Characterization of rbSAT during reactive barriers dismantlement

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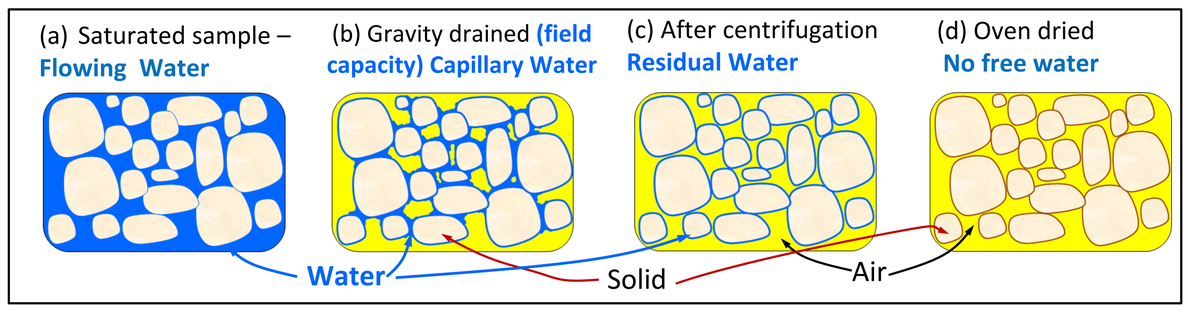
Introduction

Installing Reactive Barriers (RB) at the bottom of infiltration basins during Soil Aquifer Treatment (SAT) has proven to improve the quality of recharged water (Valhondo et al., 2014, 2015, 2018). In order to gain understanding of the biochemical processes, six replicates of rbSAT (Reactive Barrier - Soil Aquifer Treatment) systems were operated with reclaimed water for three years. Five of them had a reactive barrier. Samples of the flowing water had been taken along the systems during the three years. At the end of the experiment, we dismantled the barriers, which allowed us to get a (destructive) sampling of the barrier material to characterize the spatial variability of physical, and biogeochemical parameters of the remaining solids and resident water. In this work, we show the methodology to obtain the water from the dismantled barriers and preliminary results.



Schematic representation water state at the four extraction stages: (a) saturated, (b) at field capacity, (c) residual water after centrifugation, and (d) after oven drying (no water).

Procedure

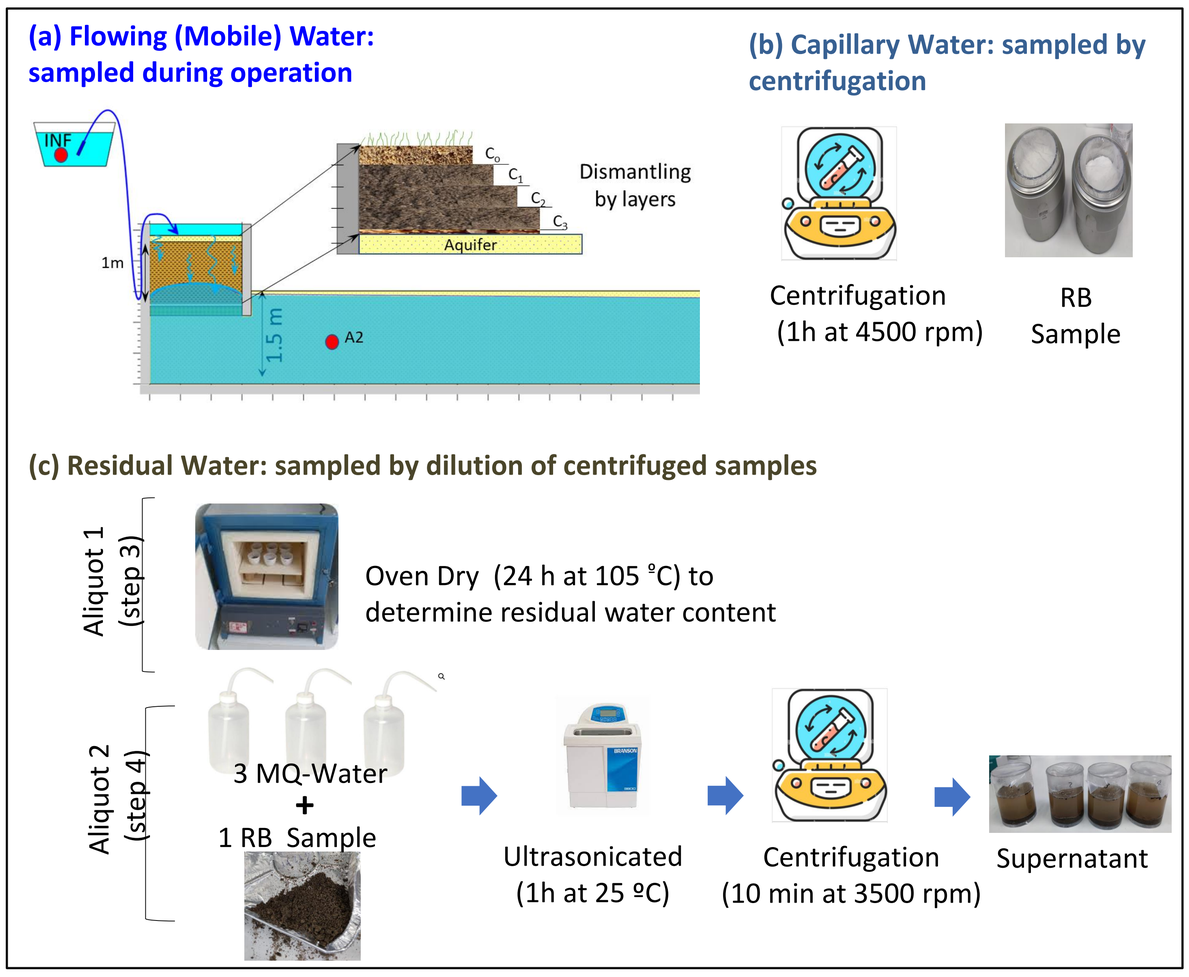
In essence, the goal is to determine the species dissolved in the water retained after drainage (capillary water at field capacity), as well as the weakly sorbed species (that get into solution after dilution in milli-Q) water. Water sampling consisted of four steps:

1. **Flowing water: S**amples of the recharge water (INF), and at the outlet of the reactive barriers (A2) were taken before dismantling at each system (Table) during a recharge period.
2. **Water retained by capillarity** was extracted by centrifugation at 4500 rpm for one hour.
3. **Water content after centrifugation** was obtained by oven drying**.** An aliquot was dried for 24 h at 105ºC and the before and after weights were recorded.
4. **Milli-Q dilution.** A second aliquot of the centrifuged sample is reserved for dilution in Milli-Q water to determine if any solute is sorbed to the solid phase. Dilution is performed by mixing Milli-Q water and the centrifuged aliquot with a 3:1 ratio.

Finally, major and minor ions, dissolved organic carbon (DOC), microplastics, and emerging contaminants (pharmaceuticals-PhACs and personal care products-PCPs) were analyzed from the water samples.

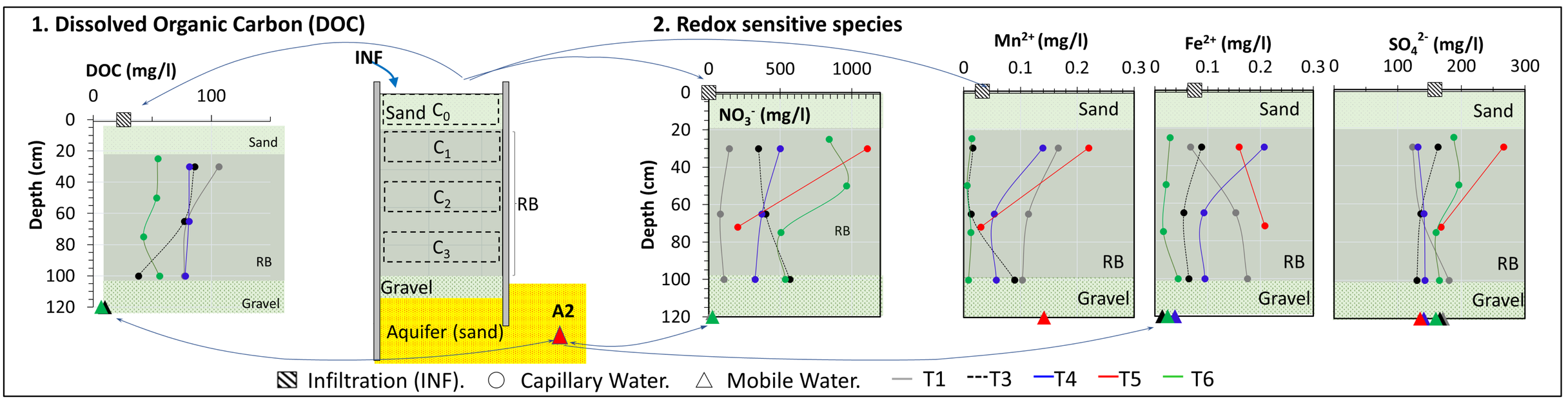
Table Composition of the reactive barriers.

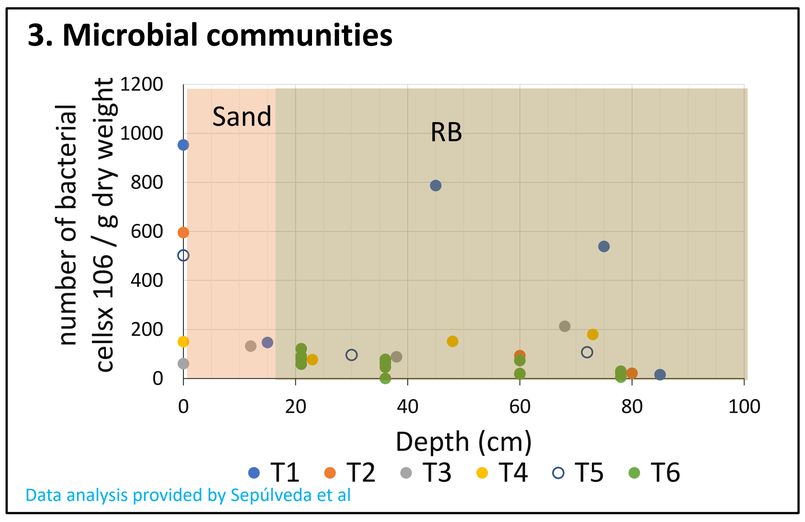
Reactive Barriers		T1	T2	T3	T4	T5	T6
Materials	Sand	48%	100%	48%	48%	48%	38%
	OM	48%	-	48%	48%	-	58%
	Wood chips	-	-	-	-	48%	
	Clay	2%		2%	2%	2%	2%



The image (a) Cross section of rbSAT sampled at INF (inflow) and A2 for flowing water during operation, the RB was dismantled by layers (C_0 though C_3) after 1 day drainage; (b) extraction of the water retained by capillarity; and (c) extraction of residual water.

Results and Discussion





Conclusions

1. DOC remains similar (often slight increase) after passage through the RB. But, it is far larger in capillary water. The same can be said about nitrate, even more dramatic: absent in INF and aquifer water, but very high, even higher than corresponding to full nitrification of INF ammonia (some 40-60 mg/L). Both suggest an intense microbial activity within biofilm and wood of the RB.
2. It is clear that intense aerobic respiration, nitrification and denitrification reactions occur within the barrier. Beyond these, concentrations of redox indicators suggest that some Fe reducing, Mn reducing and sulfate reduction conditions may have been reached locally,
3. Microbial communities confirm intense degradation processes uniformly across the barriers.

References

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Acknowledgements

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