

Modern methane and dissolved organic matter radiocarbon signatures suggest rapid transfer of organic carbon from a tropical forest to the underlying subterranean estuary ecosystem

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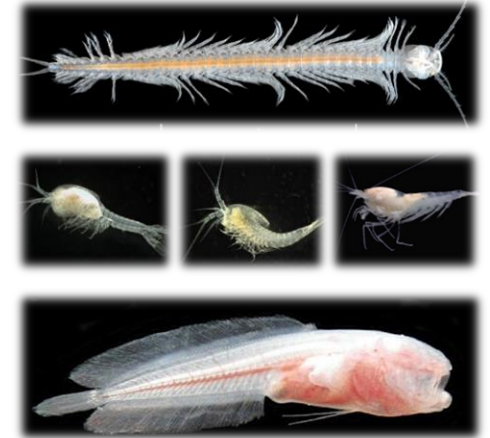
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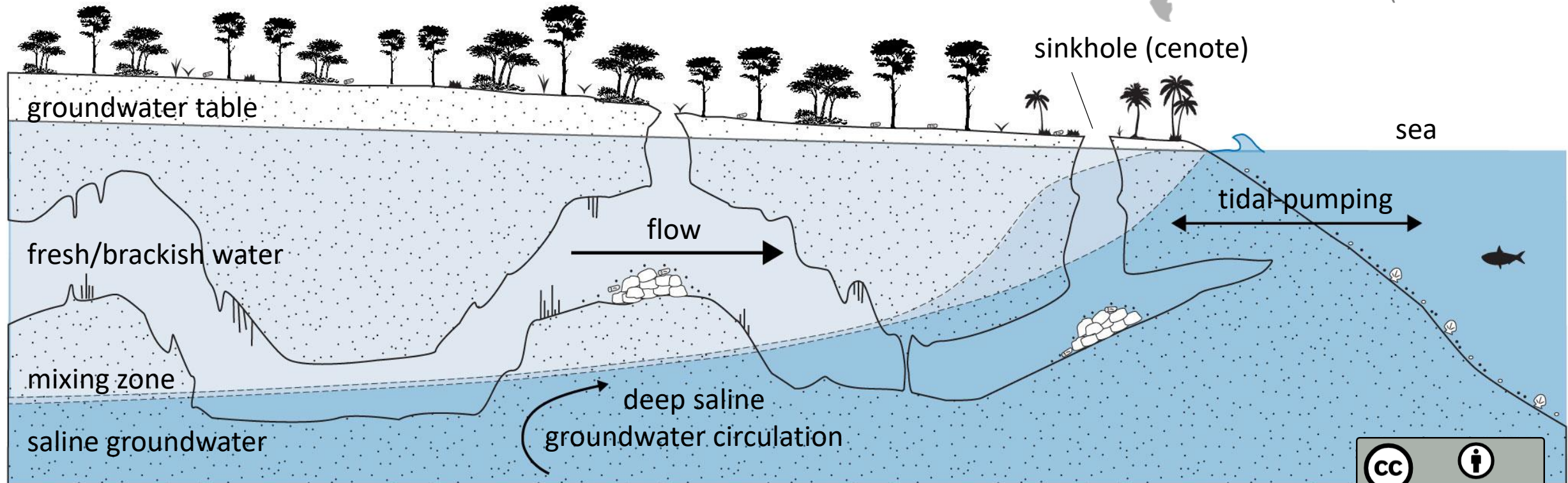


Coastal caves: windows into the karst subterranean estuary

- Study Site: Yucatán Peninsula, Mexico
- Methane (CH_4) and dissolved organic carbon (DOC) derived from organic matter degradation in the tropical forest soil fuels the subterranean food web residing in coastal caves (Brankovits et al., 2017)



cave fauna (source: TAMUG)

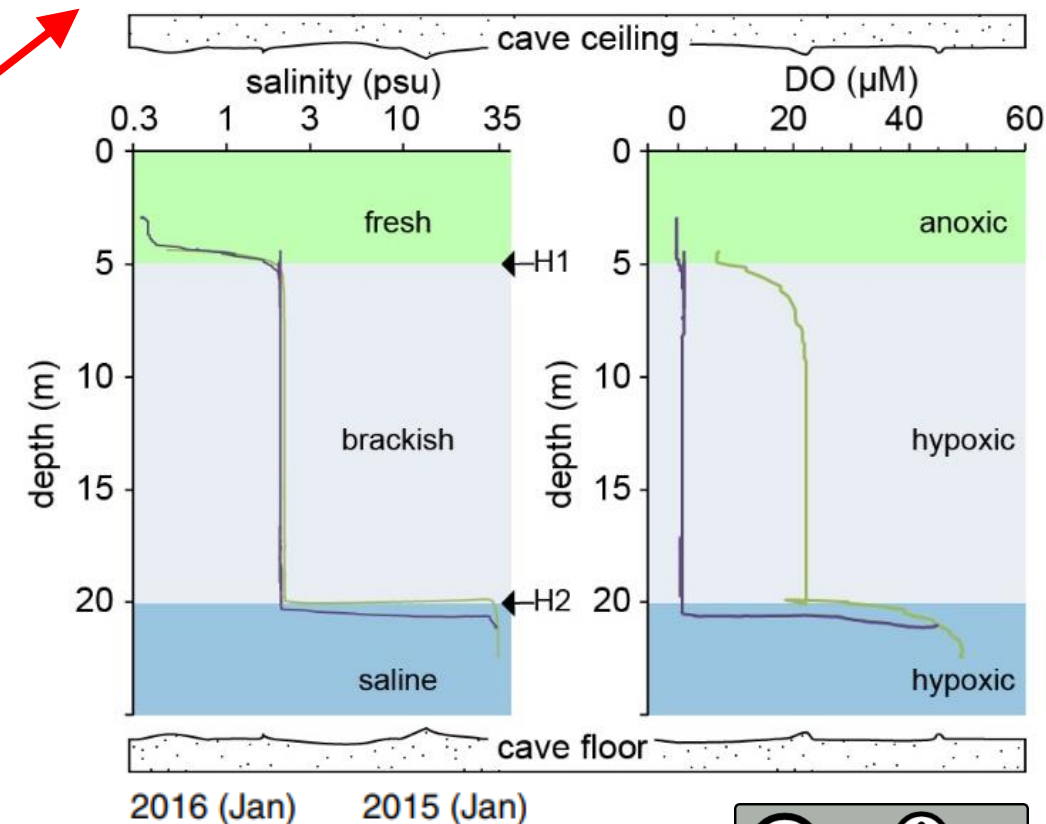


Goals

Determine the turnover of major carbon sources by measuring radiocarbon (^{14}C) on DIC, DOC, and CH_4 from *fresh*, *brackish*, and *saline* water masses



Cave water column profiles



H1 = halocline 1 / H2 = halocline 2



Results

modern C dominates the low salinity waters in the upper aquifer

aged C dominates the deeper aquifer

fresh	source	pMC	age (^{14}C yrs)	$\delta^{13}\text{C}$ (‰)	conc.
	DOC	105	>modern	-27.9	518 μM
	CH_4	101	>modern	-71.5	6 460 nM
	DIC	86.4	1170 \pm 15	-15.2	3.2 mM

brackish	DOC	103	>modern	-27.8	65 μM
	CH_4	<i>below detection</i>		-52.7 *	160 nM *
	DIC	80.6	1730 \pm 25	-14.7	6.8 mM

saline	DOC	47.3	6010 \pm 95	-29.0	21 μM
	CH_4	<i>below detection</i>		-56.3 *	110 nM *
	DIC	58.4	4320 \pm 25	-3.1	2.0 mM

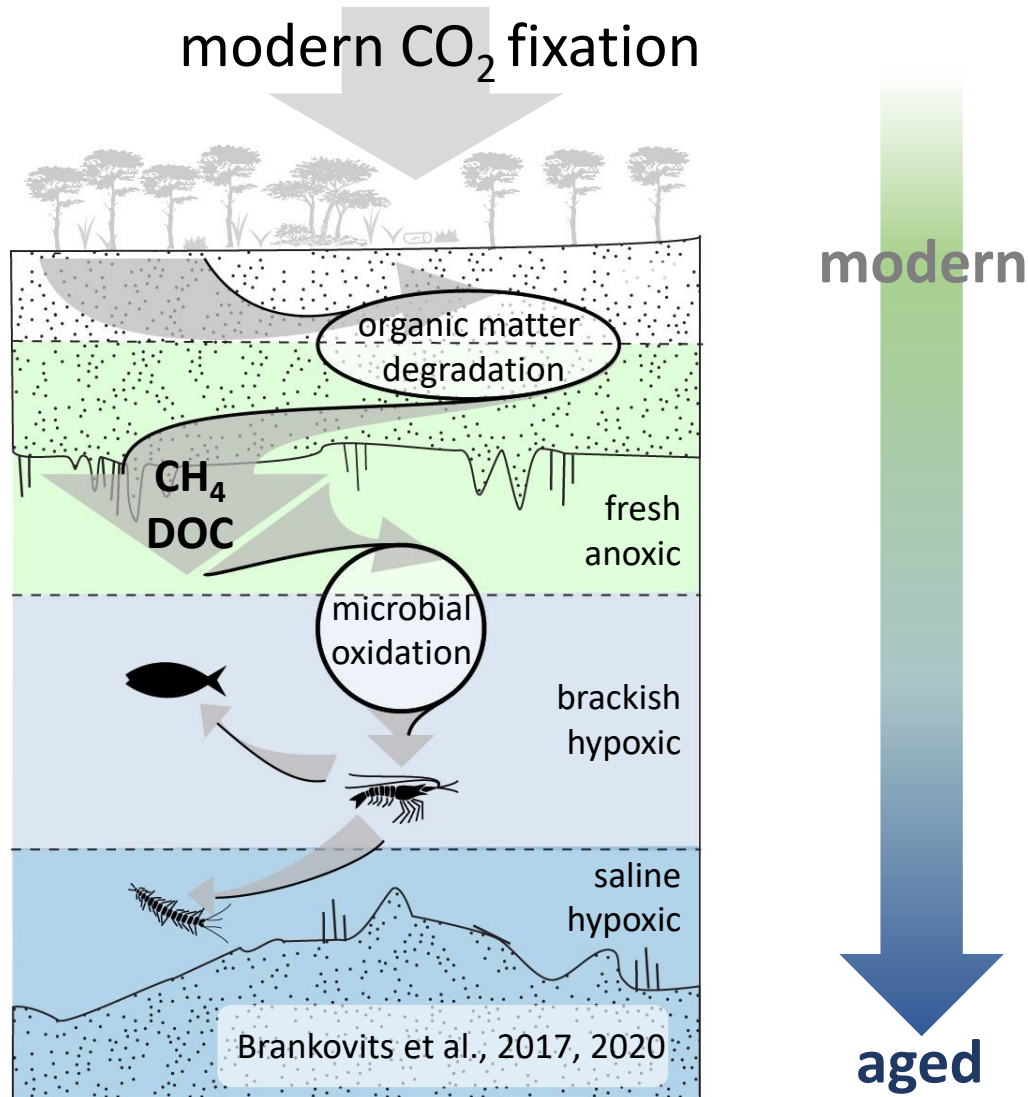
* in italic: data from previous study (Brankovits et al., 2017)

modern

aged



Top-down supplied major carbon sources for the subterranean food web comprised of modern carbon



- Methane and DOC production in the carbonate rock/soil matrix are efficient and relatively rapid processes in this karst landscape
- Sources of nutrition for the food web are intimately linked to the surface habitat
- All this suggests that these ecosystems are vulnerable to nearby land use alterations – a major environmental concern in the region

Interested in more on methane biogeochemistry in coastal karst landscapes?

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Related Work

Brankovits, D., Pohlman, J.W., Niemann, H., Leigh, M.B. et al. Methane- and dissolved organic carbon-fueled microbial loop supports a tropical subterranean estuary ecosystem. *Nature Communications* **8**, 1835 (2017)

Brankovits, D. & Pohlman, J.W. Methane oxidation dynamics in a karst subterranean estuary. *Geochimica et Cosmochimica Acta* **277**, 320-333 (2020)

