EGU 2020: Session HS2.3.6 « Micropollutants and pathogens in the soil-groundwater-river continuum: modeling and monitoring”

Sulfamethoxazole (SMX) mobility and risk of contamination of water resources at thecatchment scale (Katari - Titicaca Lake, Bolivia)

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MMAyA Ministerio de Medio Ambiente y Agua

IRD Institut de Recherche pour le Développement FRANCE

UNIVERSITÉ Grenoble Alpes

IGE Institut des géosciences de l'environnement

Observatoire OSUG des Sciences de l'Univers de Grenoble

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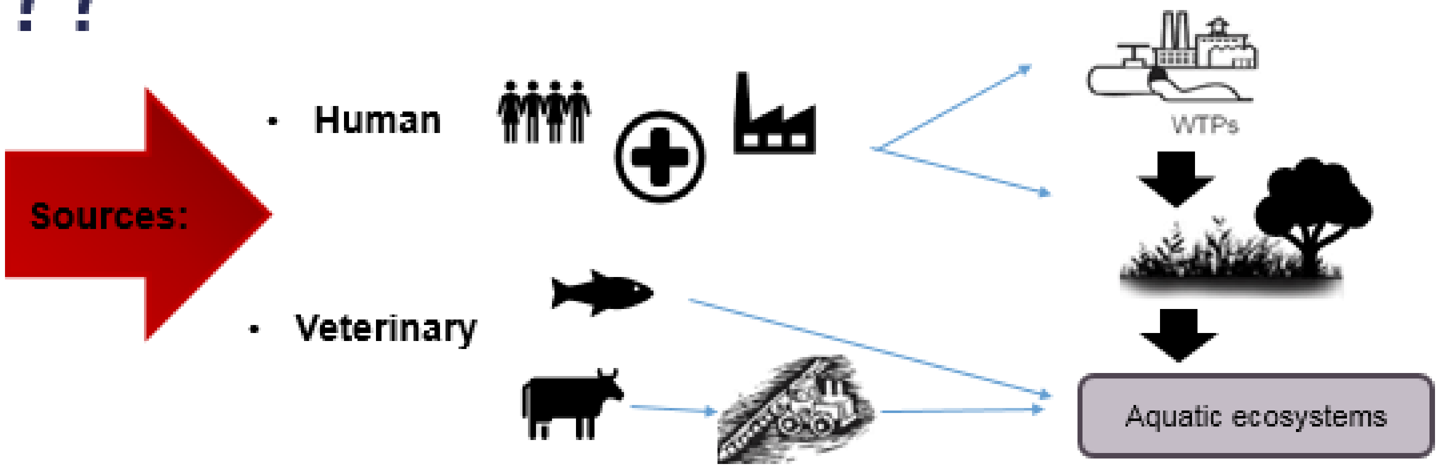
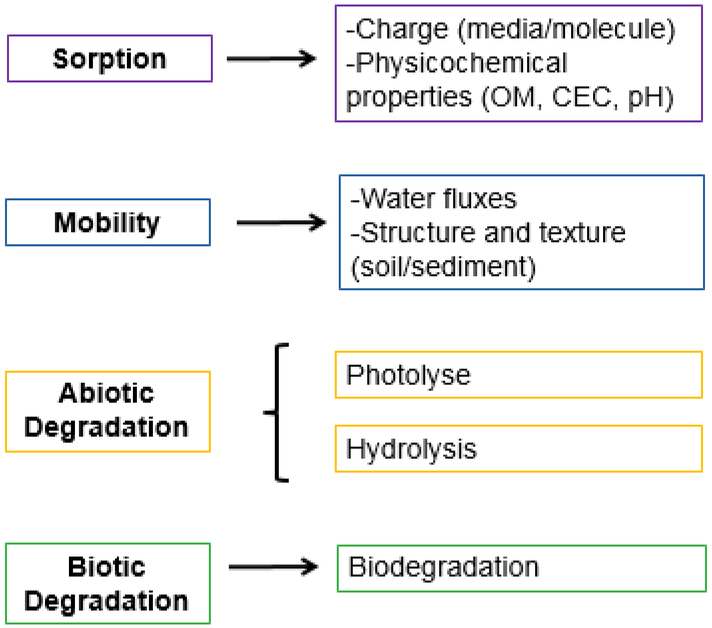
Antibiotic pollution???

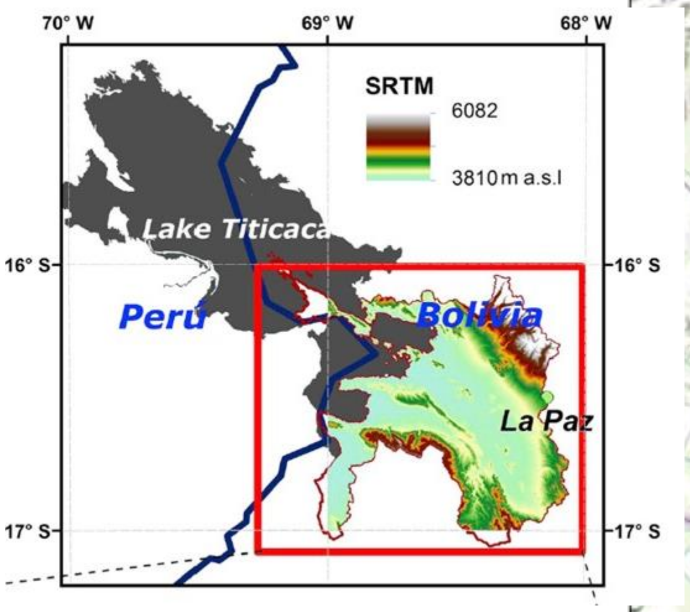


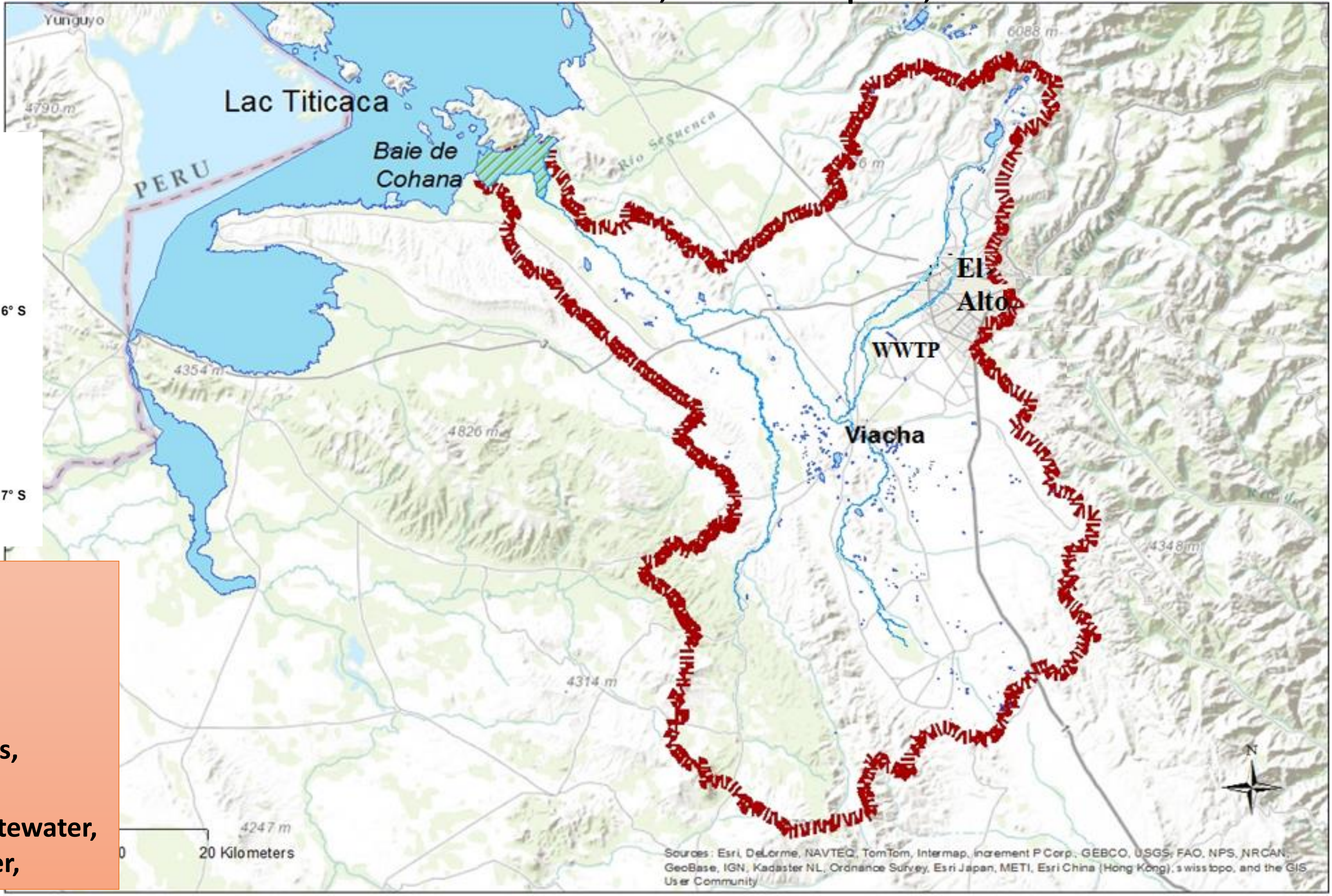
Environmental fate



Study site

Katari Basin, Northen Altiplano, Bolivia





Particular conditions:

-High altitude (3800-6000m)

-High UV radiation

-Contrasting climatological conditions (precipitation, flows, temperature)

-Presence of SMX in soils, wastewater, surface water and groundwater,

Objectives

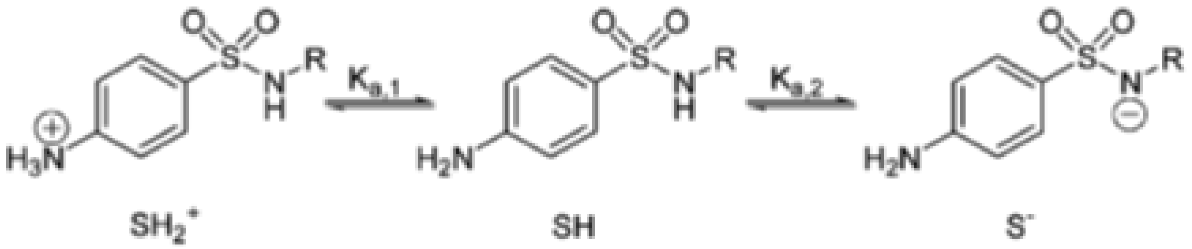
Evaluate and model the potential mobility of the sulfonamide antibiotic Sulfamethoxazole (SMX) in natural soils with contrasted properties and land uses by identifying the more relevant processes leading to SMX retention or retardation

Sulfamethoxazole (SMX)

Family: Sulfonamide
Bacteriostatic antibacterial: inhibition of bacterial folic acid synthesis (analogous structure with para-aminobenzoic acid (PABA))
Commonly used worldwide in combination with trimethoprim (TMP) in animal and human medicine.

excretion rate
45 à 70%

- photosensitive
- acid – base reactivity



- pKa1 : 1,6
- pKa2 : 6,2

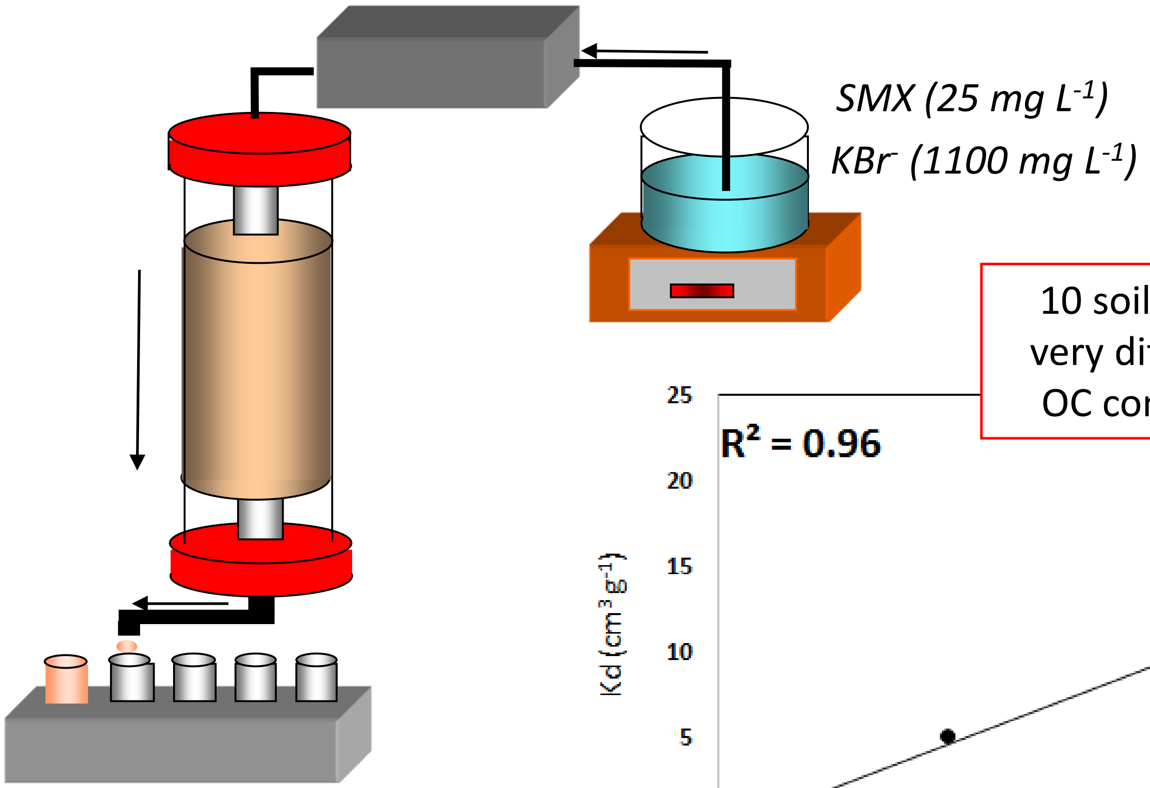
* SH_2^+ = cationic form, SH = neutral form, S^- = anionic form.

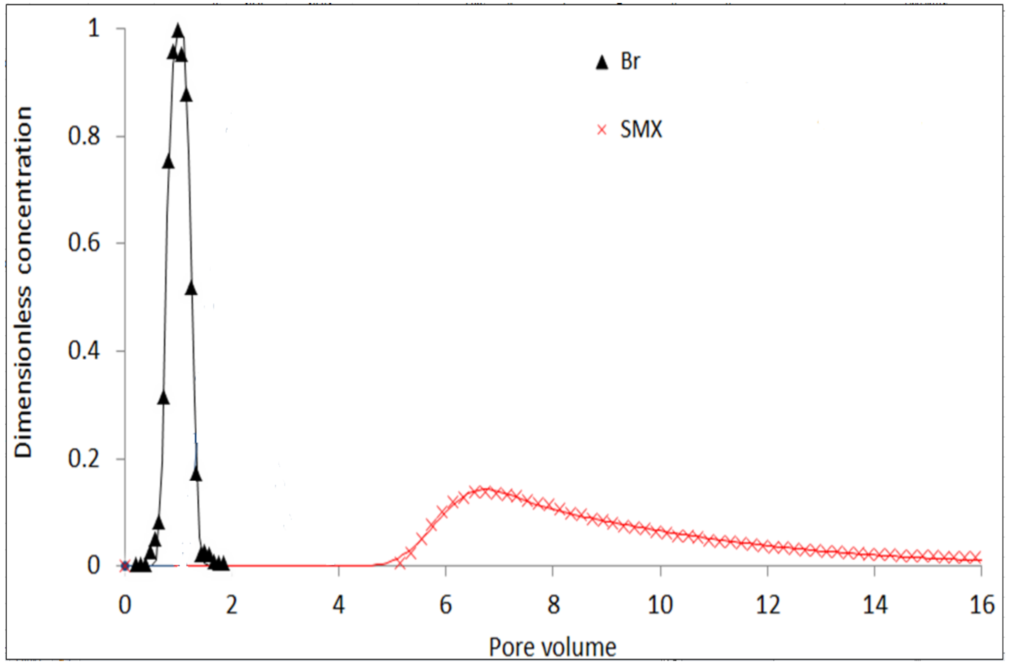
Boreen *et al*, 2005

Sorption and photolysis greatly influence the environmental fate of SMX, Biodegradation could also play a role

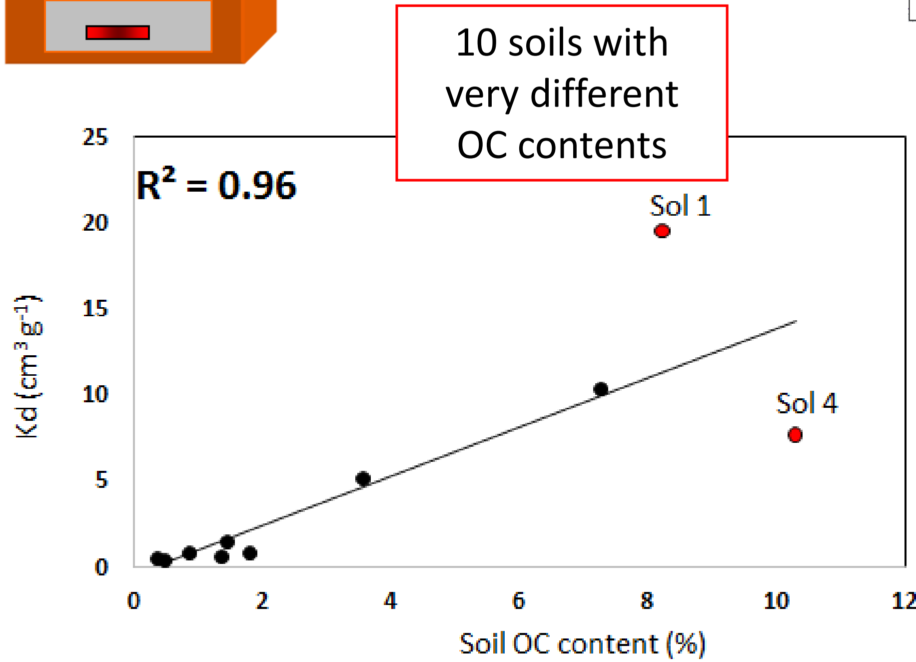
Materials and methods

SMX displacement experiments were carried out in **repacked columns** (10 soils) by injecting a pulse of SMX and water tracer (Br-)





The Break Through Curves were modelled using **Hydrus 1D** and finding the best fit to experimental curves by trial and errors



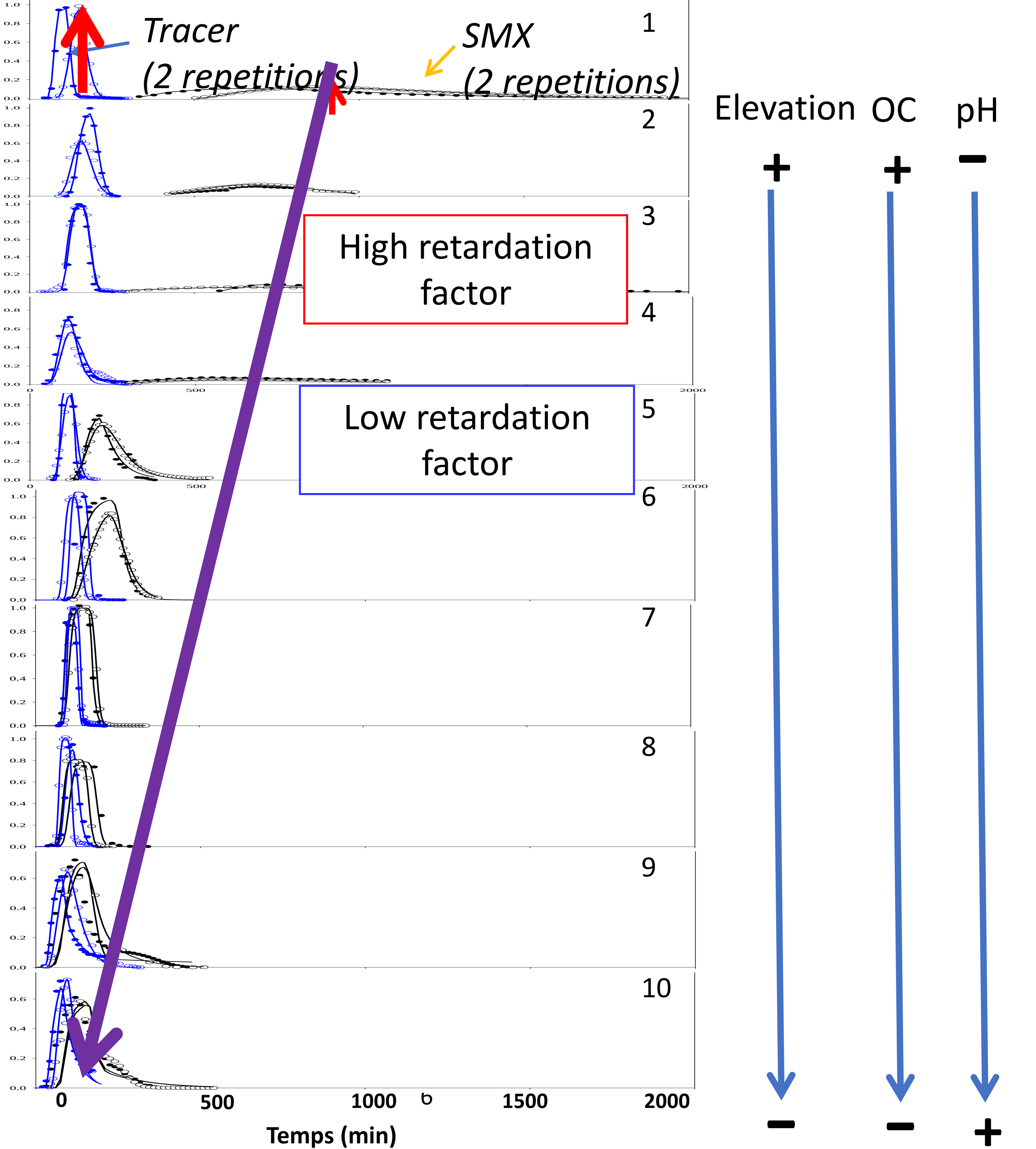
Previous results on batch experiment: Kd (SMX) vs. soil OC content (%) on the same 10 soils (unpublished)

Main results

- A chemical non-equilibrium sorption process was involved in SMX transport.
- Organic and acid soils showed a higher SMX sorption capacity.
- Transport of SMX was related with pH-dependent speciation.

Conclusion

- SMX can be classified as a moderately to highly mobile compound in the studied watershed, depending principally on soil properties such as pH and OC.
- Potential risks of surface and groundwater pollution by SMX were thus identified in the lower part of the studied catchment, threatening Lake Titicaca water quality.



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Perfil 1: Milluni (4700 m)

Perfil 6: Laja (4100m)

Perfil 10: Cohana Bay (3800m)