



Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment

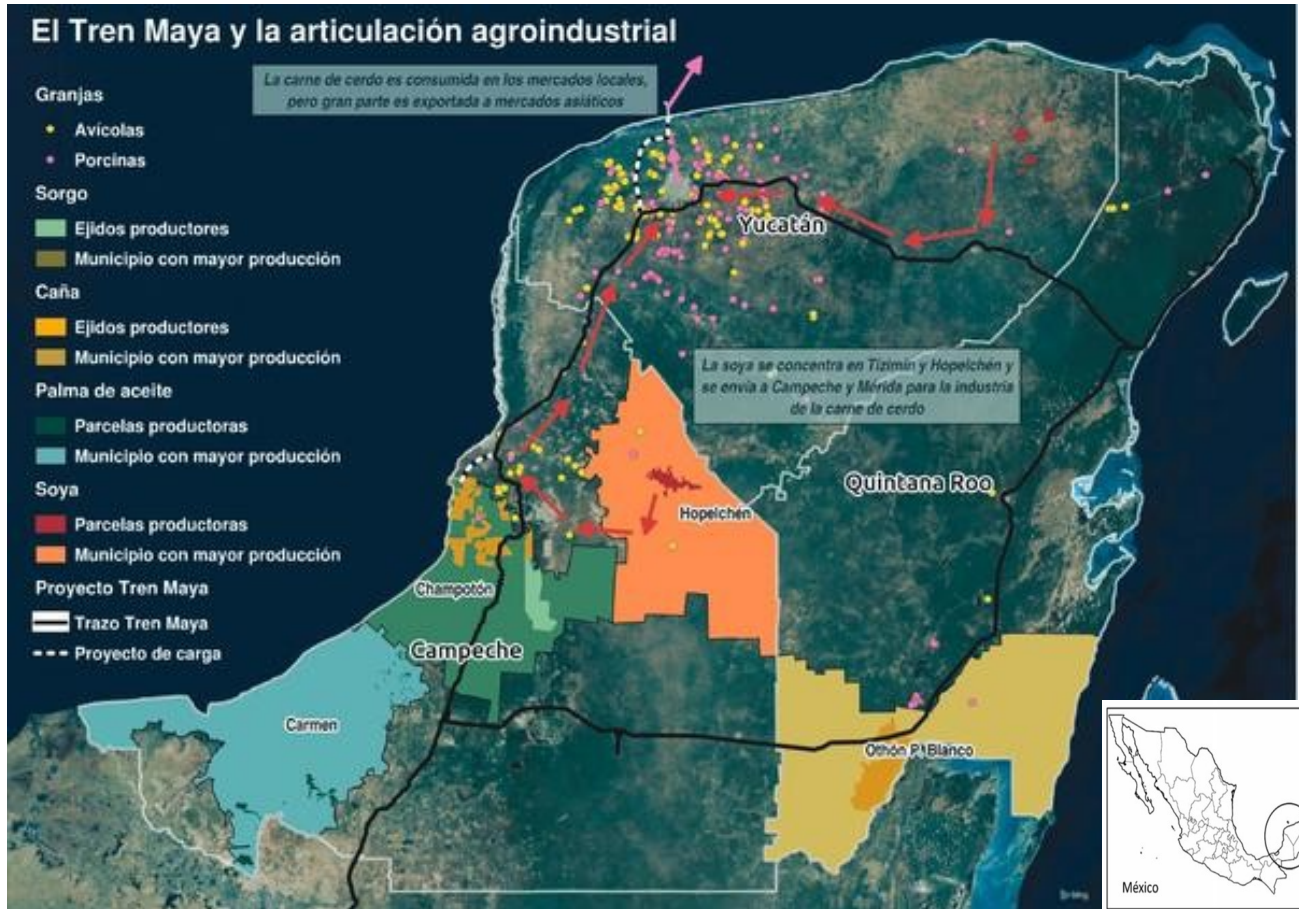
Assessment of emerging organic contaminants at the groundwater of Yucatán peninsula: recreational and water supply

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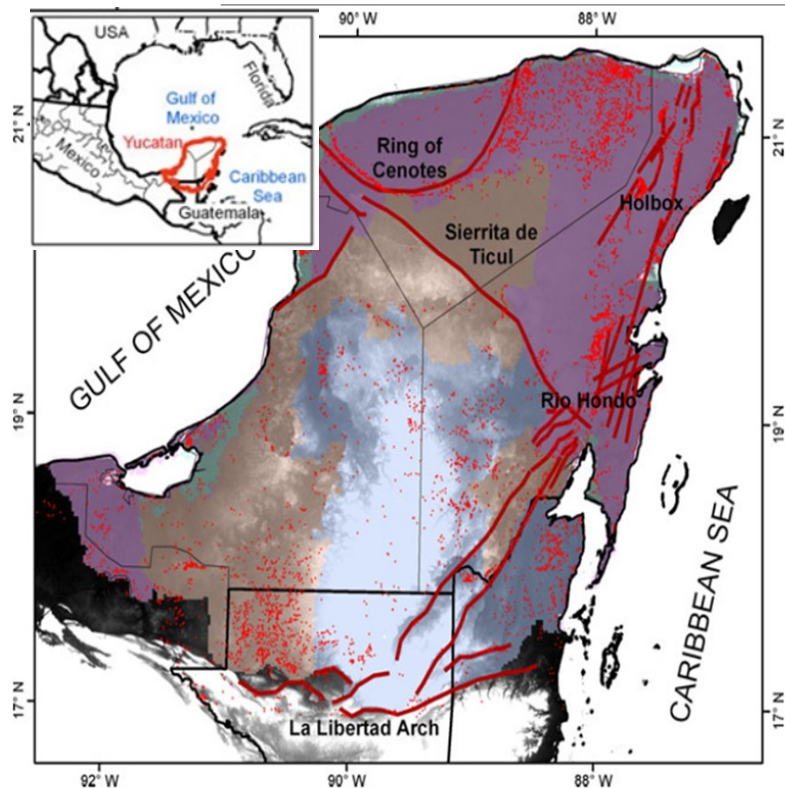


Importance of the Yucatan peninsula



- Tourism as the predominant economic activity: 3er economic activity for the country
- Mexico National bank ; 8.0% PIB Producto Interno Bruto total, promoting 1.8 millones jobs
- A combined population of 5.1 million people
- UN-Habitat study, it is estimated that **by 2030, the population will grow 42.7% in 18 municipalities around the Yucatán Peninsula and Southeast.**
- This growth would be the result of the development of the Tren Maya, as it is expected in the places where the railroad will have a station

Yucatan Peninsula its hydrogeological characteristics



Karstic conditions most open to the atmosphere

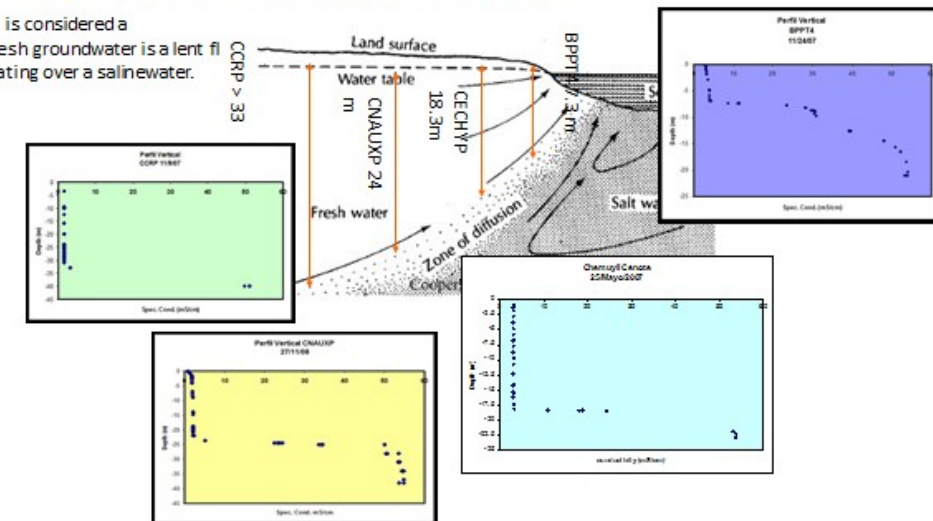
No surface drainage, except for few meters near the coast

Karstic coastal aquifer highly vulnerable

Groundwater behaves as lens floating over saline water

Narrow fresh water lens towards the coast

It is considered a fresh groundwater is a lens floating over a saline water.



Why emergent contaminants?

Water quality at the Yucatan Peninsula had been focusing on Bacteriological quality (fecal indicators) and Nitrogen compounds.

Very recent the presence of organic compounds at the Yucatán Peninsula has been of some concern mainly related to specific areas of recreational (tourism), golf courses, agriculture activity and water supply

- **Consumption of Rx and illicit drug on increase**
- **Disposal is an issue**
- **Landfills and toilets**
- **Many communities starting collection for incineration**
- **Animals**
- **75% of antibiotics produced in USA for animals**
- **Prophylactic**
- **Personal Care**
- **Bathing and Swimming**

Where to evaluate?

Wells

- Water distribution
- At 14-22 Km from the coast
- Tulum, Puerto Morelos



Sinkholes (Cenotes)

- Recreational use
- Cattle areas
- Not use



Karst lake (Uphala)

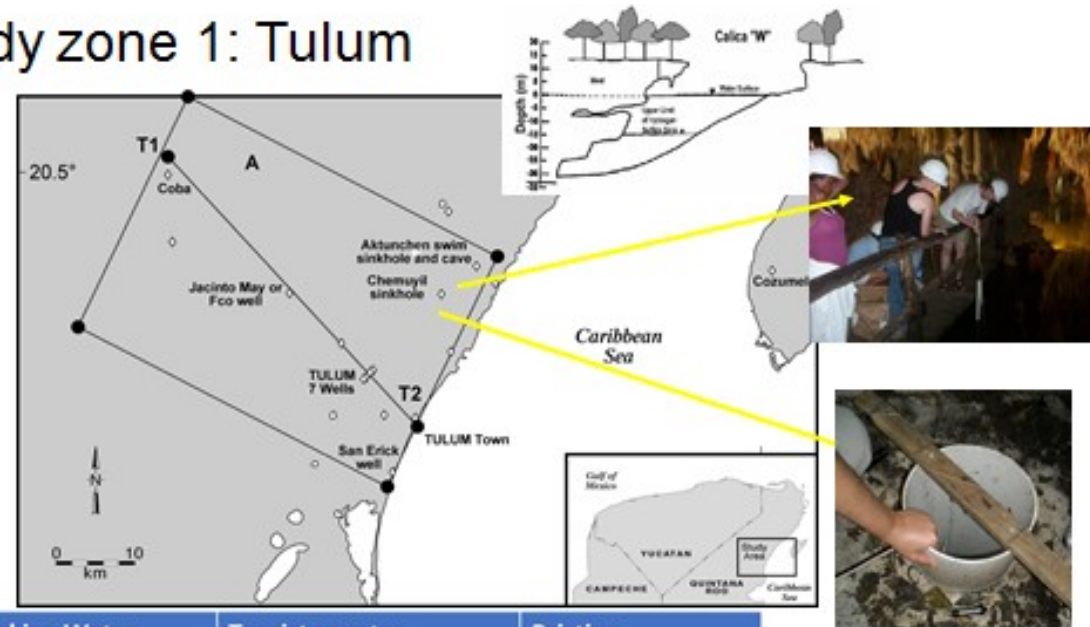
- Nastural Federal Reserve
- Recreational Activities
- Monkeys habitats



Findings

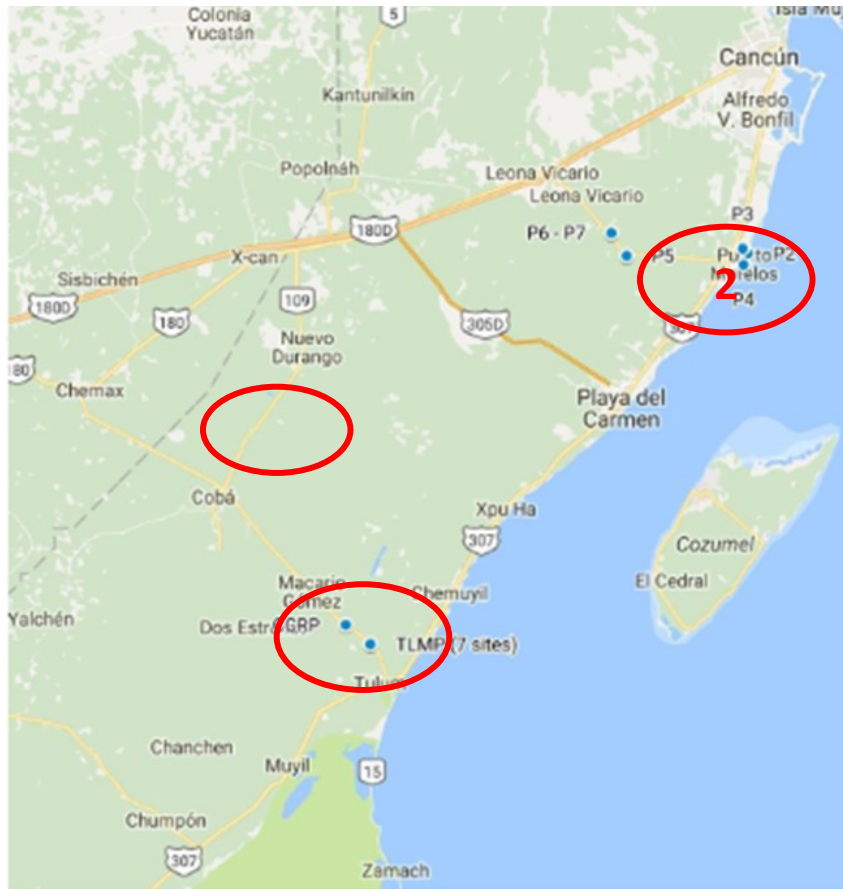


Study zone 1: Tulum

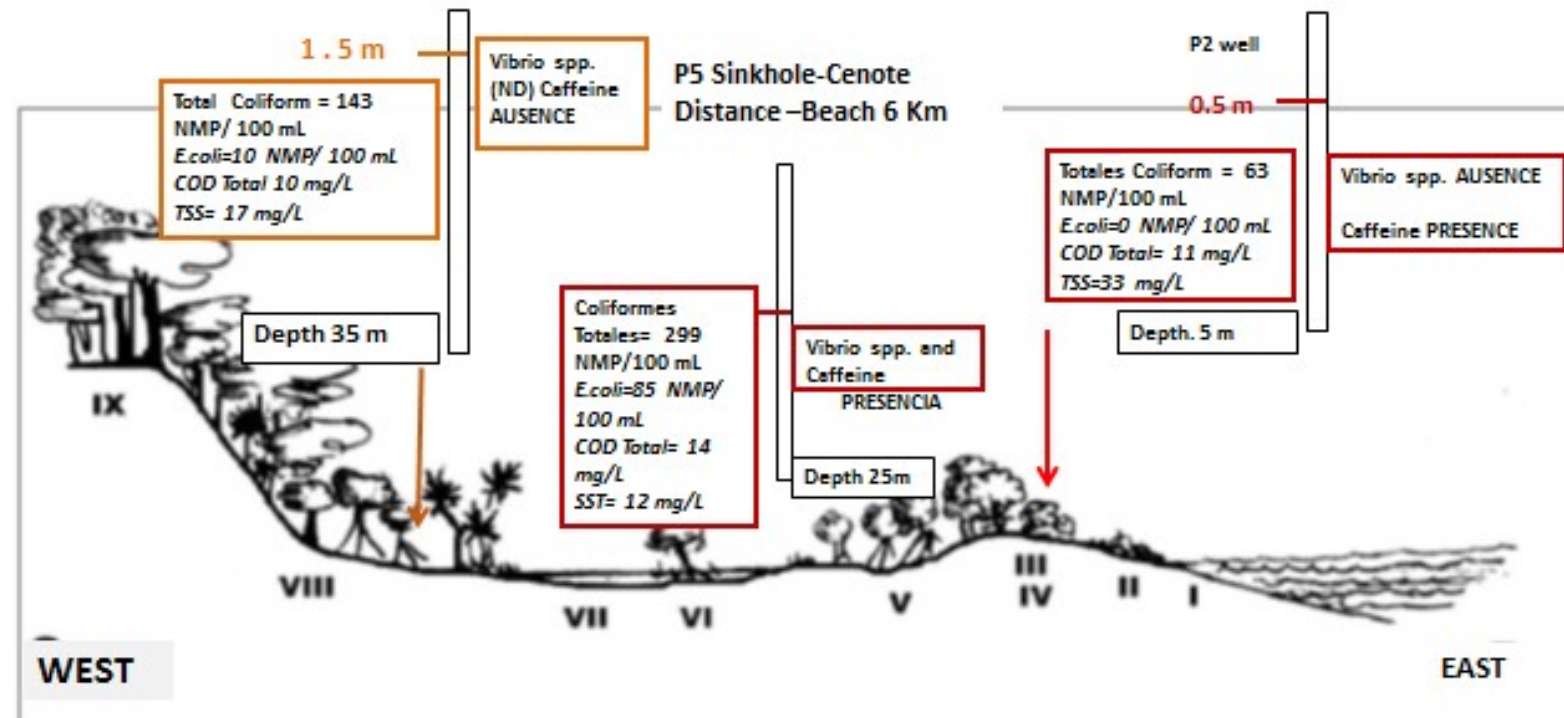


Drinking Water	Tourist cenotes	Pristine
Caffeine	Caffeine	N/F
Erythromycin	DEET	Erythromycin
Norfloxacin	Norfloxacin	N/F

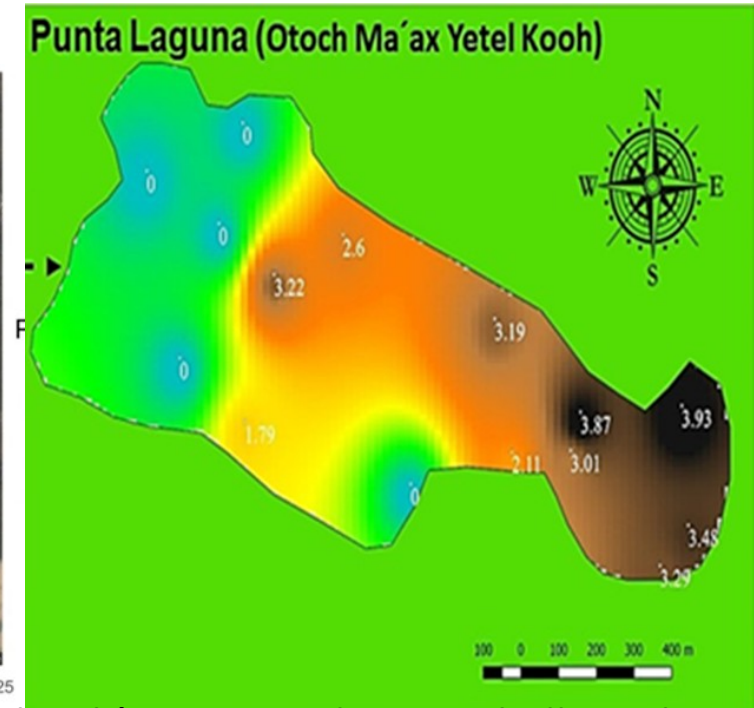
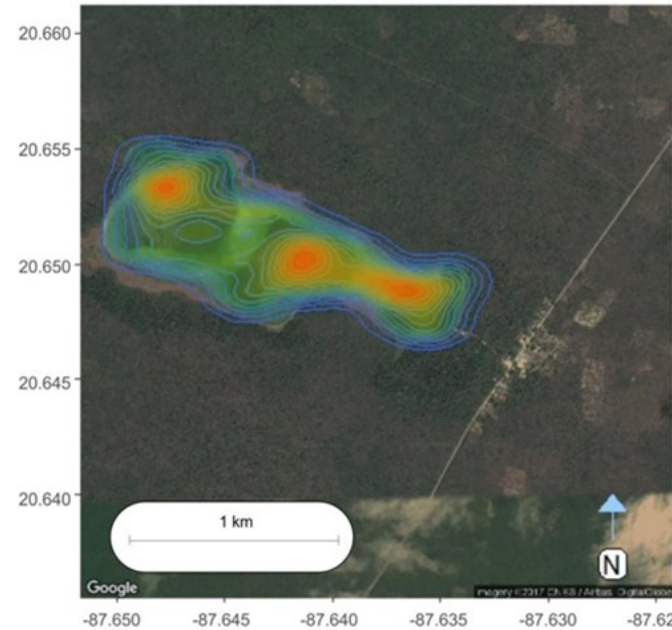
Findings



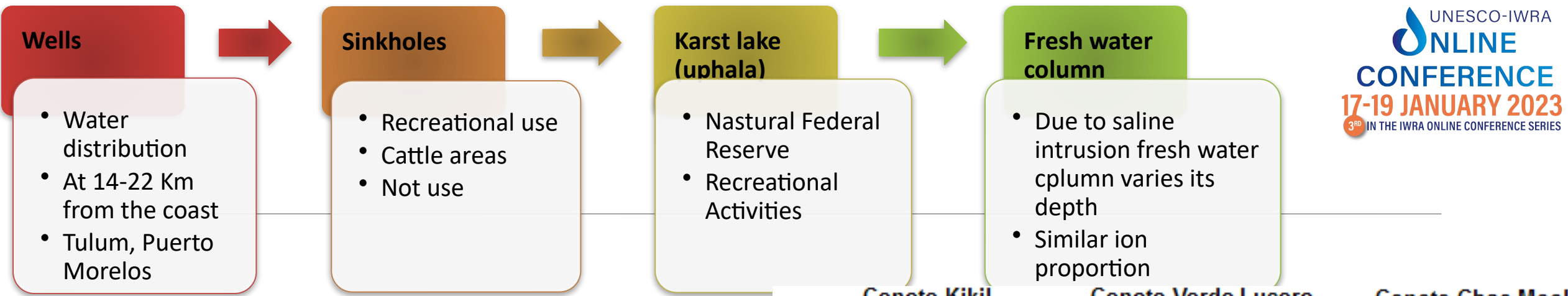
P3 well
 Distance–Beach 30 Km



Findings



- Bathymetry indicated 25 m as its depth's areas and 3.5 m shallow along the connection of the sections.
- Spatial distribution of caffeine indicate: the eastern zone has the highest caffeine concentrations (black 0.39 mg/L), the northwestern zone has the lowest caffeine concentrations (orange-yellow 0.32-0.29 mg/l), the rest of the water body showed no detectable caffeine (blue).



	Cenote Kikil	Cenote Verde Lucero	Cenote Chac Mool
1m	<p>IONS (mg/L)</p> <p>Ca₂⁺ 113 Na⁺ 201 K⁺ 5.2 Mg₂⁺ 61 Cl⁻ 413 SO₄²⁻ 55.9 CO₃⁺ 229.2</p> <p>Fecal Coliforms NMP/100 mL</p> <p>700.35 <i>E.Coli</i> 506.6 Antibiotics</p>	<p>IONS (mg/L)</p> <p>Ca₂⁺ 133 Na⁺ 111 K⁺ 3.8 Mg₂⁺ 31 Cl⁻ 198 SO₄²⁻ 39.5 CO₃⁺ 237.5</p> <p>Fecal Coliforms NMP/100 mL</p> <p>321.85 <i>E.Coli</i> 76.6 Antibiotics</p>	<p>IONS (mo/L)</p> <p>Ca₂⁺ 64 Na⁺ 186 K⁺ 6.57 Mg₂⁺ 31 Cl⁻ 795 SO₄²⁻ 167 CO₃⁺ 210.3</p> <p>Fecal Coliforms NMP/100 mL</p> <p>247.7 <i>E.Coli</i> 23.35 Antibiotics</p>
4m	<p>IONS (mg/L)</p> <p>Ca₂⁺ 120 Na⁺ 197 K⁺ 4.3 Mg₂⁺ 57 Cl⁻ 420 SO₄²⁻ 58.6 CO₃⁺ 296.0</p> <p>Fecal Coliforms NMP/100 mL</p> <p>829 <i>E.Coli</i> 193.2 No Antibiotics</p>	<p>IONS (mg/L)</p> <p>Ca₂⁺ 140 Na⁺ 117 K⁺ 4.1 Mg₂⁺ 34 Cl⁻ 205 SO₄²⁻ 40.6 CO₃⁺ 239.2</p> <p>Fecal Coliforms NMP/100 mL</p> <p>512.95 <i>E.Coli</i> 80.2 Antibiotics</p>	<p>IONS (mo/L)</p> <p>Ca₂⁺ 61 Na⁺ 188 K⁺ 7.08 Mg₂⁺ 32 Cl⁻ 789 SO₄²⁻ 166 CO₃⁺ 239.5</p> <p>Fecal Coliforms NMP/100 mL</p> <p>288.15 <i>E.Coli</i> 37.7</p>
8m	<p>IONS (mg/L)</p> <p>Ca₂⁺ 120 Na⁺ 194 K⁺ 4.3 Mg₂⁺ 59 Cl⁻ 422 SO₄²⁻ 58.1 CO₃⁺ 270.4</p> <p>Fecal Coliforms NMP/100 mL</p> <p>829 <i>E.Coli</i> 229 Antibiotics</p>	<p>IONS (mg/L)</p> <p>Ca₂⁺ 126 Na⁺ 104 K⁺ 3.8 Mg₂⁺ 29 Cl⁻ 214 SO₄²⁻ 41.1 CO₃⁺ 214.0</p> <p>Fecal Coliforms NMP/100 mL</p> <p>829 <i>E.Coli</i> 111.8 No Antibiotics</p>	<p>Saline Intrusion</p>

In Summary

Emergent contaminants in a groundwater dependent ecosystem, at the touristic and non-touristic sampled sites is occurring.

The detection of fecal indicators such as: *Escherichia coli* (*E. coli*) and the determination of caffeine makes evident that not only in the touristic sites the extent of the contamination implies a human source.

- Implication: Promote a Monitoring more specific and with more parameters

Water quality at the groundwater system is deteriorating in sites along the rise of developments.

- Implication: Distinguishing pollution sources allows you to define control strategies and protection policies

THANK
YOU



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