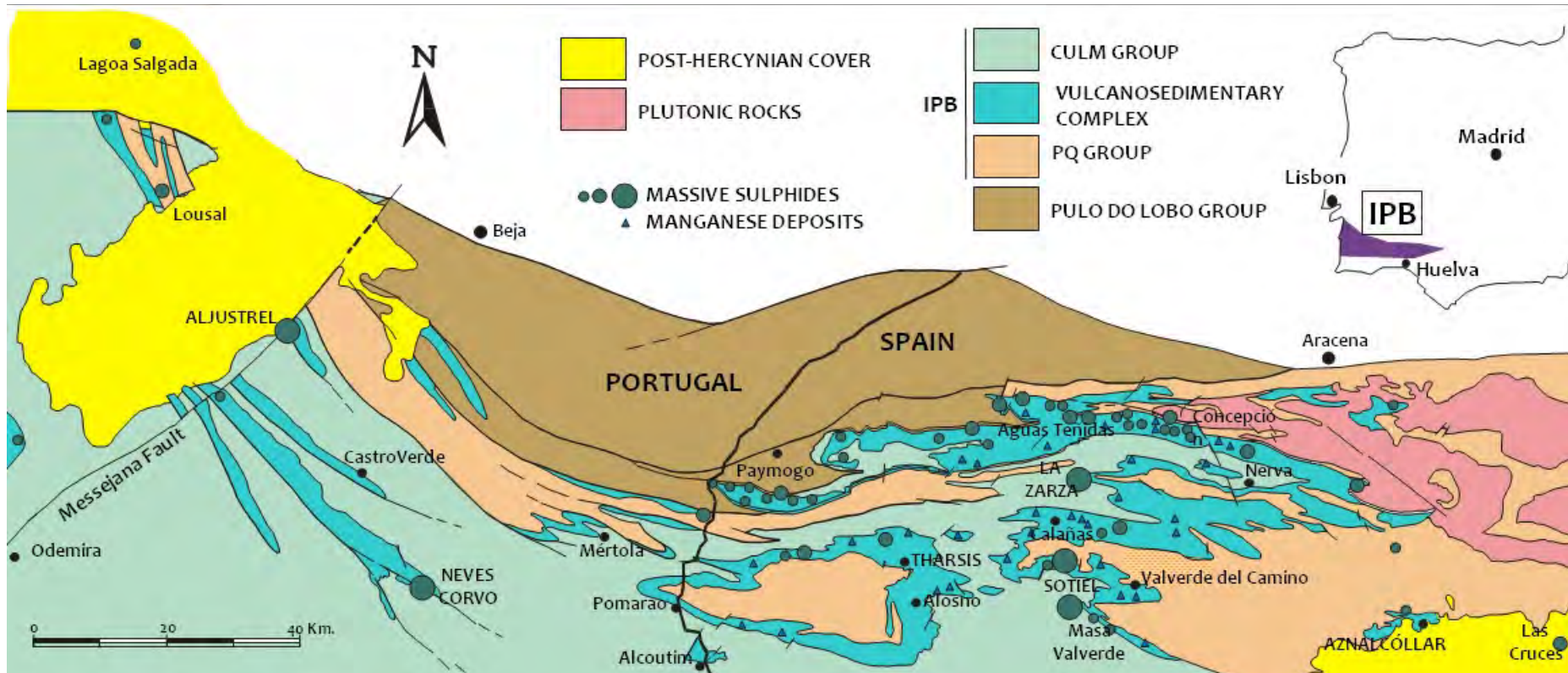


Extraction of REEs from Acid Mine Drainage in the Iberian Pyrite Belt (SW Spain)

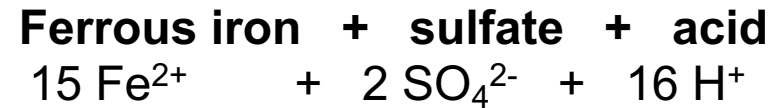
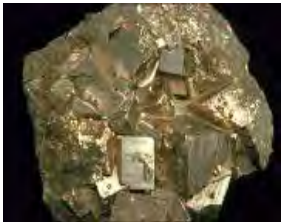
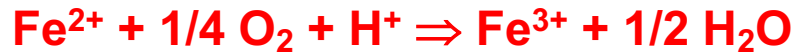
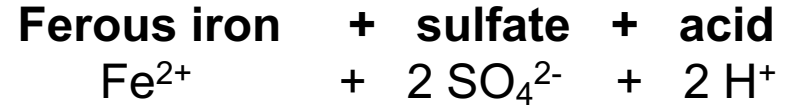
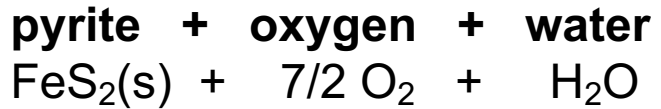
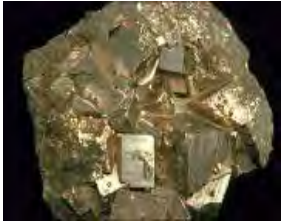


The Iberian Pyrite Belt

- ✓ A belt of 400 Km long, 80 km wide, from Seville to Lisbon
- ✓ Original reserves of sulphides exceeding ~ 1700 Mt
- ✓ Mining activities dating back to the Third Millennium BC



The origin of the problem



The consequences

Mine dumps



Tunnels



Open pits



Shafts



Channels



Leaching



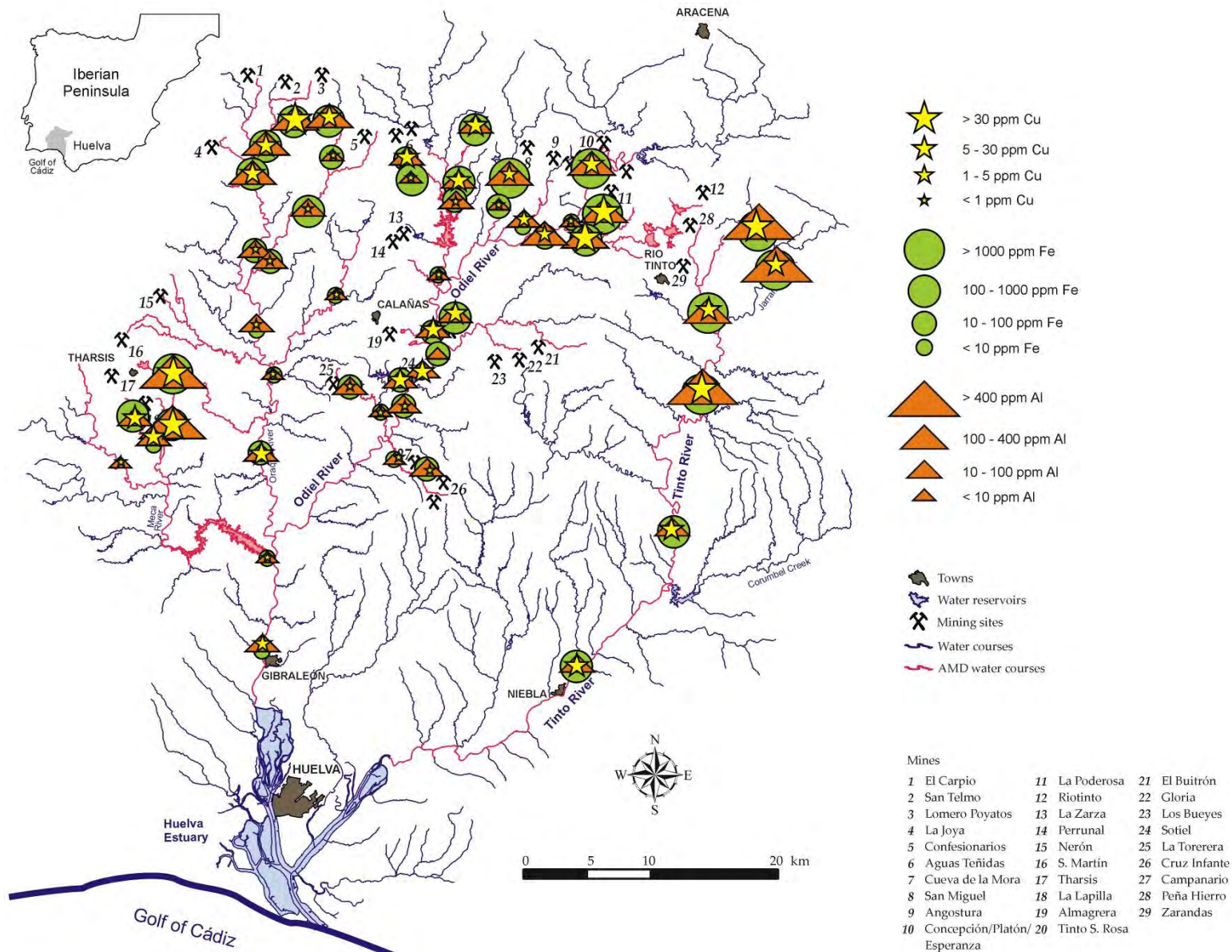
AMD



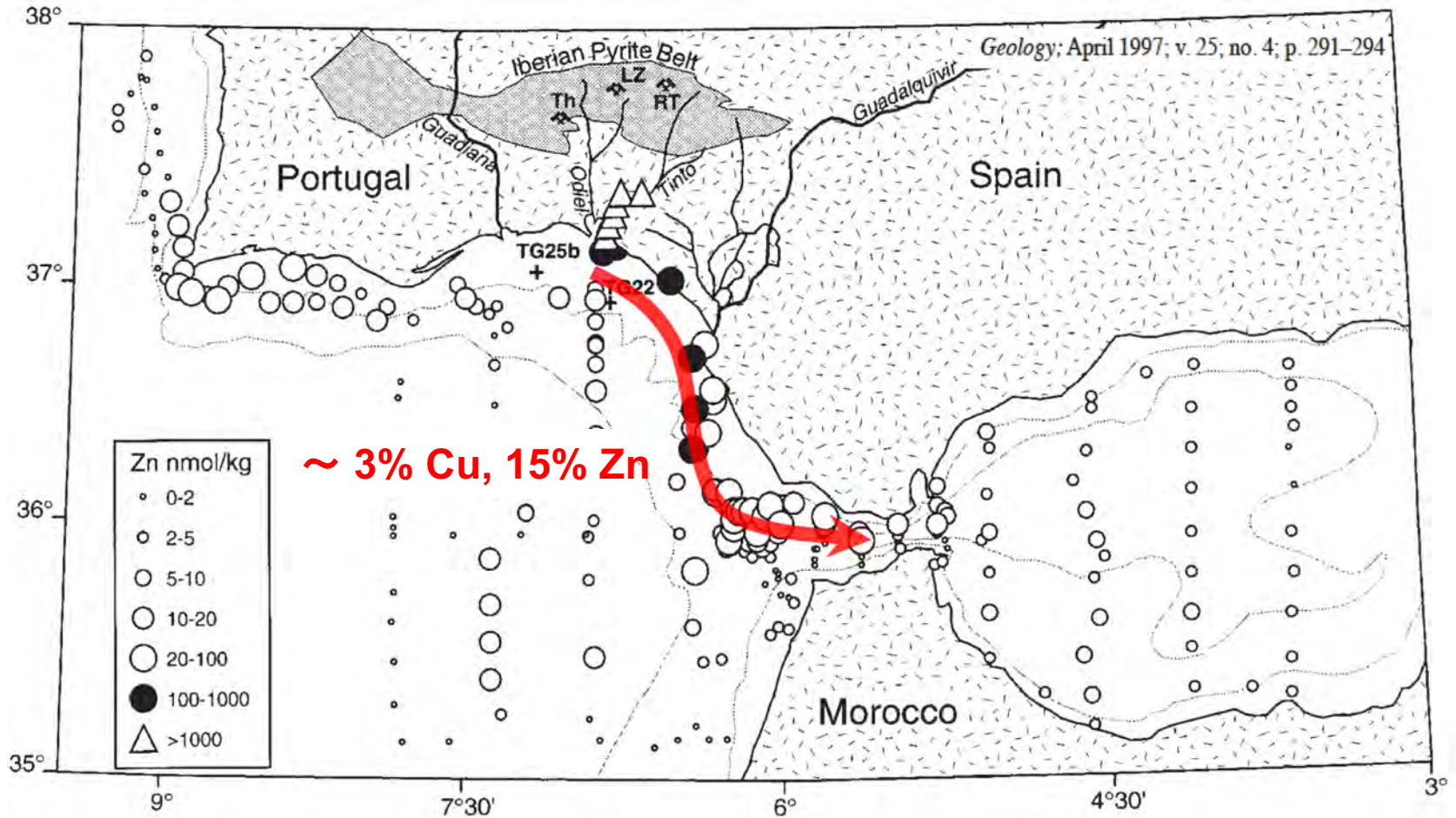
The consequences



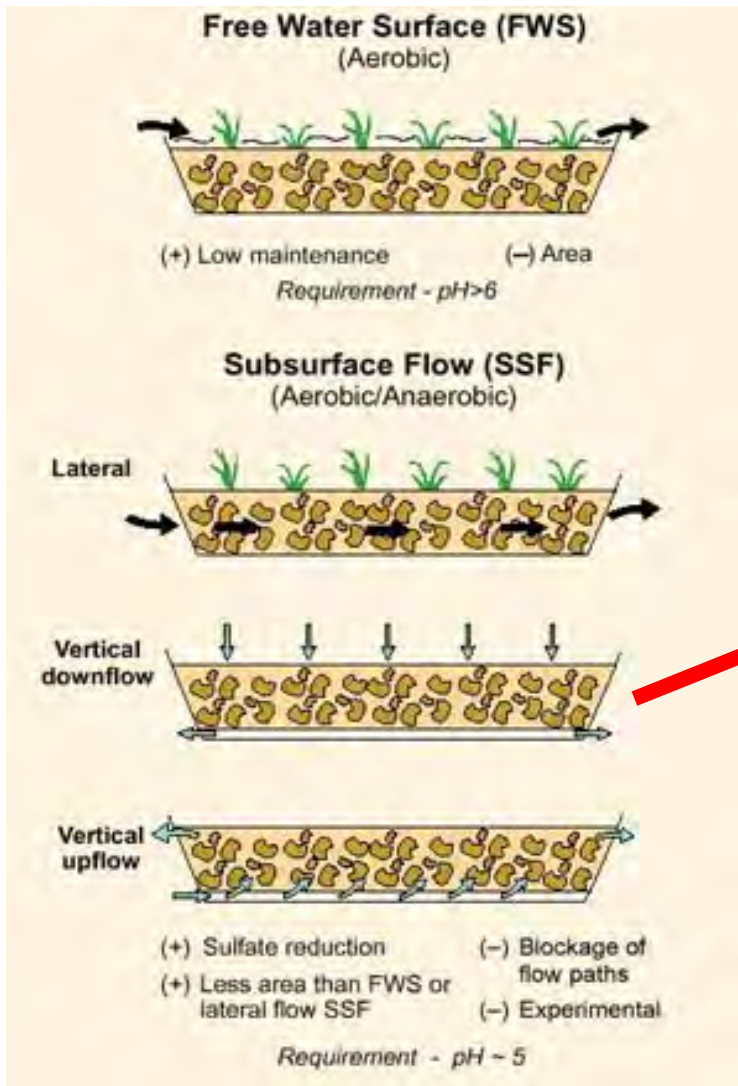
Pollution in the Odiel and Tinto rivers



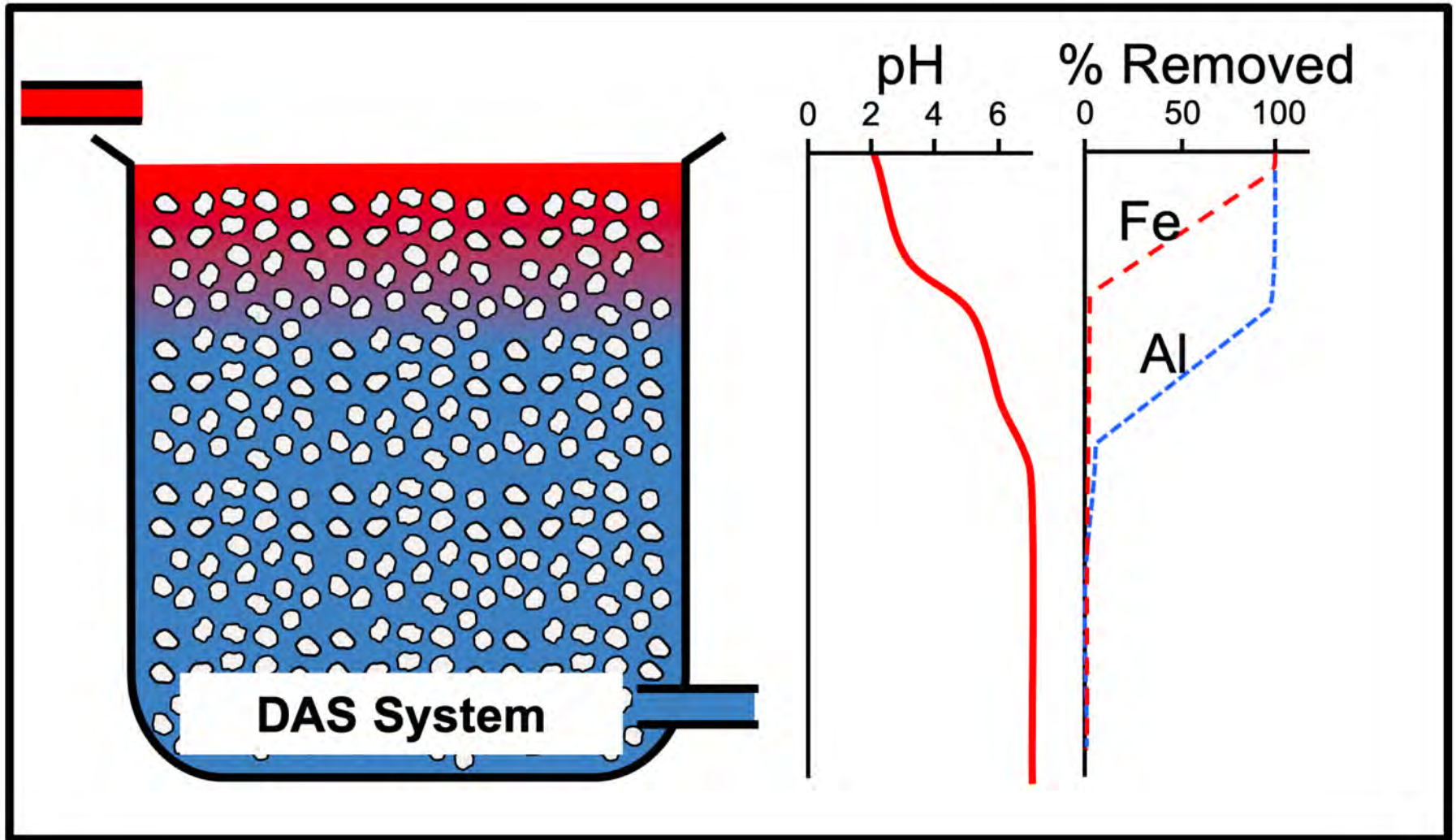
Transfer of metals to the Atlantic Ocean



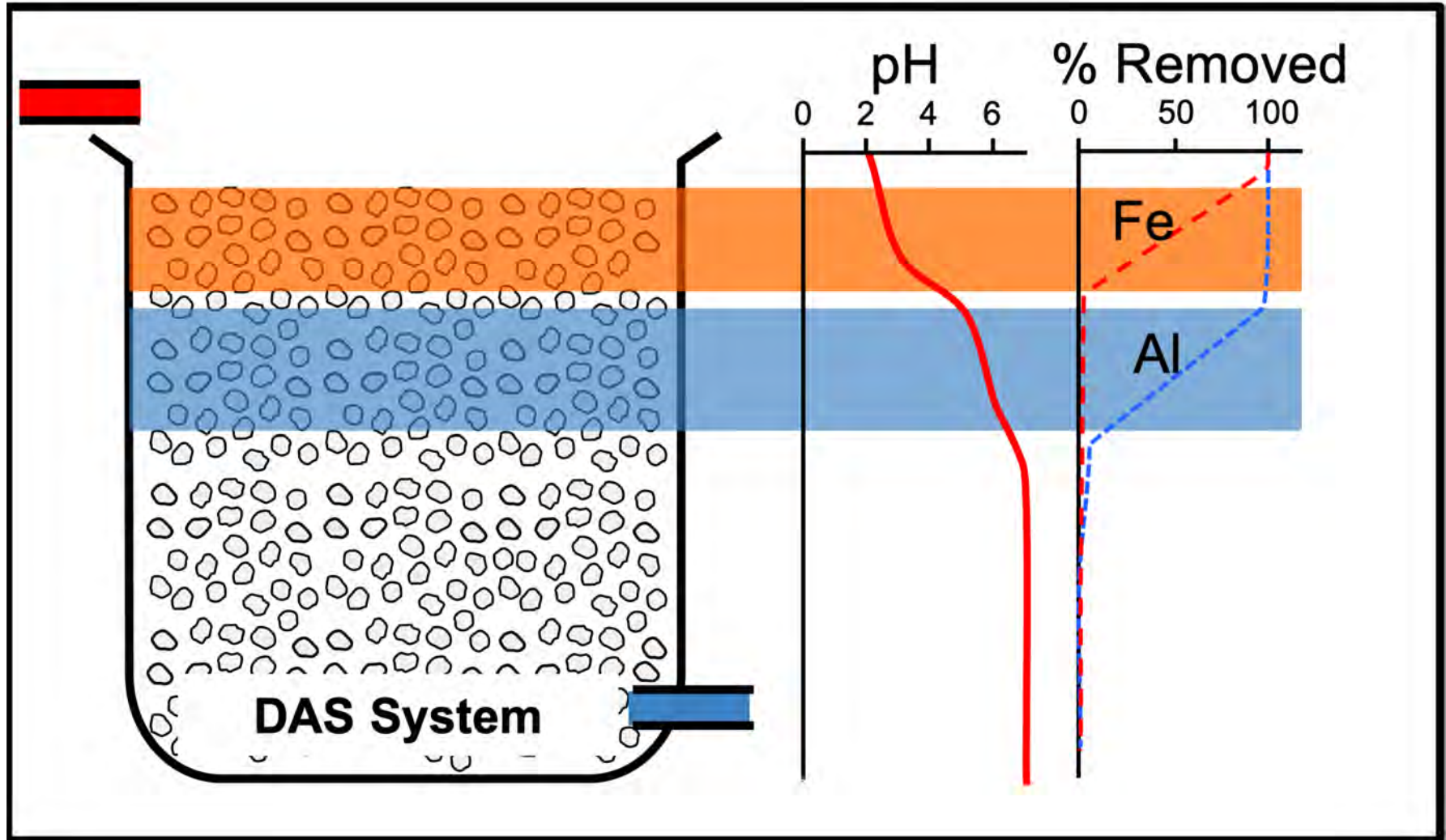
Passive Treatment with DAS technology



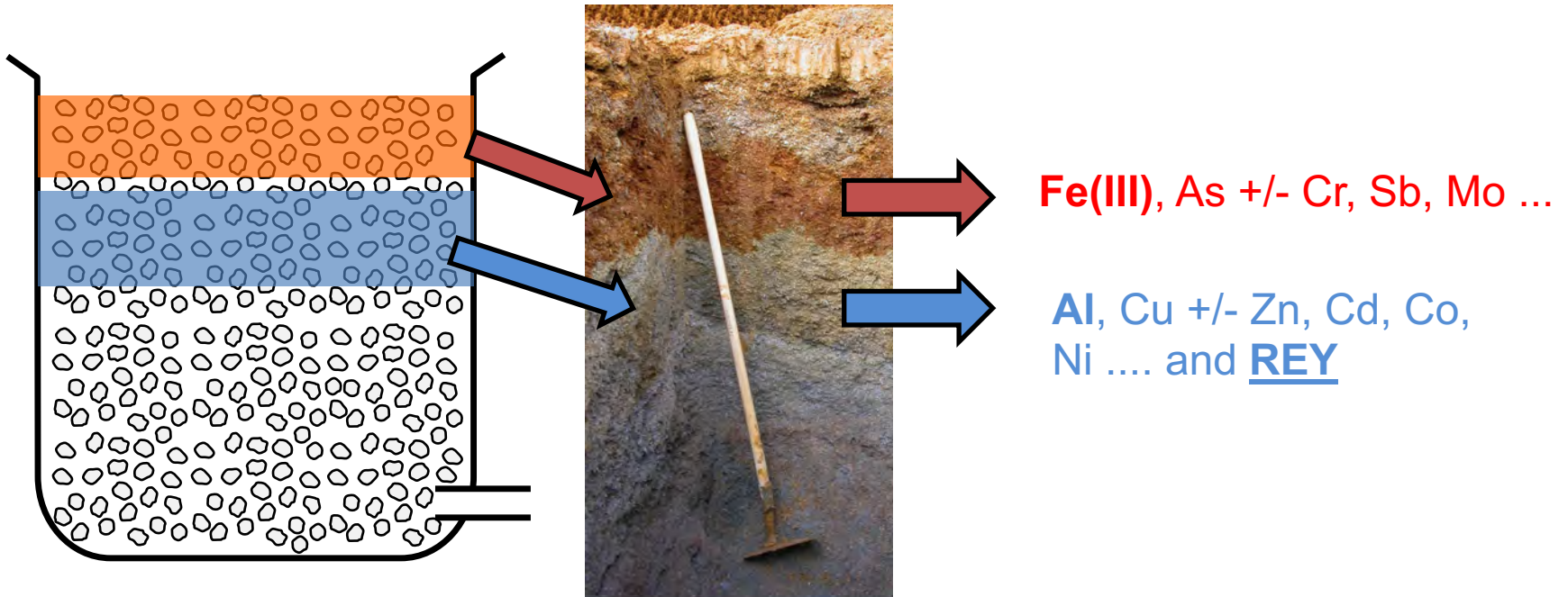
Passive Treatment with DAS technology



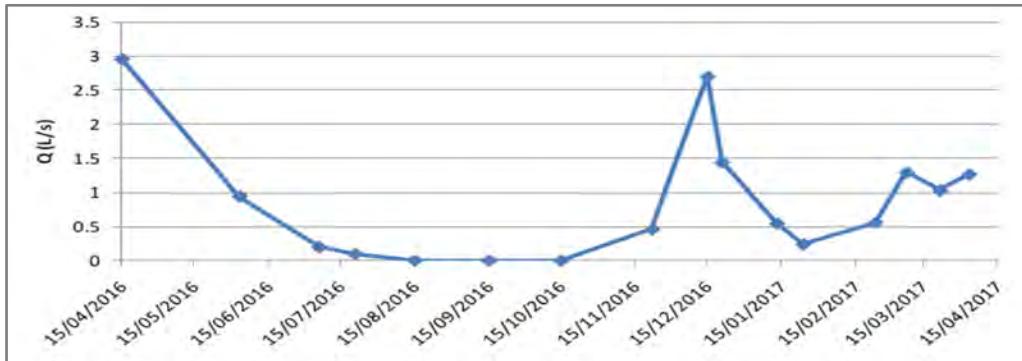
Passive Treatment with DAS technology



Passive Treatment with DAS technology

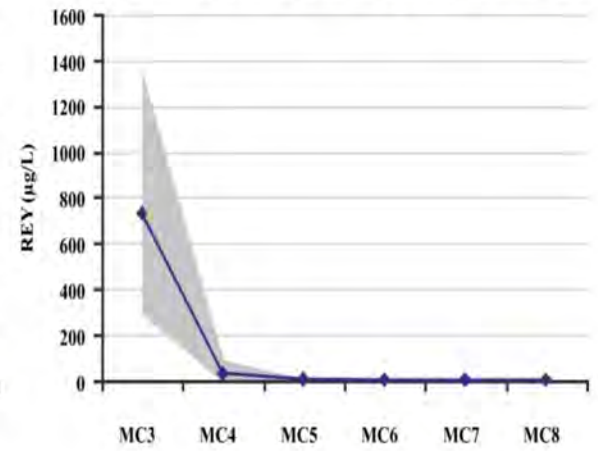
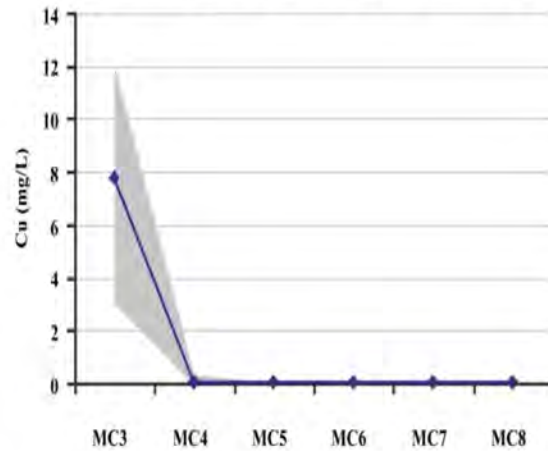
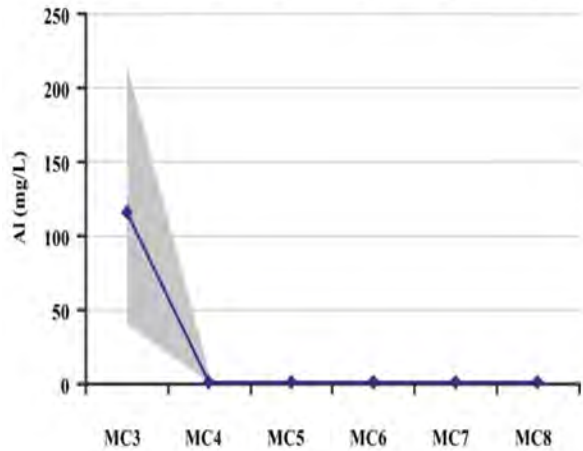
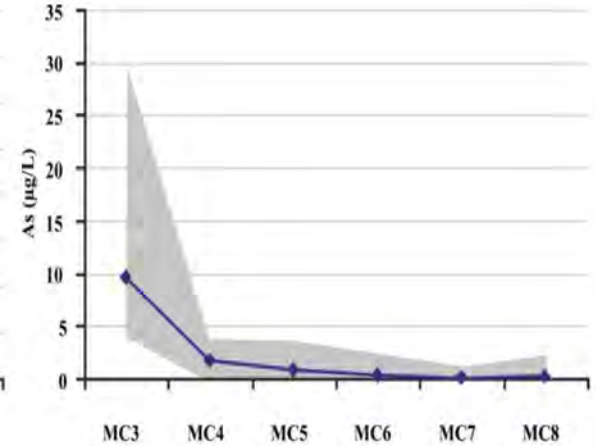
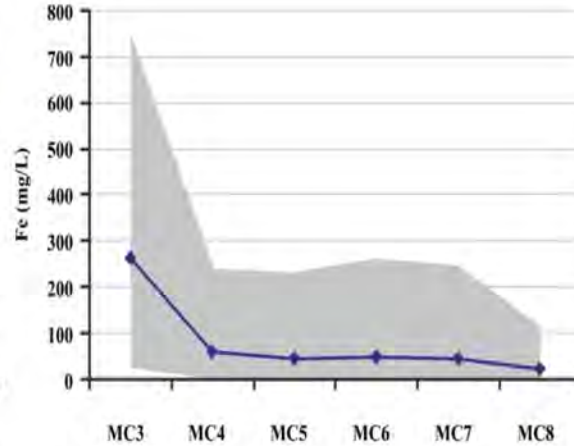
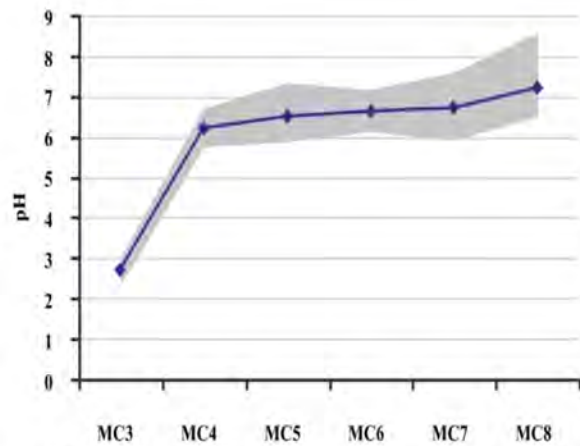


Passive Treatment at Mina Concepción

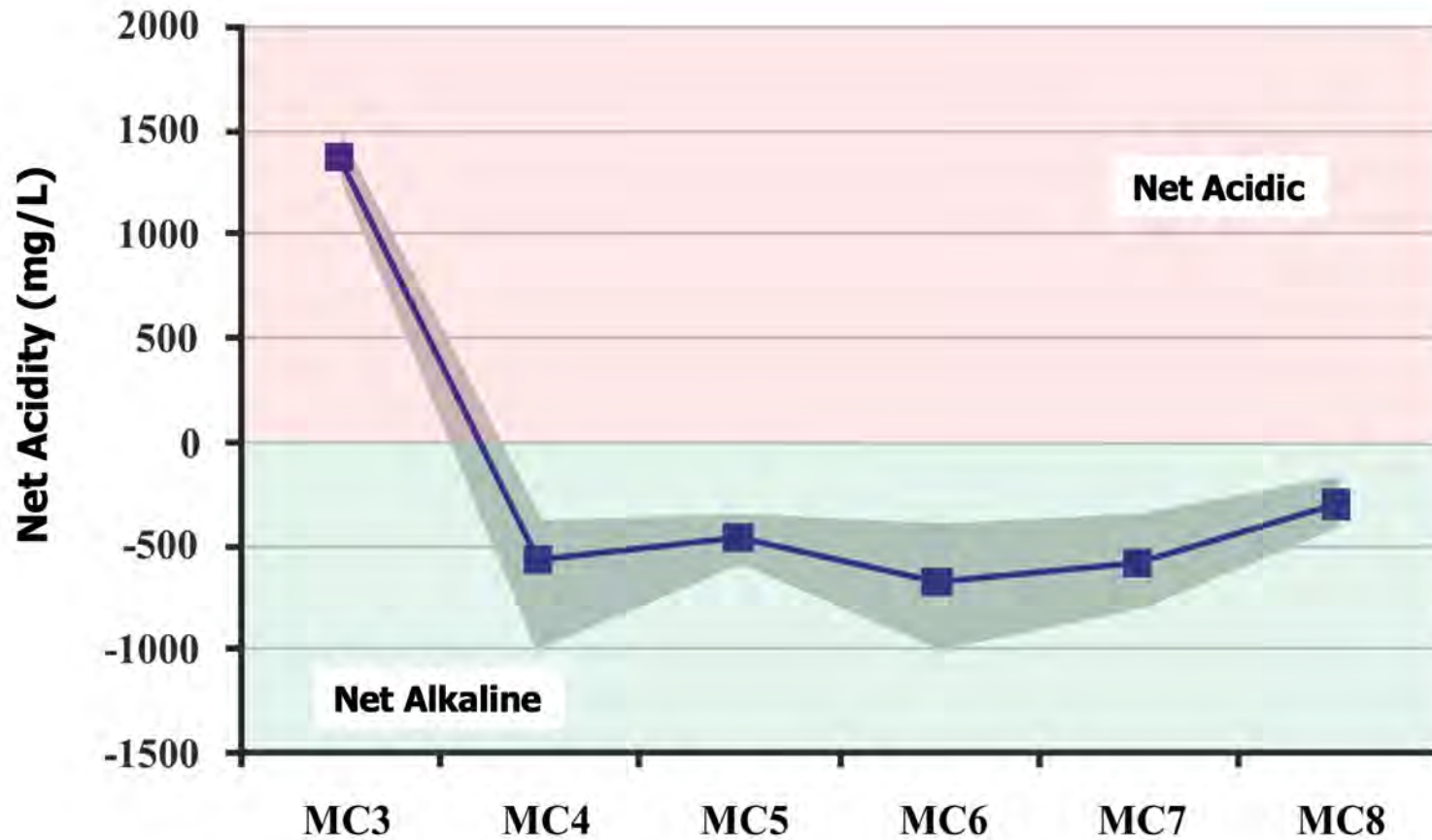


	pH	Al	Cu	Fe	Zn	REY	Q
		mg/L	mg/L	mg/L	mg/L	mg/L	L/s
MC1	2,66	85	11	446	26	1,2	1,1
MC2	2,76	198	7	48	2	0,5	

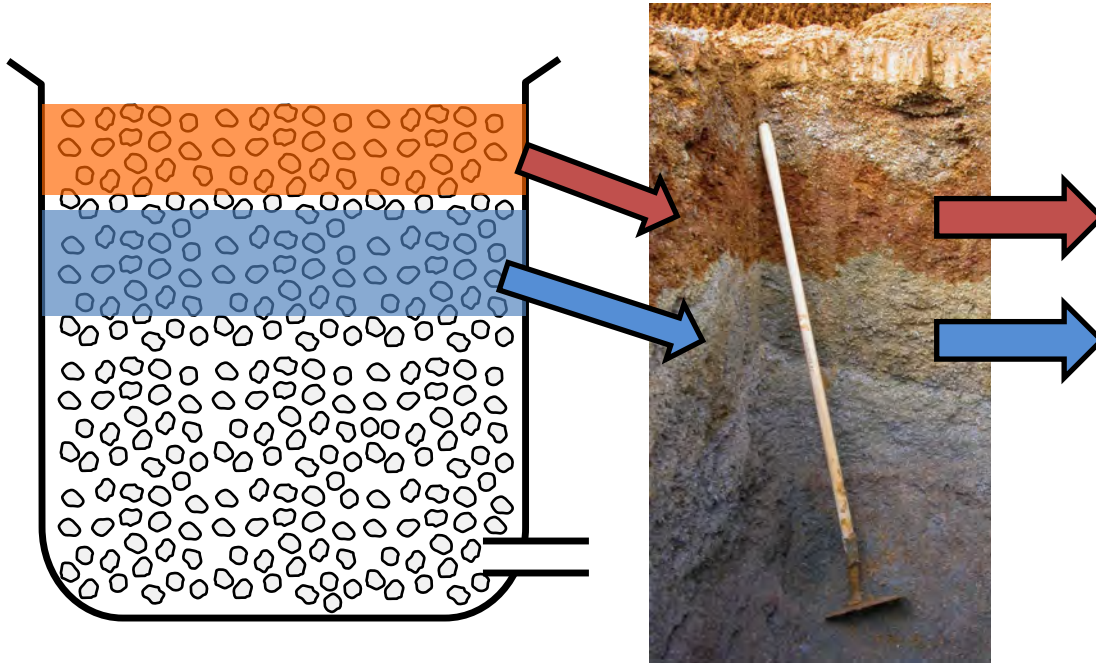
Passive Treatment at Mina Concepción



Passive Treatment at Mina Concepción

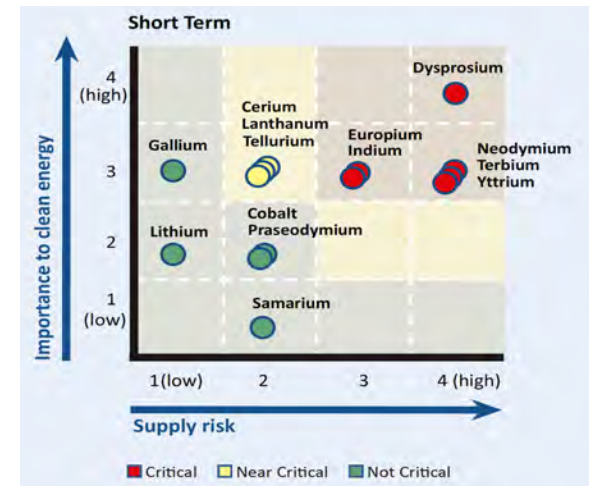


Metals accumulation in DAS systems

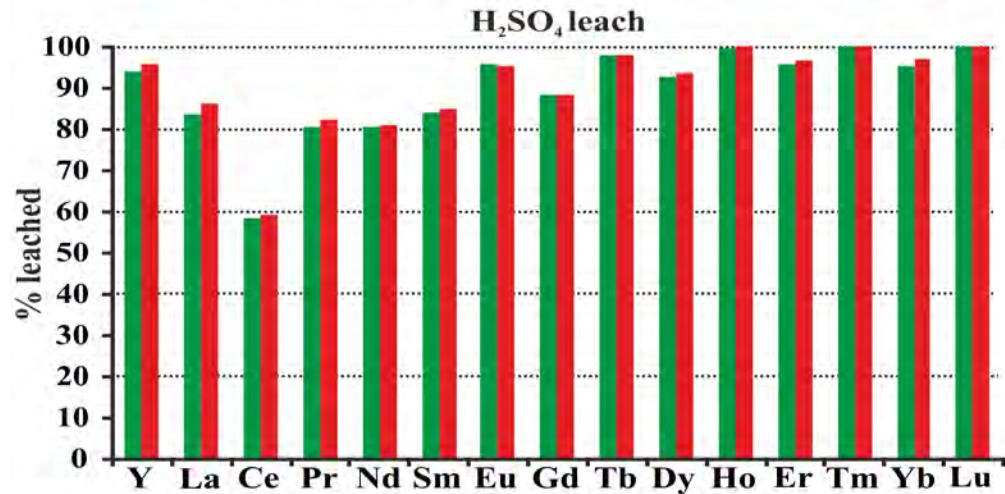
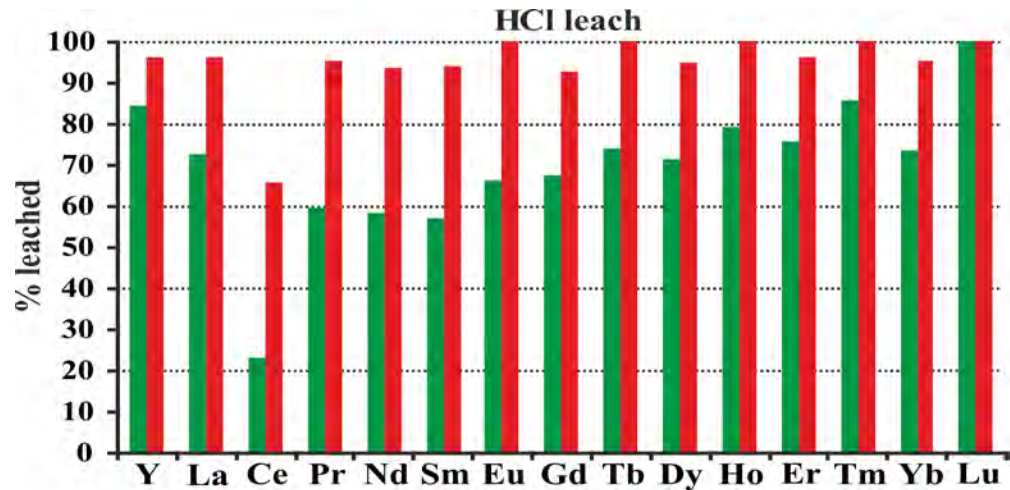


Fe(III), As +/- Cr, Sb, Mo ...

Al, Cu, Pb +/- Zn, Cd, Co, Ni +REE & Y (REY)



REE recovery leaching test



0.5 M 1 M

REE contents in AMD from IPB

More than 100 abandoned mines, some of them with tens of AMD sources !!!

Example of low REY concentration: Mina Esperanza



Mean flow: 0.5 L/s

Mean REY: 0.72 mg/L

Annual output: 11.3 kg/year

REE contents in AMD from IPB

Example of middle REY concentration: Perrunal mine



Mean flow: 1.2 L/s

Mean REY: 2.1 mg/L

Annual output: 79.5 kg/year

REE contents in AMD from IPB

Example of high REY concentration: Poderosa mine

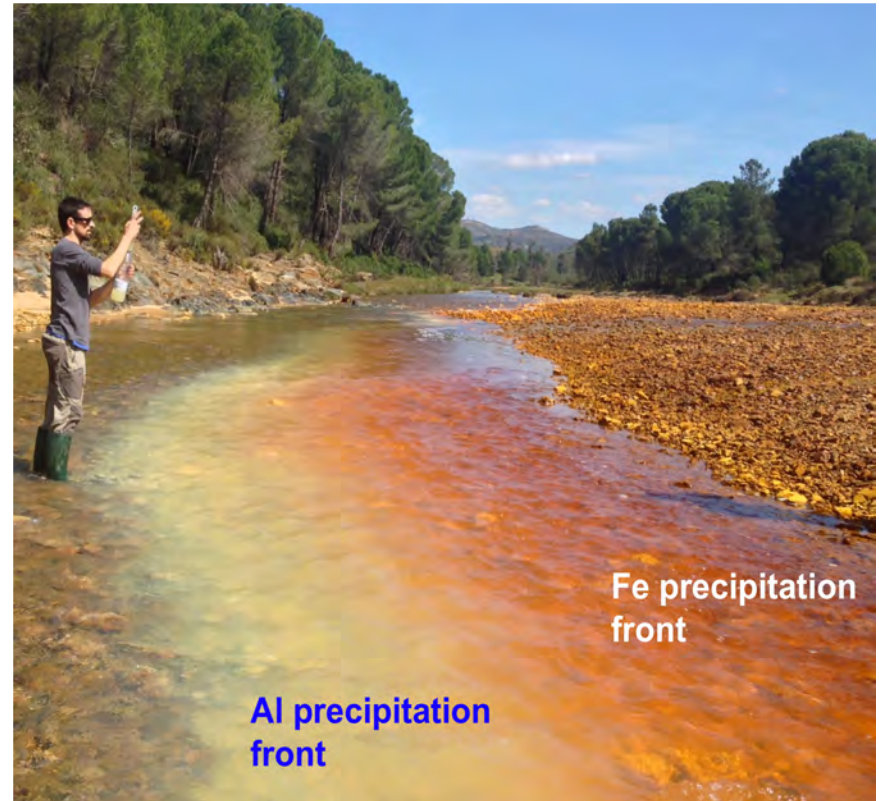
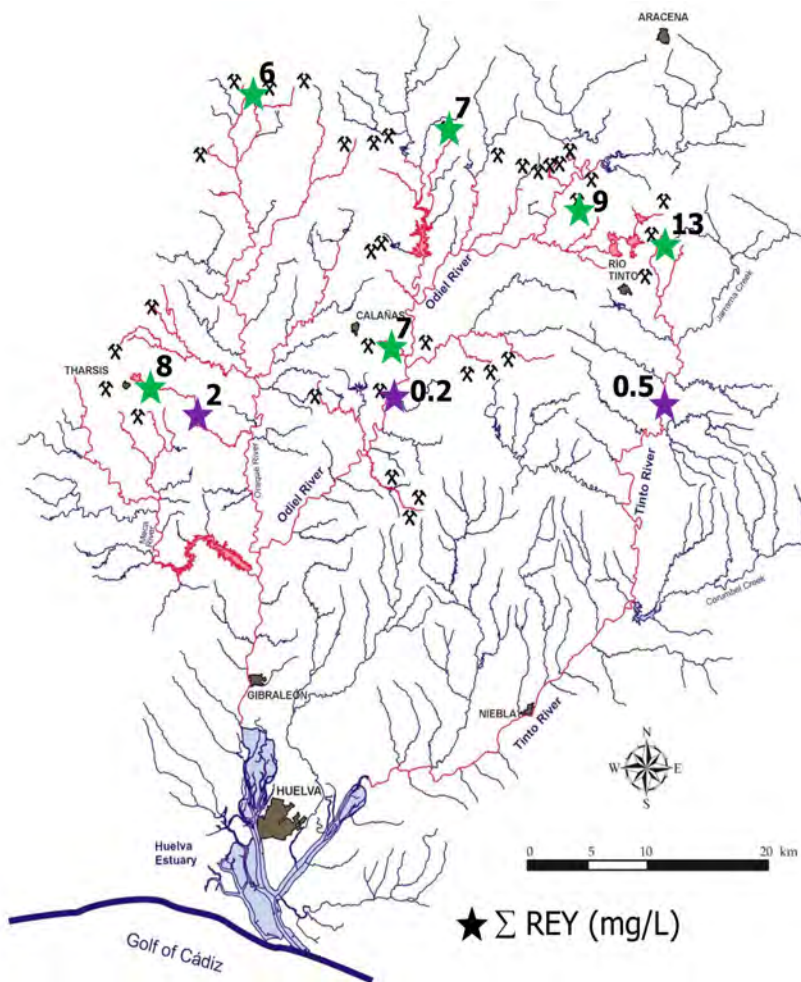


Mean flow: 2.3 L/s

Mean REY: 9.2 mg/L

Annual output: 667.3 kg/year

REE contents in AMD from IPB

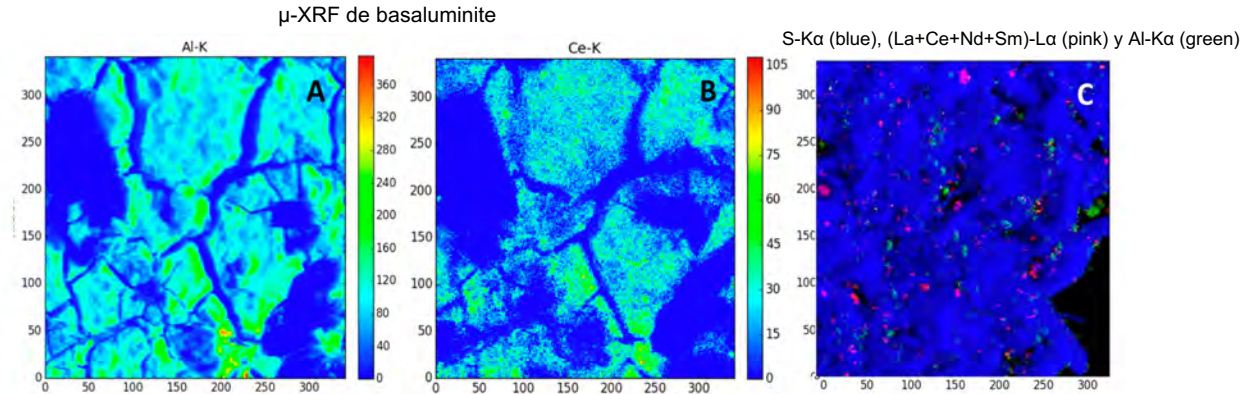


Conservative behavior at pH 5.1pH lower than 5,1
➔ can be recovered 100% with the DAS

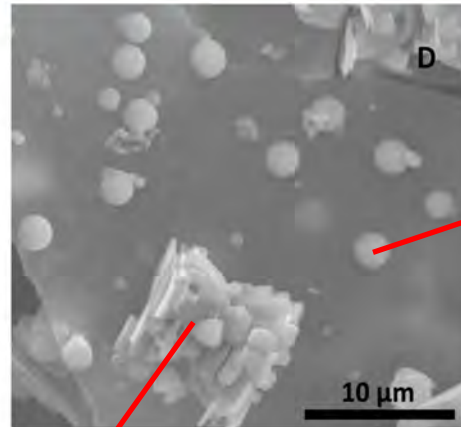
REE retention in DAS systems

Possible retention mechanisms in DAS systems

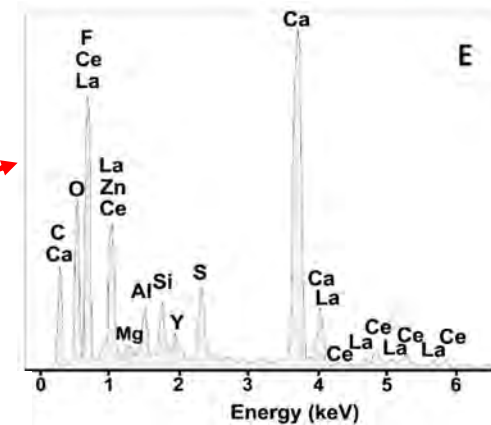
1. Sorption or coprecipitation in basaluminite (A-B)



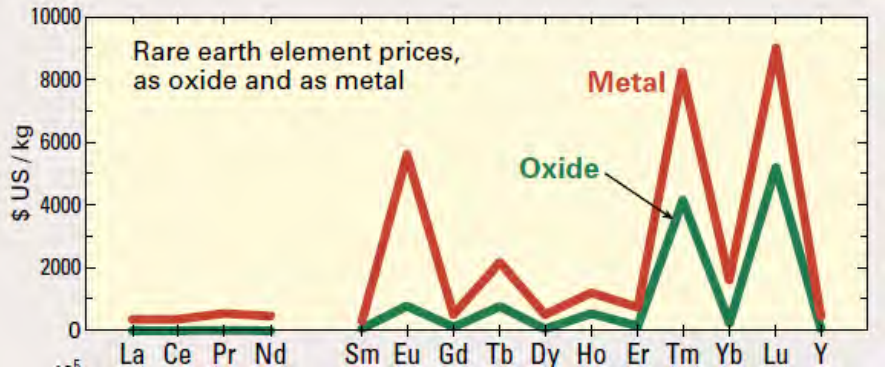
2. Fluorite precipitation (C-E) : $\text{AlF}^{2+} \rightarrow \text{F}^-$ pH > 5



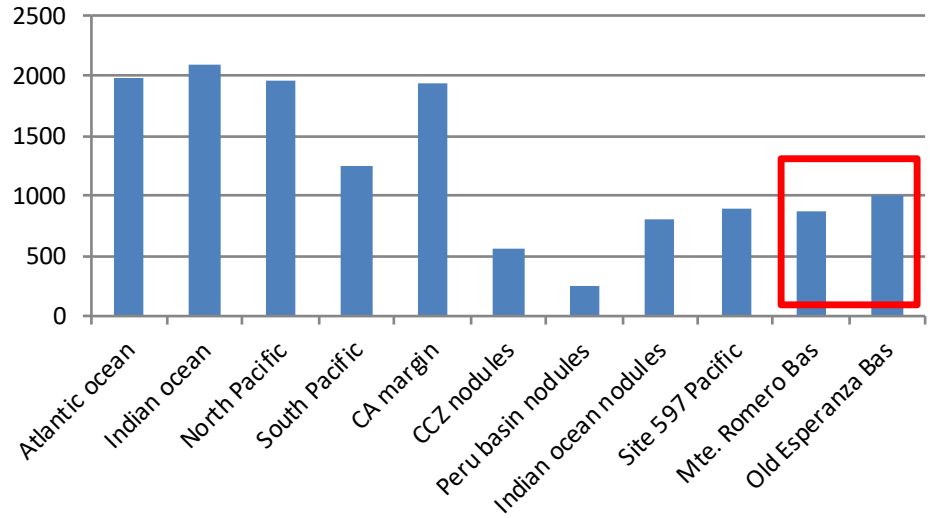
bechererita, $(\text{Zn,Cu})_6\text{Zn}_2(\text{OH})_{13}[(\text{Si,S})(\text{O,OH})_4]_2$



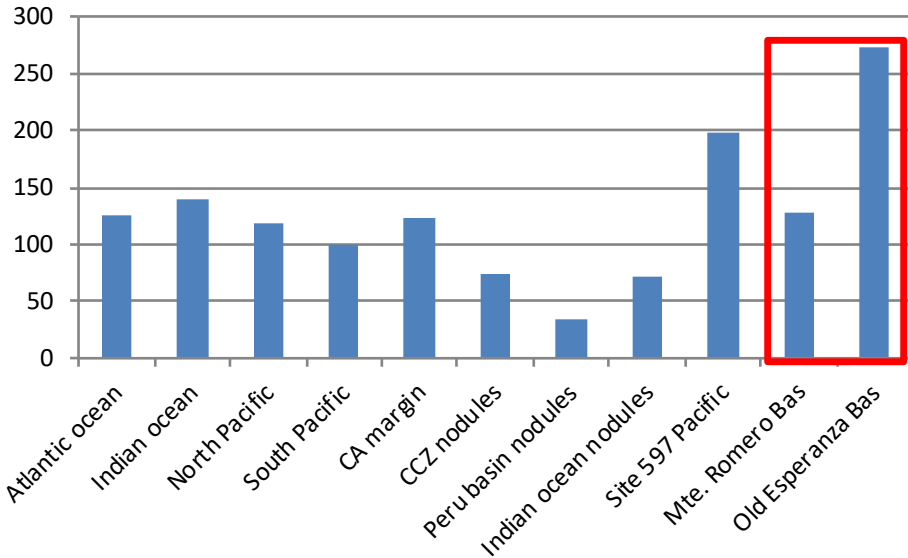
REE in AMD as a potential resource



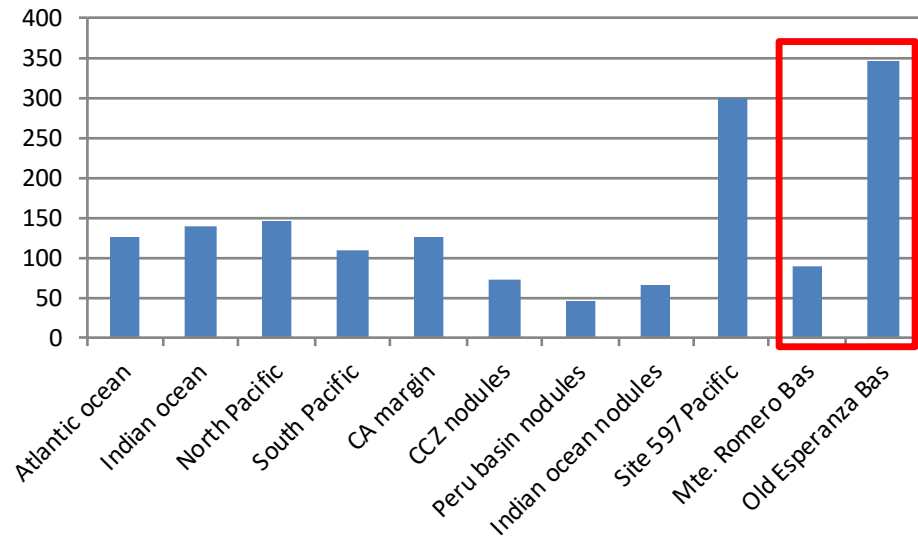
LREE



MREE



HREE



REE in AMD as a potential resource

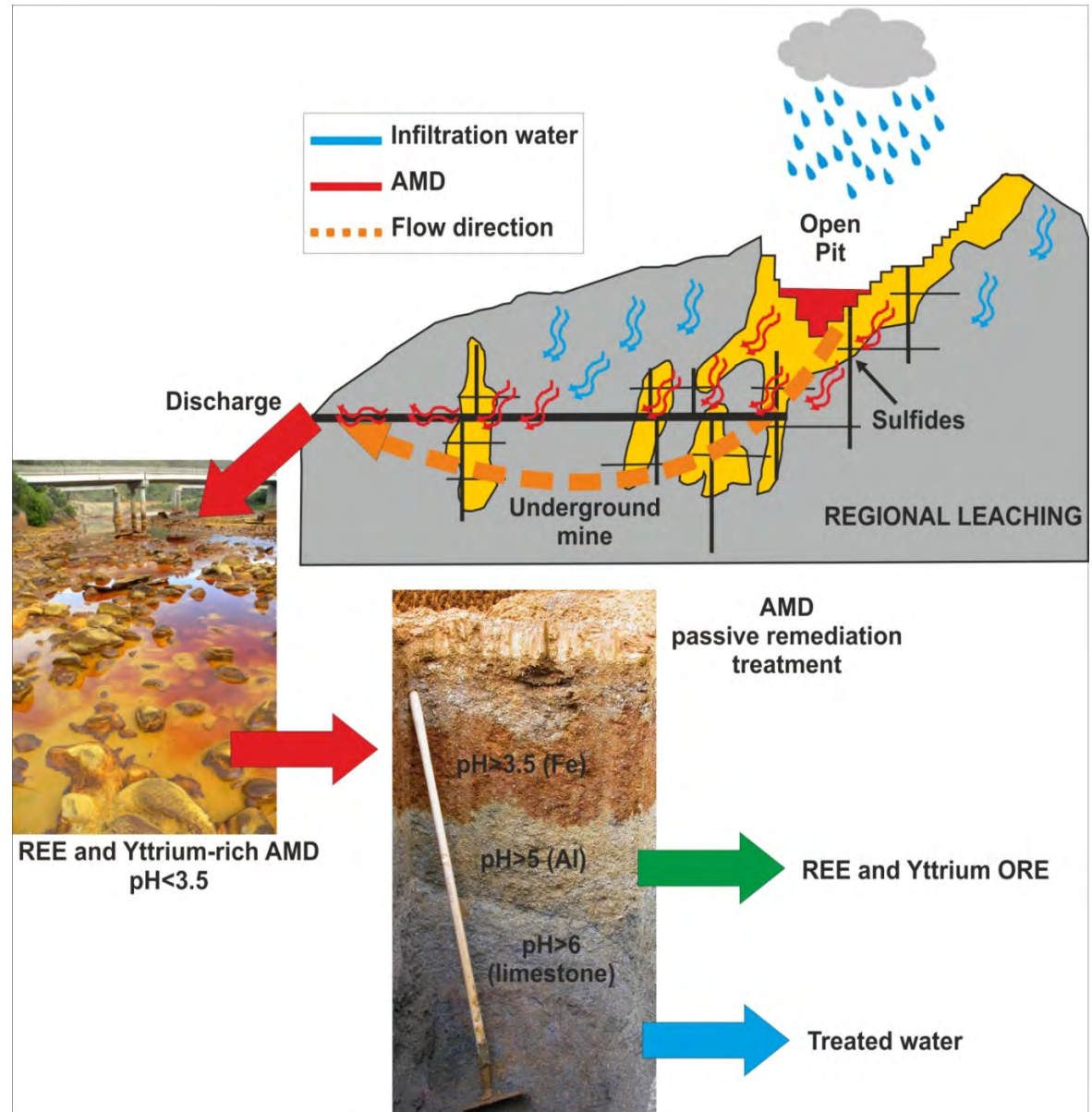
From 40 AMD sources with variable REY content:

11 kton/year of Basaluminite

21 ton/year of REY₂O₃

REY₂O₃ grade: 0.19%

Given the longevity of AMD production (100's to 1000's years), REY from AMD can be considered almost a **Renewable Resource**





Thank you for your attention !