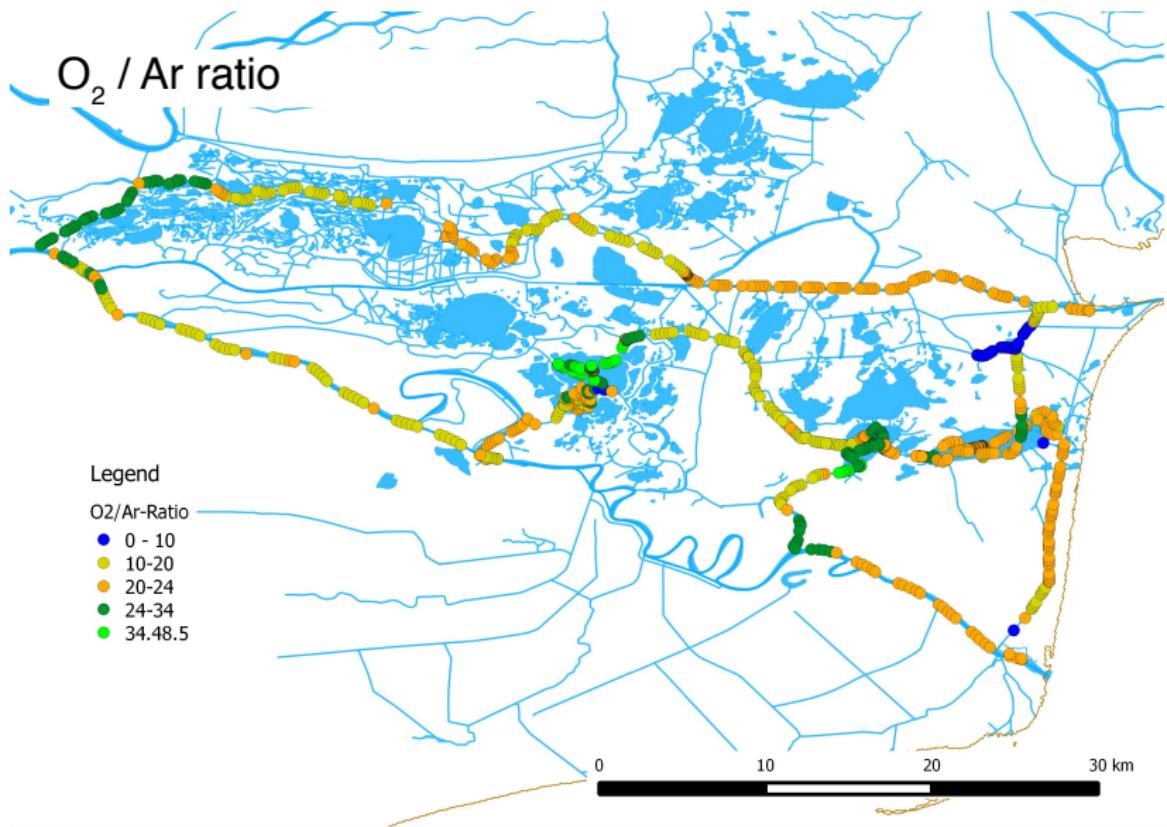


River rafting with the miniRUEDI

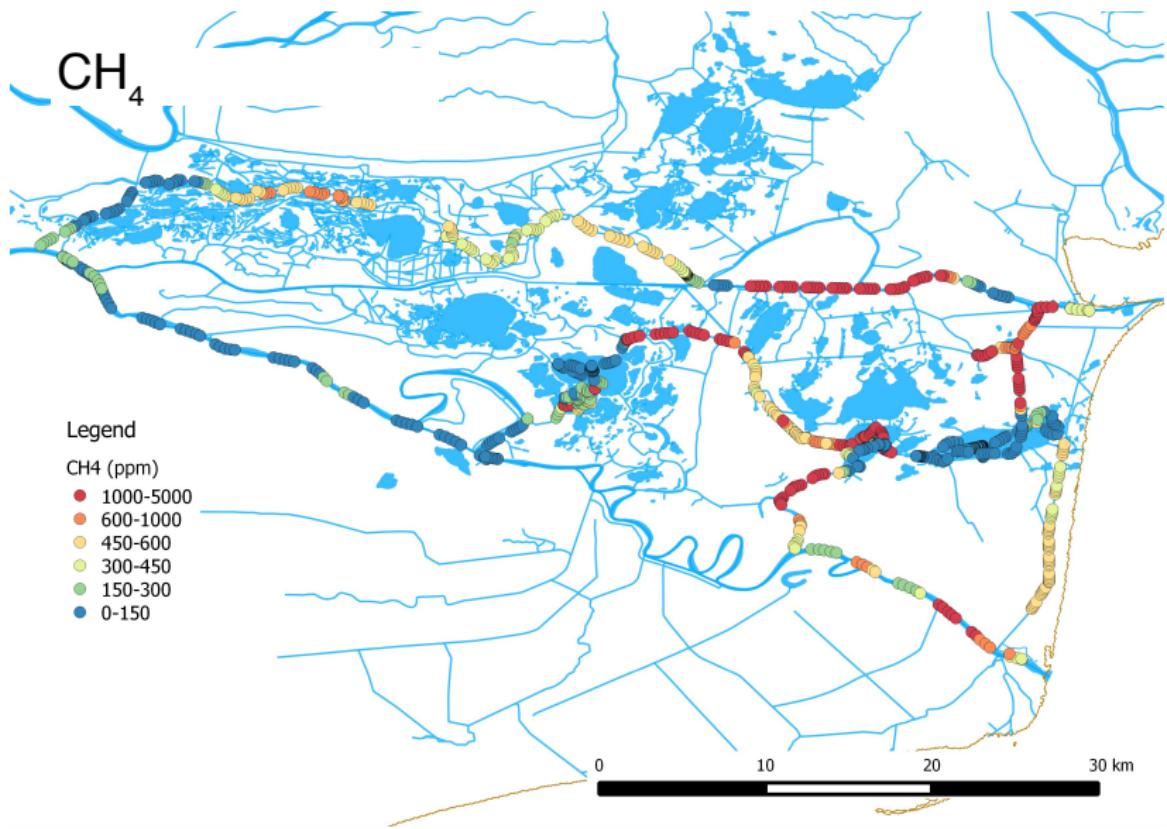
C.P. Newman, E.C. Humphrey, M.S. Brennwald,
W.P. Gardner, K.M. Palko, M.N. Gooseff

Nov 2023
miniRUEDI Symposium 2023

miniRUEDI on Danube River Delta



miniRUEDI on Danube River Delta



Connections of deep groundwater to the surface?

communications earth & environment

ARTICLE

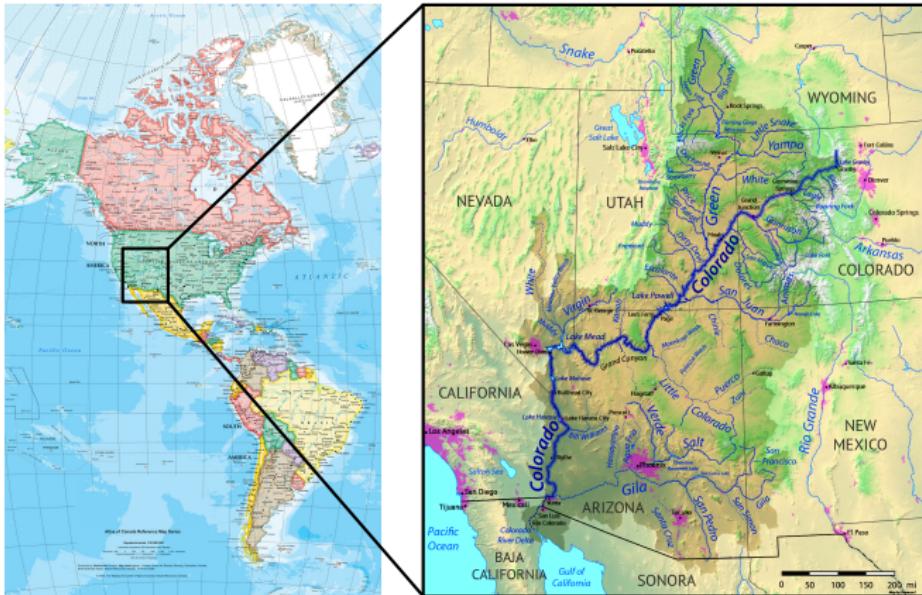
<https://doi.org/10.1038/s43247-023-00697-6>

OPEN

Groundwater deeper than 500 m contributes less than 0.1% of global river discharge

Grant Ferguson^{1,2,3,4✉}, Jennifer C. McIntosh^{1,2}, Scott Jasechko⁵, Ji-Hyun Kim⁶, James S. Famiglietti^{3,4} & Jeffrey J. McDonnell^{3,4,7,8}

Colorado River basin



Saline geothermal systems are major sources of solutes
Negative effect on downstream water use

Groundwater inflow



Groundwater inflow



Groundwater inflow

Hidden discharges in the river:

Where? How much? Water quality?

Groundwater inflow

Hidden discharges in the river:

Where? How much? Water quality?

Natural tracer tools:

Temperature, salinity

Groundwater inflow

Hidden discharges in the river:

Where? How much? Water quality?

Natural tracer tools:

Temperature, salinity

Dissolved helium!

Groundwater inflow

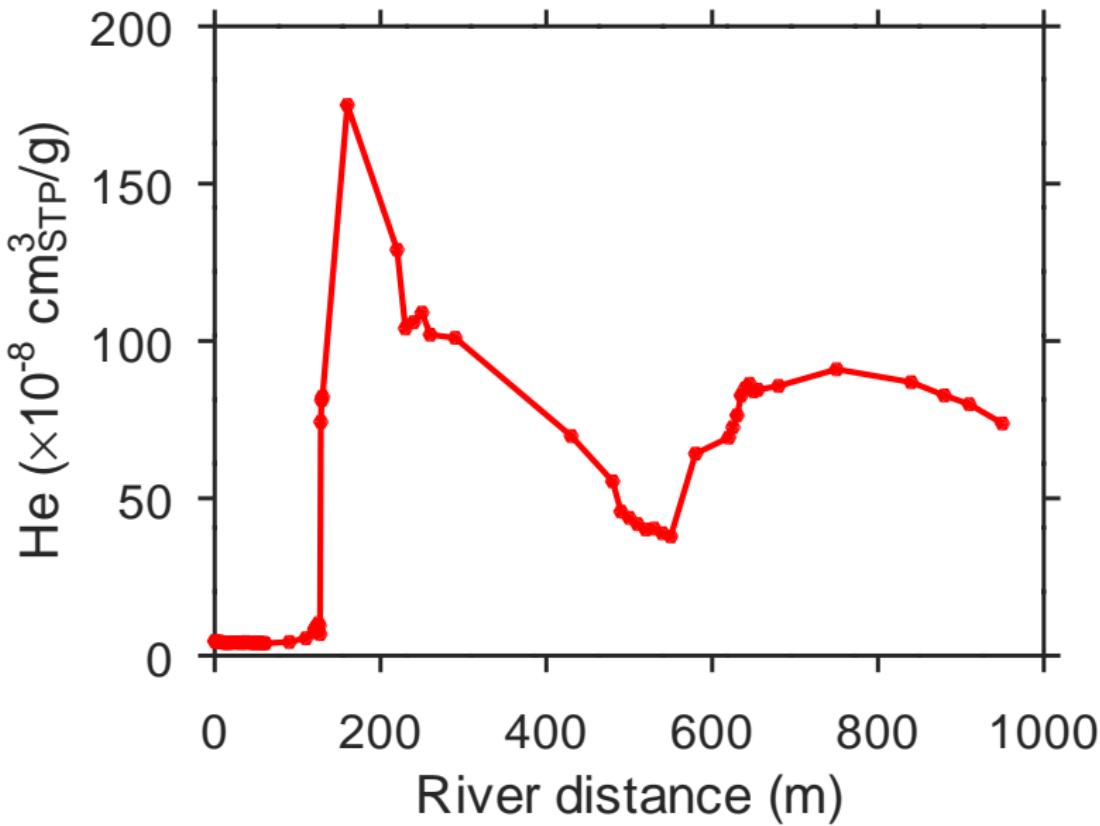


Helium analysis along the Virgin River

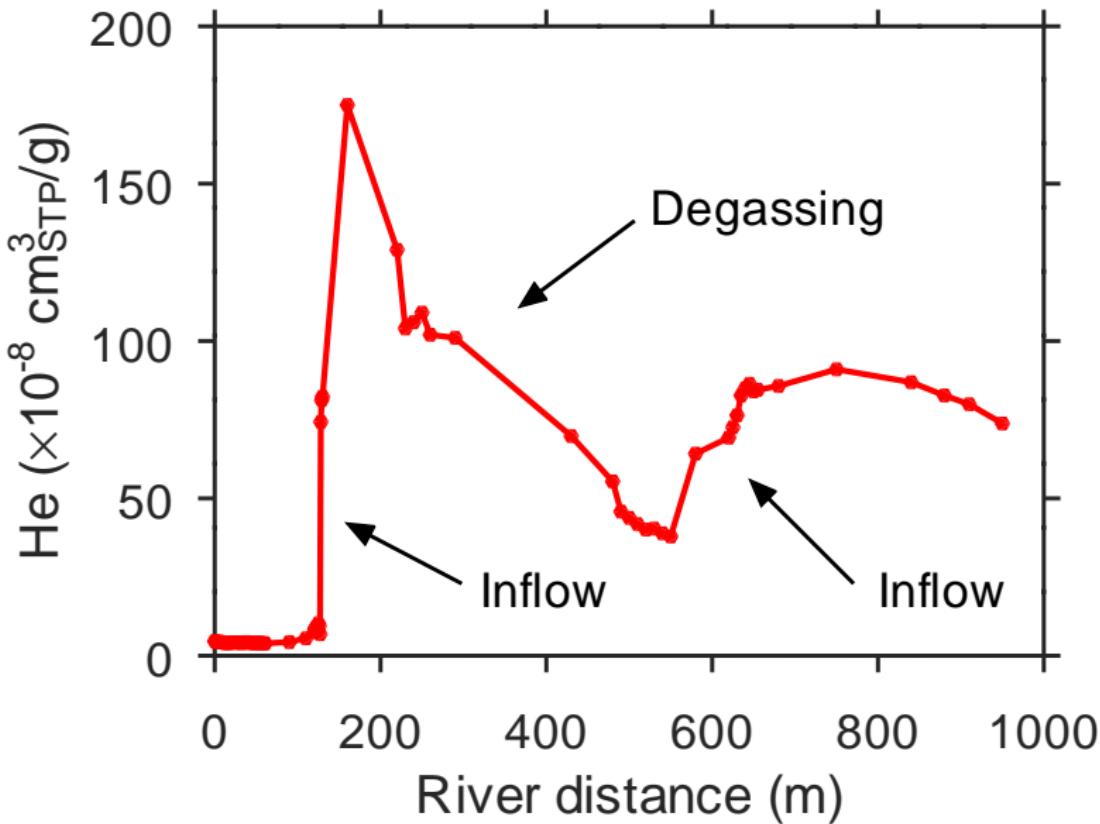


3 days on the river, 181 gas measurements

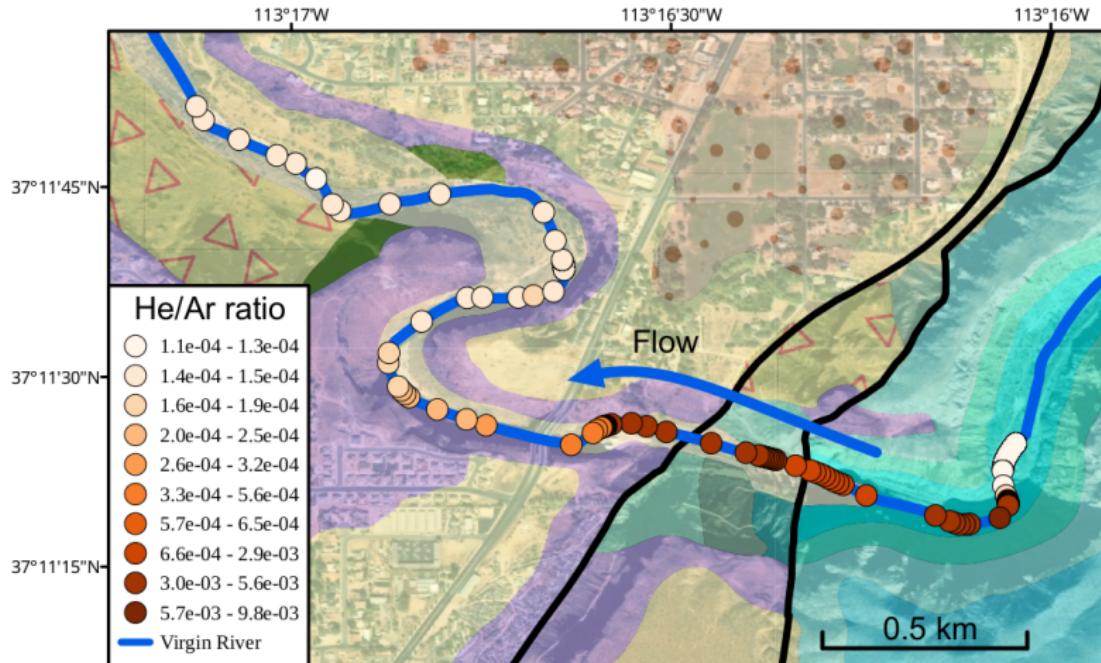
Helium analysis along the Virgin River



Helium analysis along the Virgin River



Helium analysis along the Virgin River

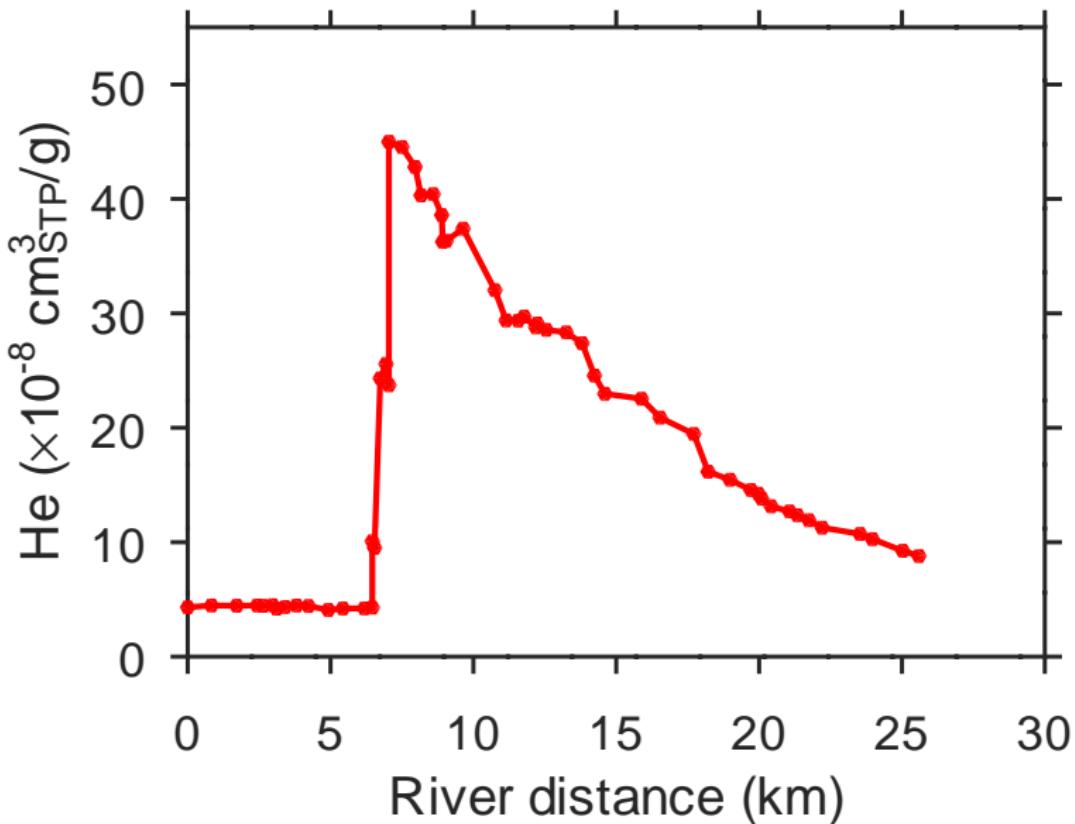


Helium analysis along the Colorado River

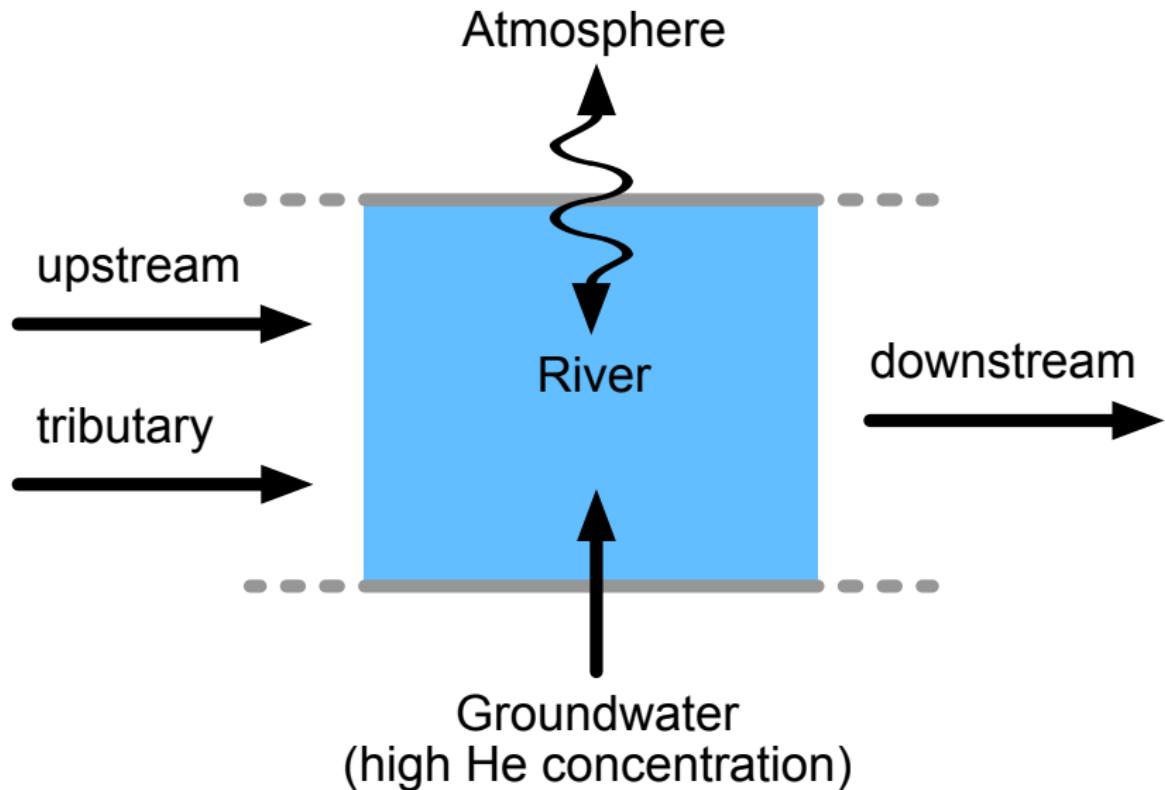


2 days on the river, 187 gas measurements

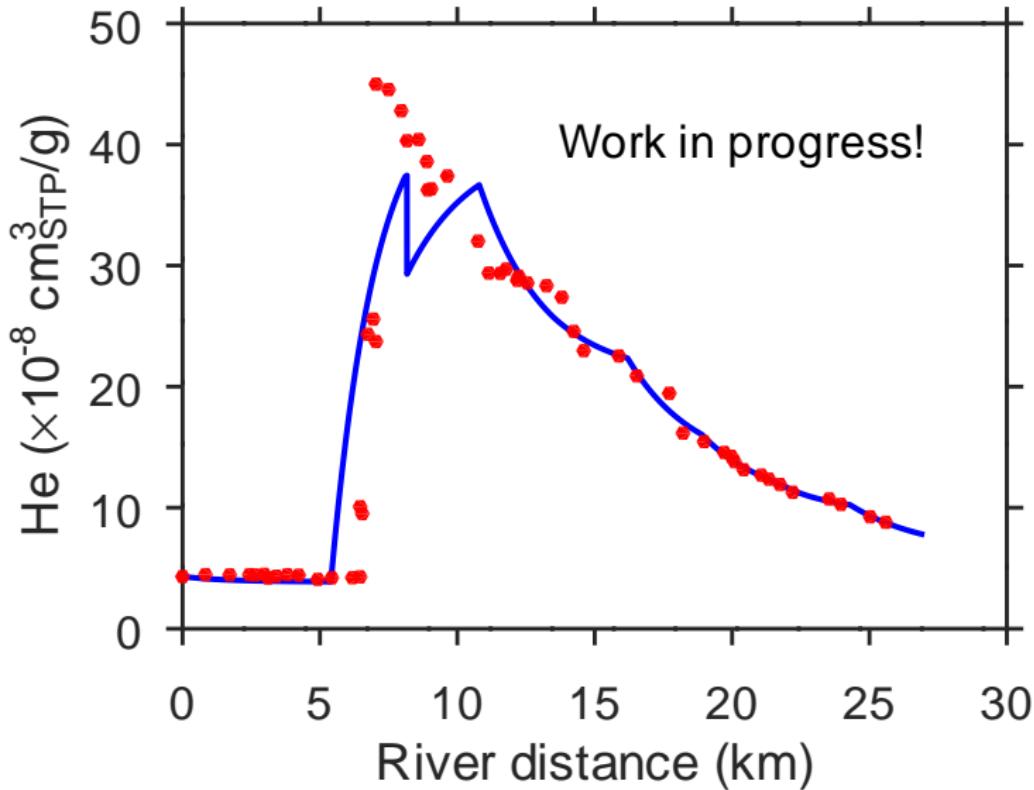
Helium analysis along the Colorado River



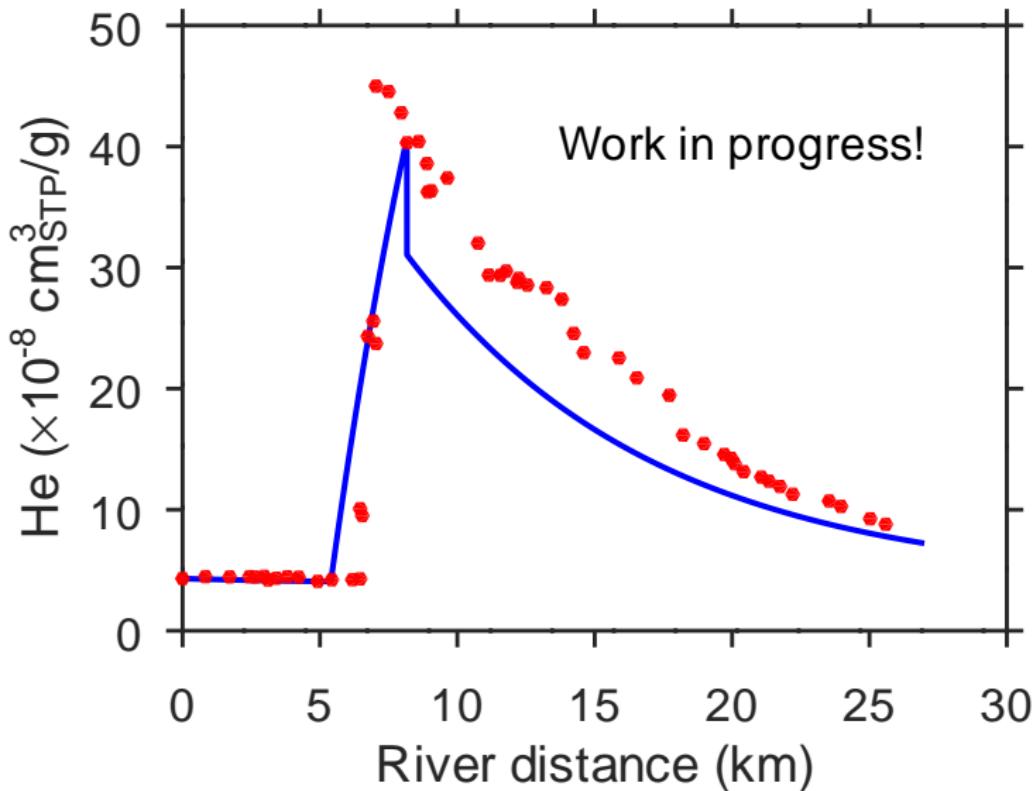
Mass balance of He and water in Colorado River



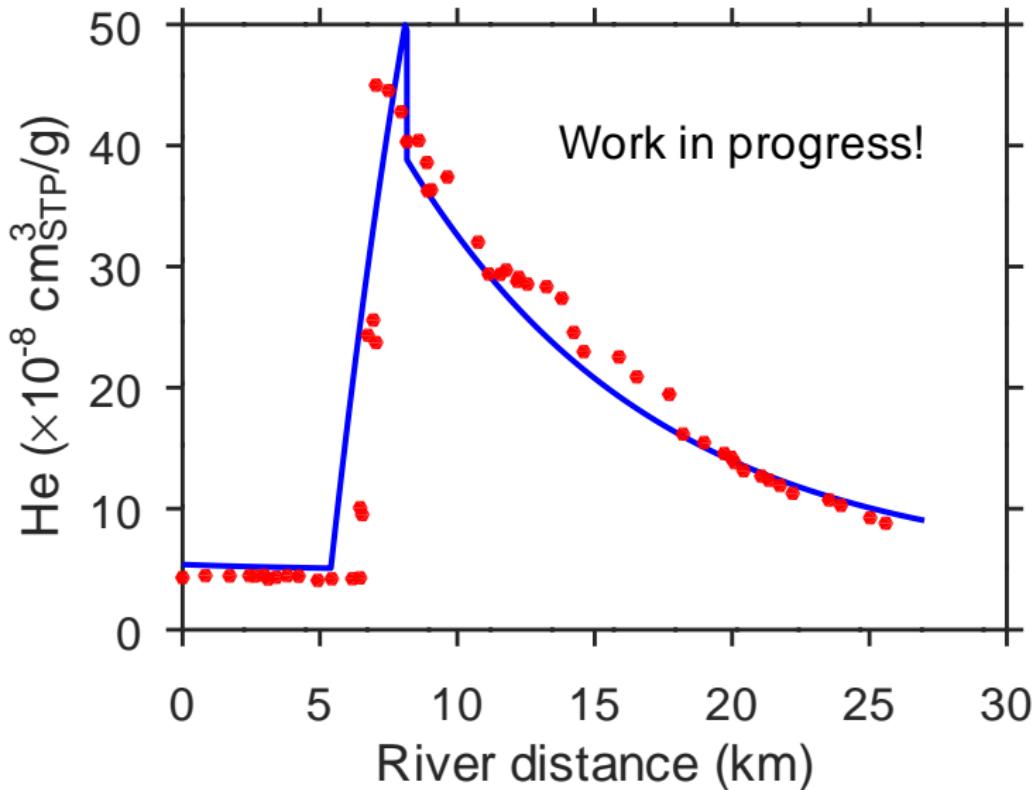
Mass balance of He and water in Colorado River



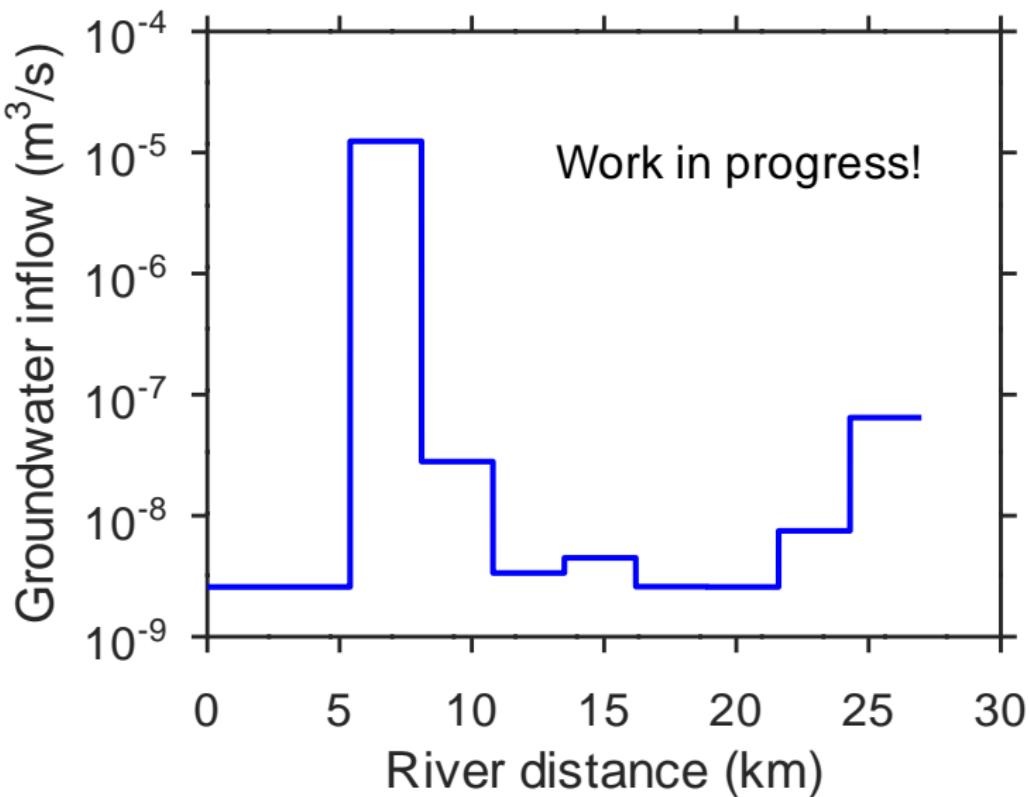
Mass balance of He and water in Colorado River



Mass balance of He and water in Colorado River



Mass balance of He and water in Colorado River



Summary, Conclusions

- ▶ There are huge helium signals both in the Virgin and Colorado rivers!
- ▶ He signals can be used to identify the locations of deep groundwater discharge into rivers, even if diffuse or “submerged”.

Locations of high-He groundwater discharge are consistent with underlying geology.
- ▶ Combined modeling of the mass balances of He and water allows estimating deep groundwater discharge into the rivers.

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Photograph: Jan Franssen, University of Montreal