

Thiosulfate oxidation by *Acidithiobacillus* spp. under varying O₂ and Fe(III) conditions

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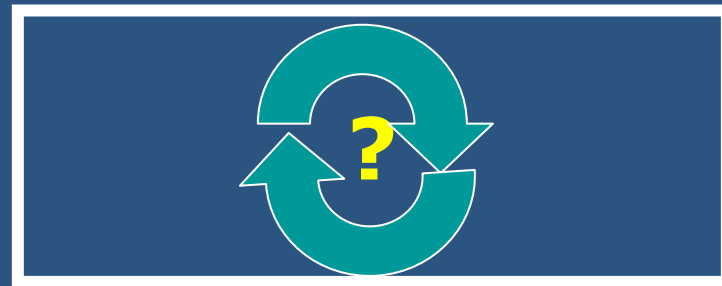


School of Geography
& Earth Sciences



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Xstrata Nickel, CFI, OIT

"Thiosalts"



Geochemical Model



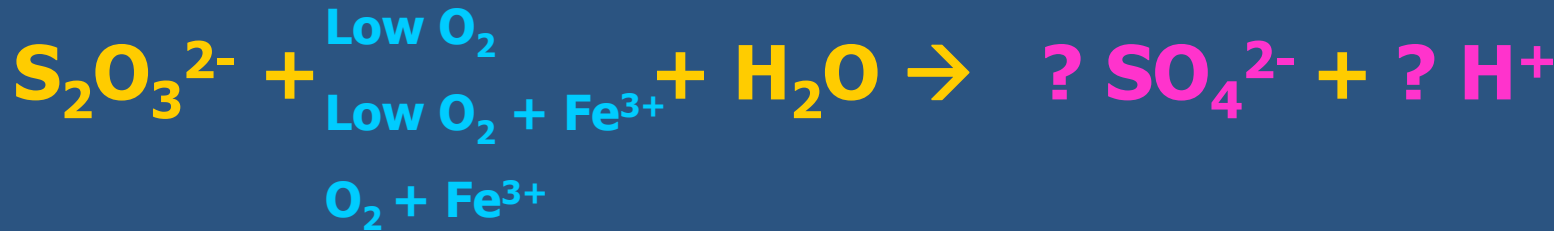
A. ferrooxidans

A. thiooxidans

A. f. + *A. t.*

OP 2002

OP 2003

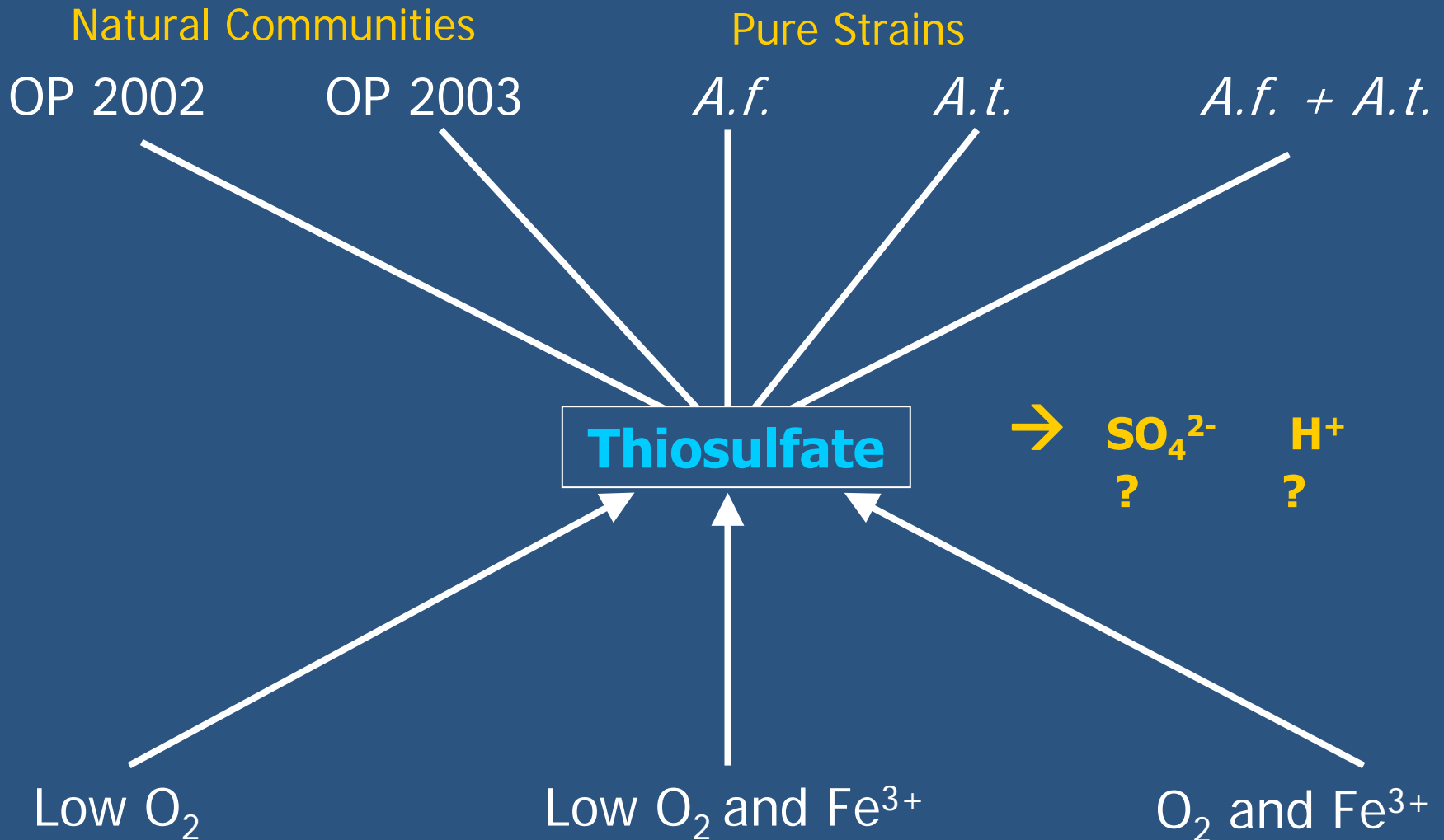


Geochemical controls

Microbial controls

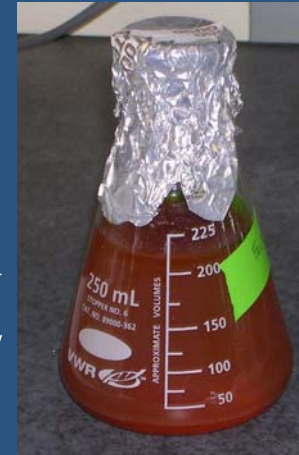


Experimental Design



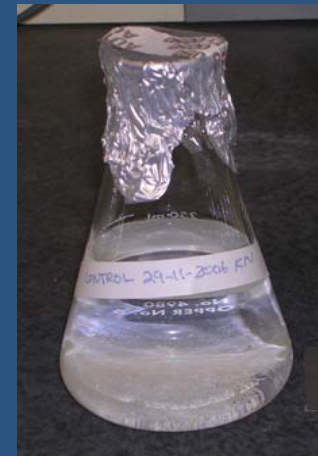
Oxygen and Iron Conditions

shaken



iron

static

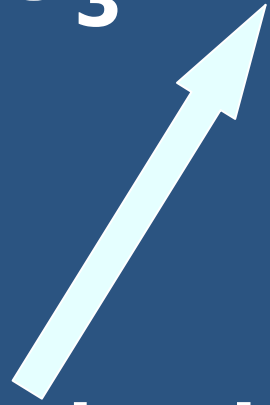


no iron

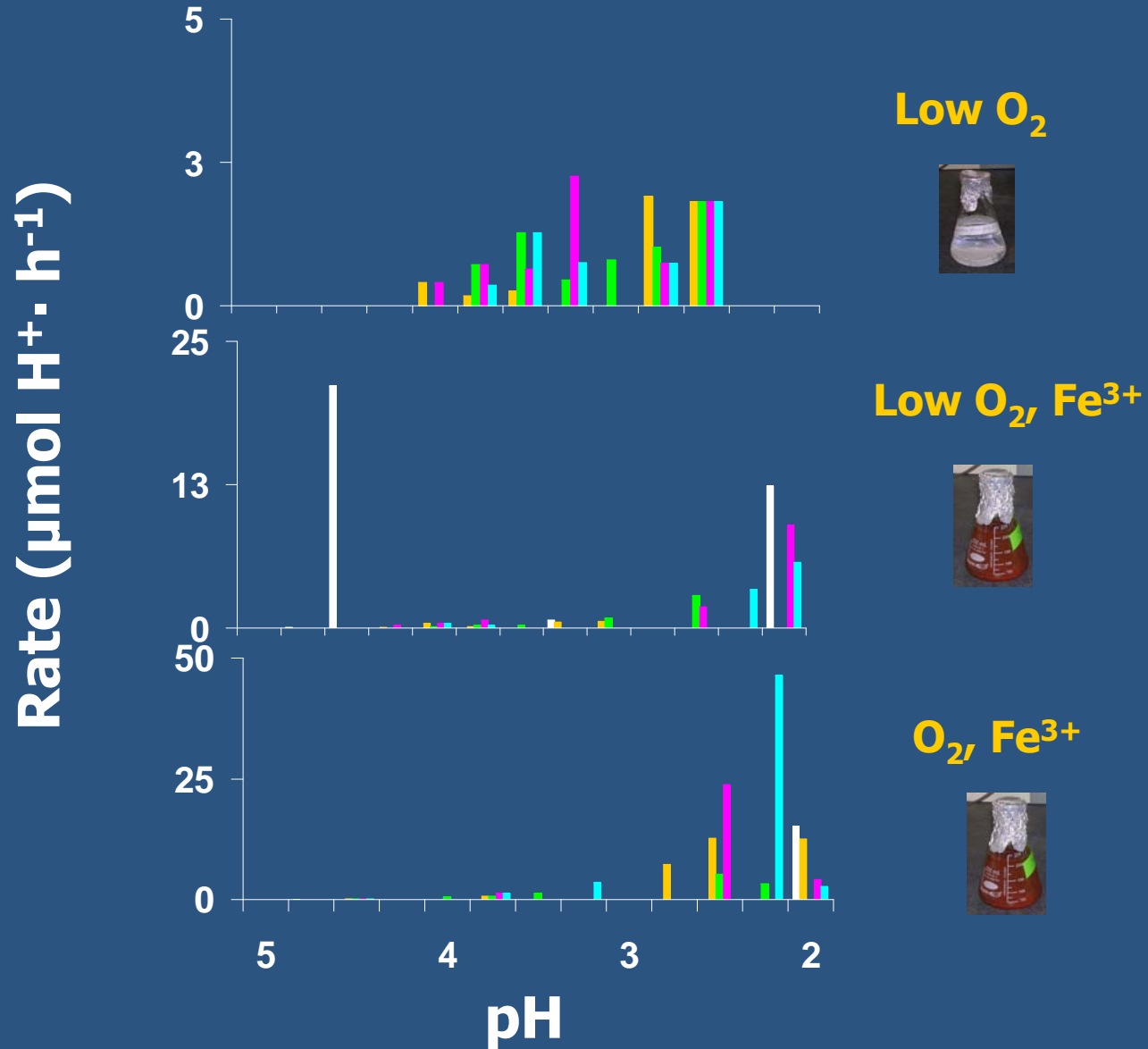
5 Microbial Controls



3 Geochemical Controls



Rates of Acid Generation

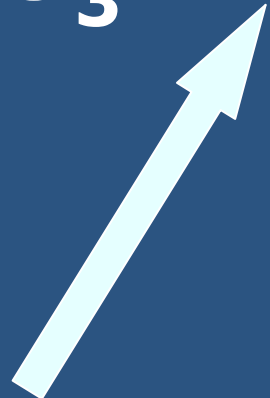


OP 2002
 OP 2003
 A.f.
 A.t.
 A.f. + A.t.

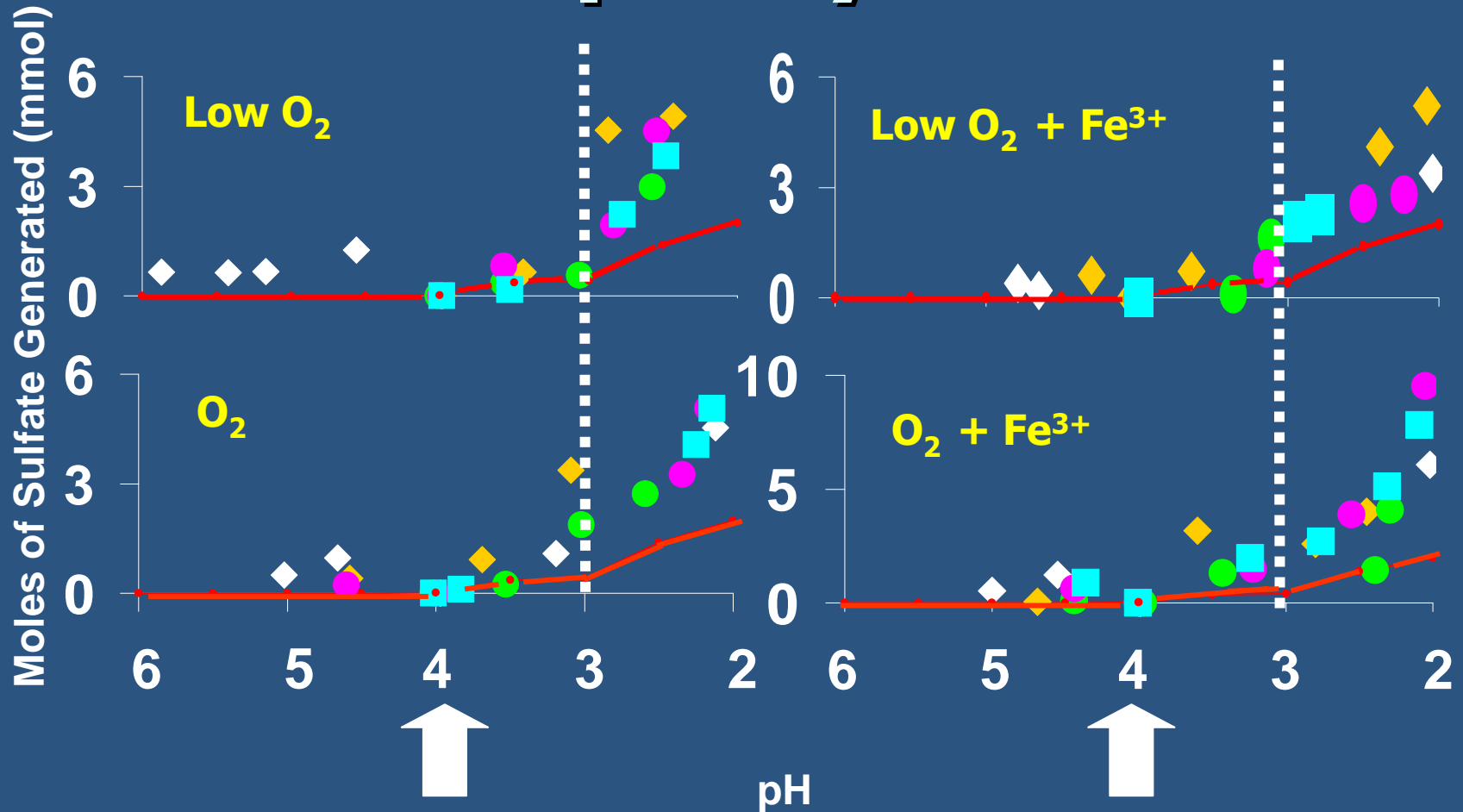
5 Microbial Controls



3 Geochemical Controls



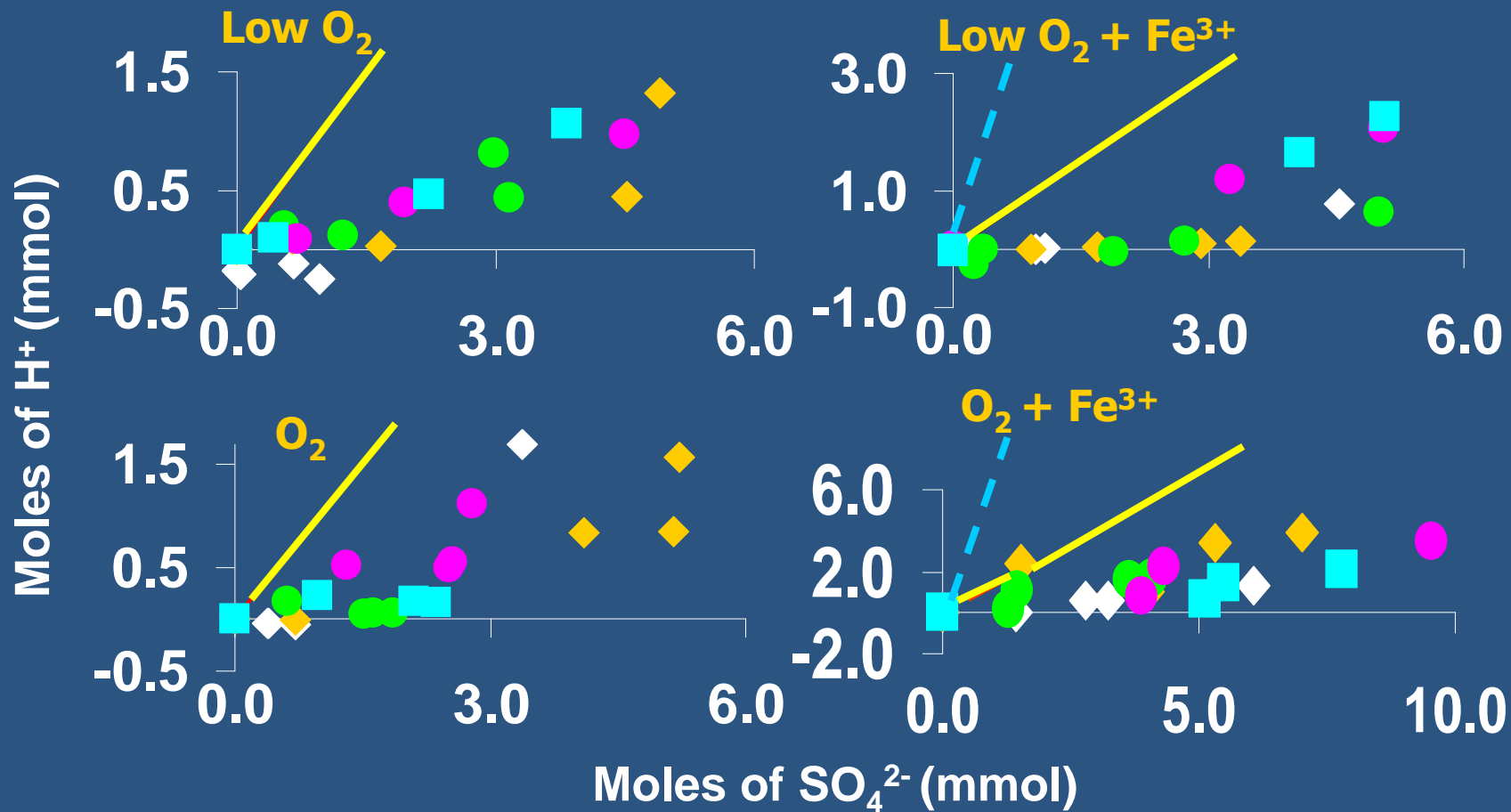
Sulfate-pH Dynamics



— Abiotic

OP 2002
 OP 2003
 A.f.
 A.t.
 A.f. + A.t.

Molar Ratios of Acid : Sulfate



Expected with O_2 as oxidant

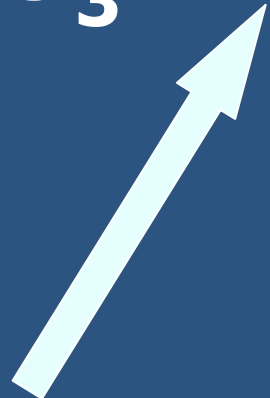
Expected with Fe as oxidant



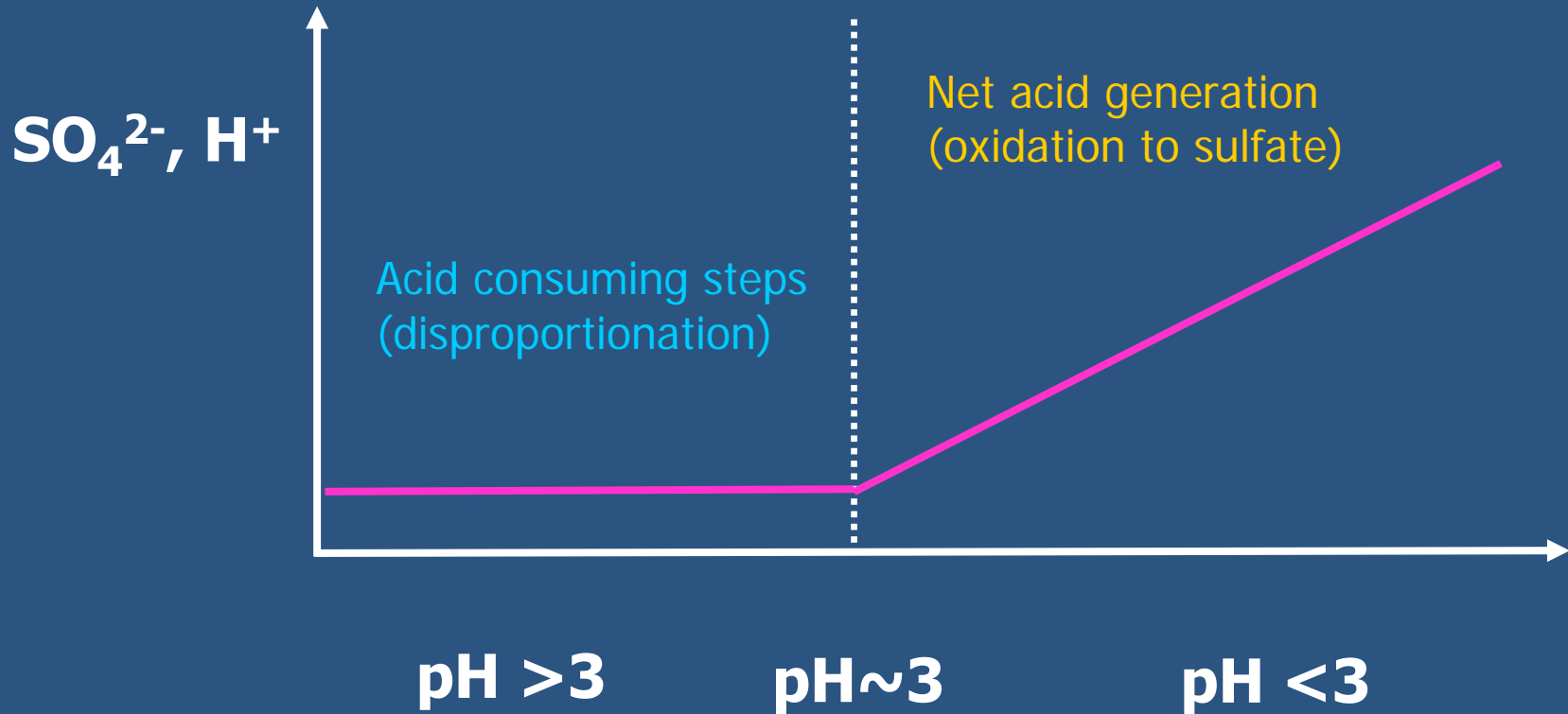
5 Microbial Controls



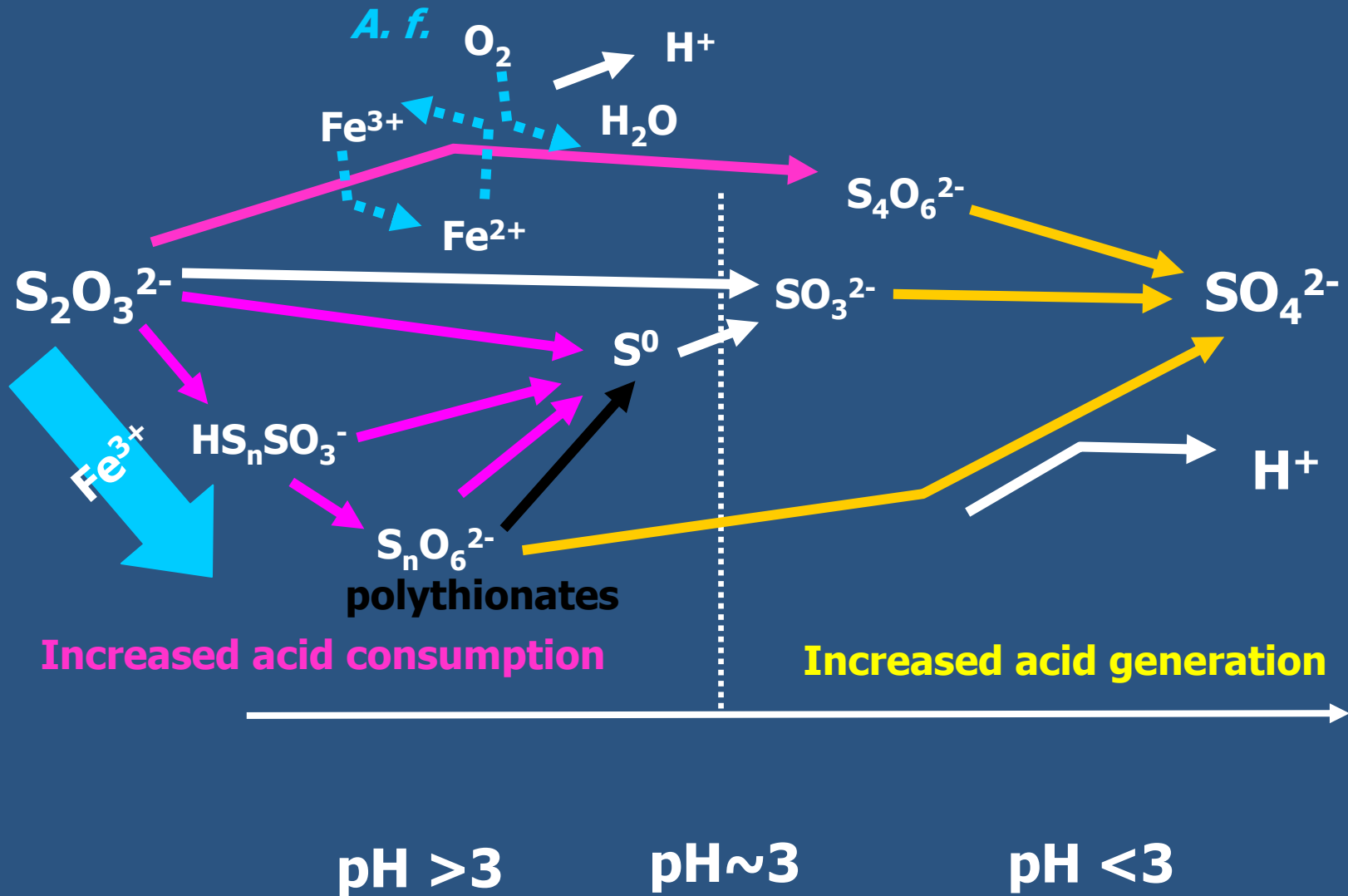
3 Geochemical Controls



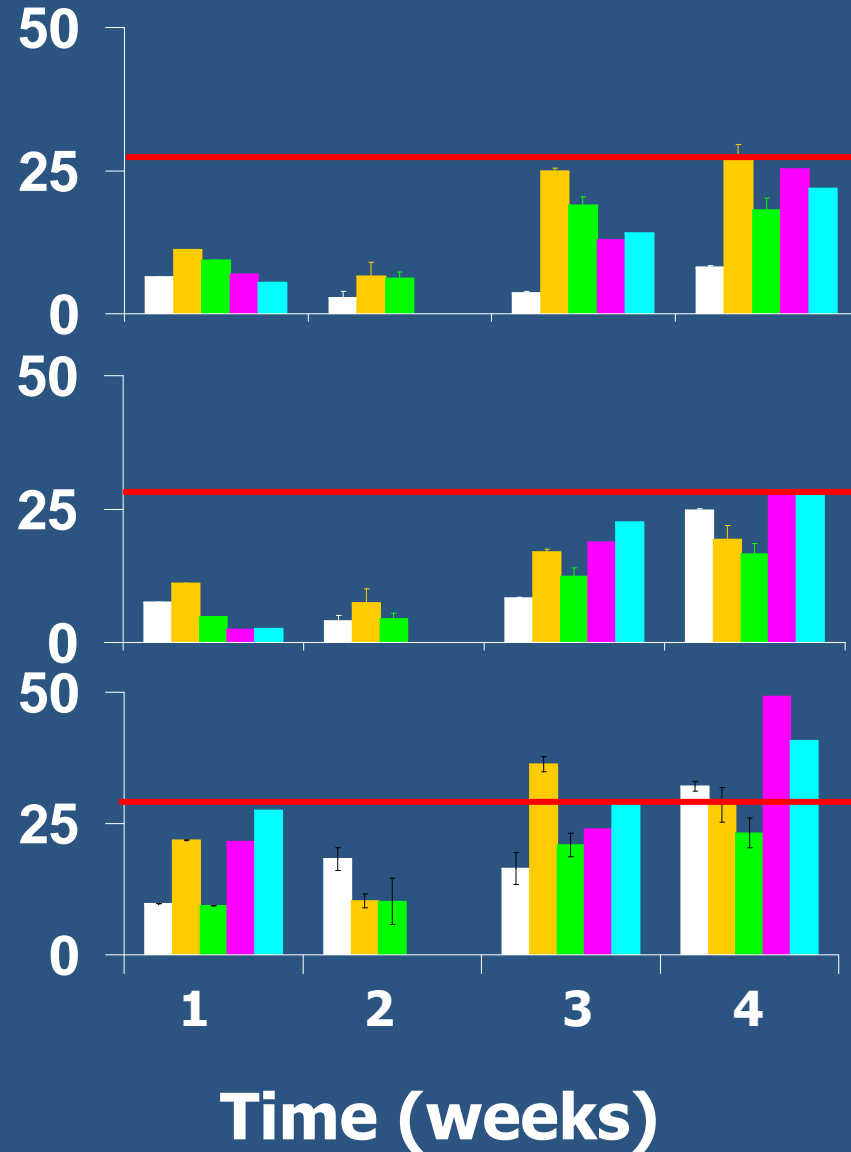
Microbial thiosulfate oxidation pathways contain **acid-consuming** and **acid-generating** steps



Microbial thiosulfate processing: Role of Fe



Sulfate Generation



Low O₂



Low O₂, Fe³⁺



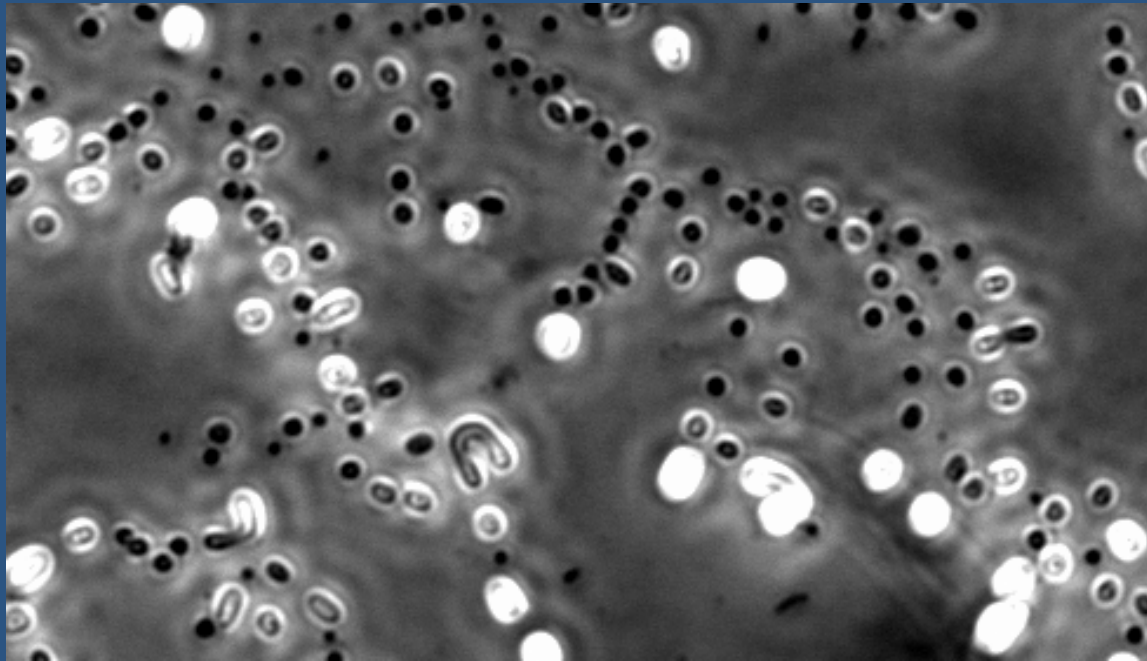
O₂, Fe³⁺



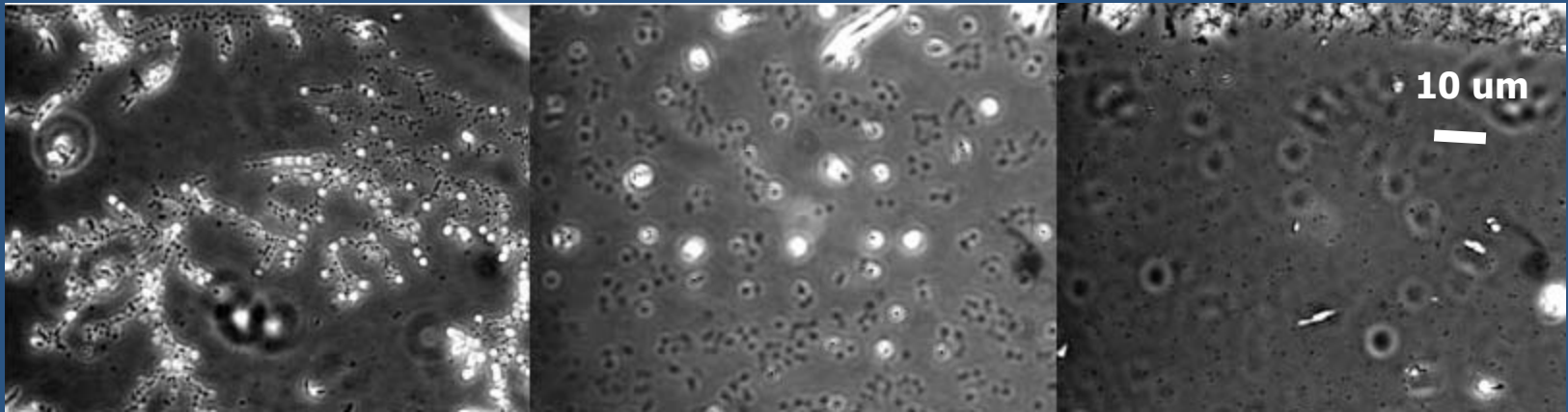
OP 2002
 OP 2003
 A.f.
 A.t.
 A.f. + A.t.

Internal Sulfur Storage

Acidithiobacillus spp. can internally store **elemental sulfur** as granules



Remobilisation of S Stores



Low O₂

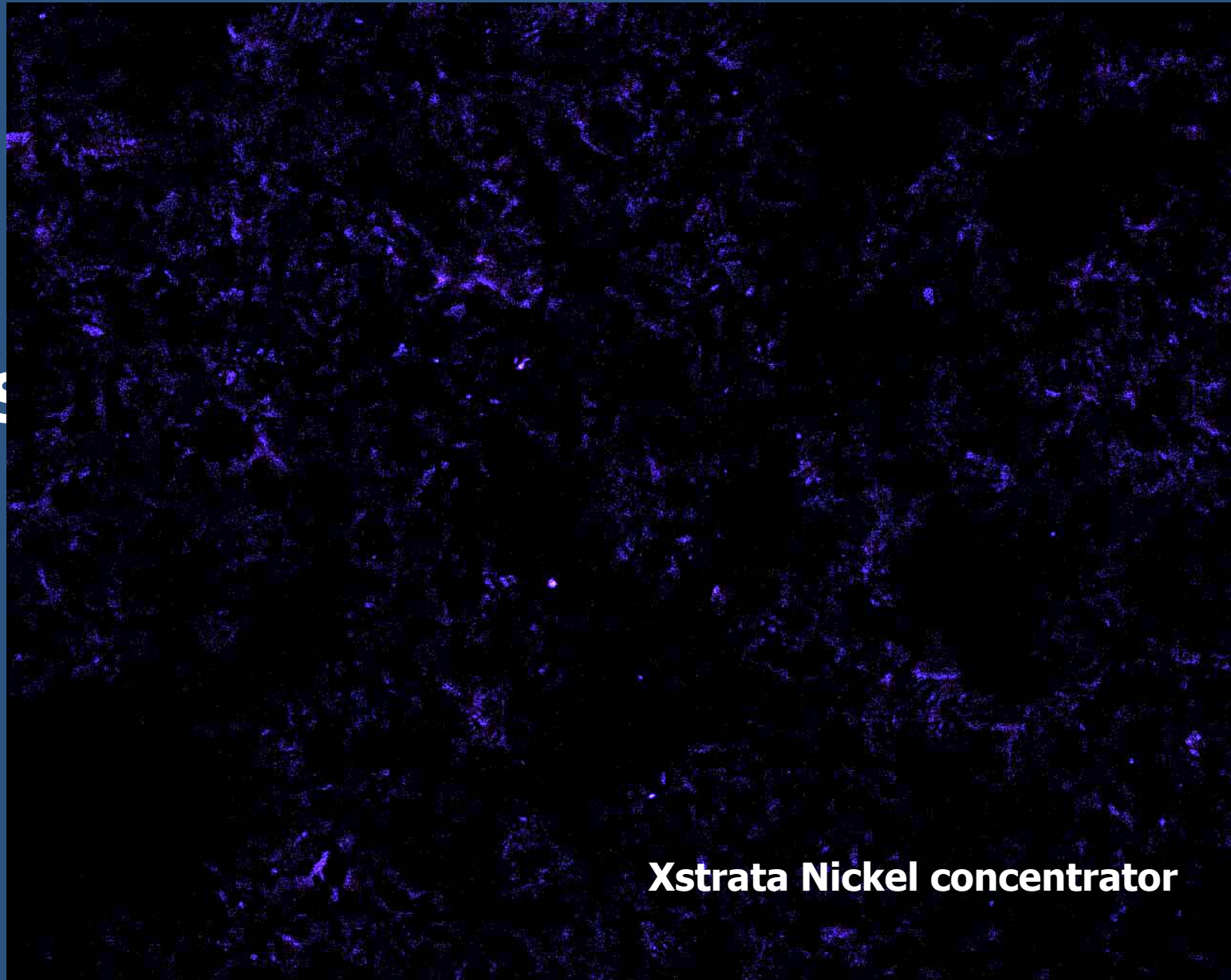
Low O₂, Fe³⁺

O₂, Fe³⁺

- observed in OP 2002, 2003, *A.t.* and *A.t.* + *A.f.* oxygenated iron systems
- Not observed in *A.f.* systems

Conclusions

- Current models → abiotic oxidation with O₂
- Microbial processing AND iron increase recycling of sulfur and change acid dynamics
- Microbial fingerprints
 - Differences in thiosalt processing
 - Influences of iron
 - Ability to mobilize internal sulfur



Xstrata Nickel concentrator