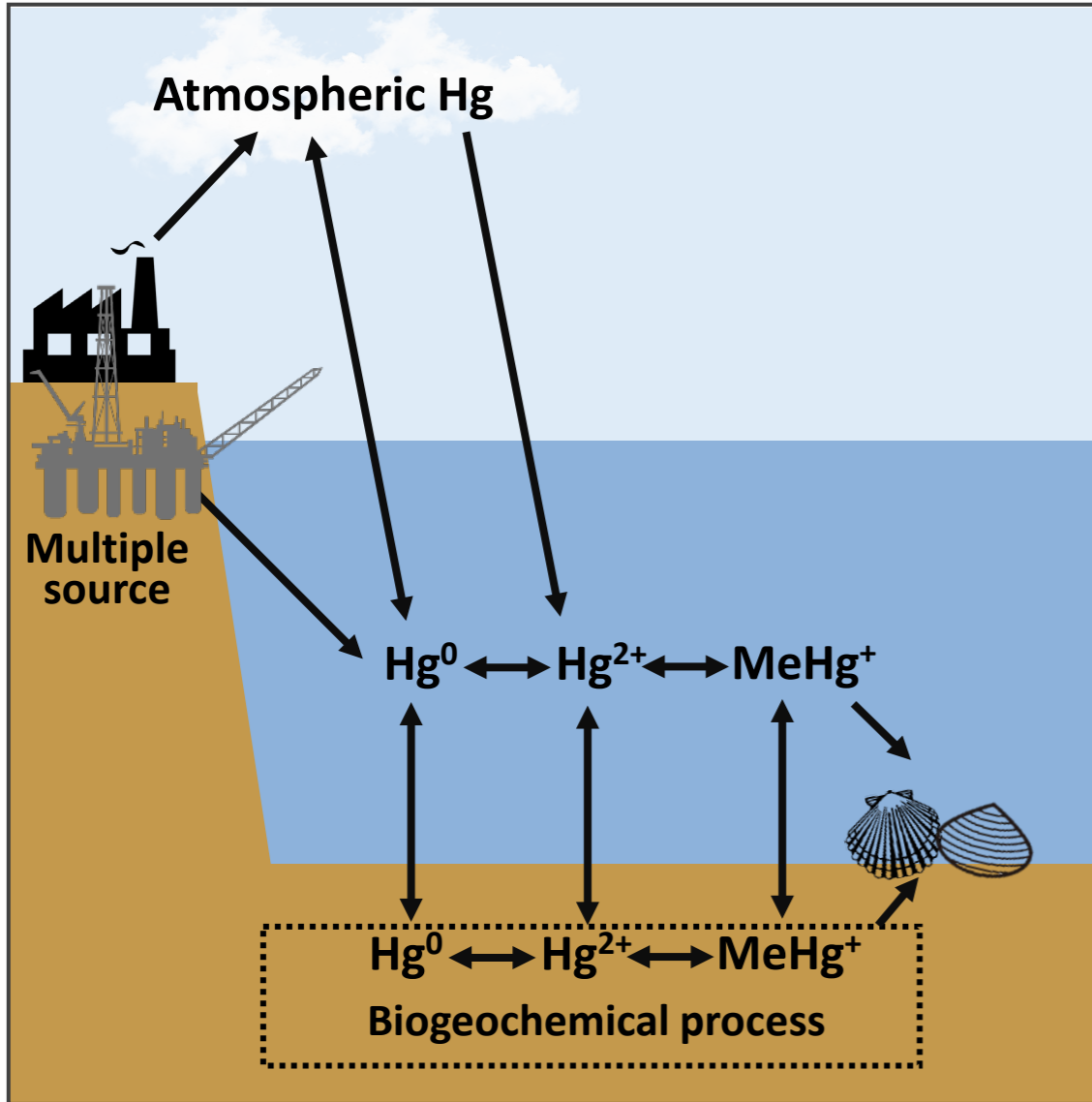


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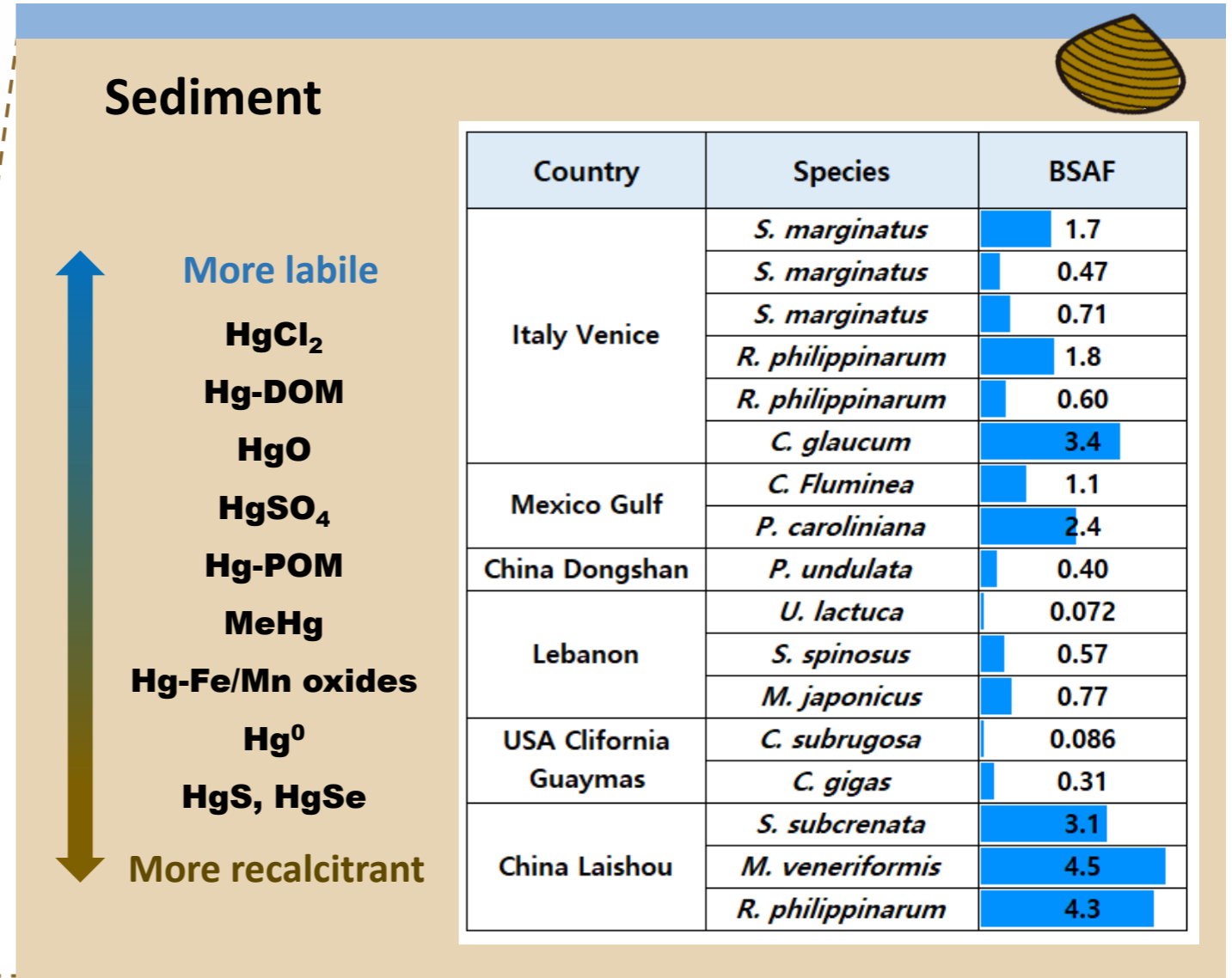
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Hg cycle in river



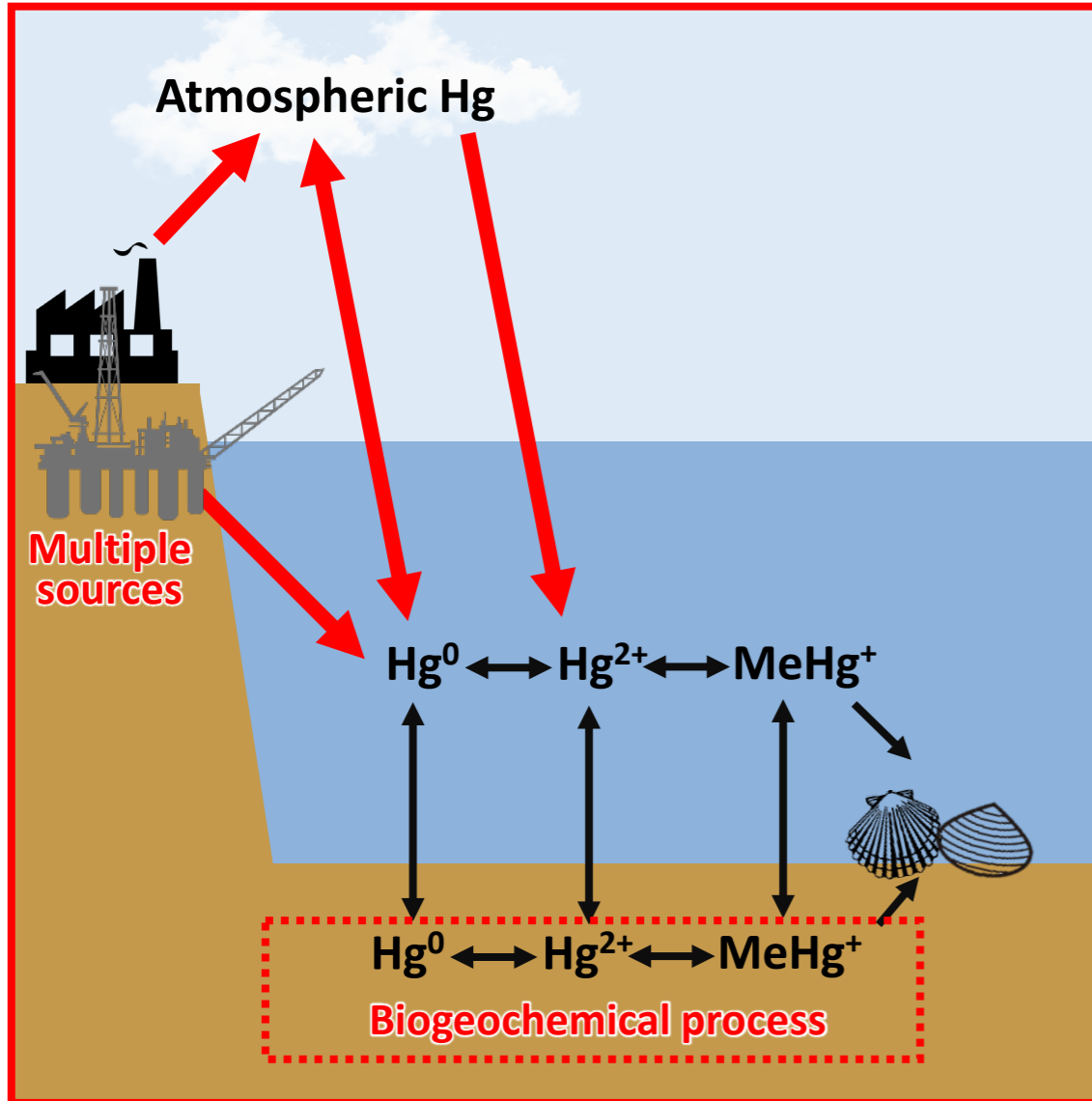
(Donovan et al., 2014; Flanders et al., 2010; Yang et al., 2022)

$$BSAF = \frac{\text{Biota THg}}{\text{Sediment THg}}$$



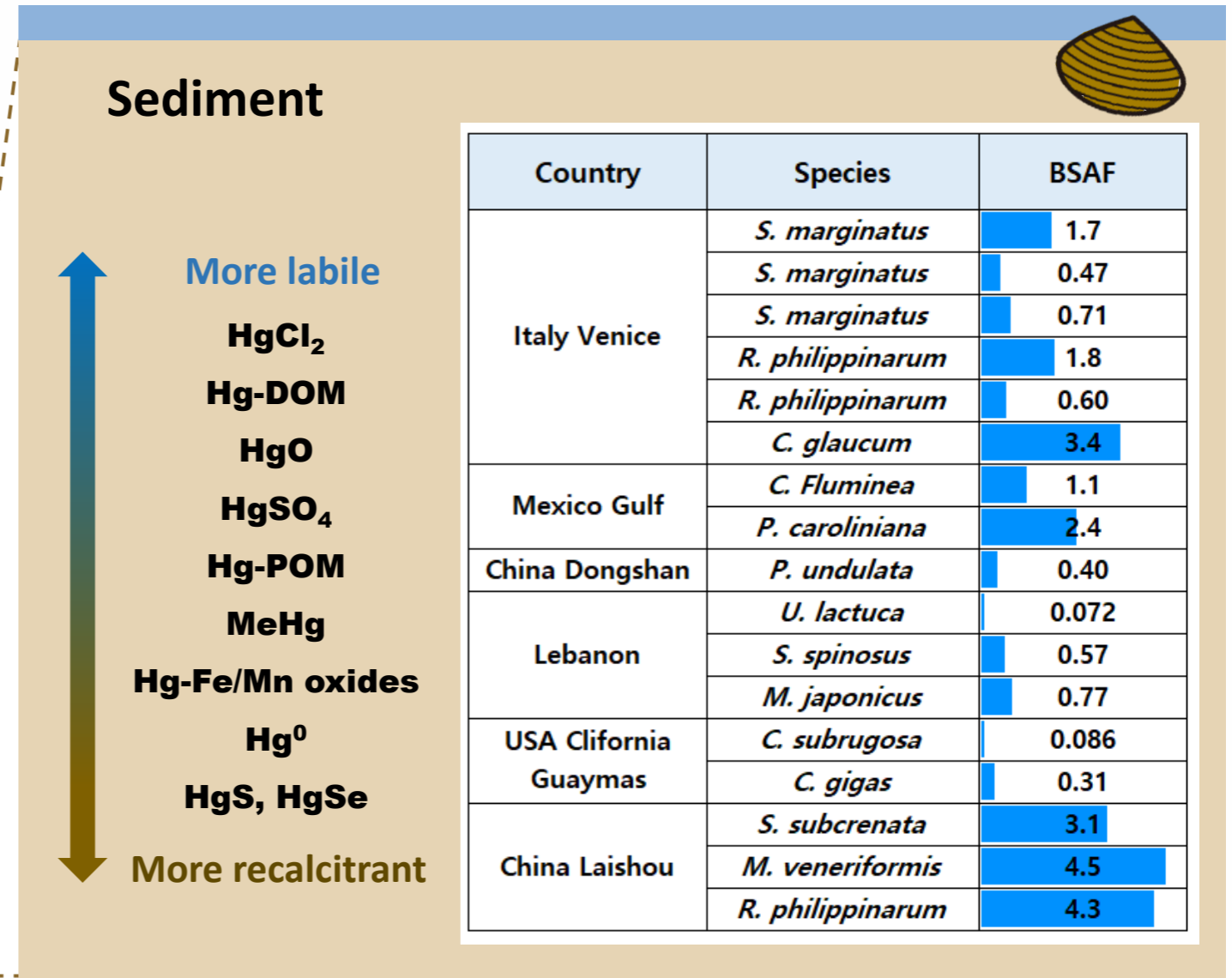
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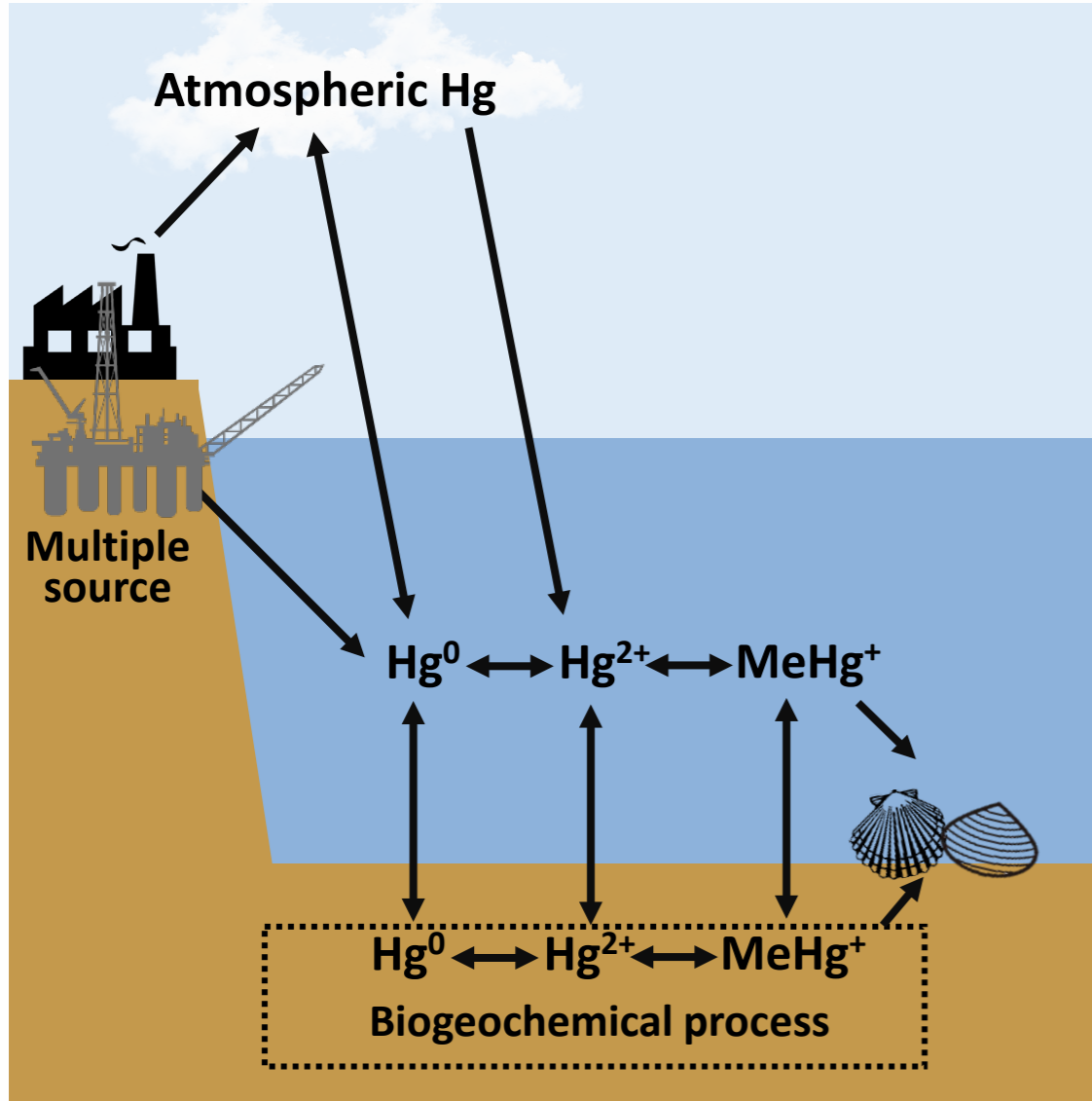
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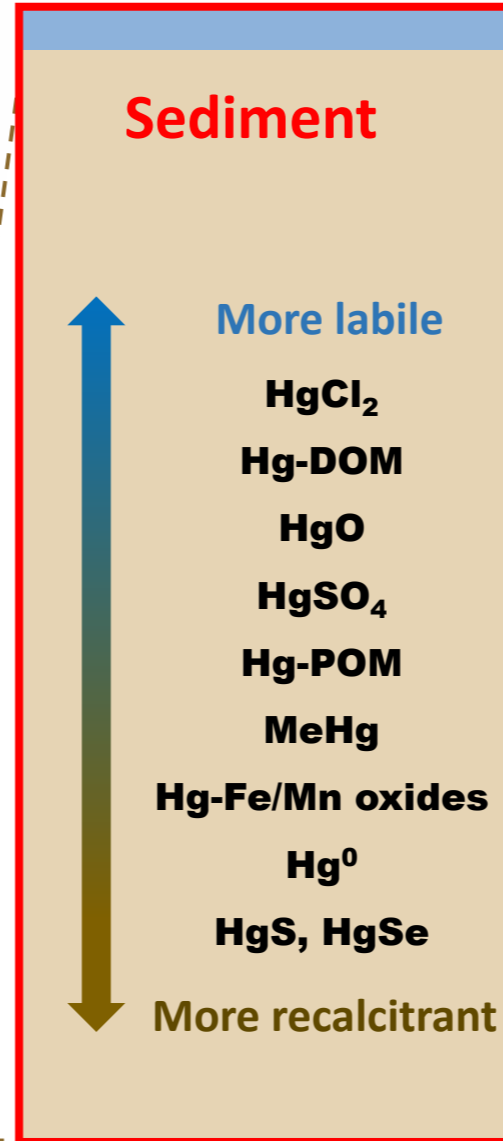


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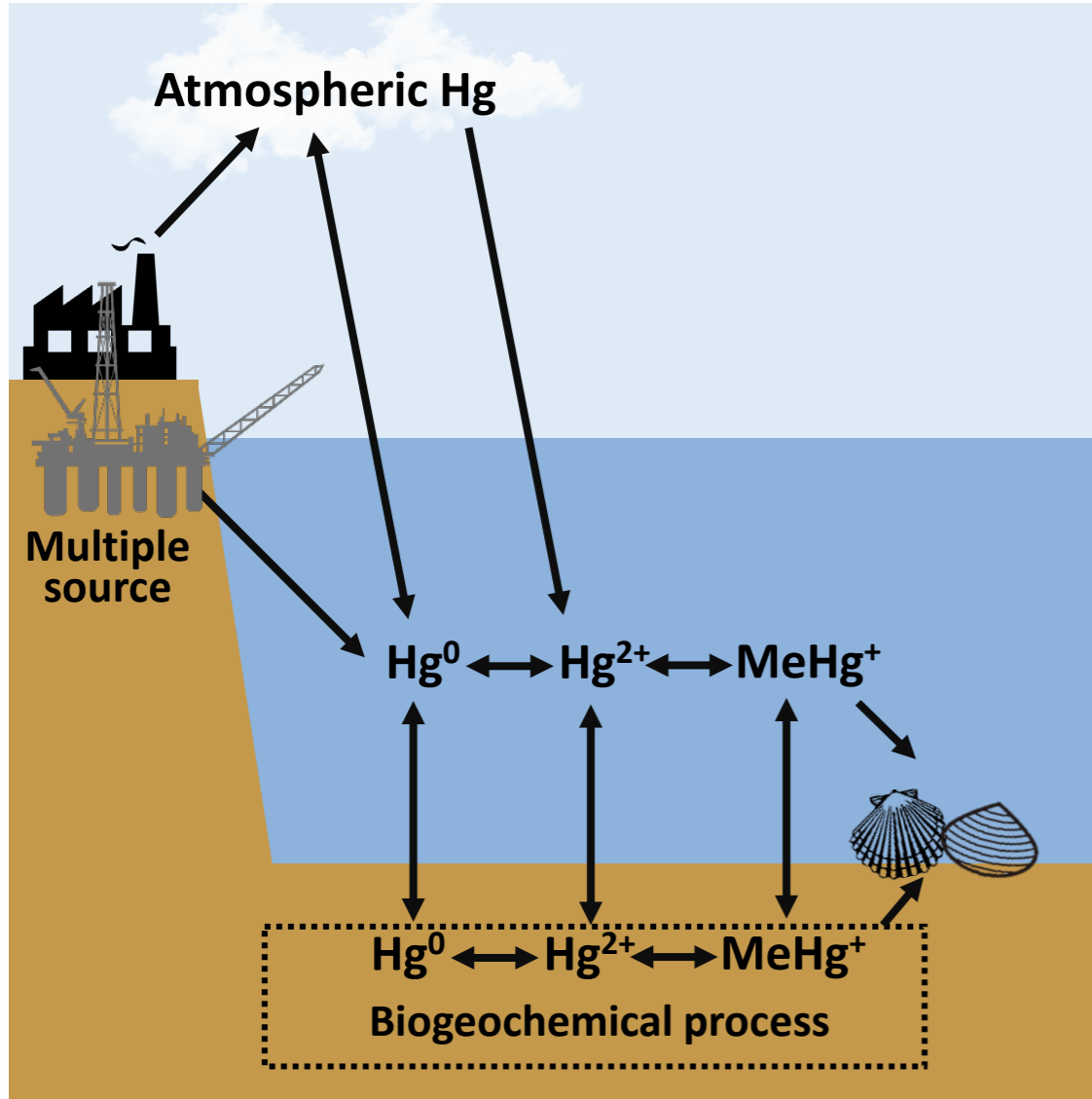


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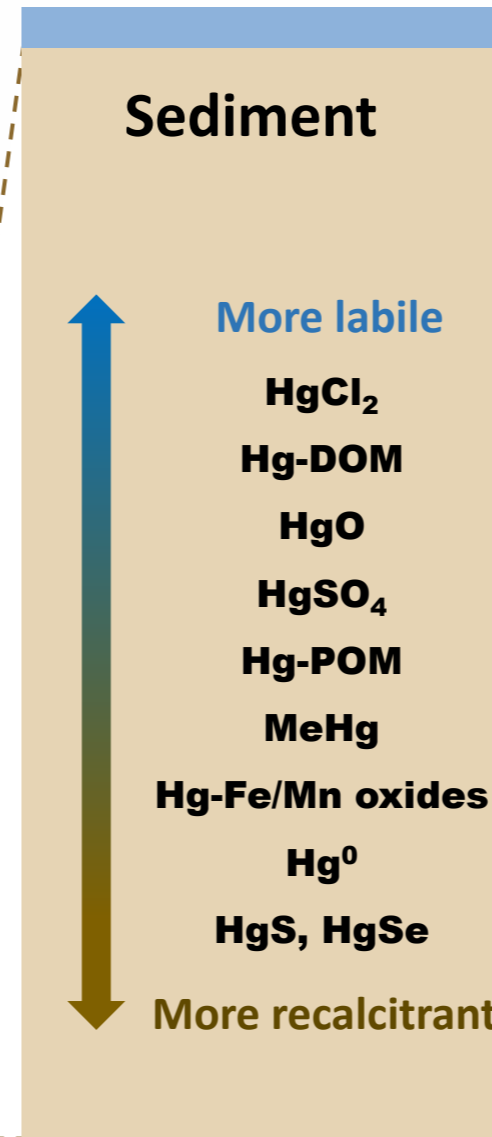
Country	Species	BSAF
Italy Venice	<i>S. marginatus</i>	1.7
	<i>S. marginatus</i>	0.47
	<i>S. marginatus</i>	0.71
	<i>R. philippinarum</i>	1.8
	<i>R. philippinarum</i>	0.60
Mexico Gulf	<i>C. glaucum</i>	3.4
	<i>C. Fluminea</i>	1.1
China Dongshan	<i>P. caroliniana</i>	2.4
	<i>P. undulata</i>	0.40
Lebanon	<i>U. lactuca</i>	0.072
	<i>S. spinosus</i>	0.57
	<i>M. japonicus</i>	0.77
USA Clifornia Guaymas	<i>C. subrugosa</i>	0.086
	<i>C. gigas</i>	0.31
China Laishou	<i>S. subcrenata</i>	3.1
	<i>M. veneriformis</i>	4.5
	<i>R. philippinarum</i>	4.3

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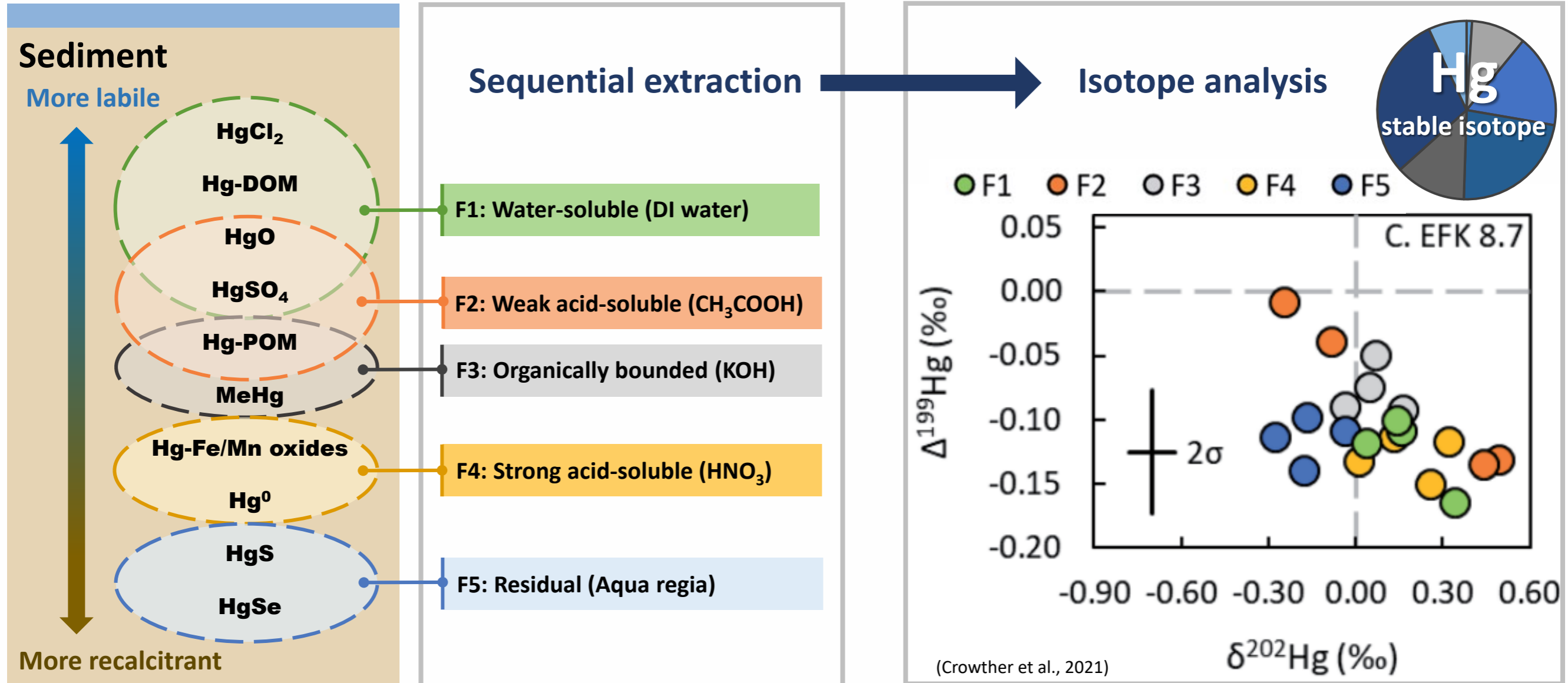
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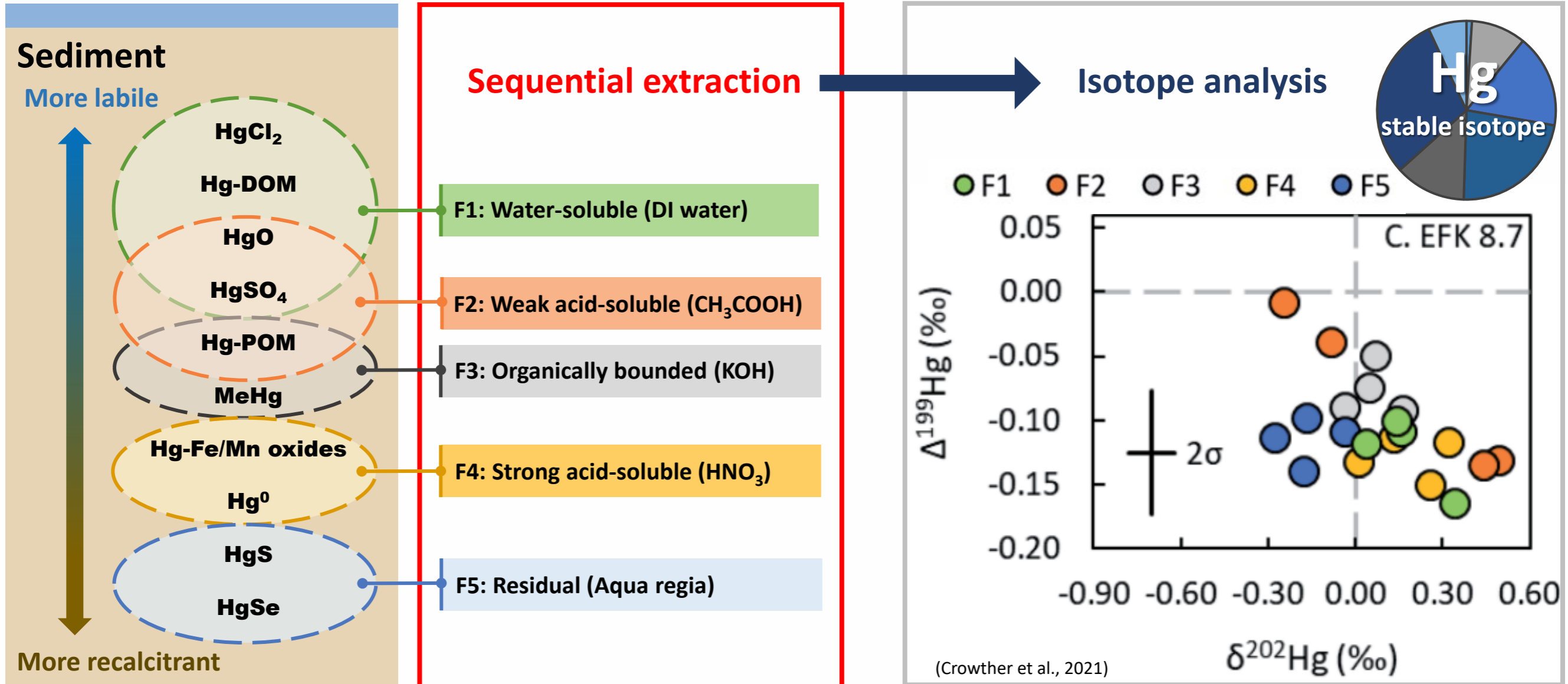


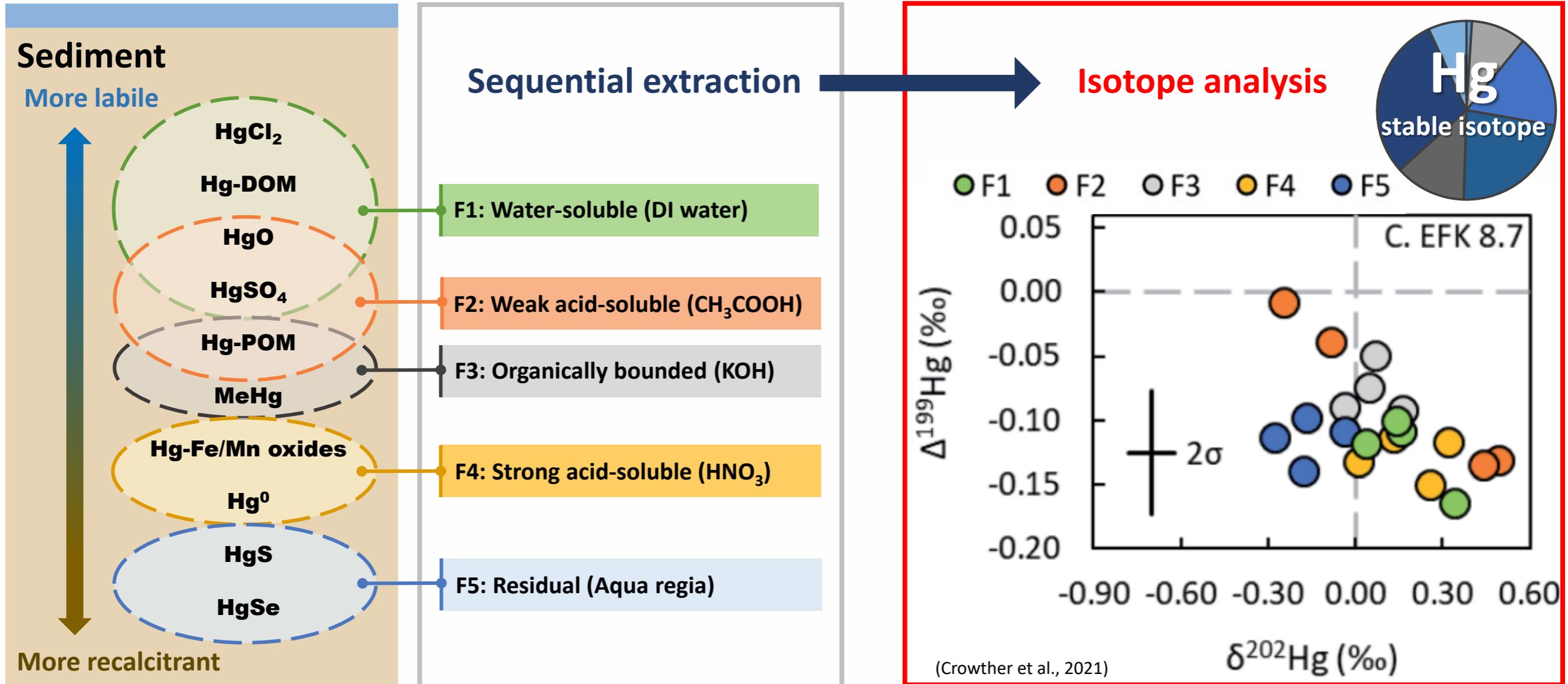
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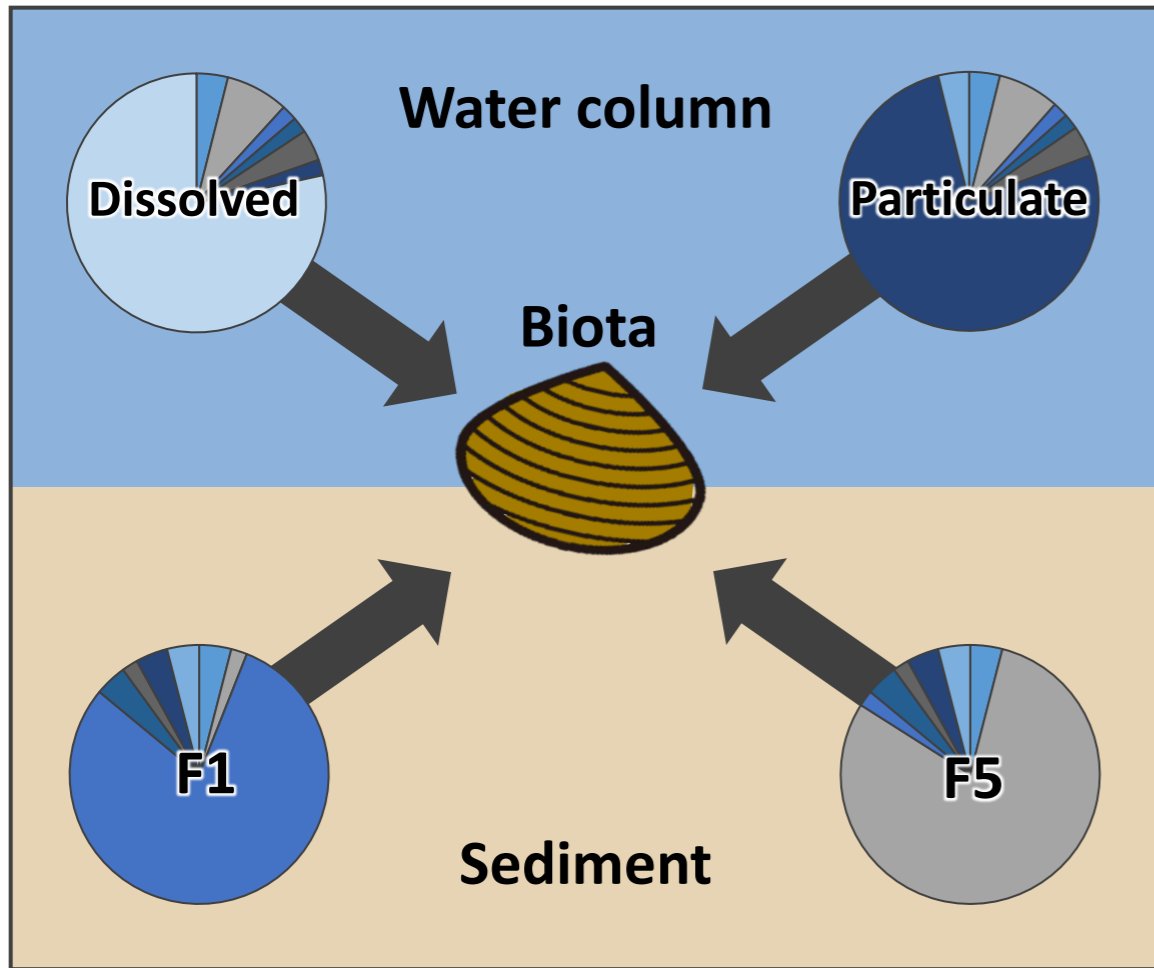
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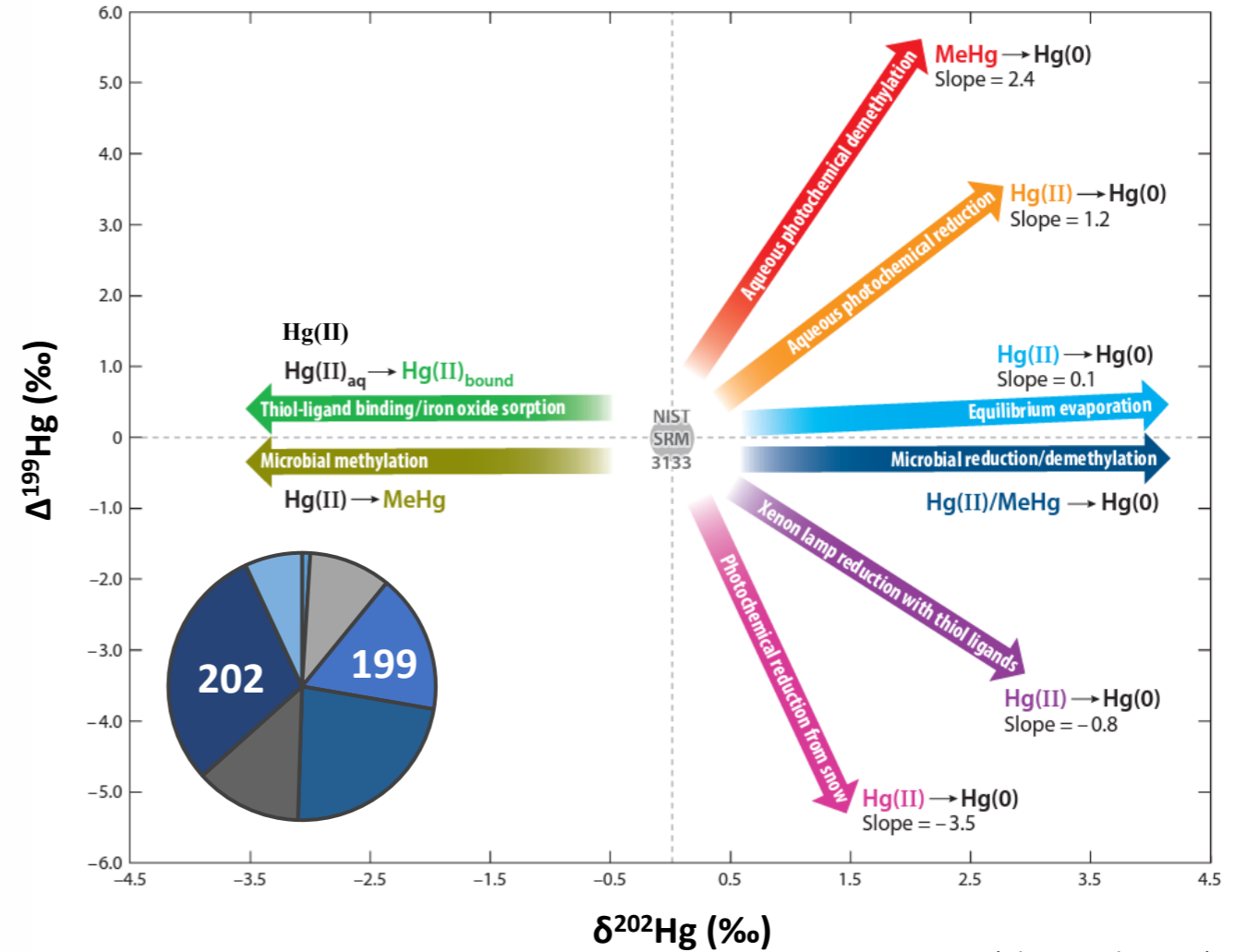




Isotope mixing

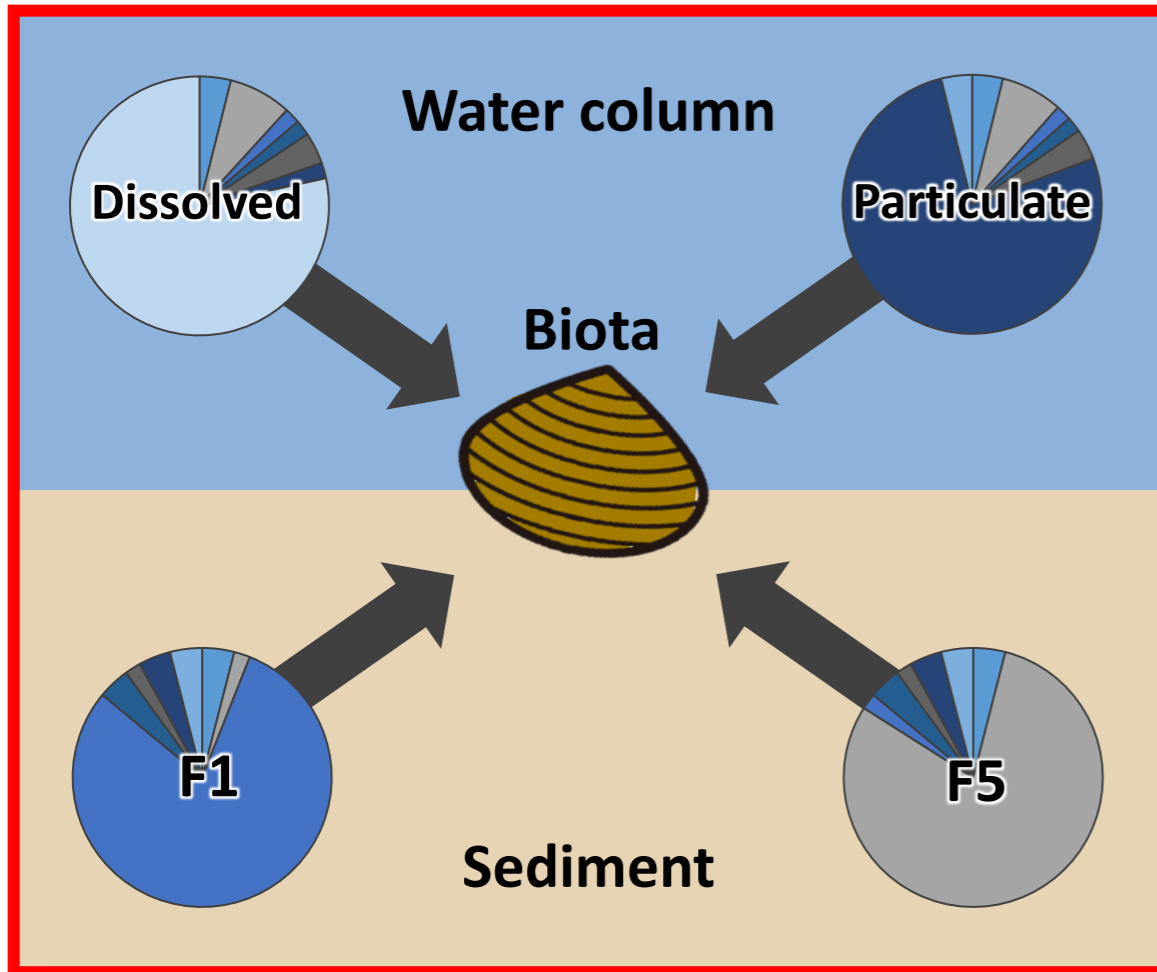


Isotope fractionation

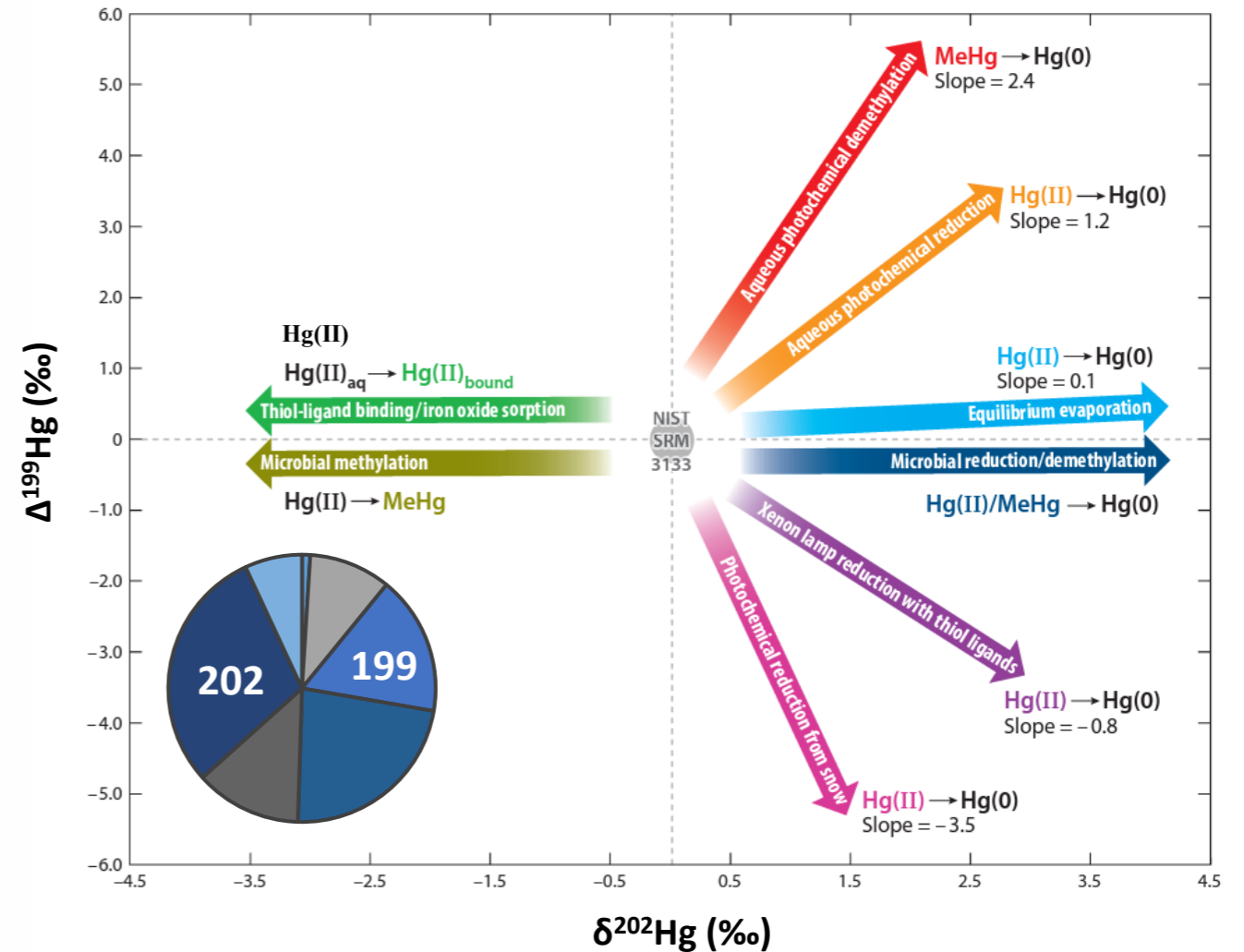


(Blum et al., 2014)

Isotope mixing

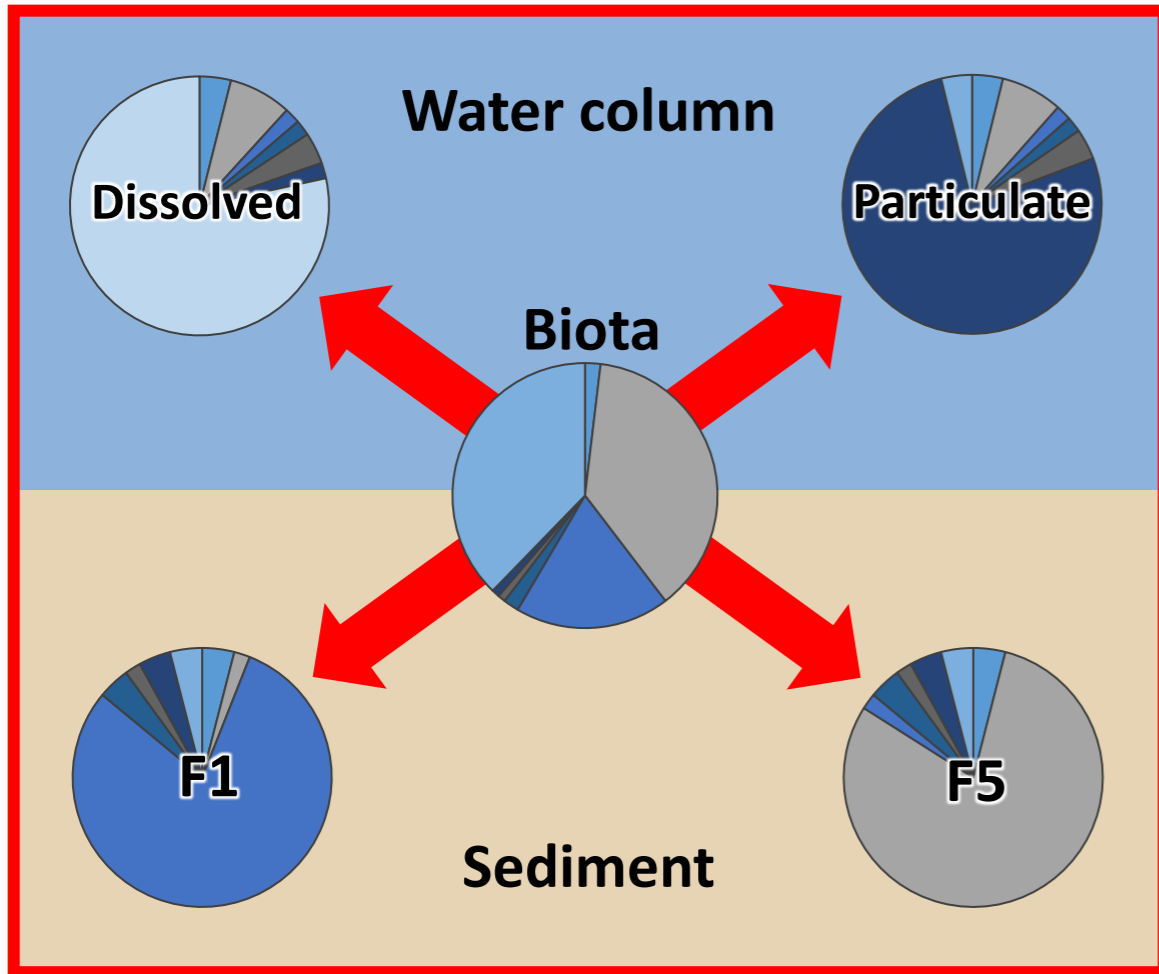


Isotope fractionation

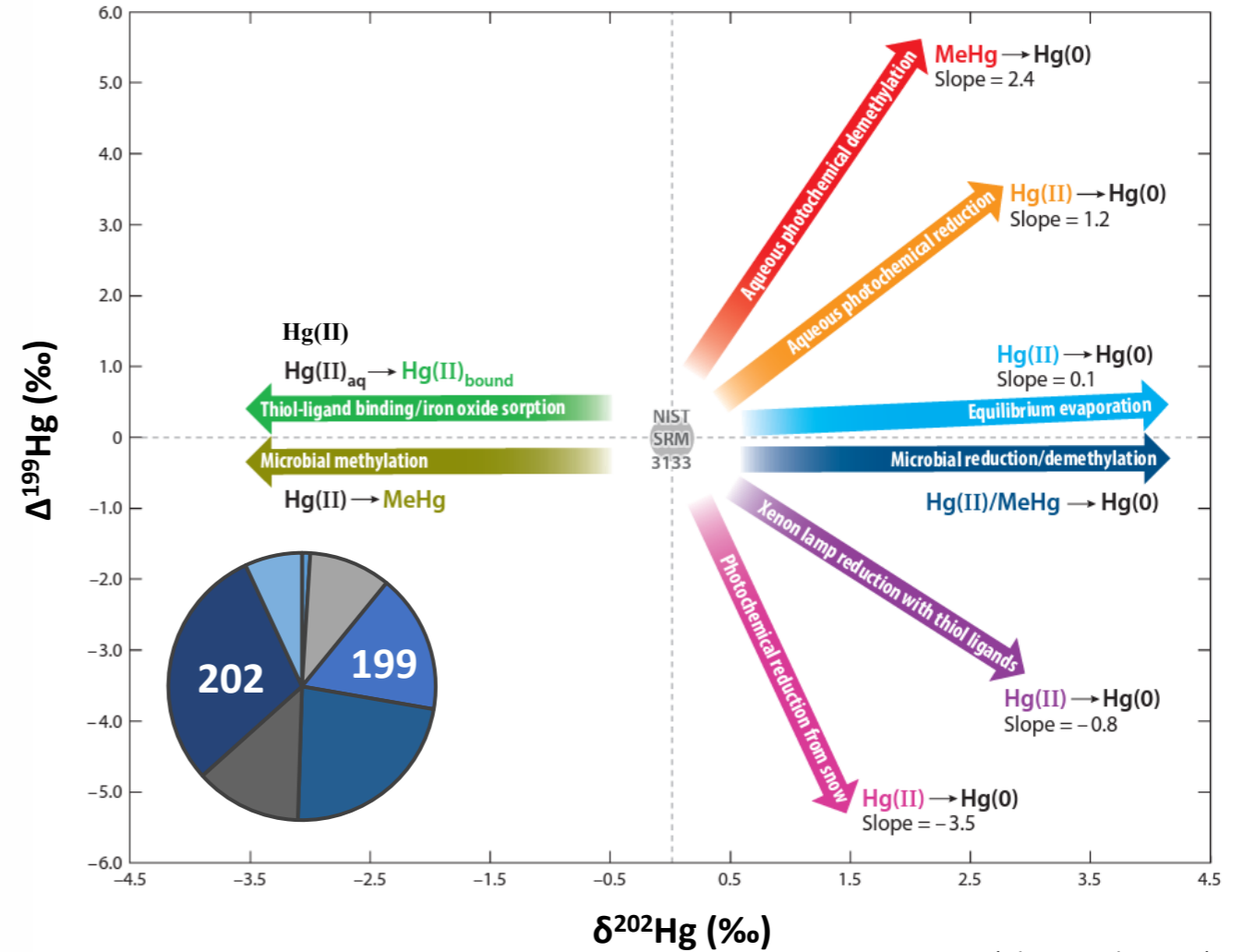


(Blum et al., 2014)

Isotope mixing

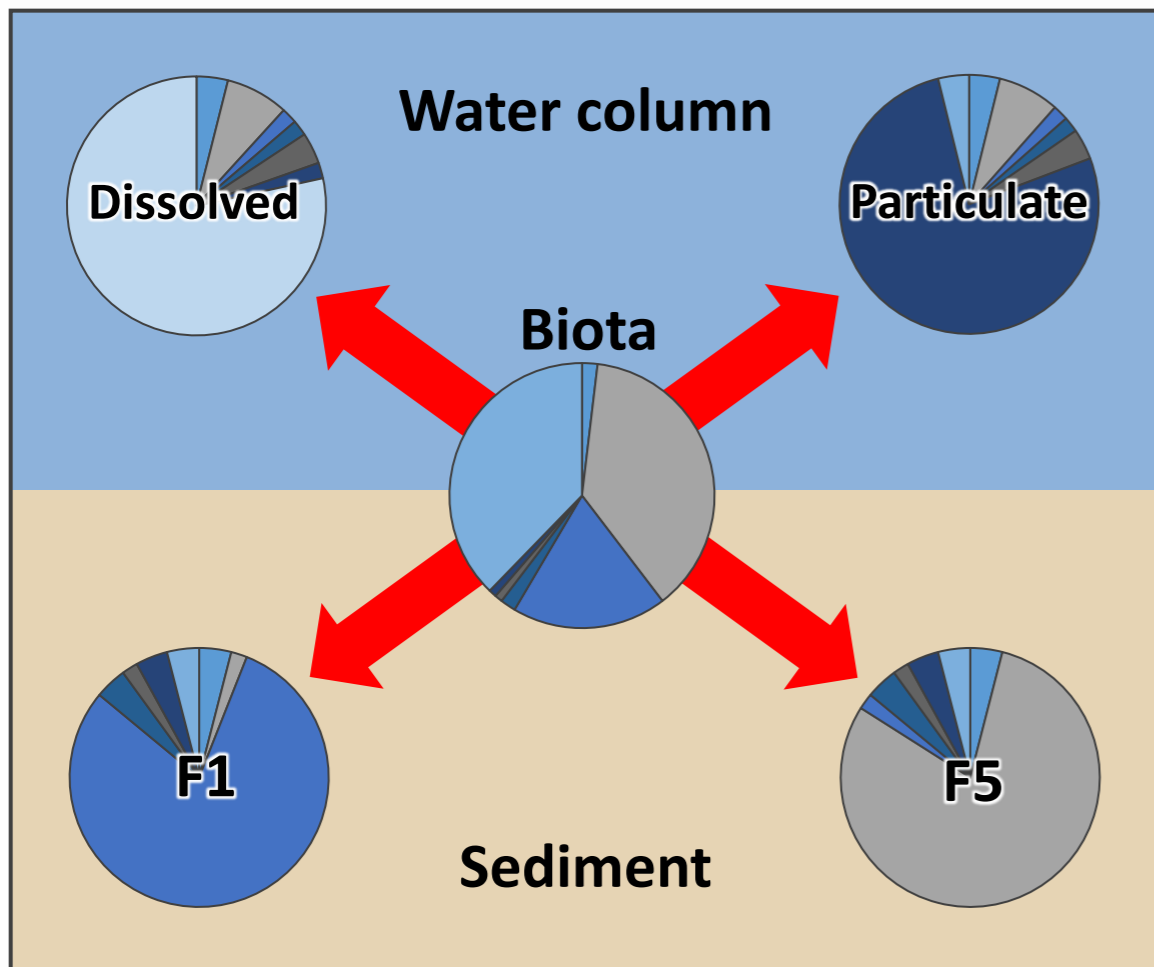


Isotope fractionation

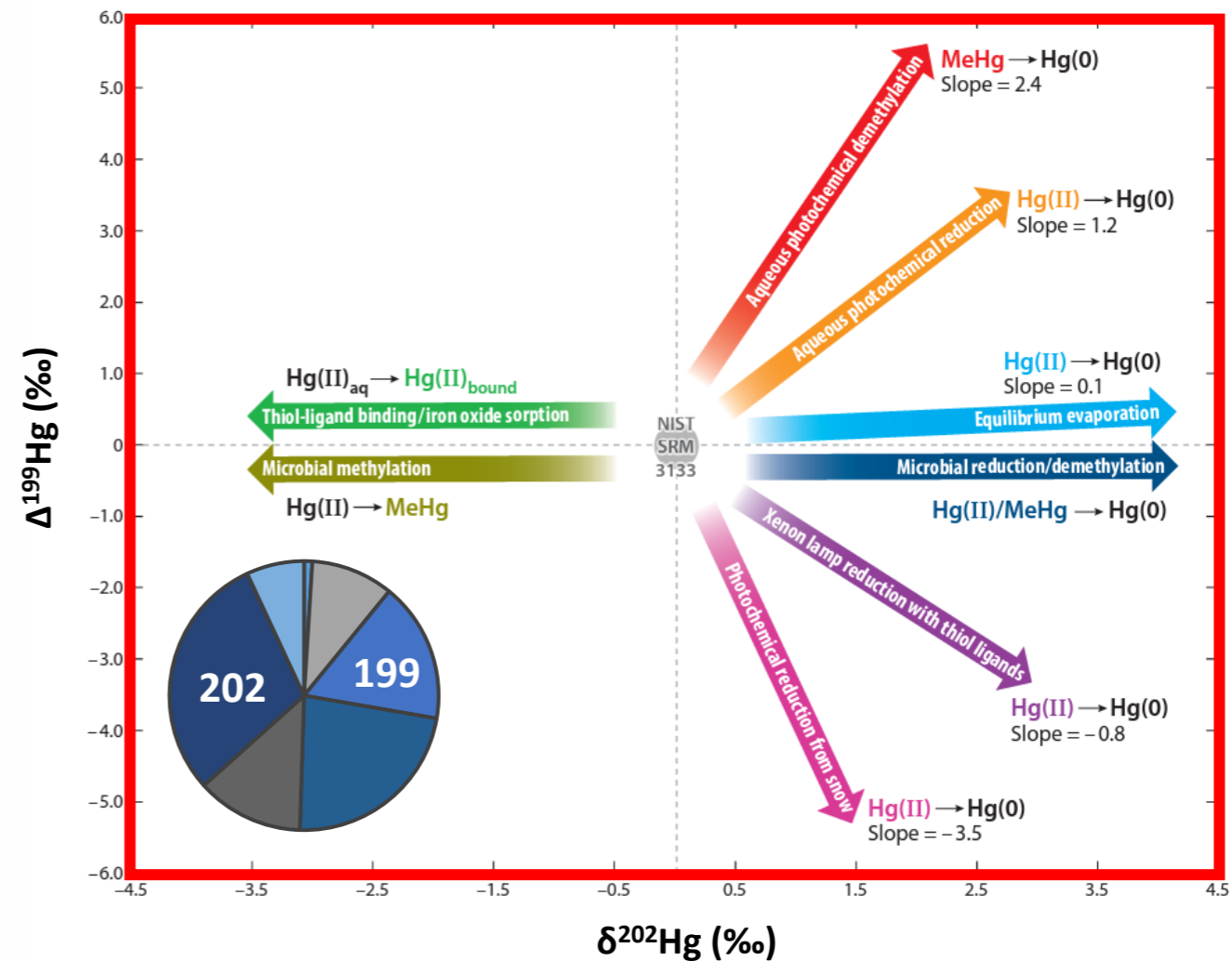


(Blum et al., 2014)

Isotope mixing



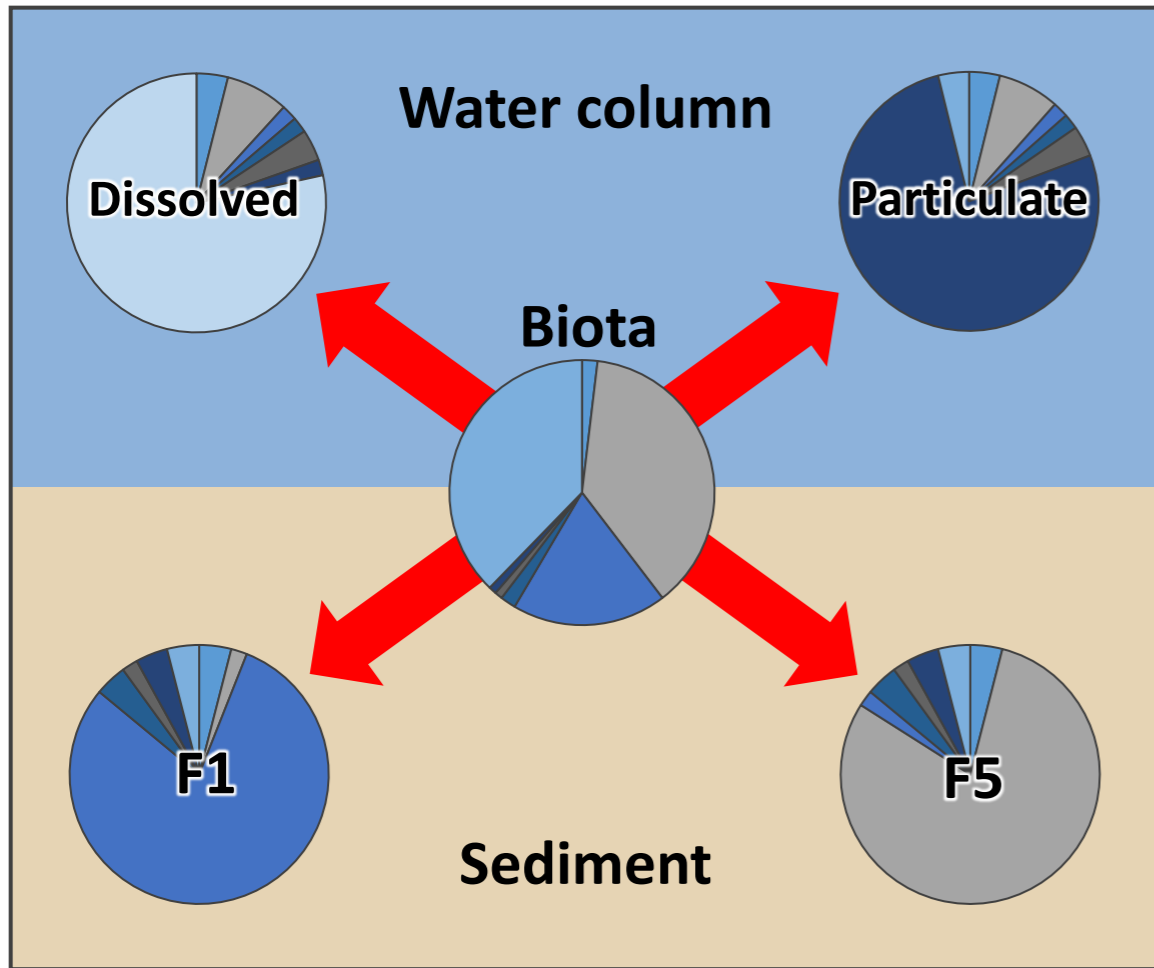
Isotope fractionation



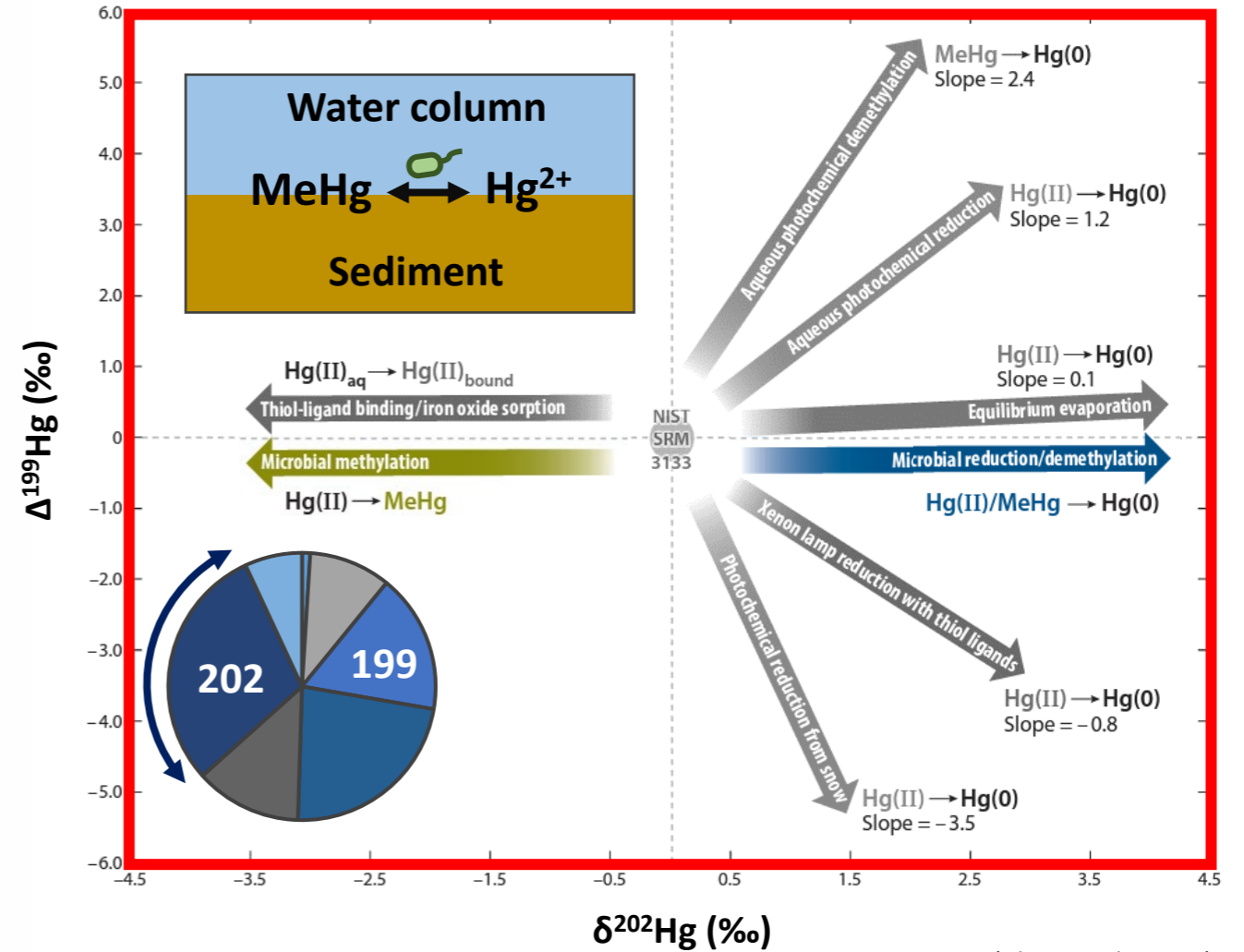
(Blum et al., 2014)

 $\delta^{202}\text{Hg}$: mass-dependent $\Delta^{199}\text{Hg}$: mass-independent

Isotope mixing

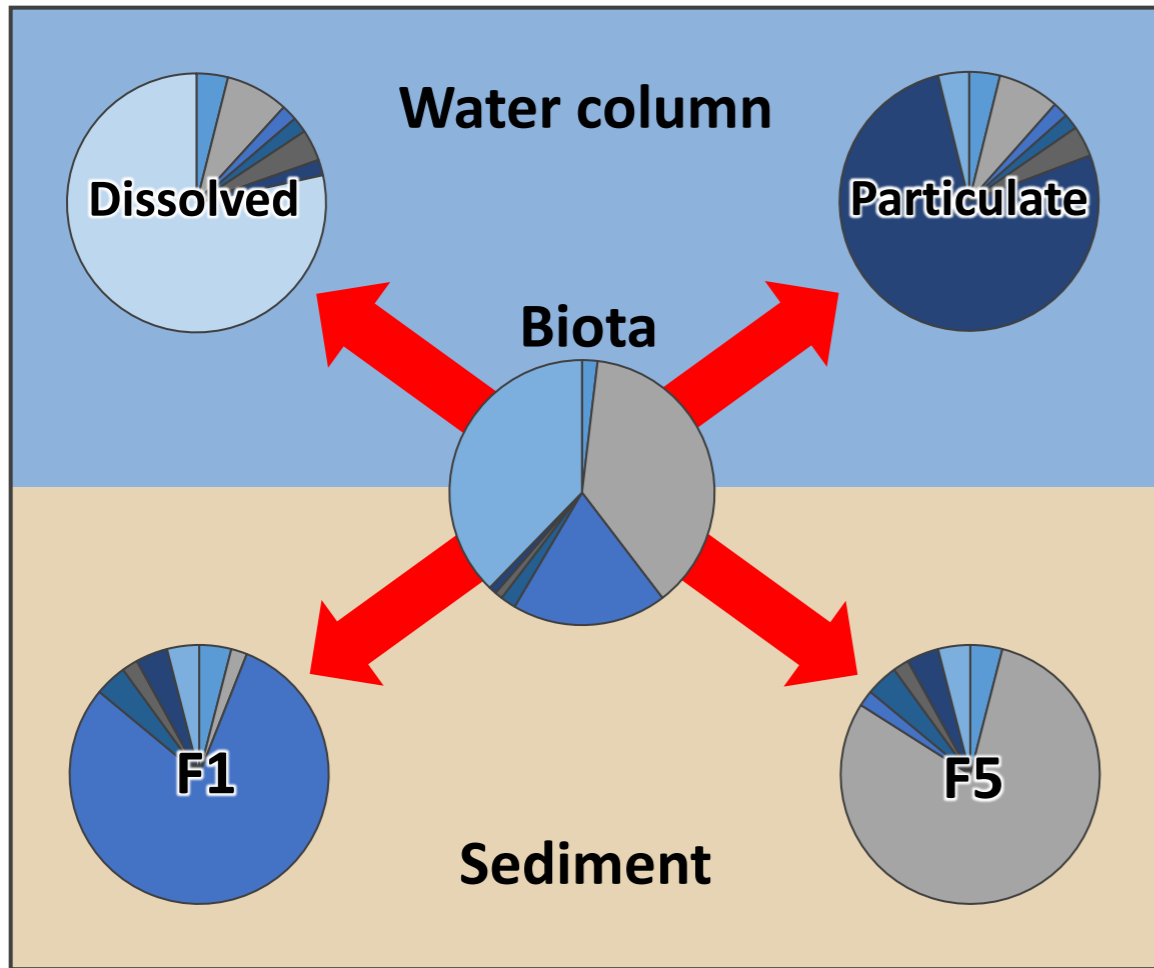


Isotope fractionation

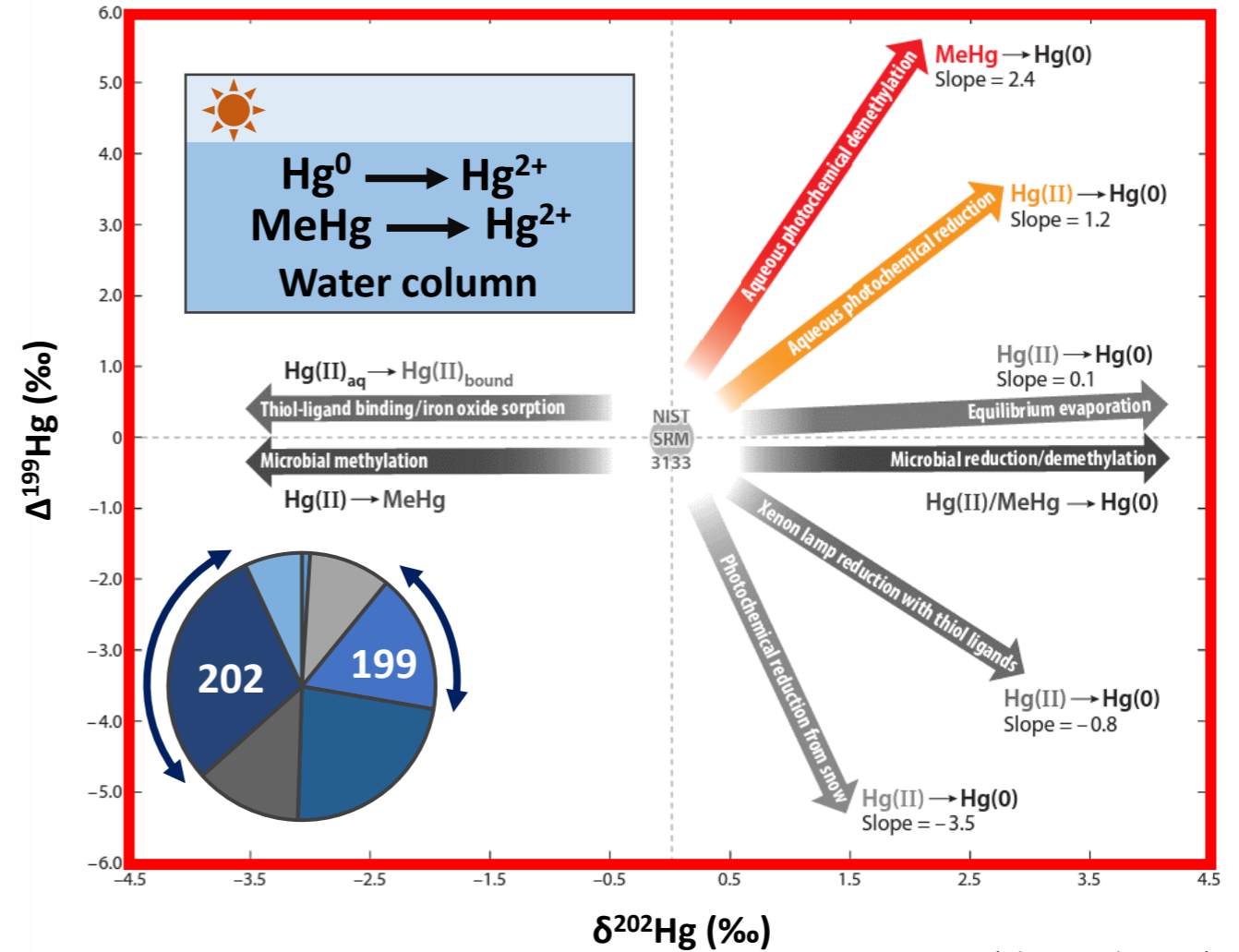


(Blum et al., 2014)

Isotope mixing

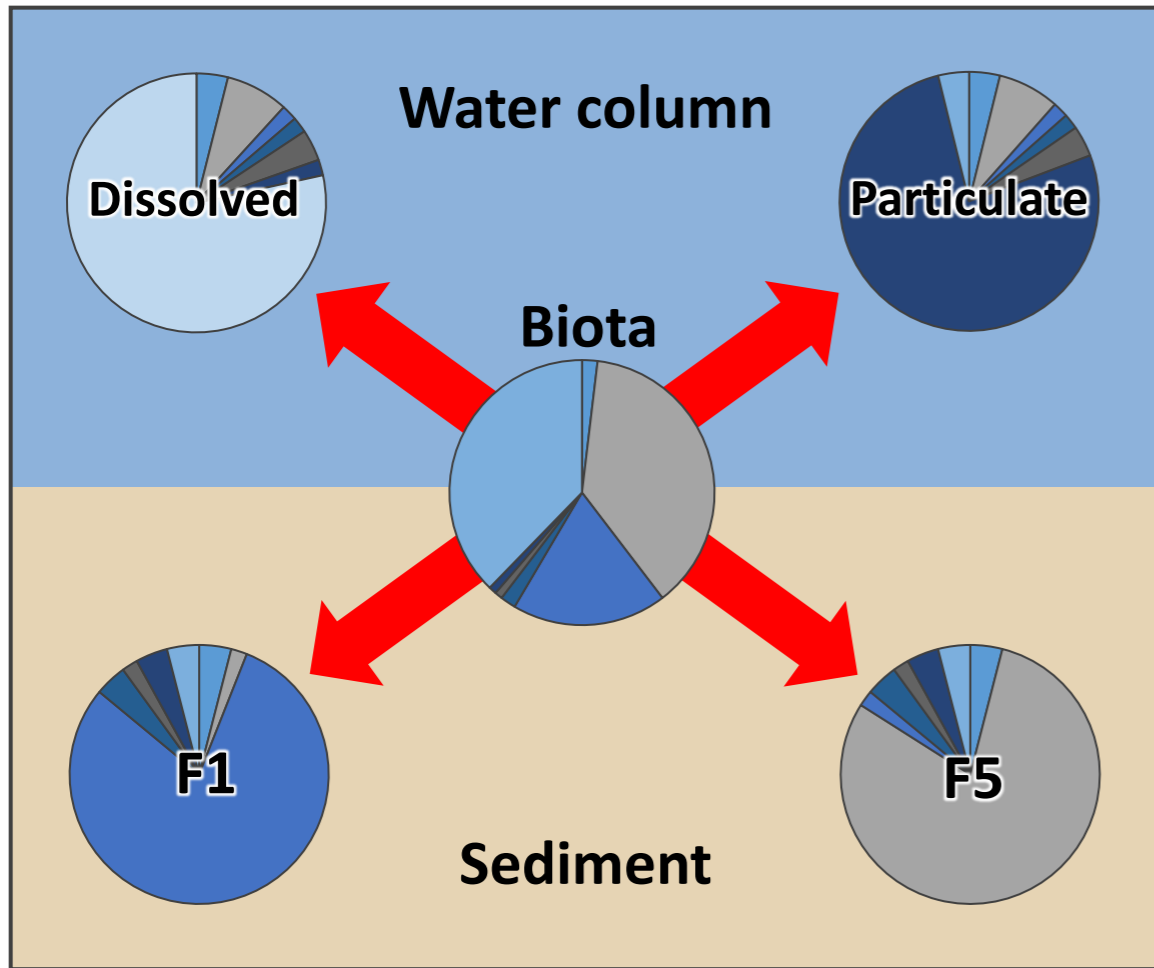


Isotope fractionation

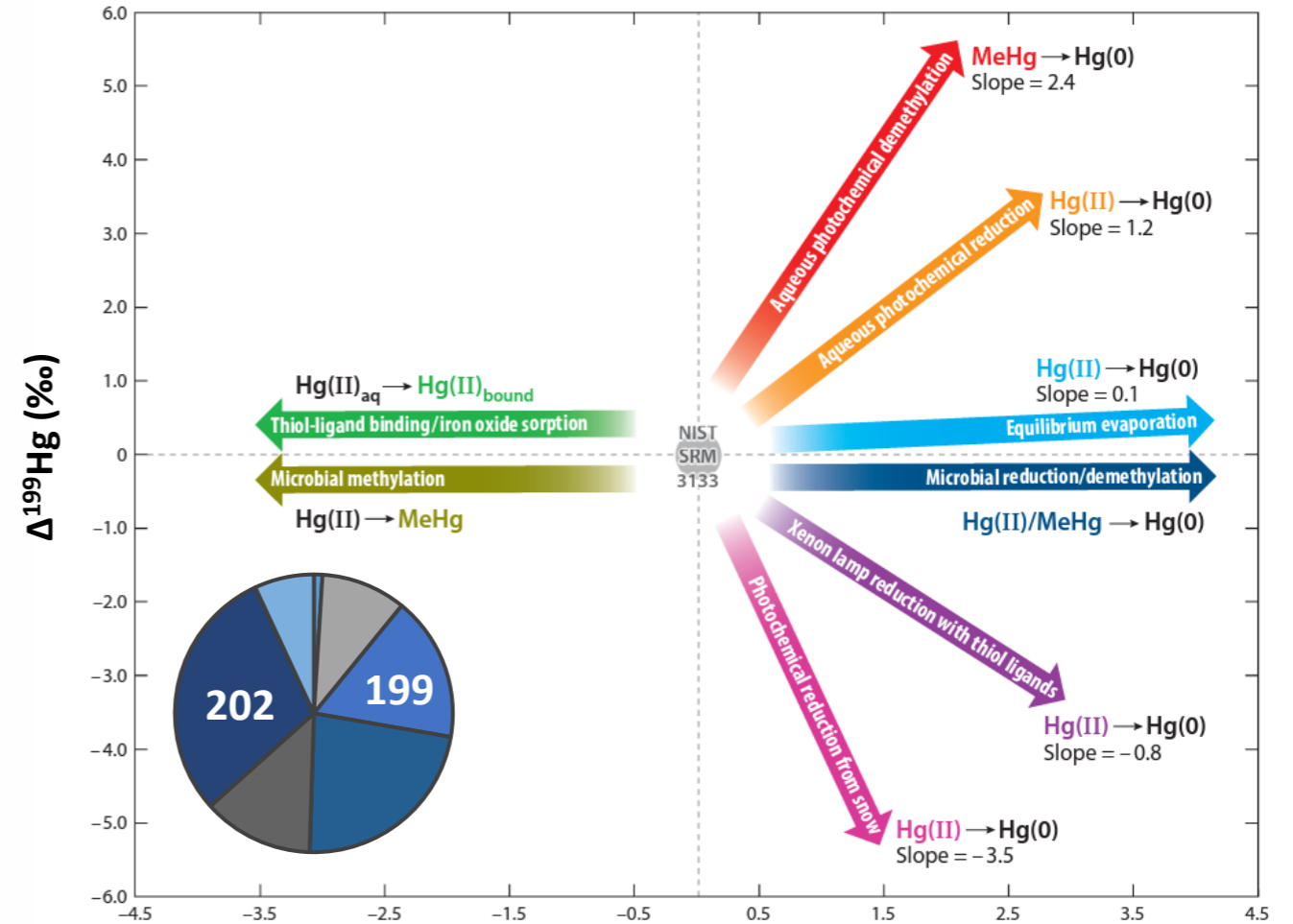


(Blum et al., 2014)

Isotope mixing



Isotope fractionation



Aquatic biota ↔ Environmental media ↔ Hg Sources
 Exposure pathway Source impact

(Blum et al., 2014)

Hyeongsan River, Republic of Korea

*In-situ* experiment

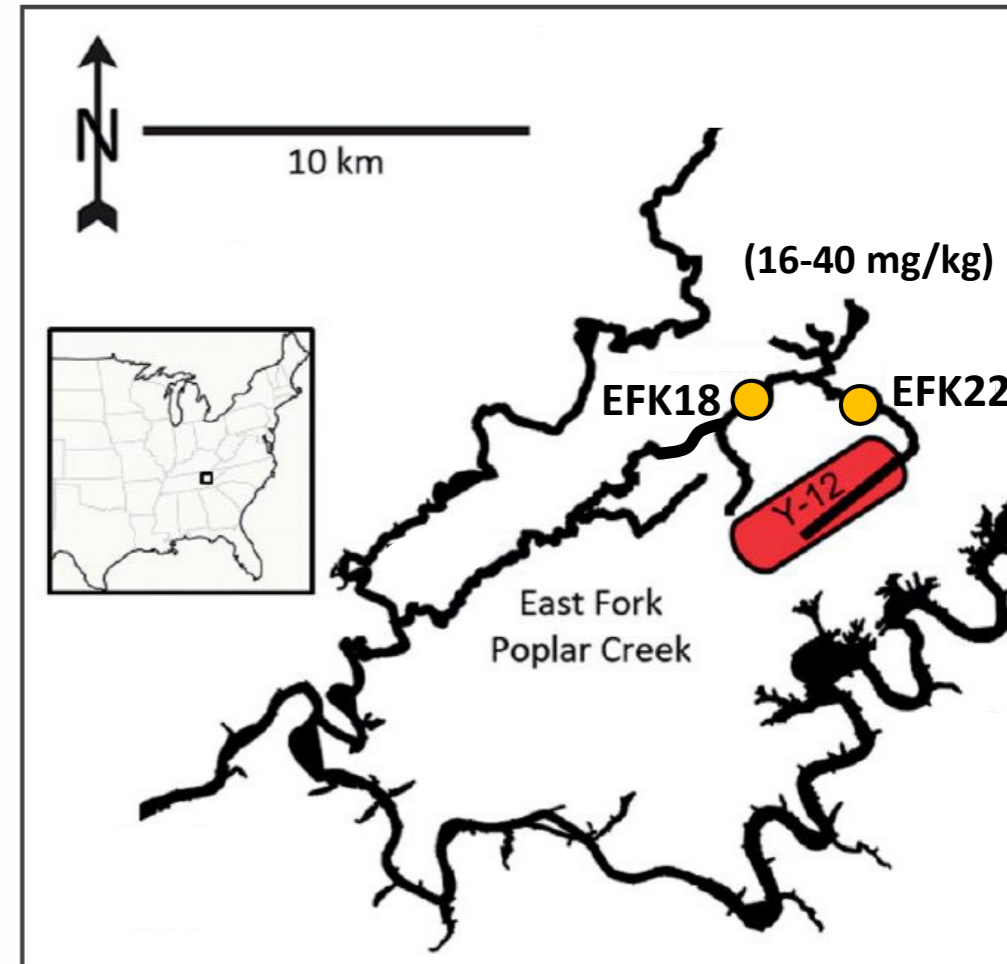
Water column

Biota

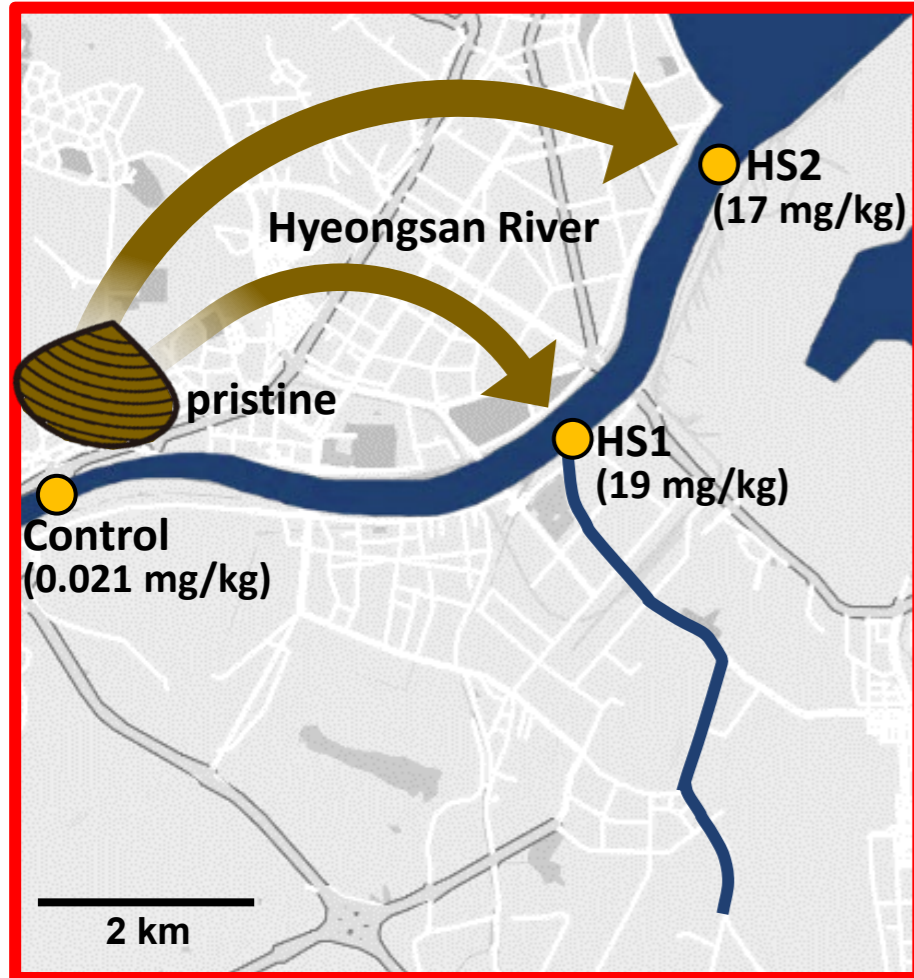
Sediment

Isotopic characterization of biota
(Pohang, Korea)

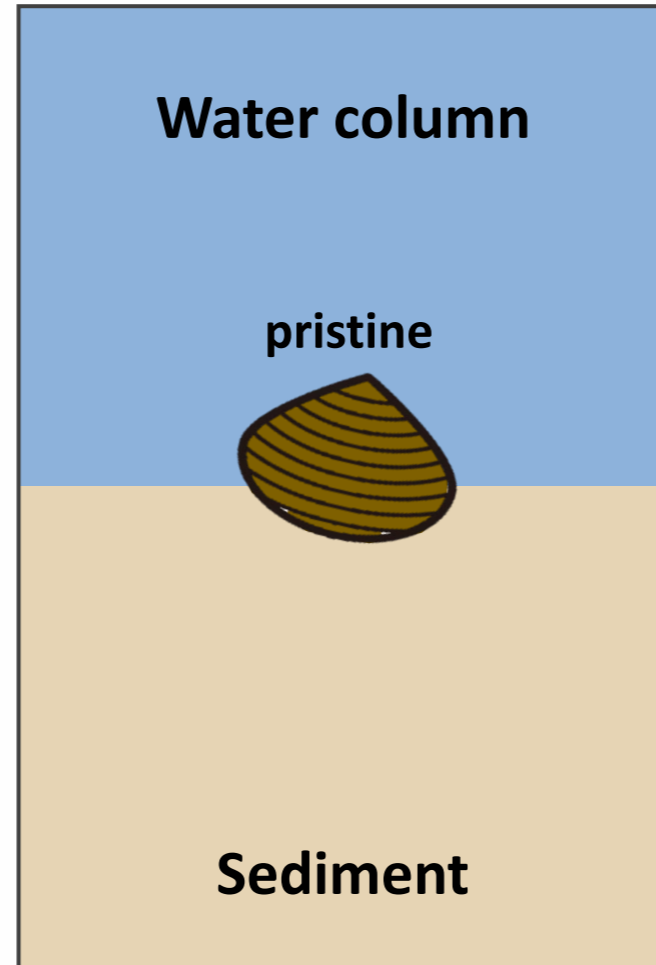
East Fork Poplar Creek, Oak Ridge, U.S.

Isotopic characterization of biota
(Oak Ridge, U.S.)

Hyeongsan River, Republic of Korea

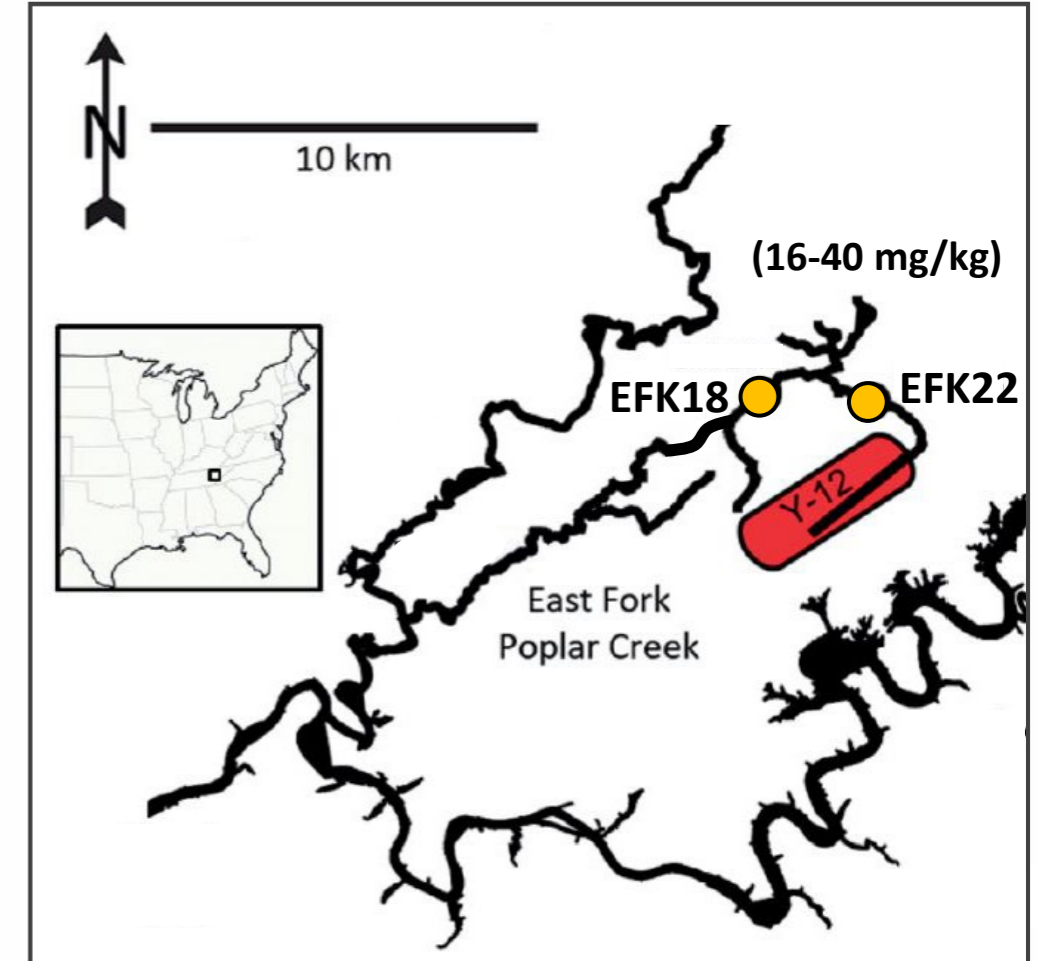


In-situ experiment



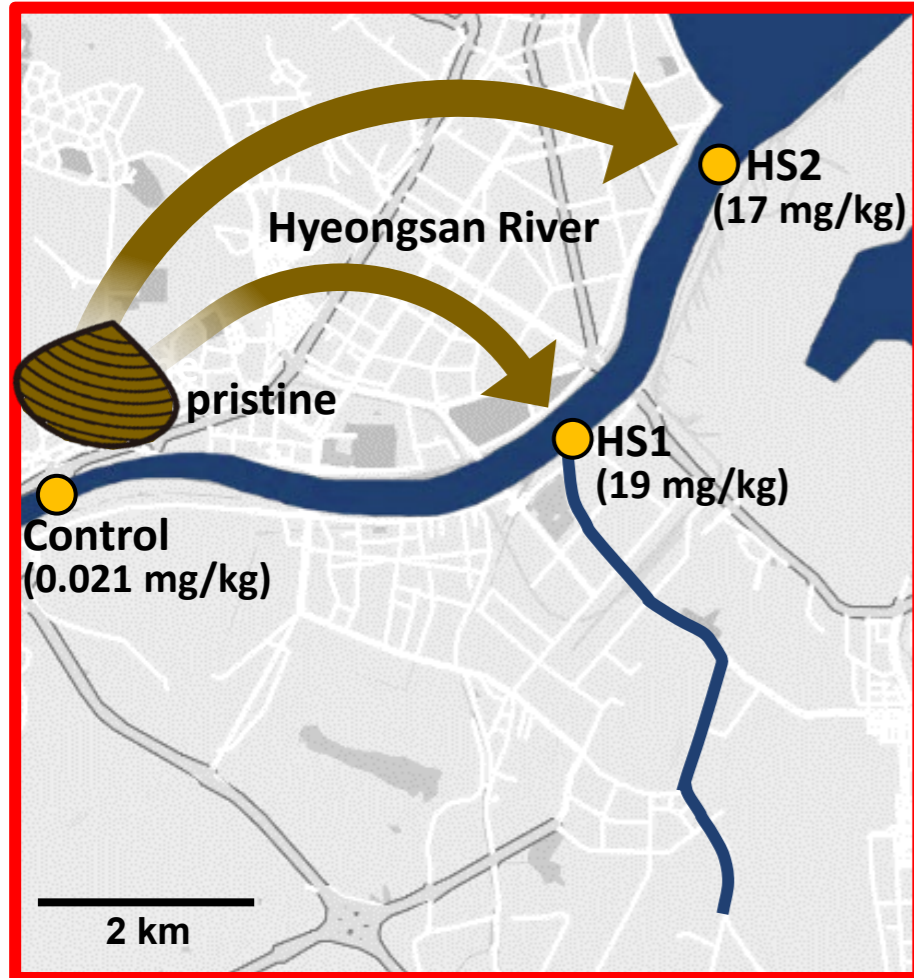
Isotopic characterization of biota
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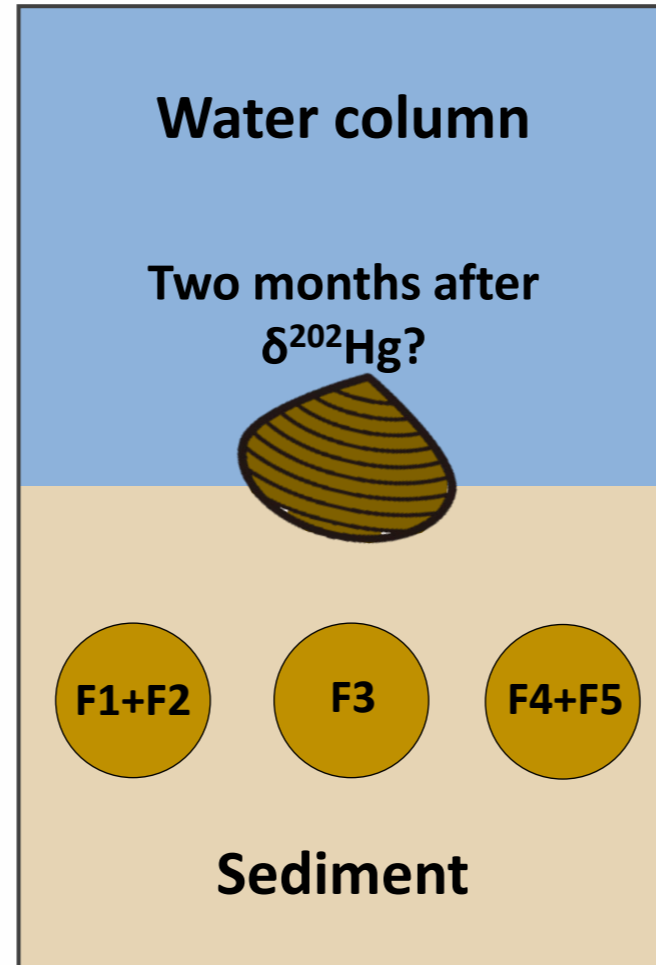


Isotopic characterization of biota
(Oak Ridge, U.S.)

Hyeongsan River, Republic of Korea

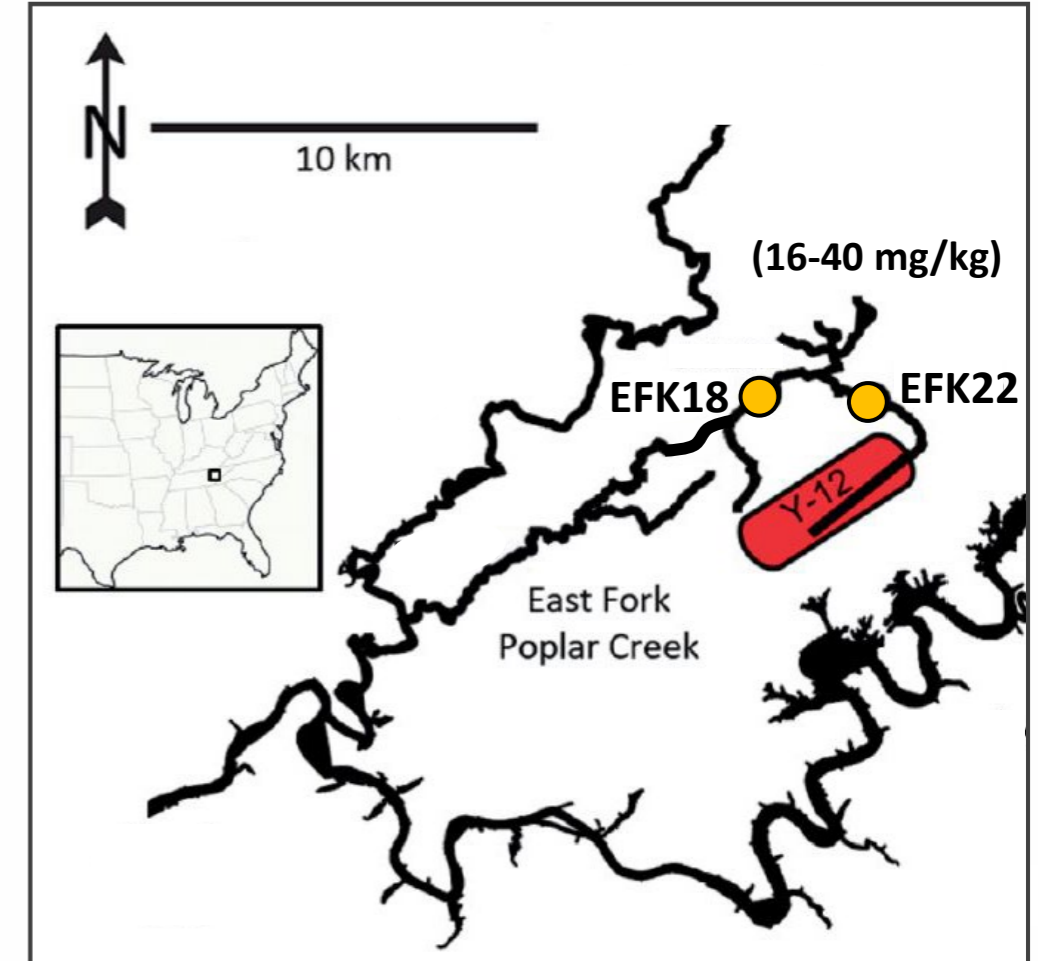


In-situ experiment



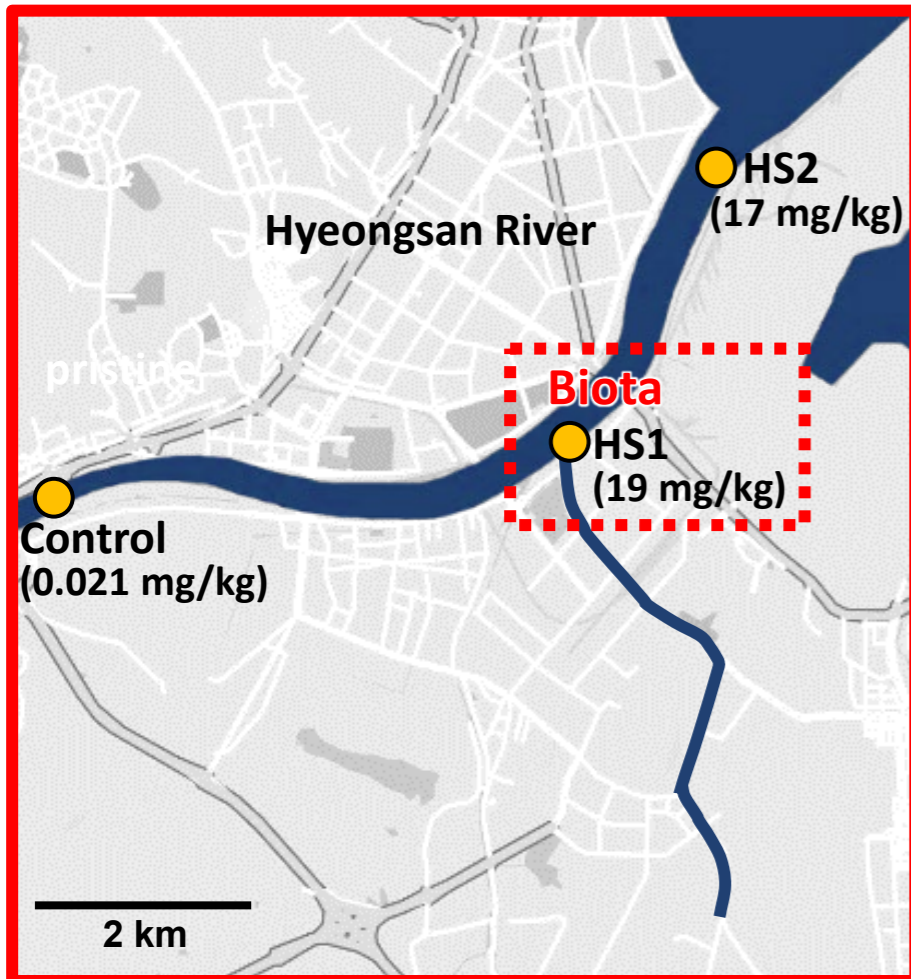
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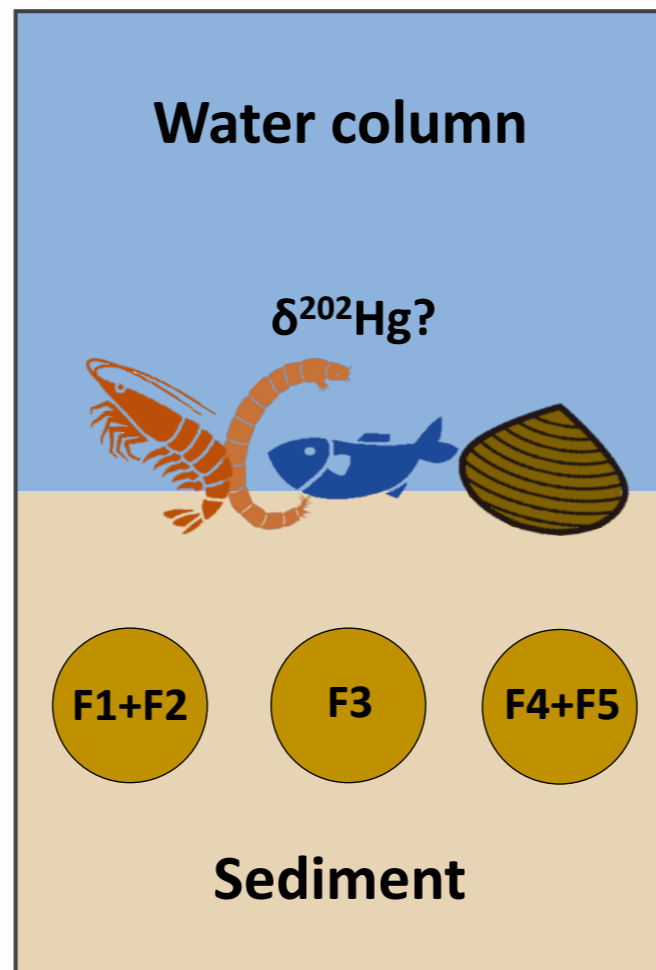


Isotopic characterization of biota
(Oak Ridge, U.S.)

Hyeongsan River, Republic of Korea

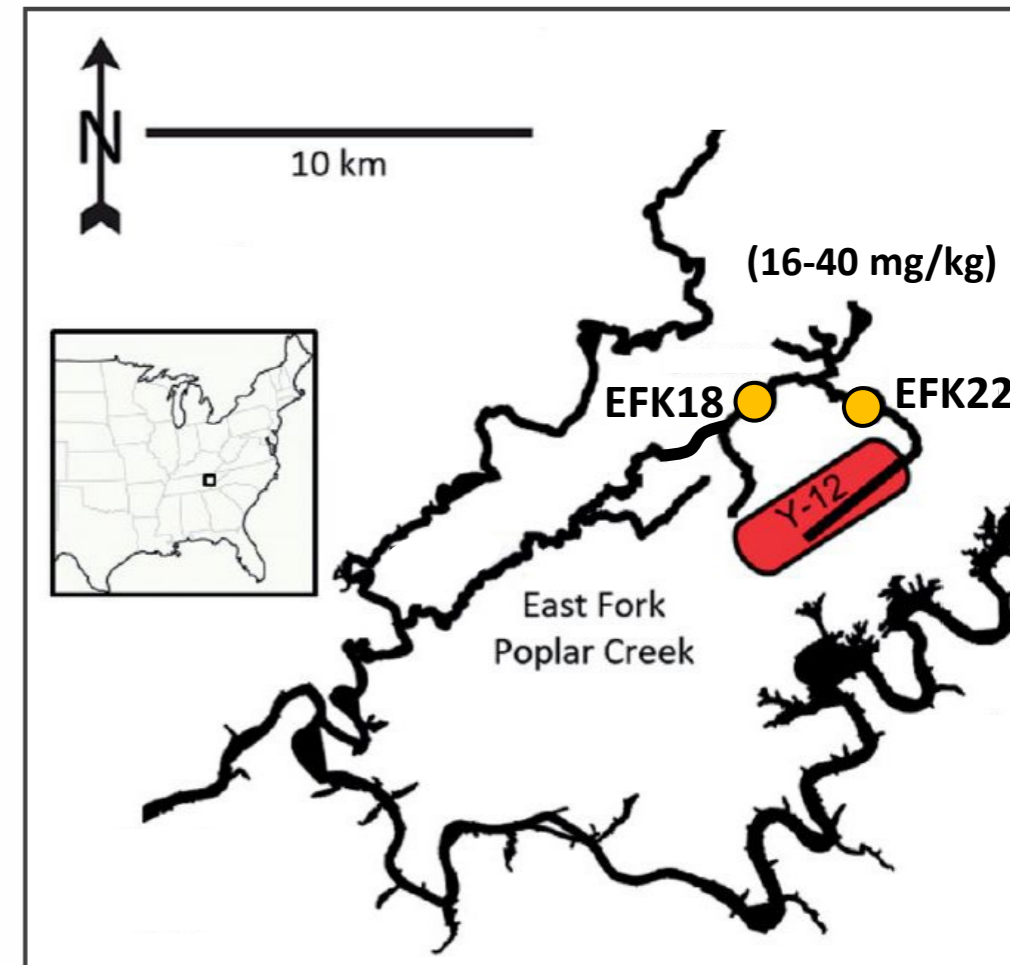


In-situ experiment



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East Fork Poplar Creek, Oak Ridge, U.S.



Isotopic characterization of biota
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Hyeongsan River, Republic of Korea



In-situ experiment

Water column

$\delta^{202}\text{Hg?}$



F1

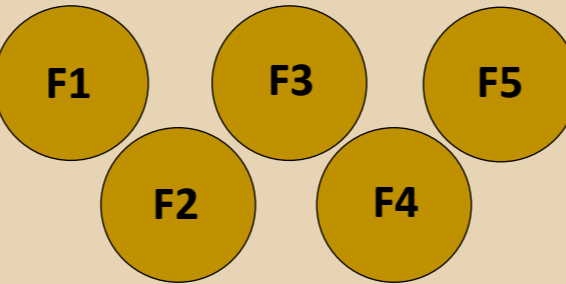
F3

F5

F2

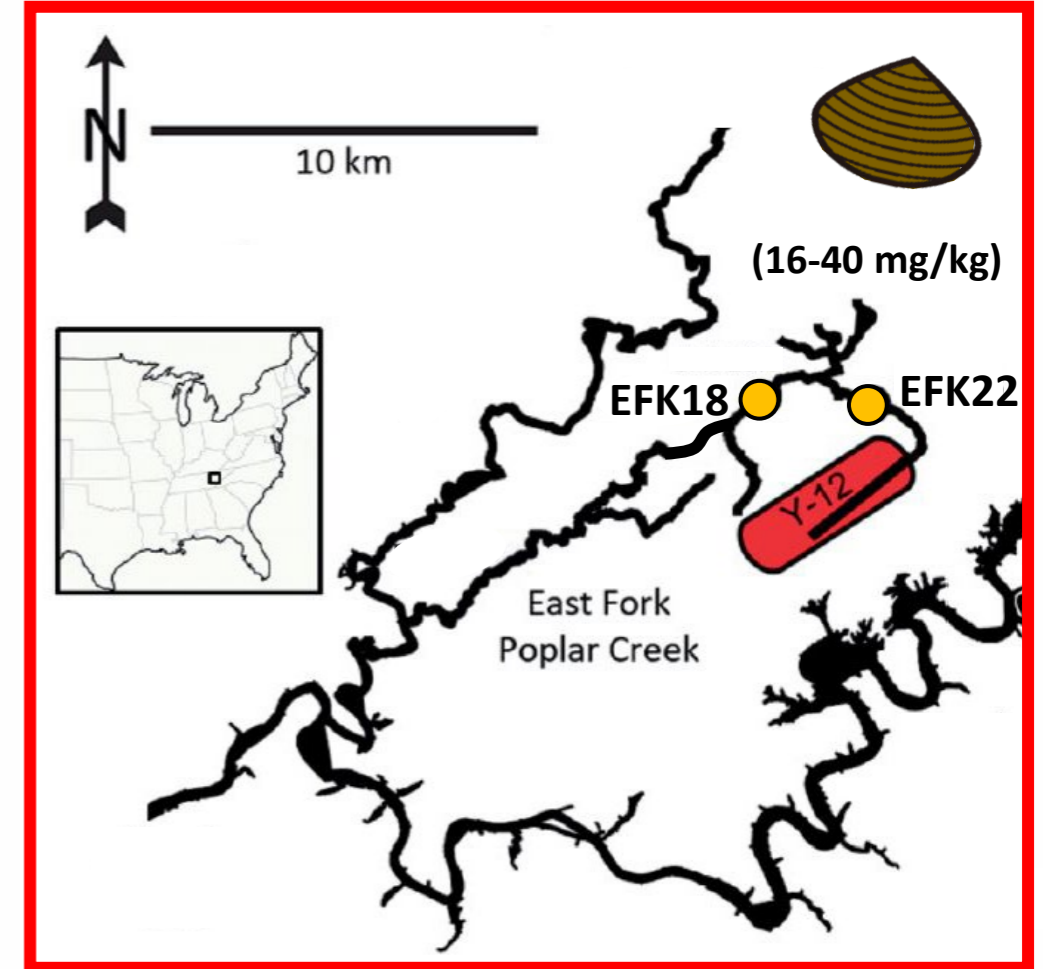
F4

Sediment



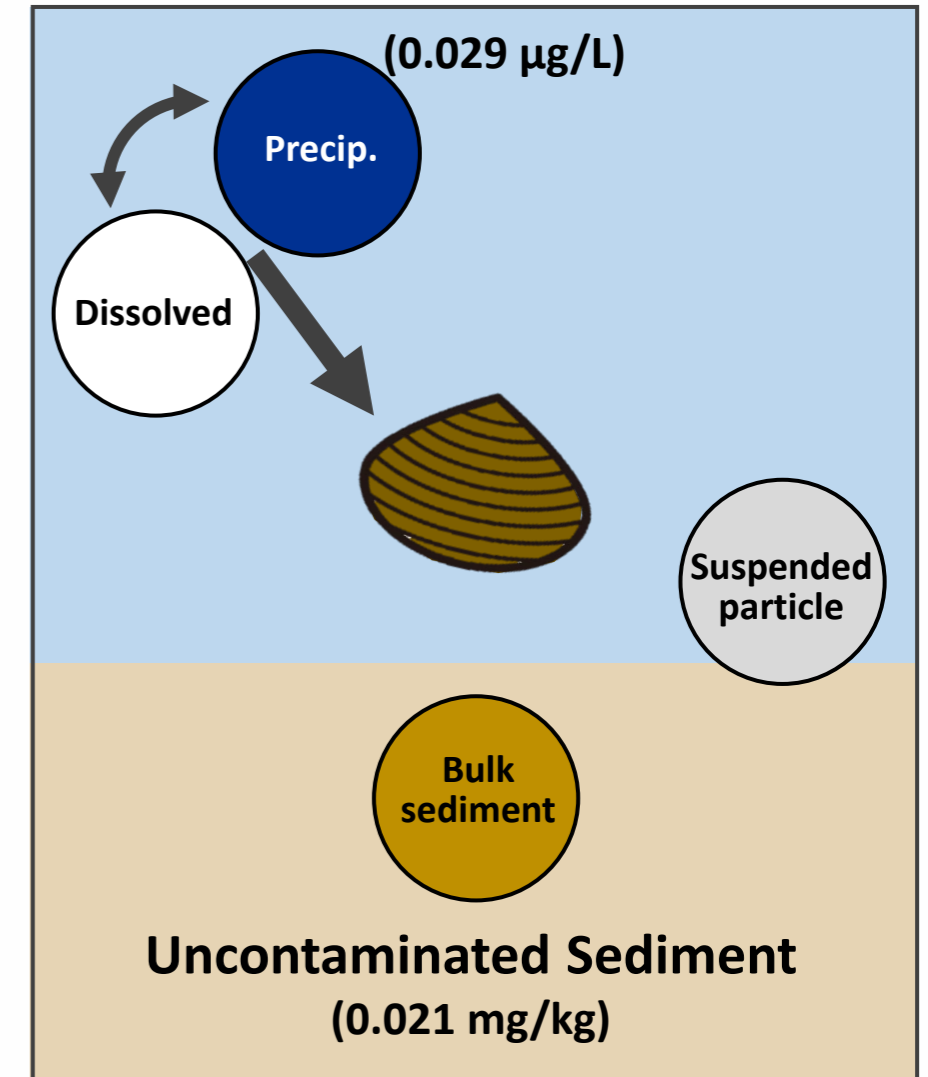
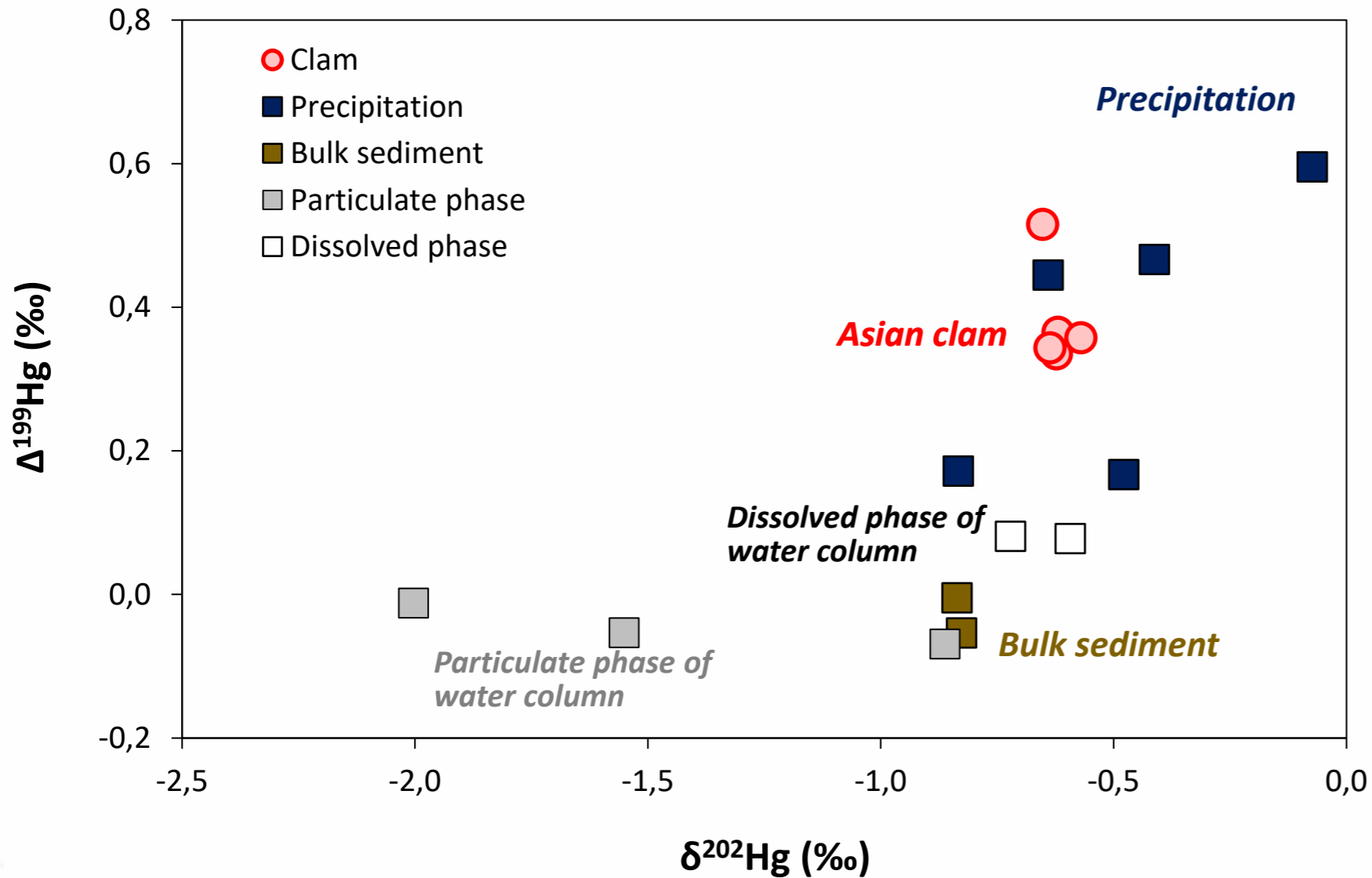
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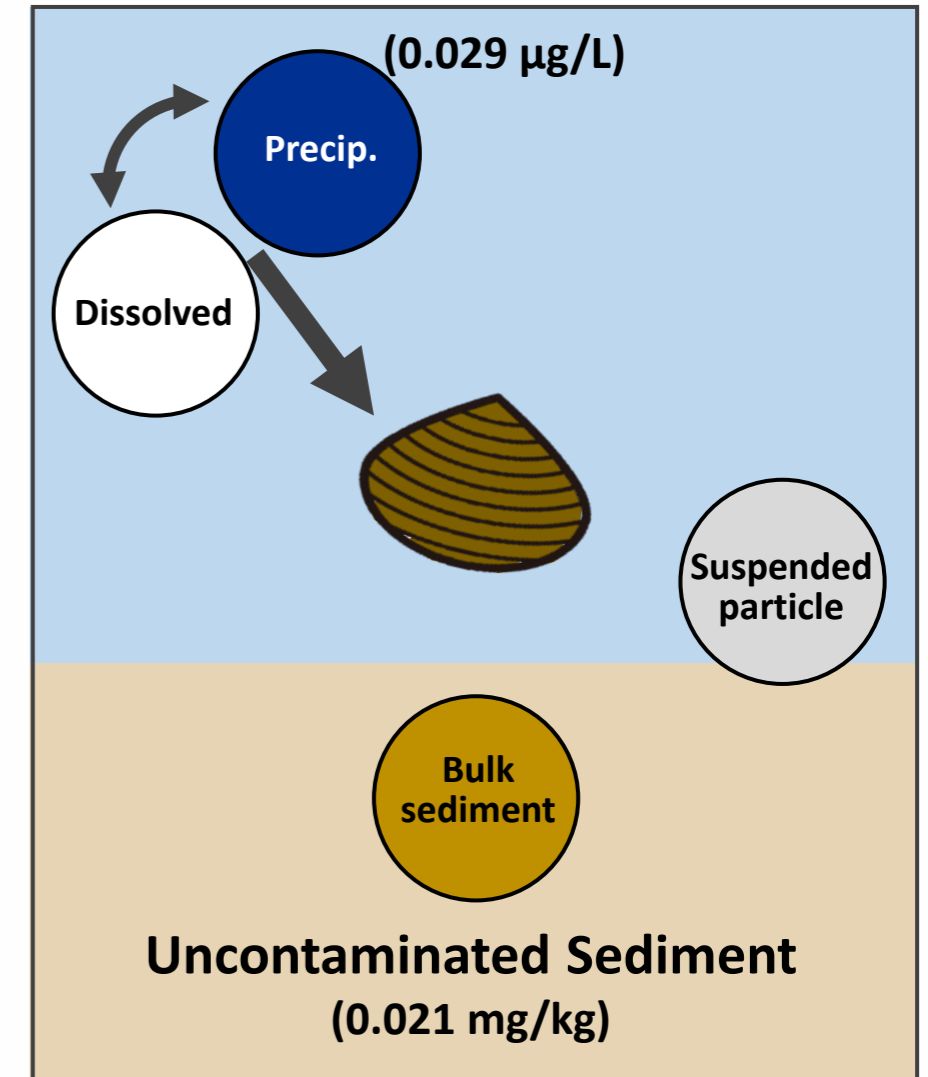
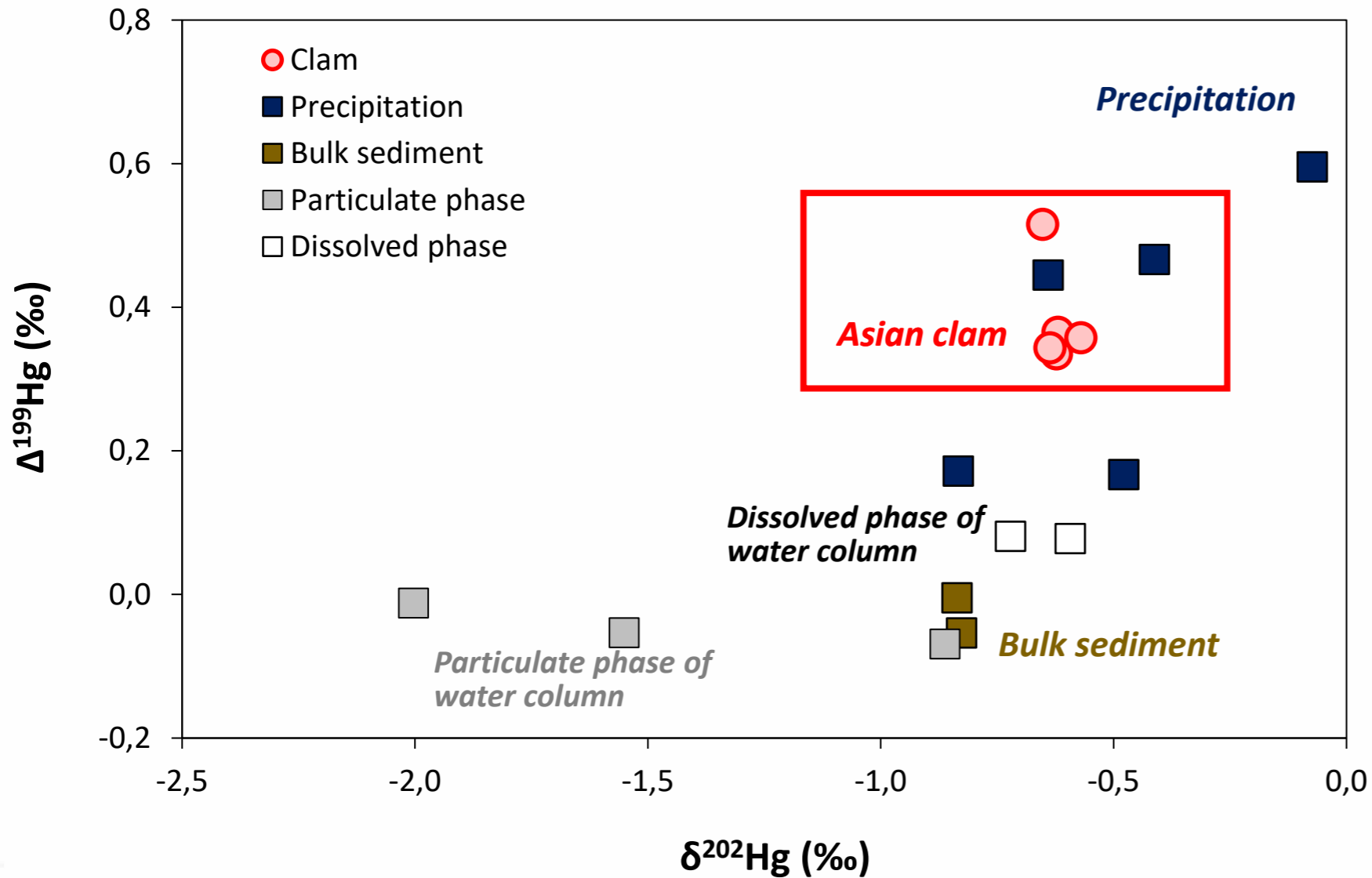


Isotopic characterization of biota
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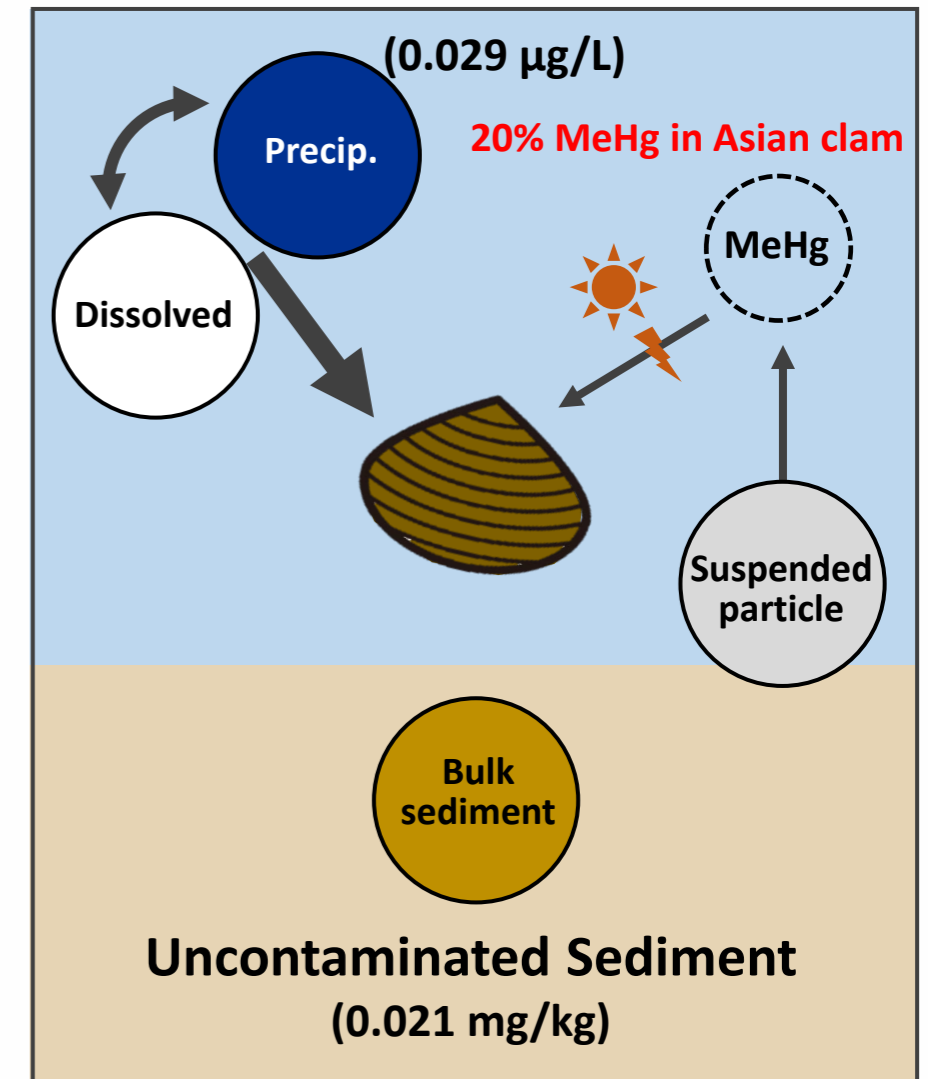
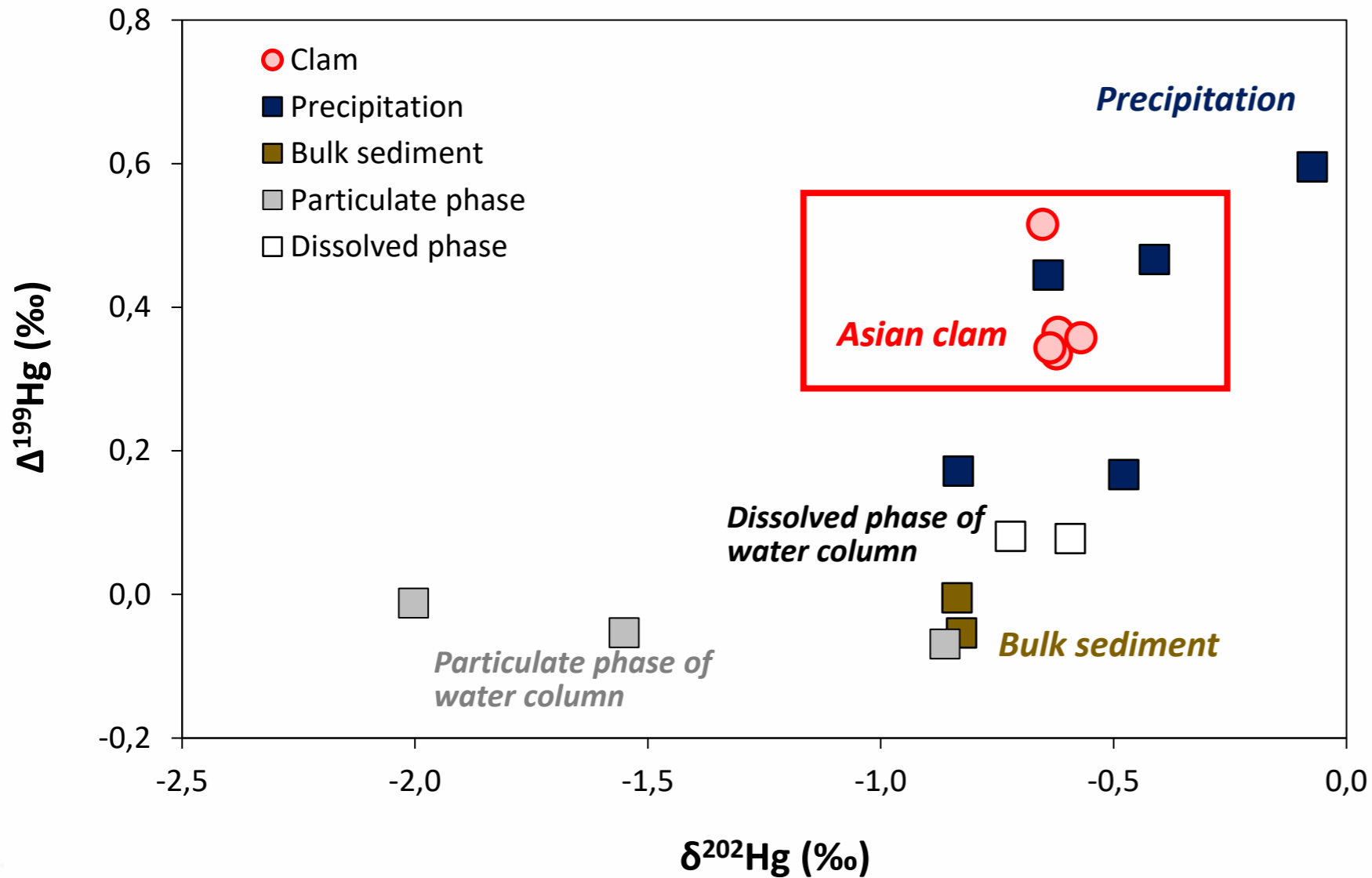
Uncontaminated site in Hyeongsan River, Republic of Korea



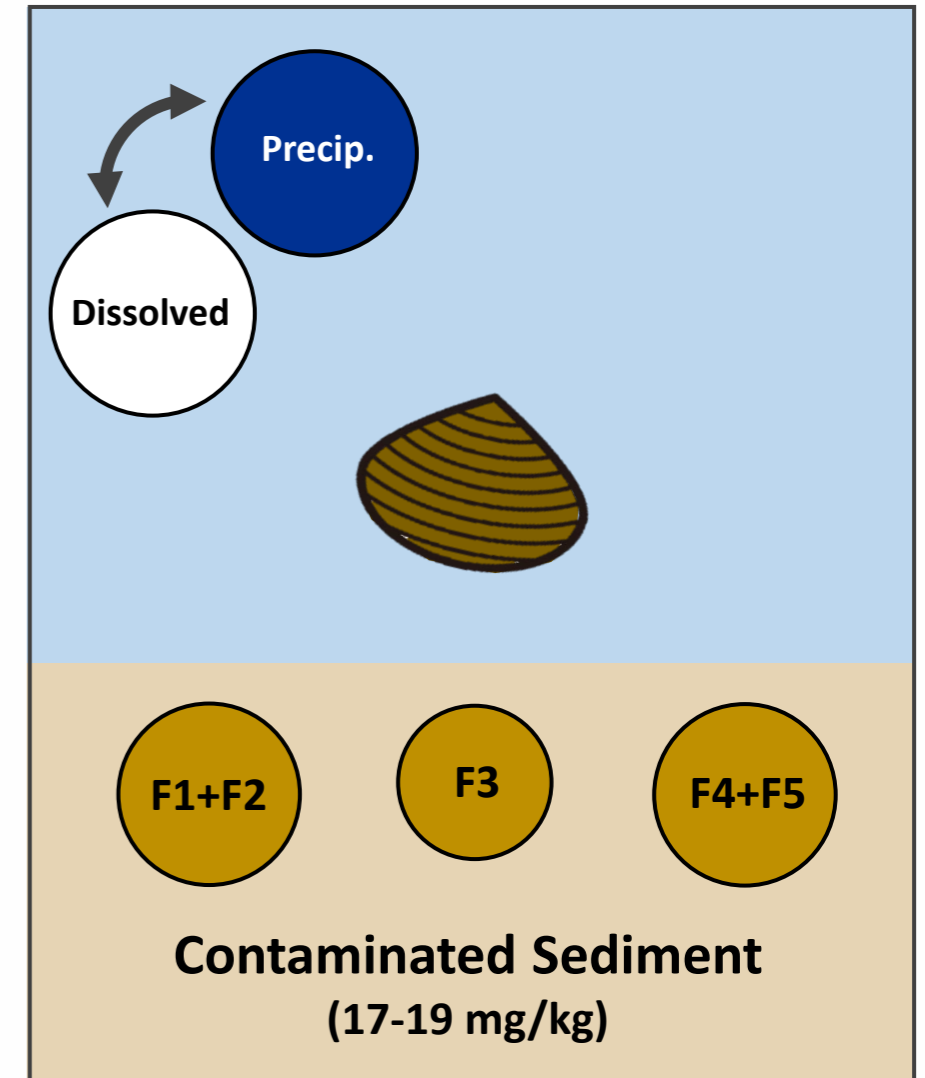
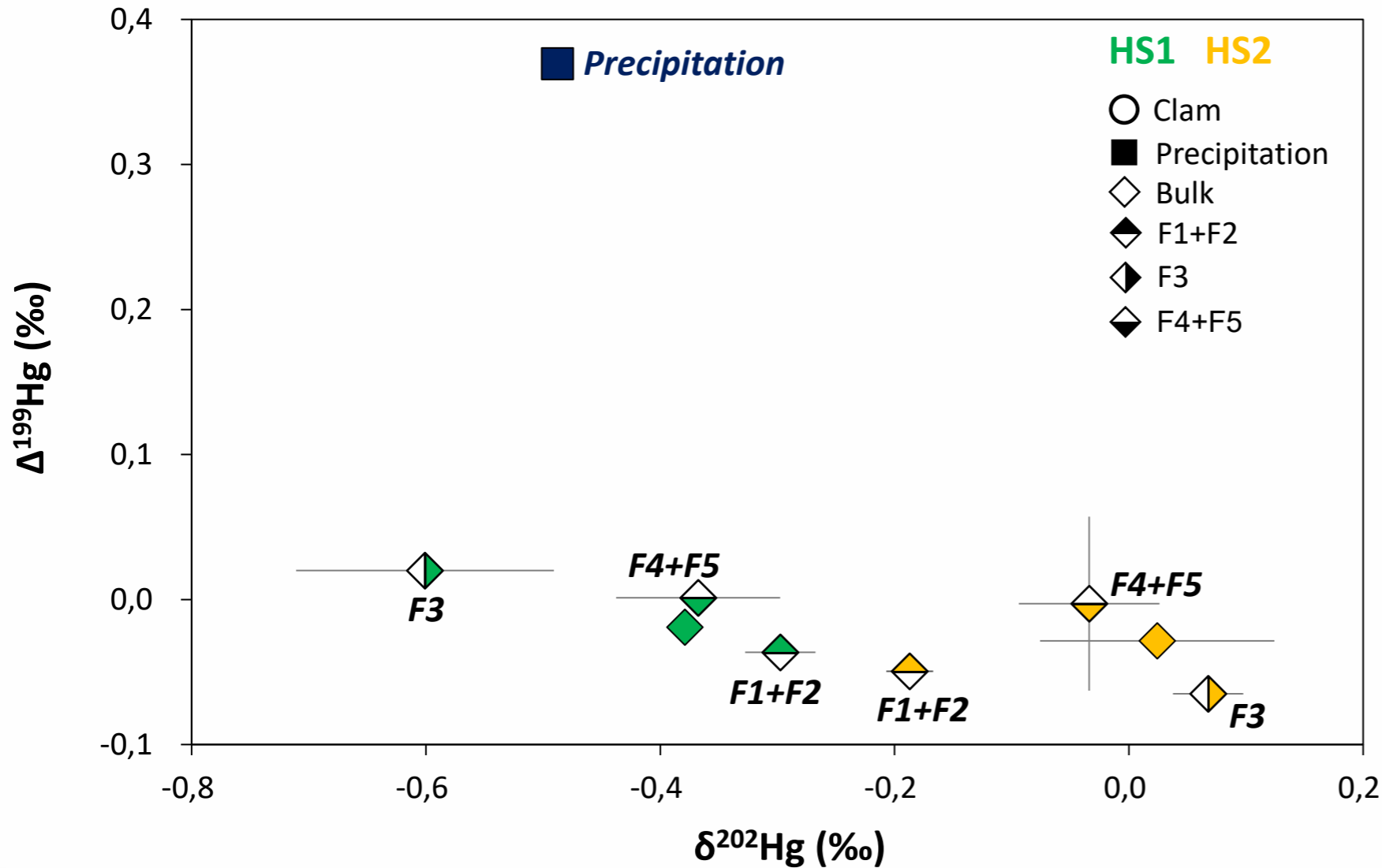
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Contaminated site in Hyeongsan River, Republic of Korea

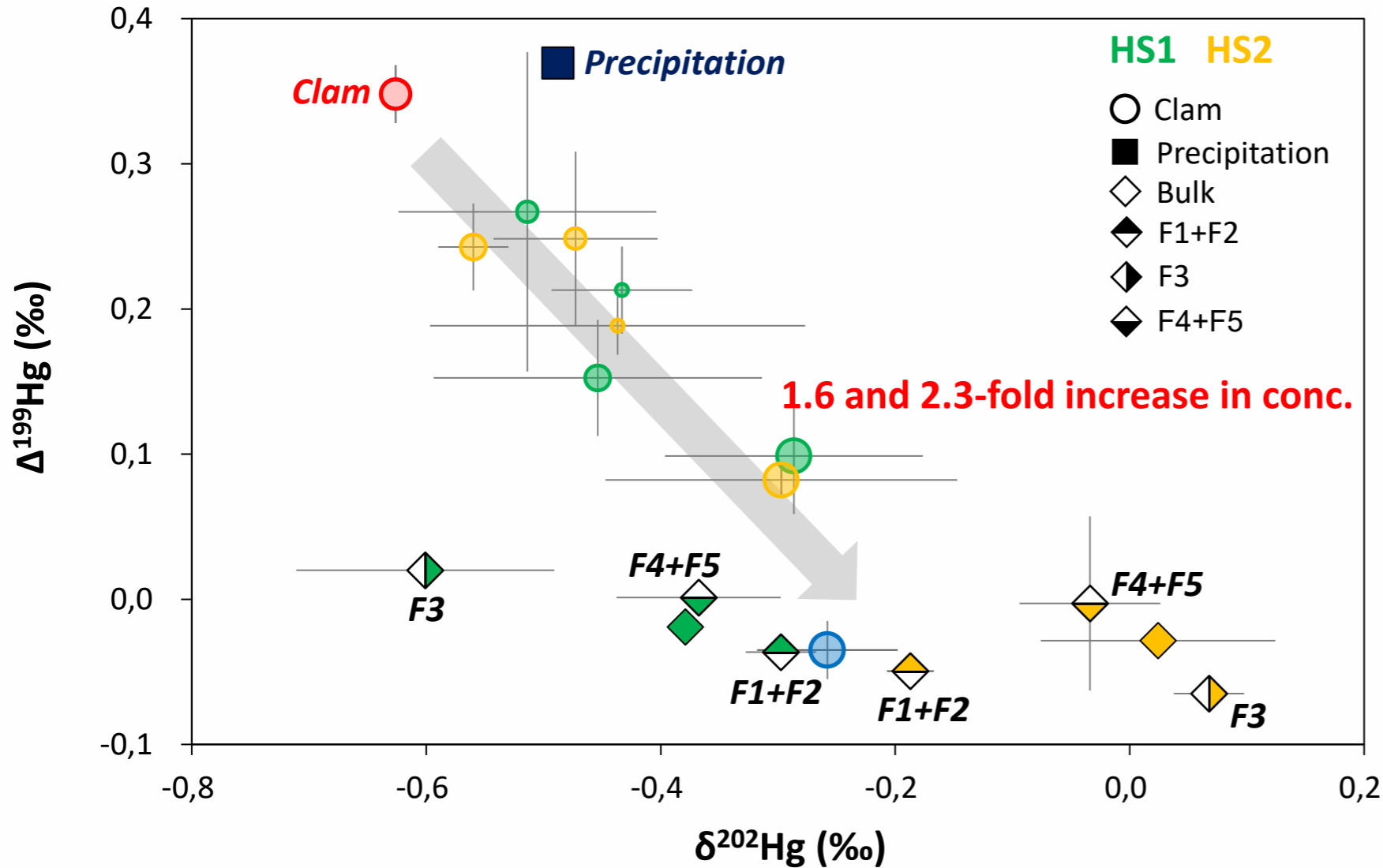


F1+F2: labile, weak acid-soluble

F3: organically bound

F4+F5: residual

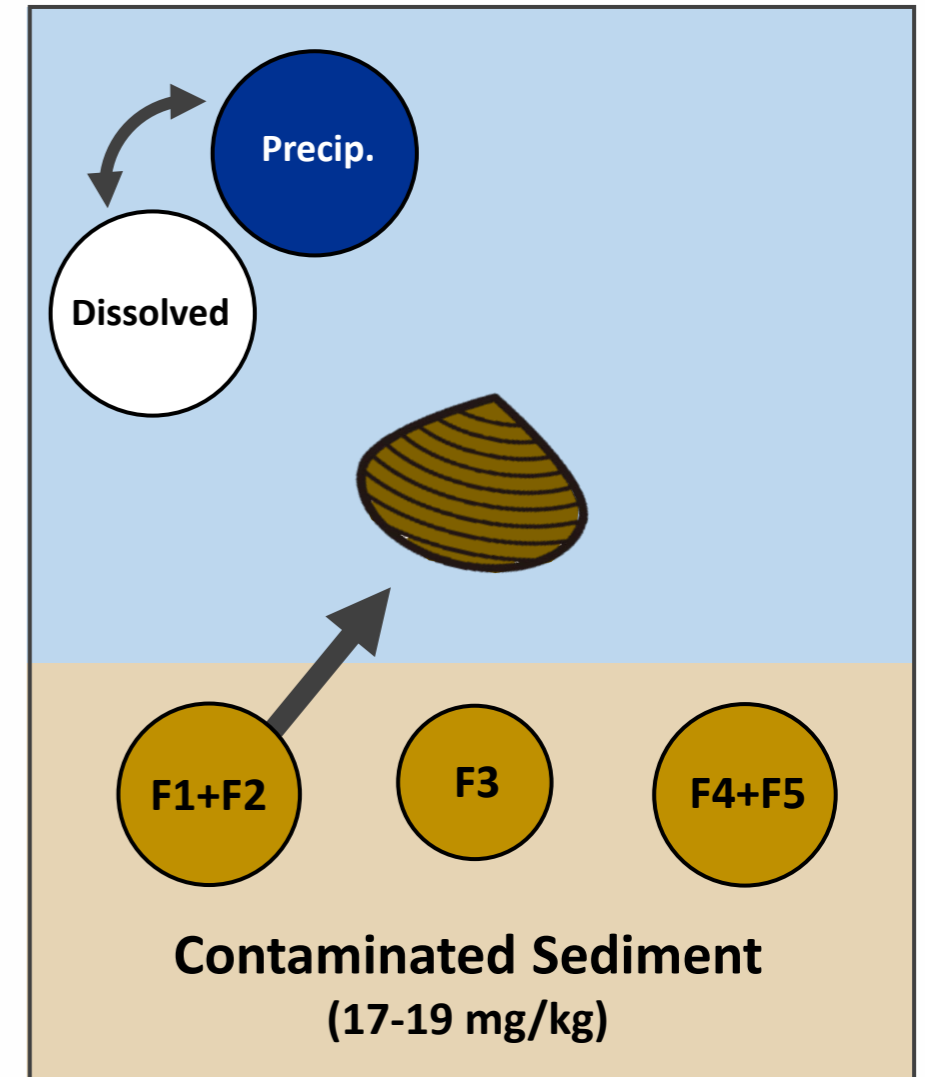
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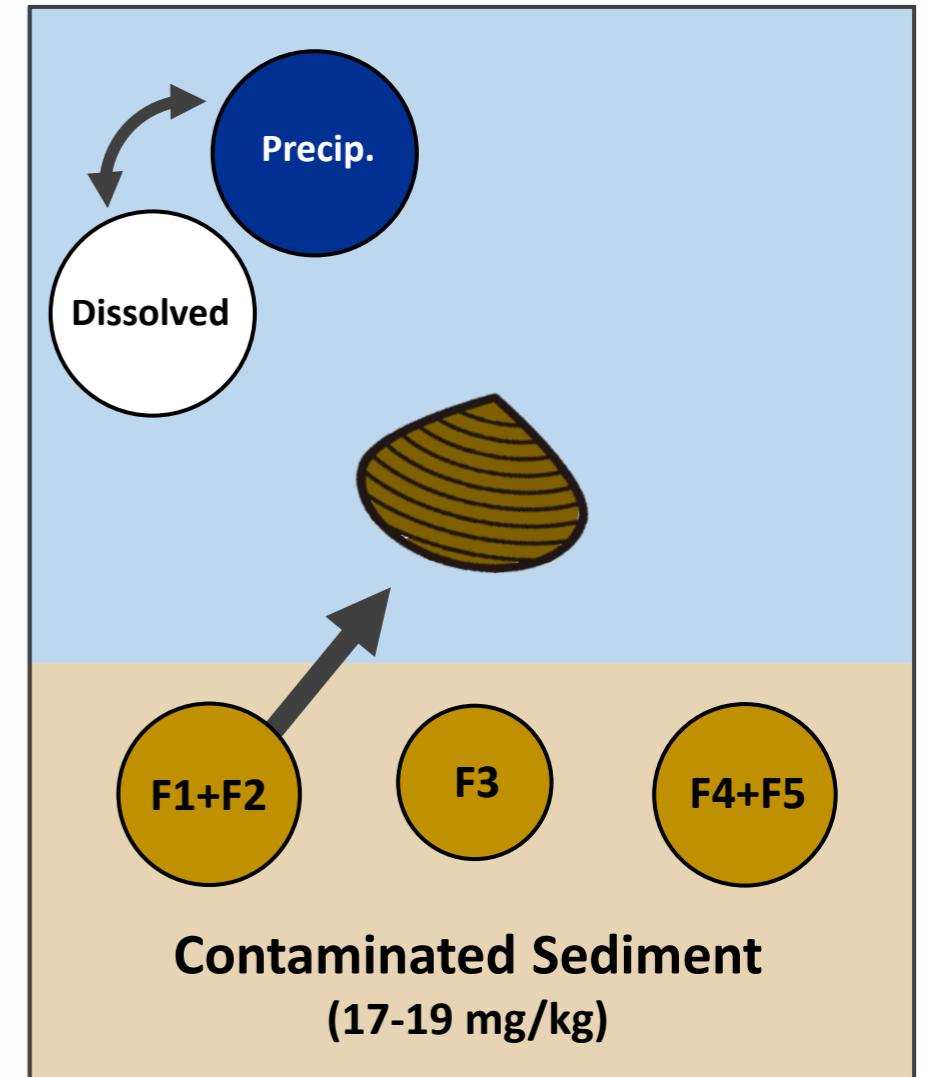
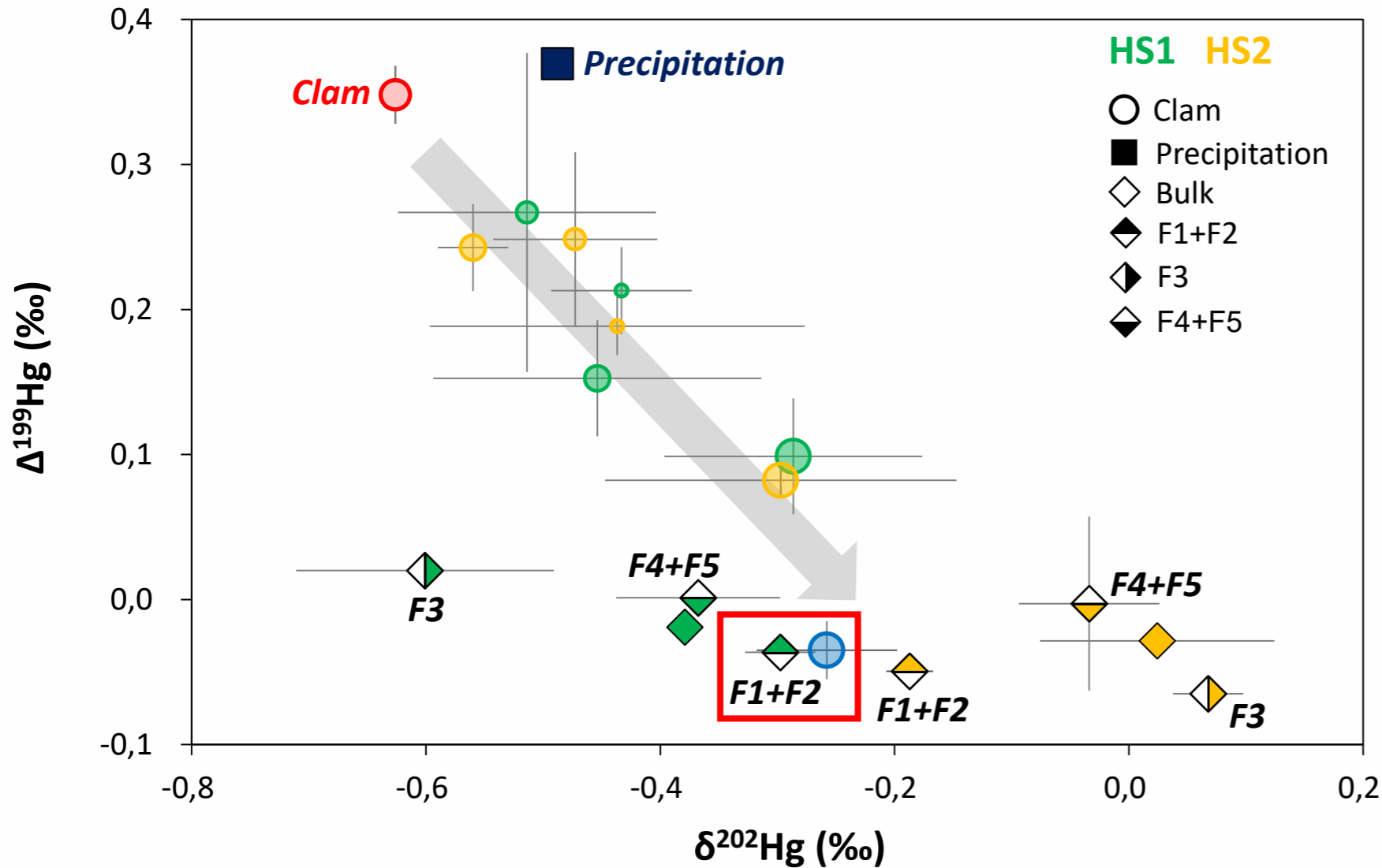
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Contaminated site in Hyeongsan River, Republic of Korea

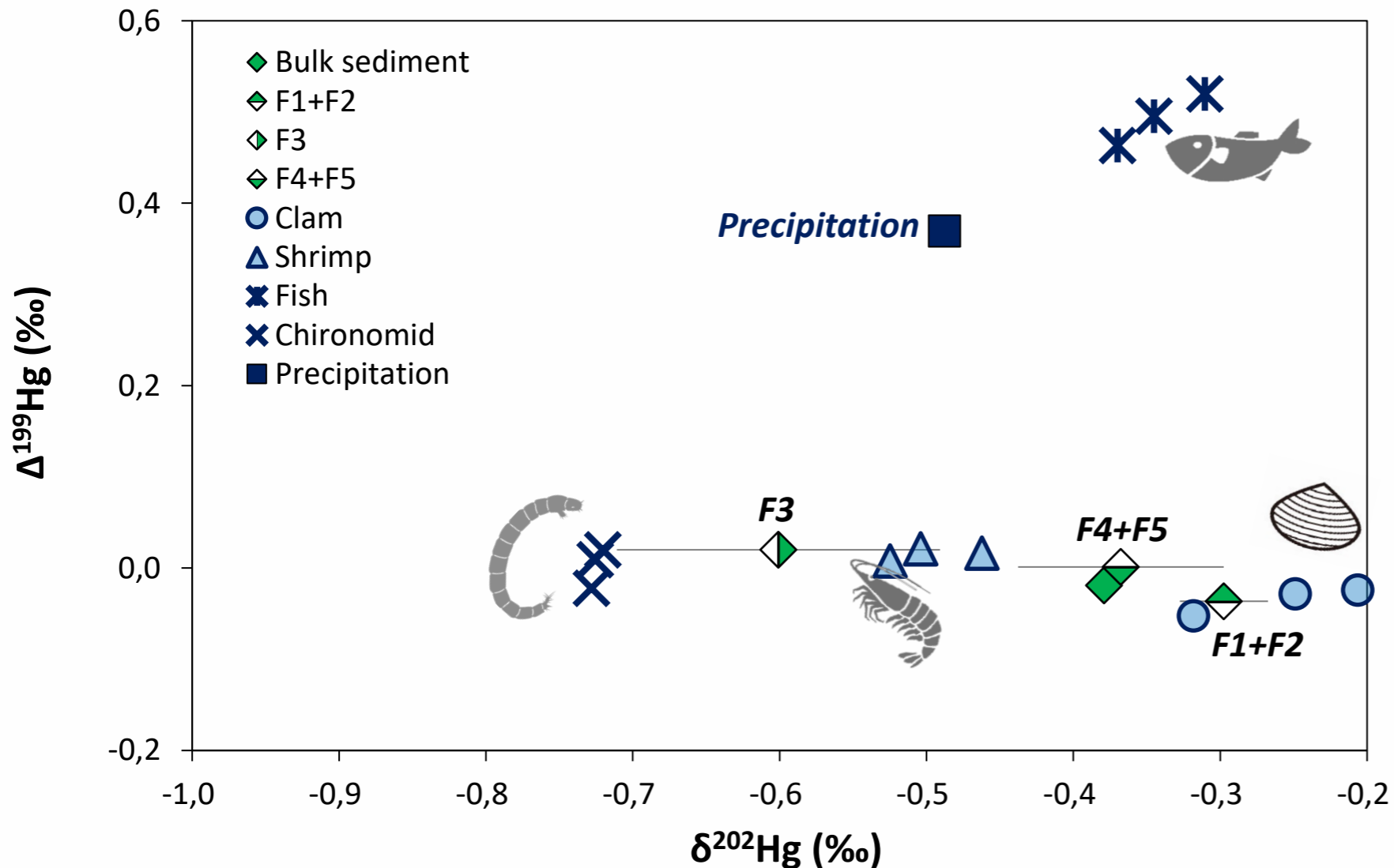


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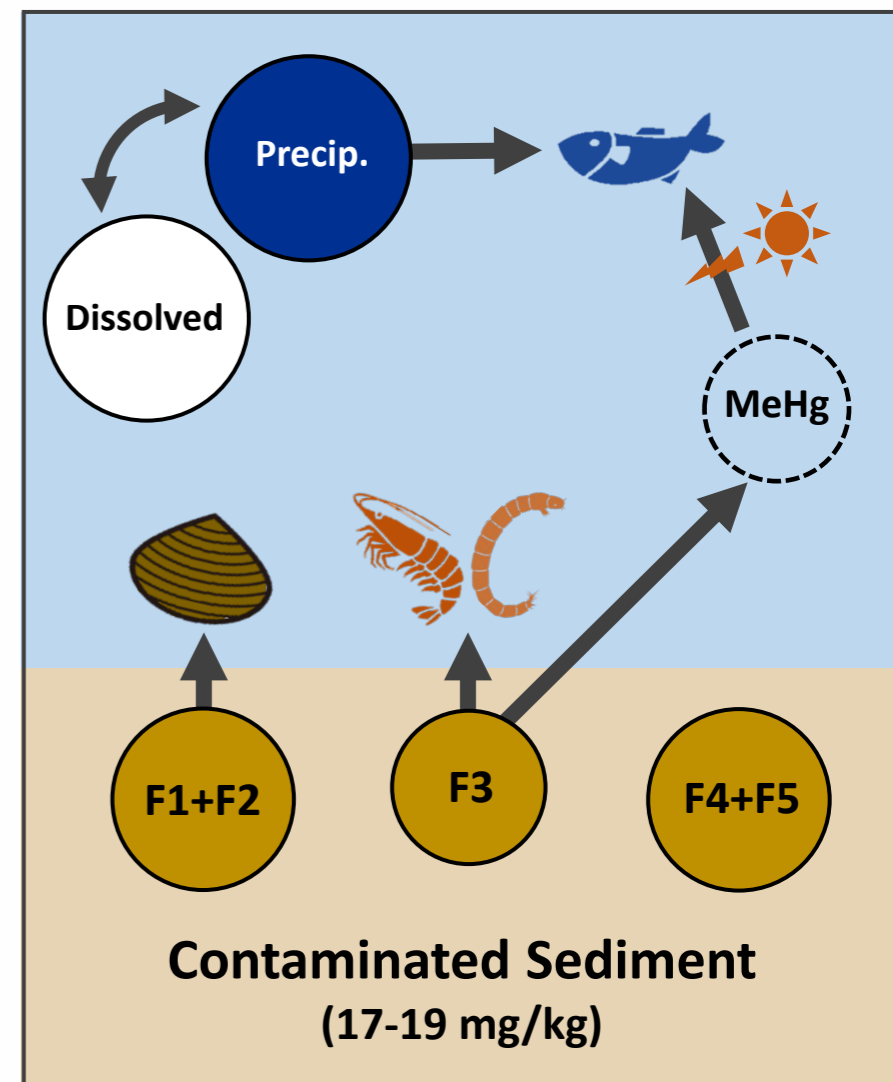
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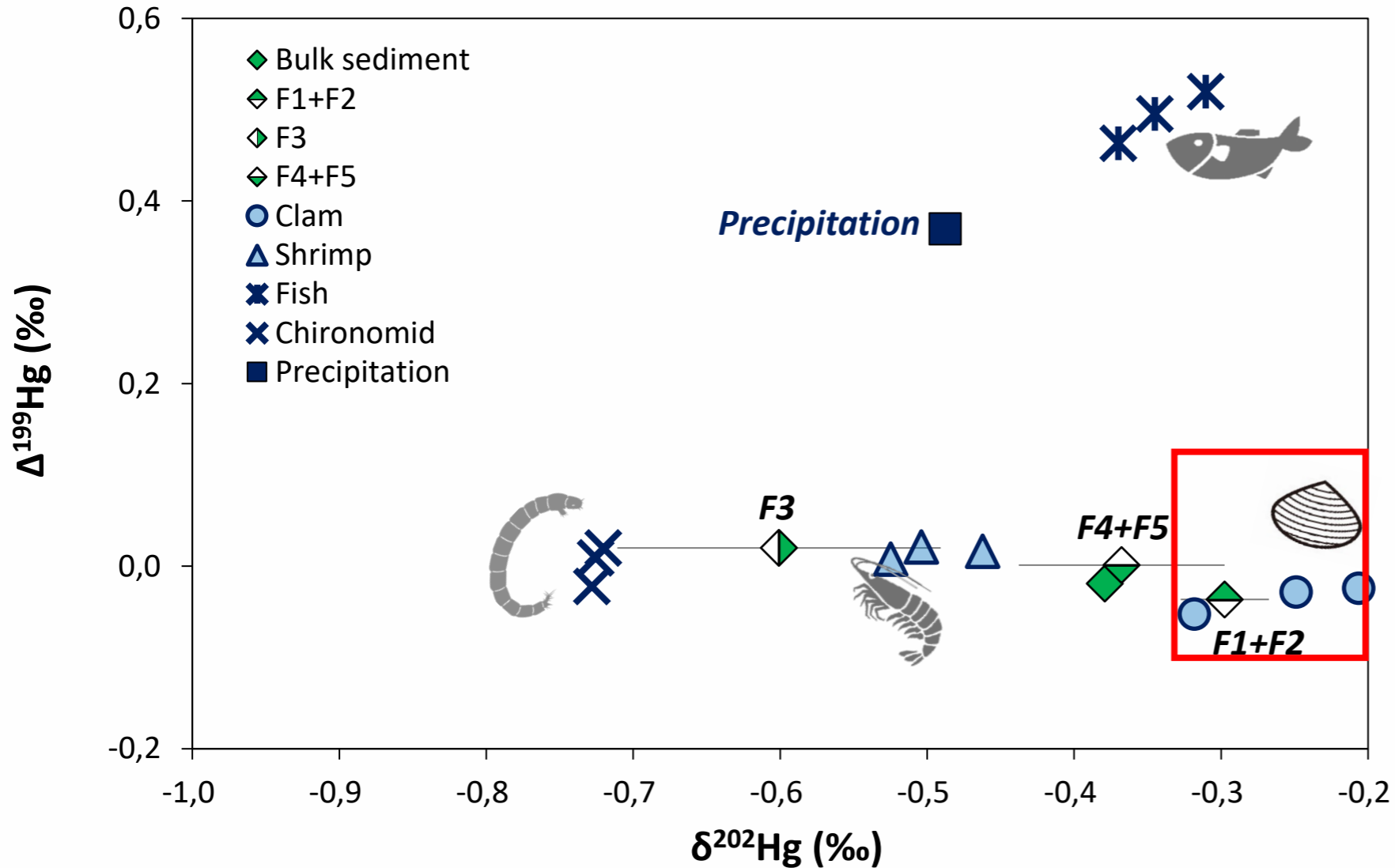
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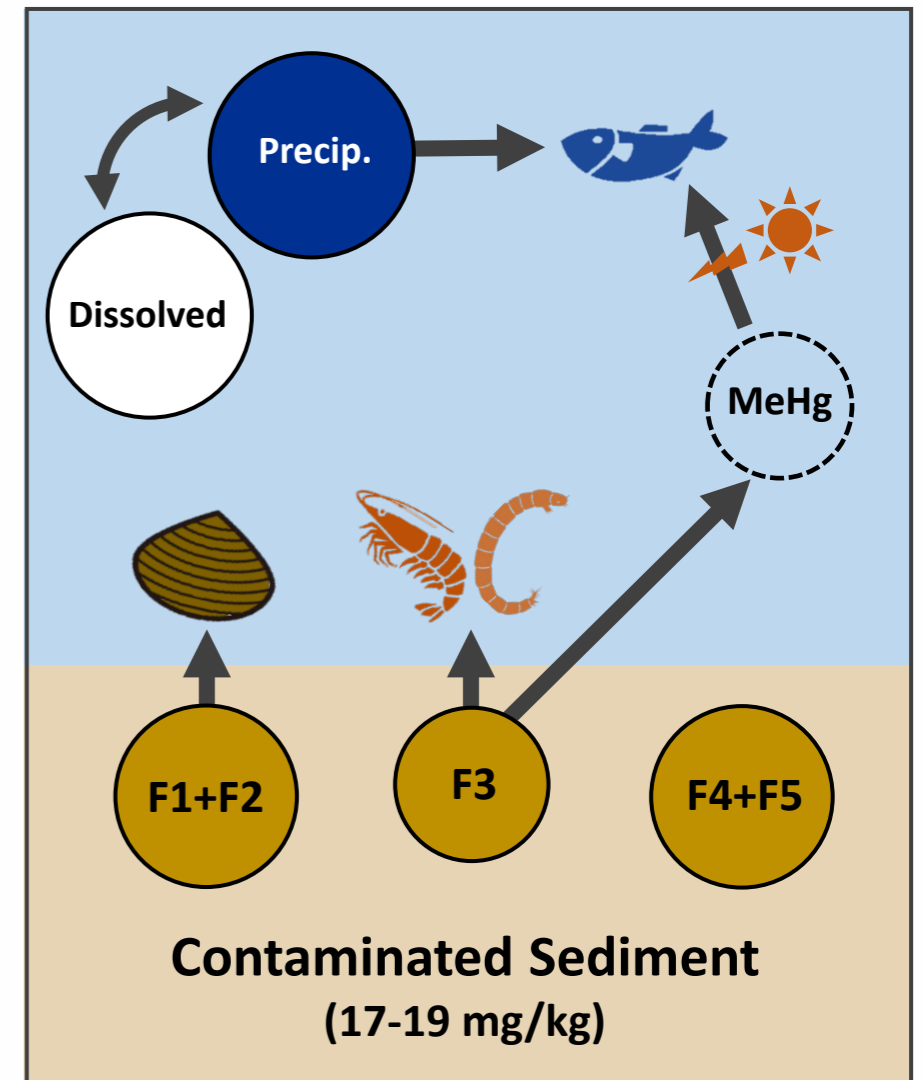
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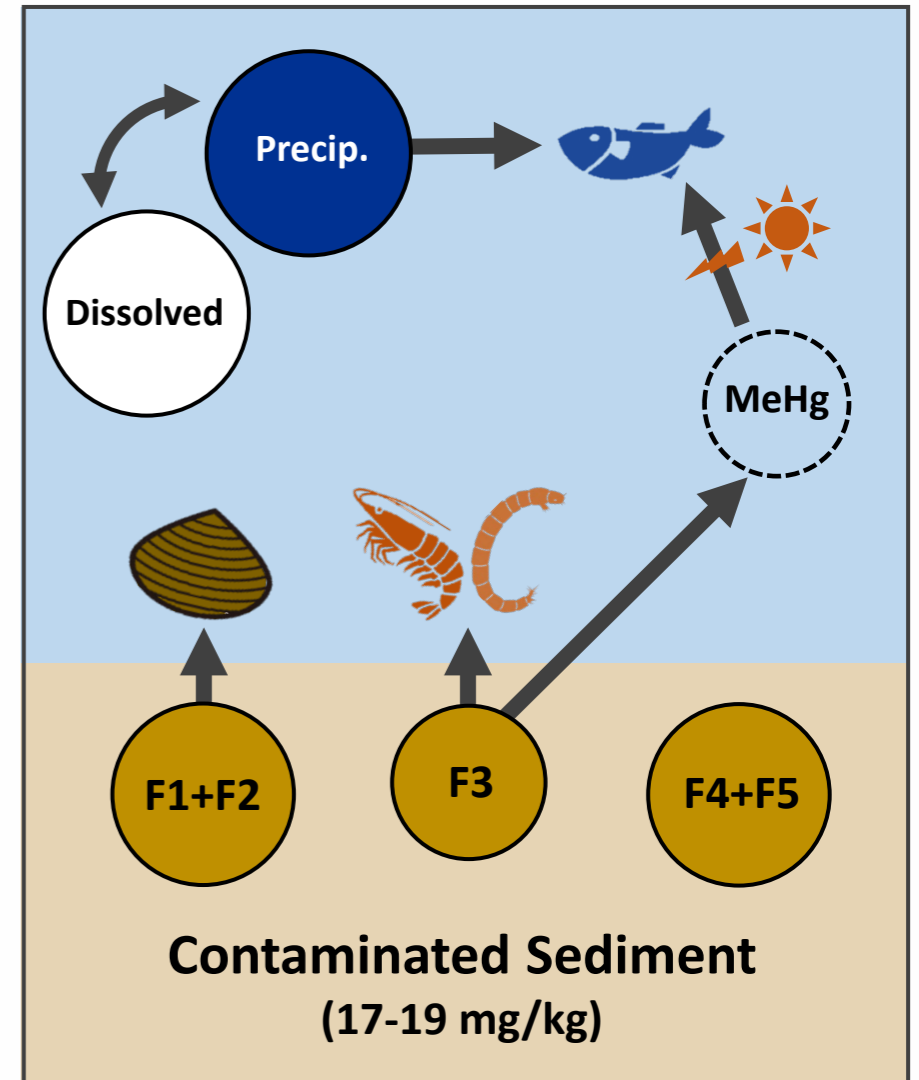
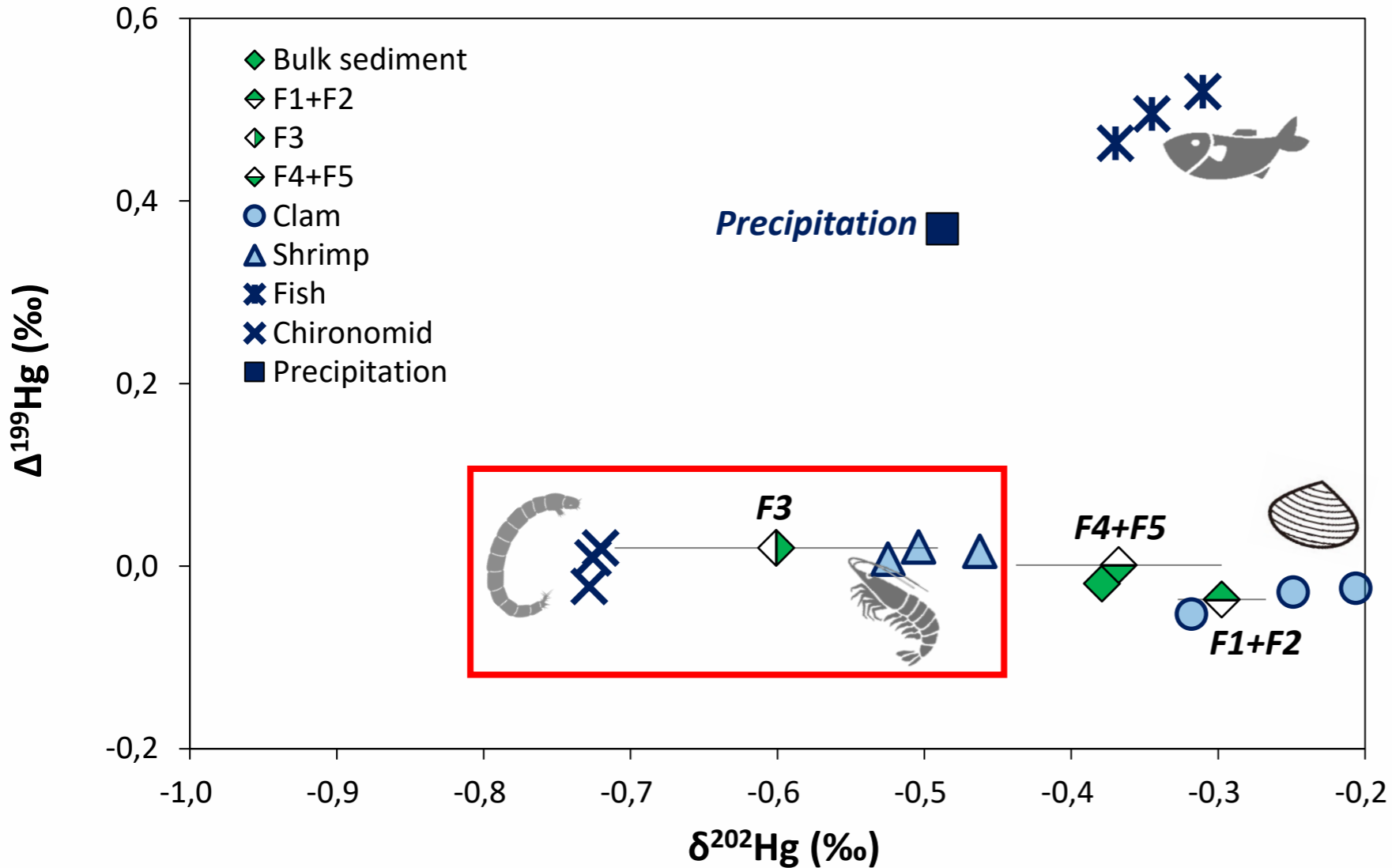
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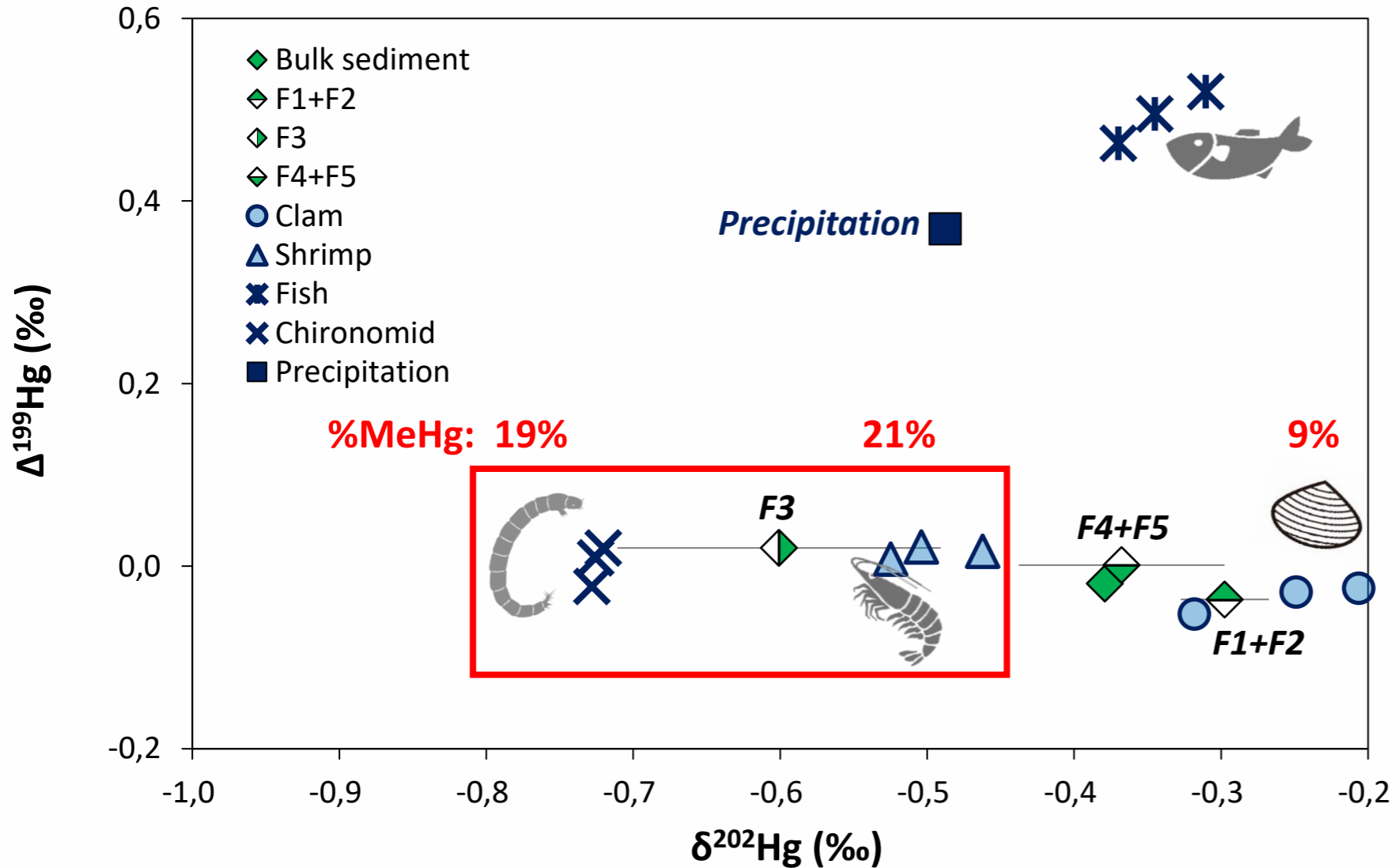


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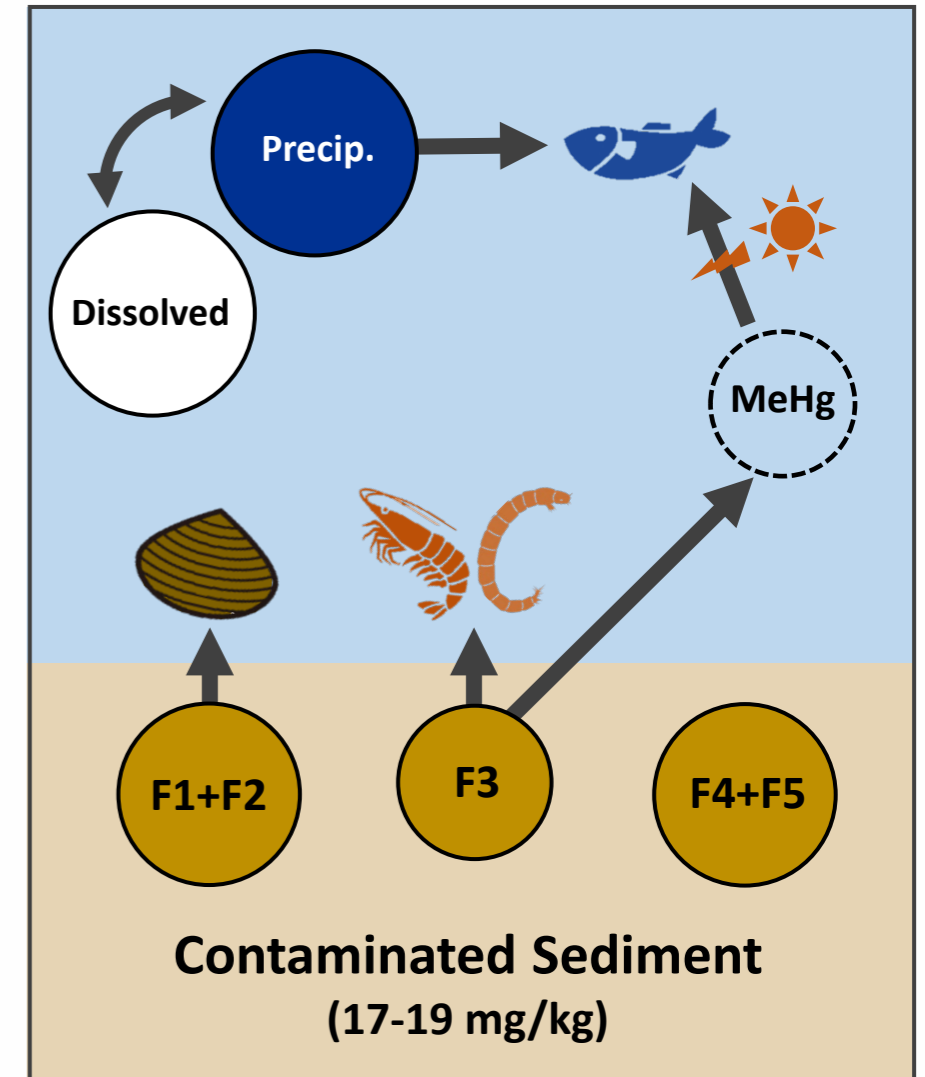
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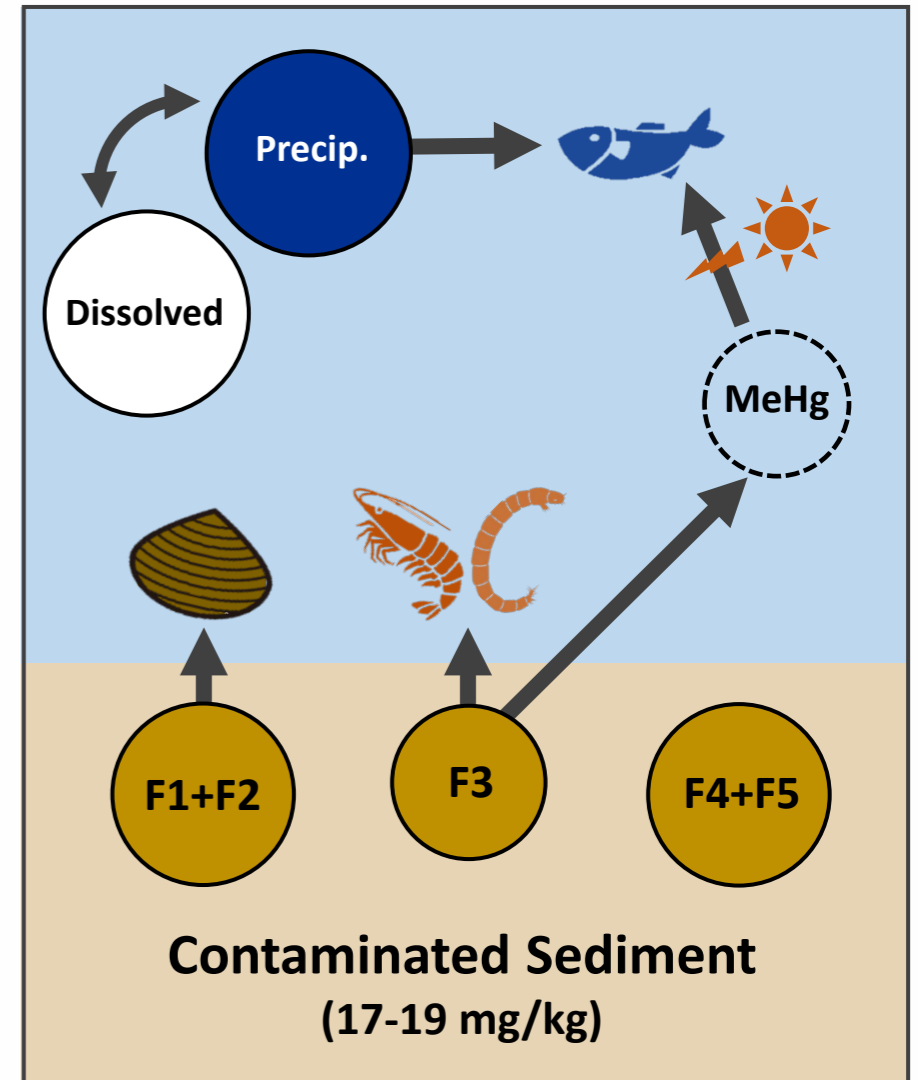
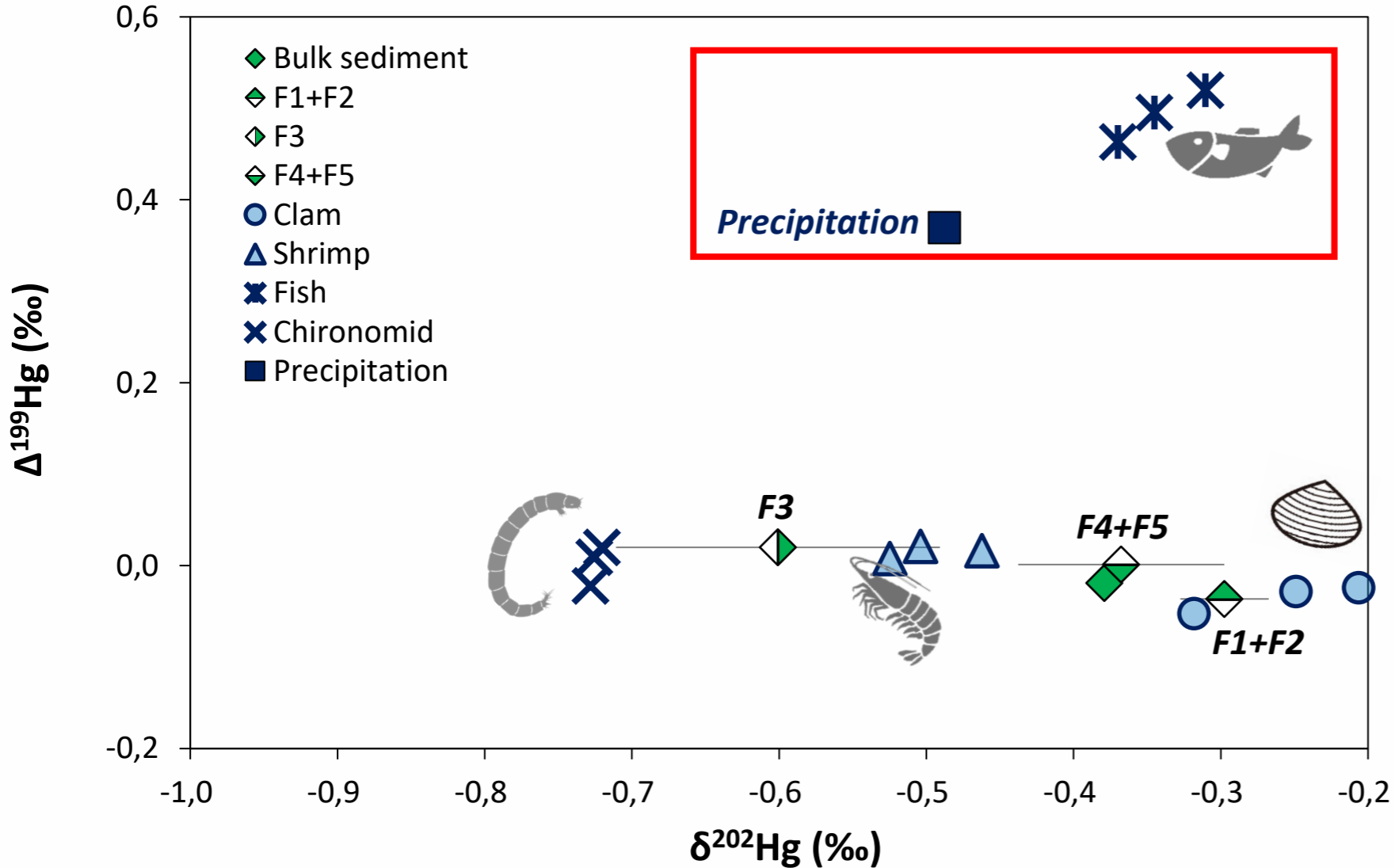
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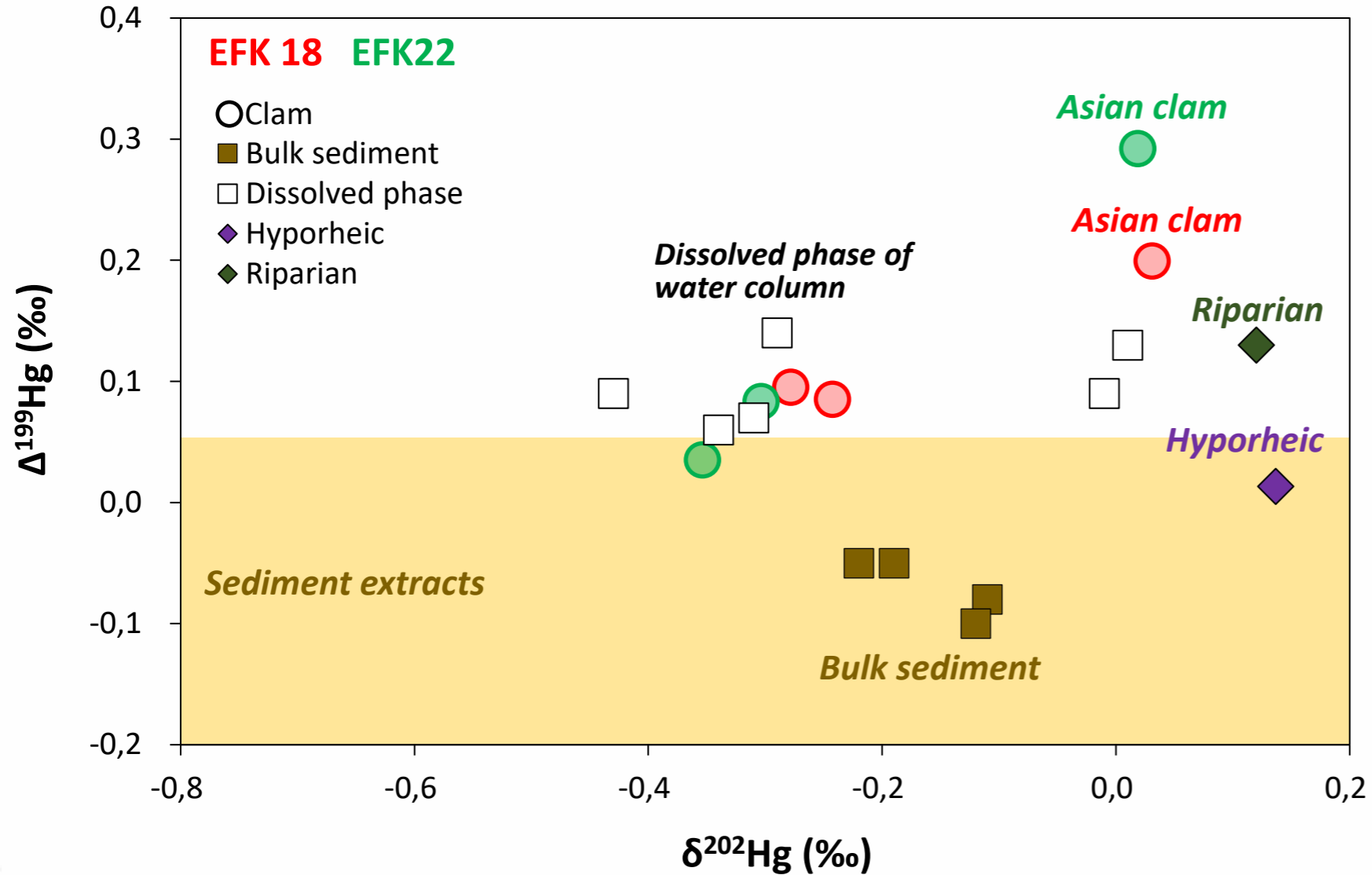


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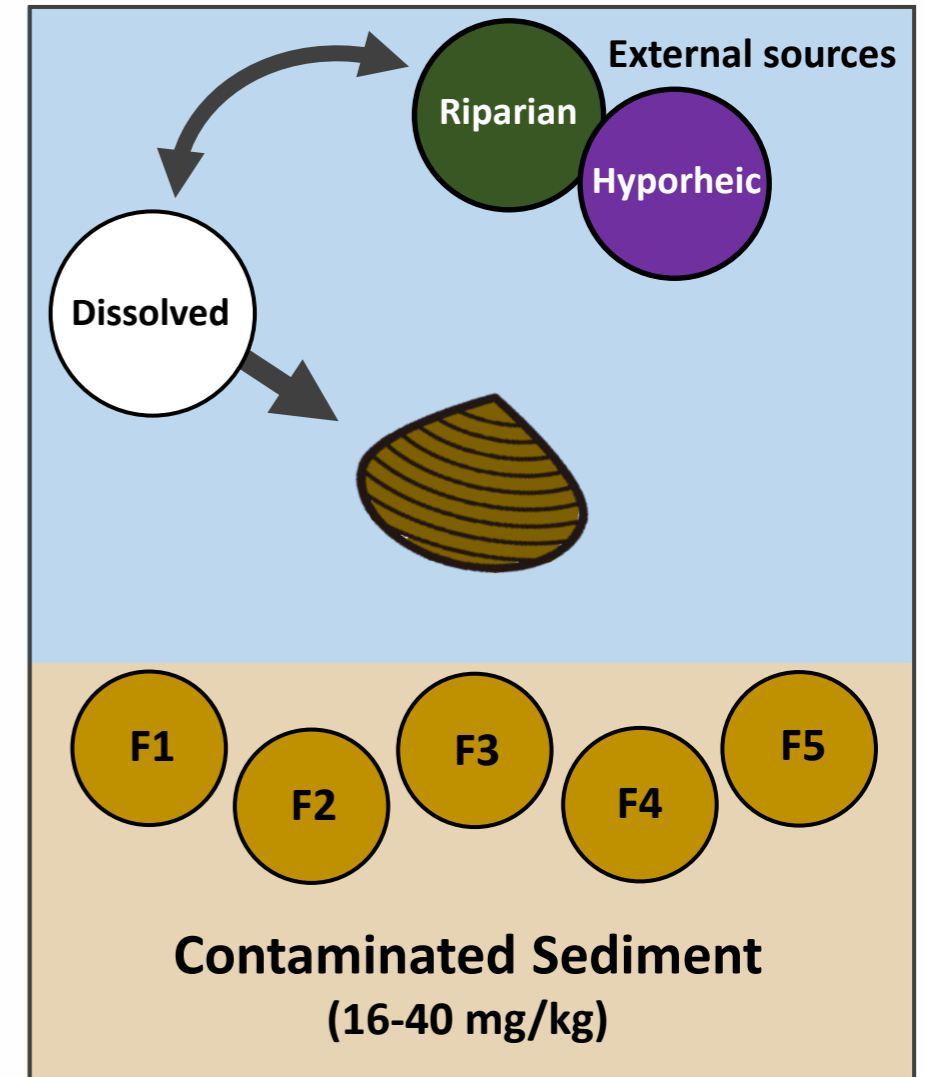
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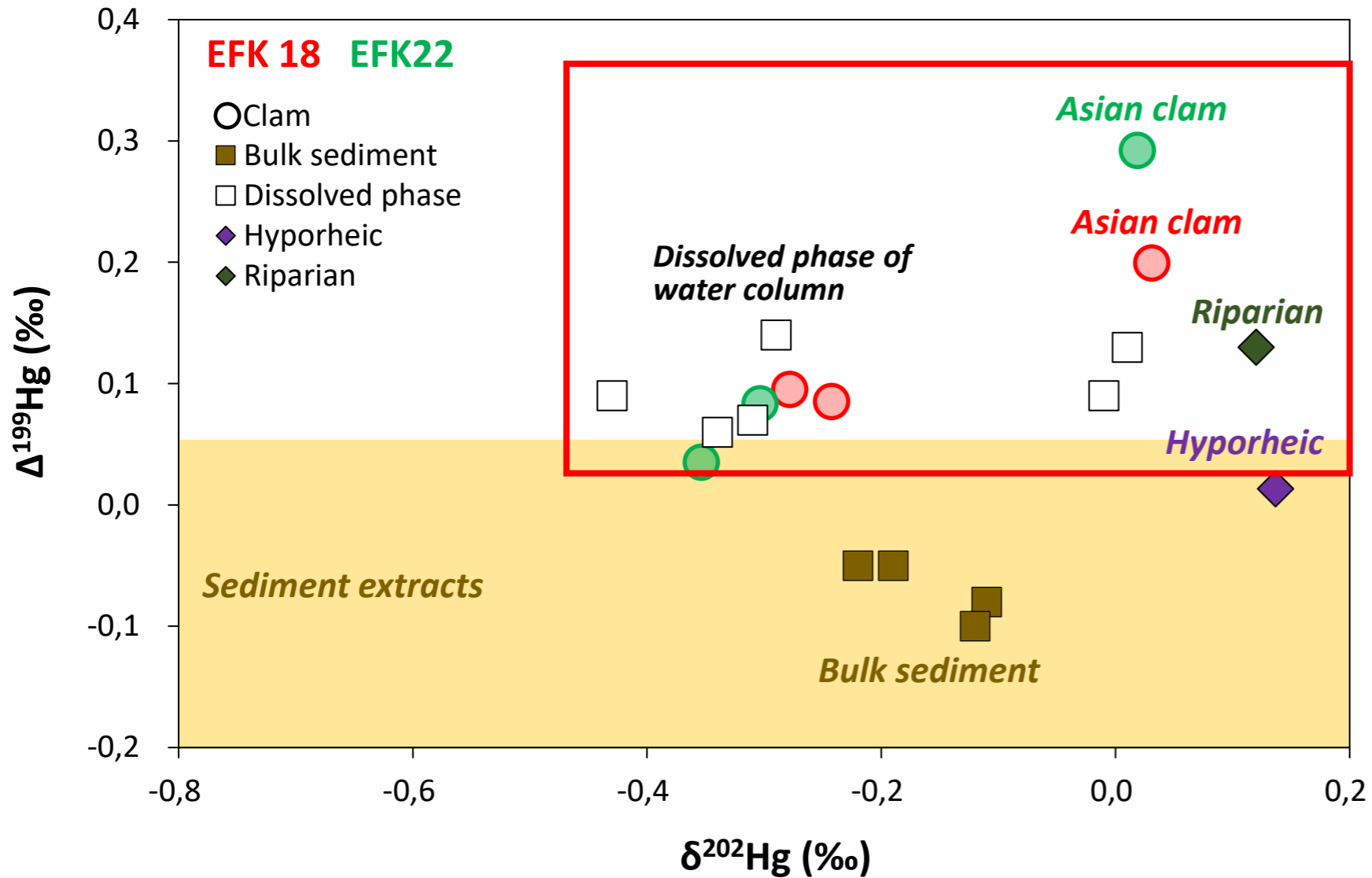
Contaminated site in Oak Ridge, U.S.



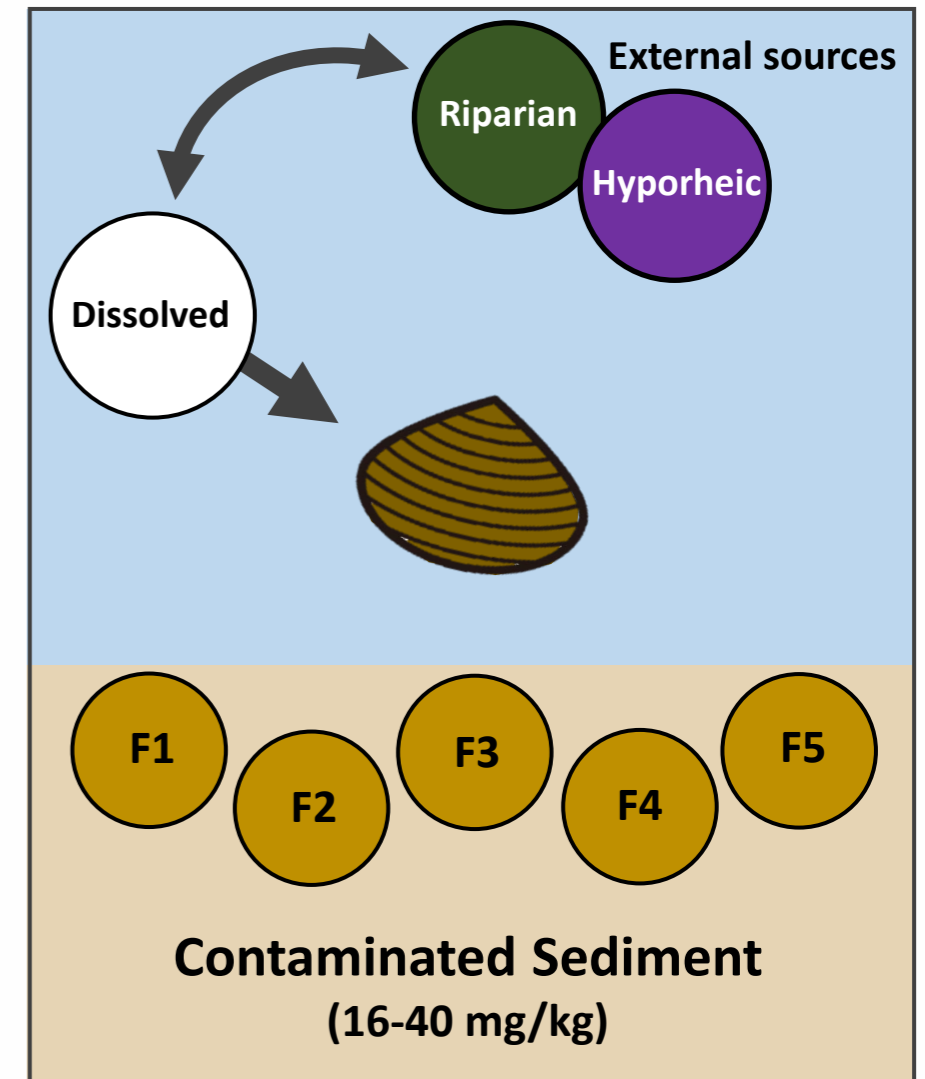
(Crowther et al., 2021; Demers et al., 2018)



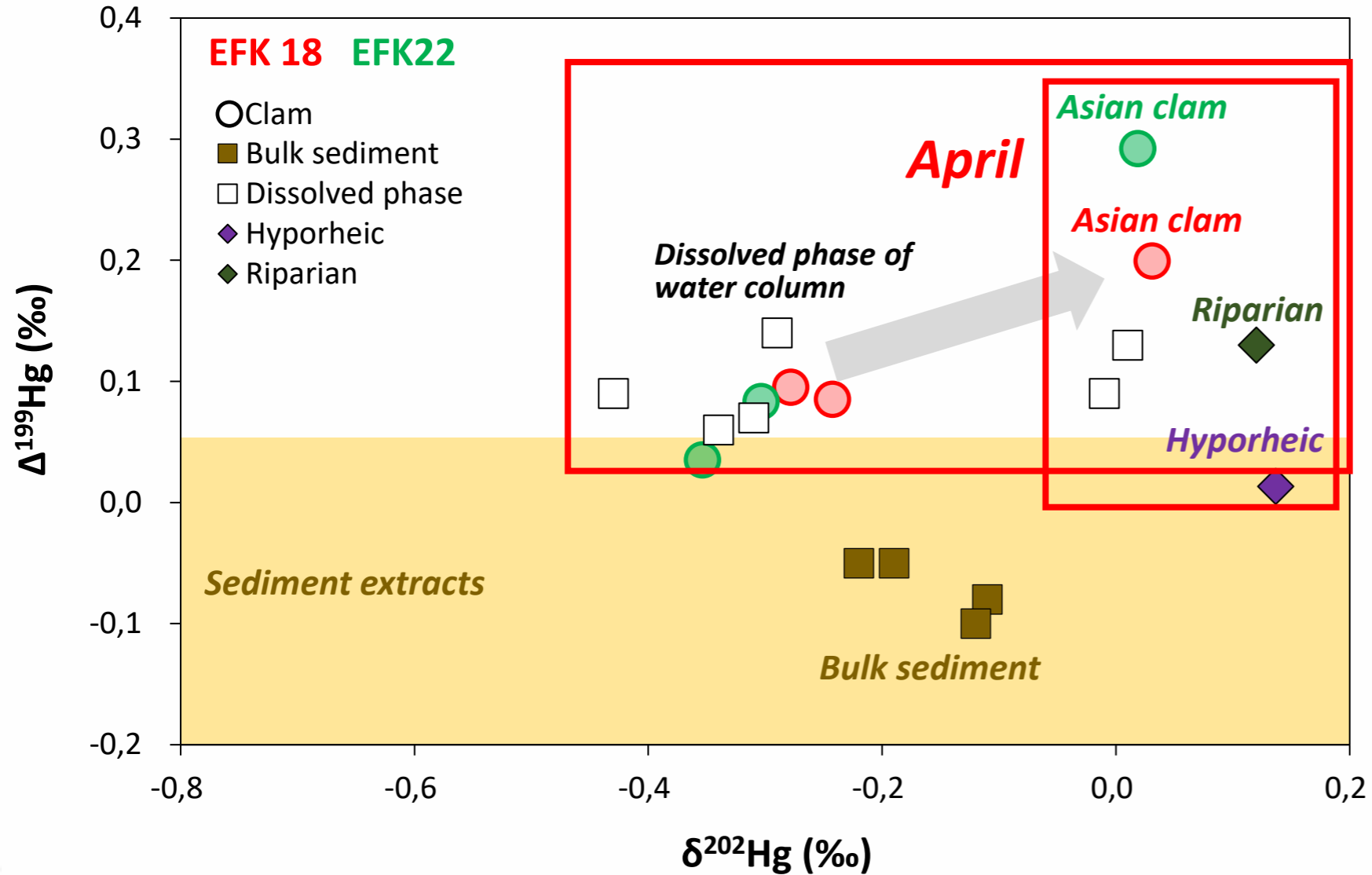
Contaminated site in Oak Ridge, U.S.



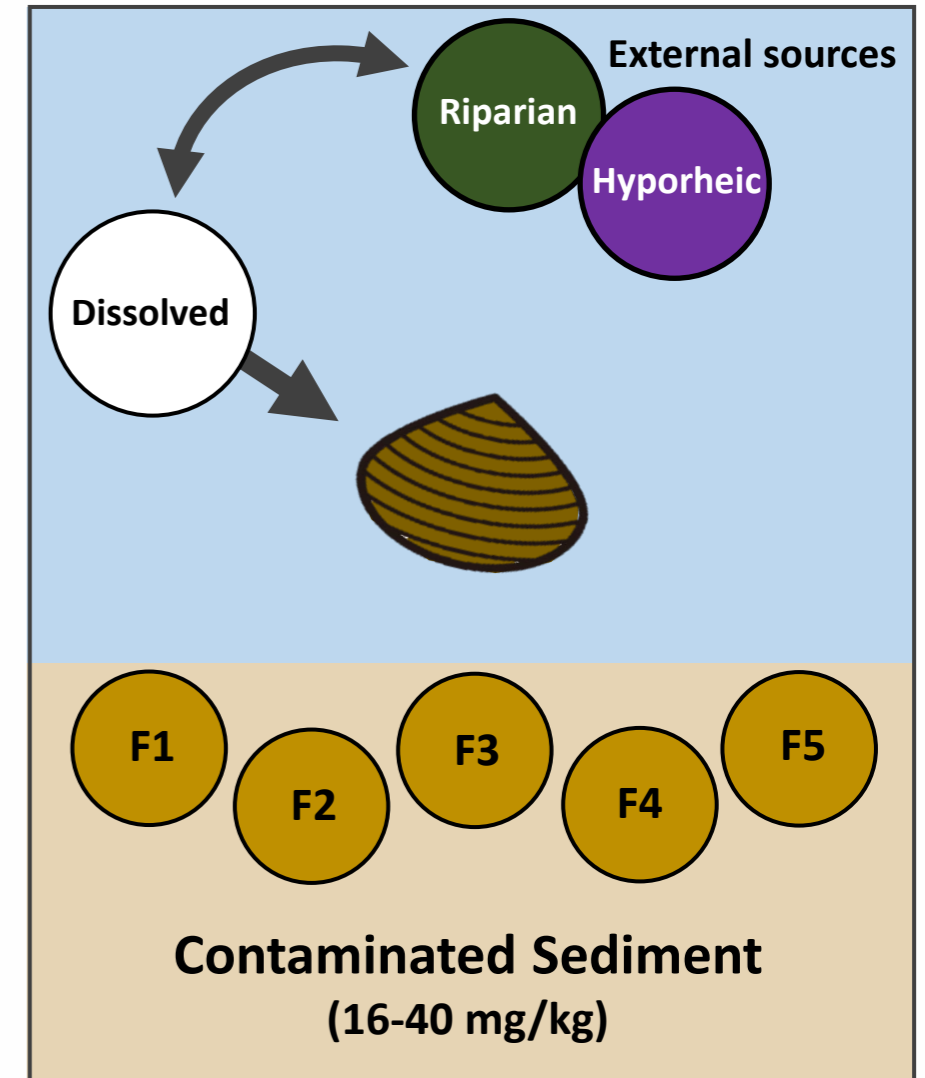
(Crowther et al., 2021; Demers et al., 2018)

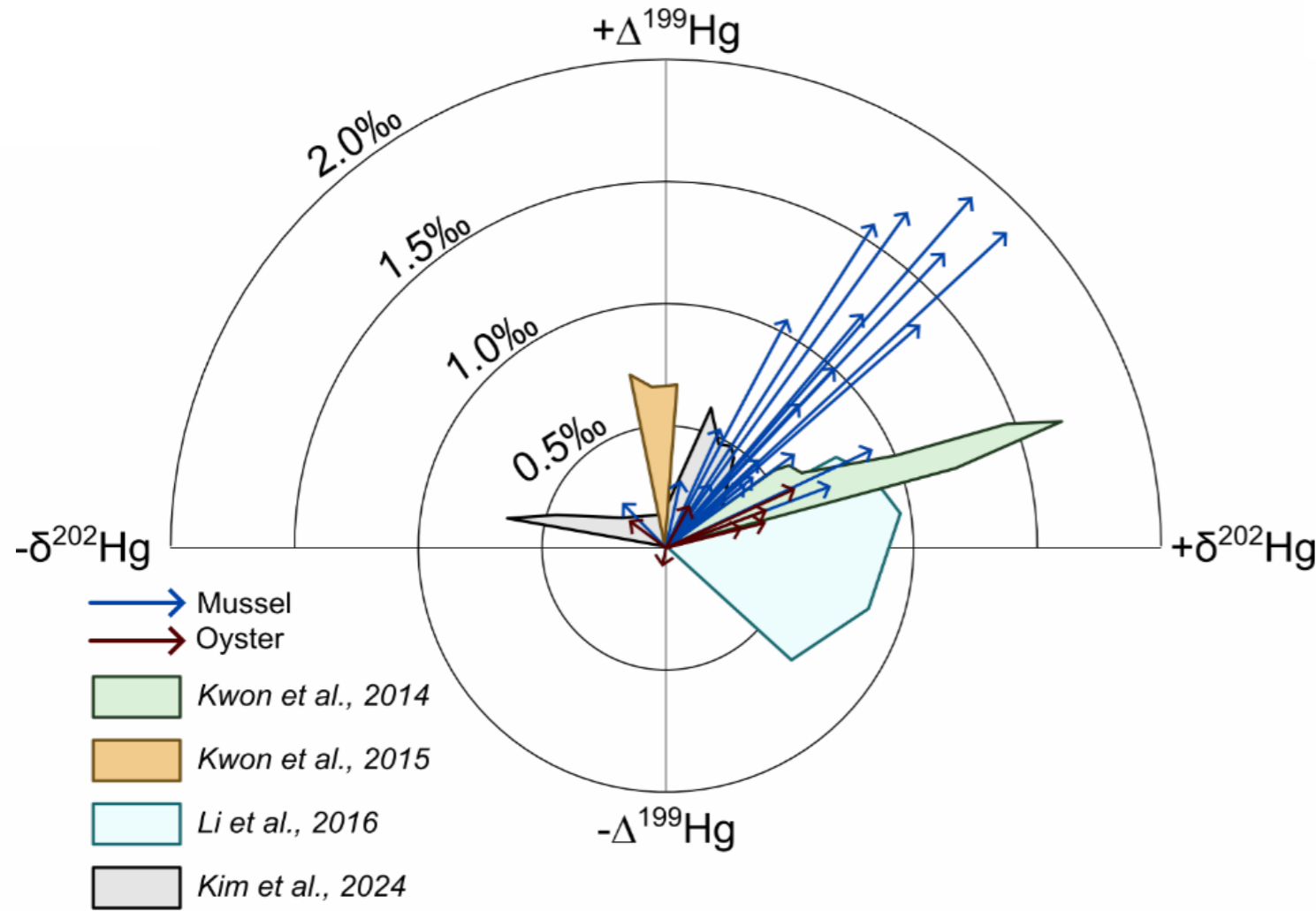


Contaminated site in Oak Ridge, U.S.

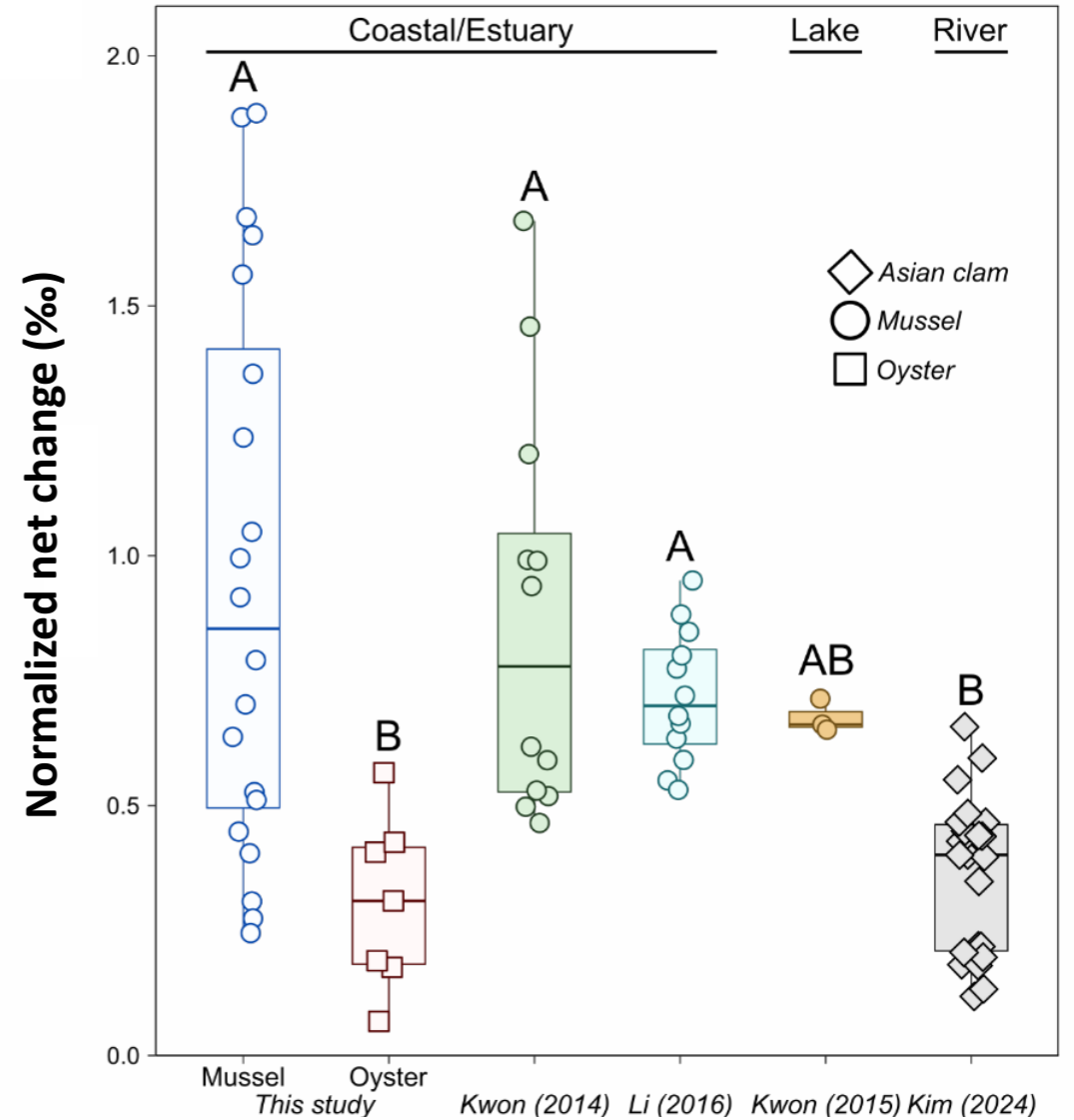


(Crowther et al., 2021; Demers et al., 2018)



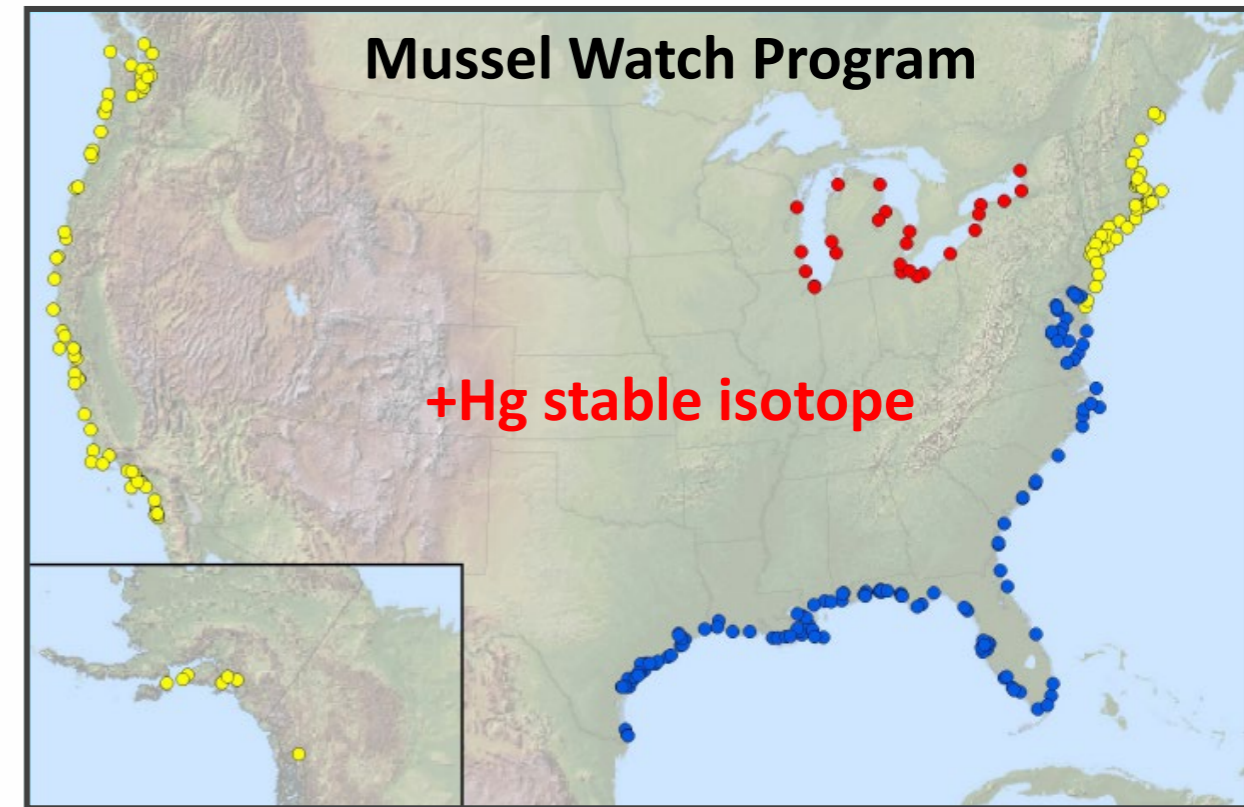
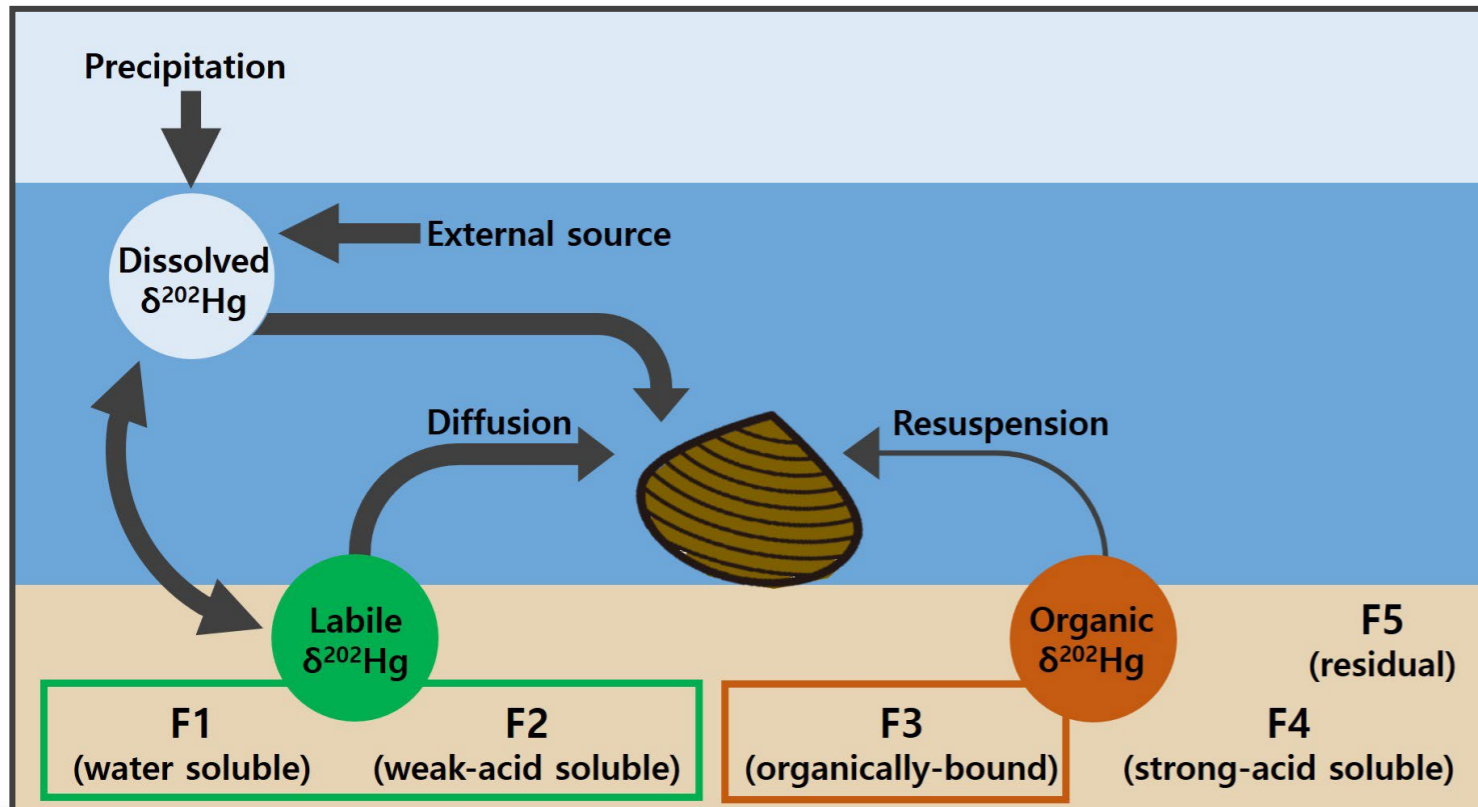


(Besnard et al., 2024, in revision)



Hg stable isotope

Aquatic biota ↔ Environmental media ↔ Hg Sources
 Exposure pathway Source impact



Thank you

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