

# Methane in Groundwater Wells of Mexico City: A Preliminary Assessment of Occurrence, Potential Origins, and Associated Risks

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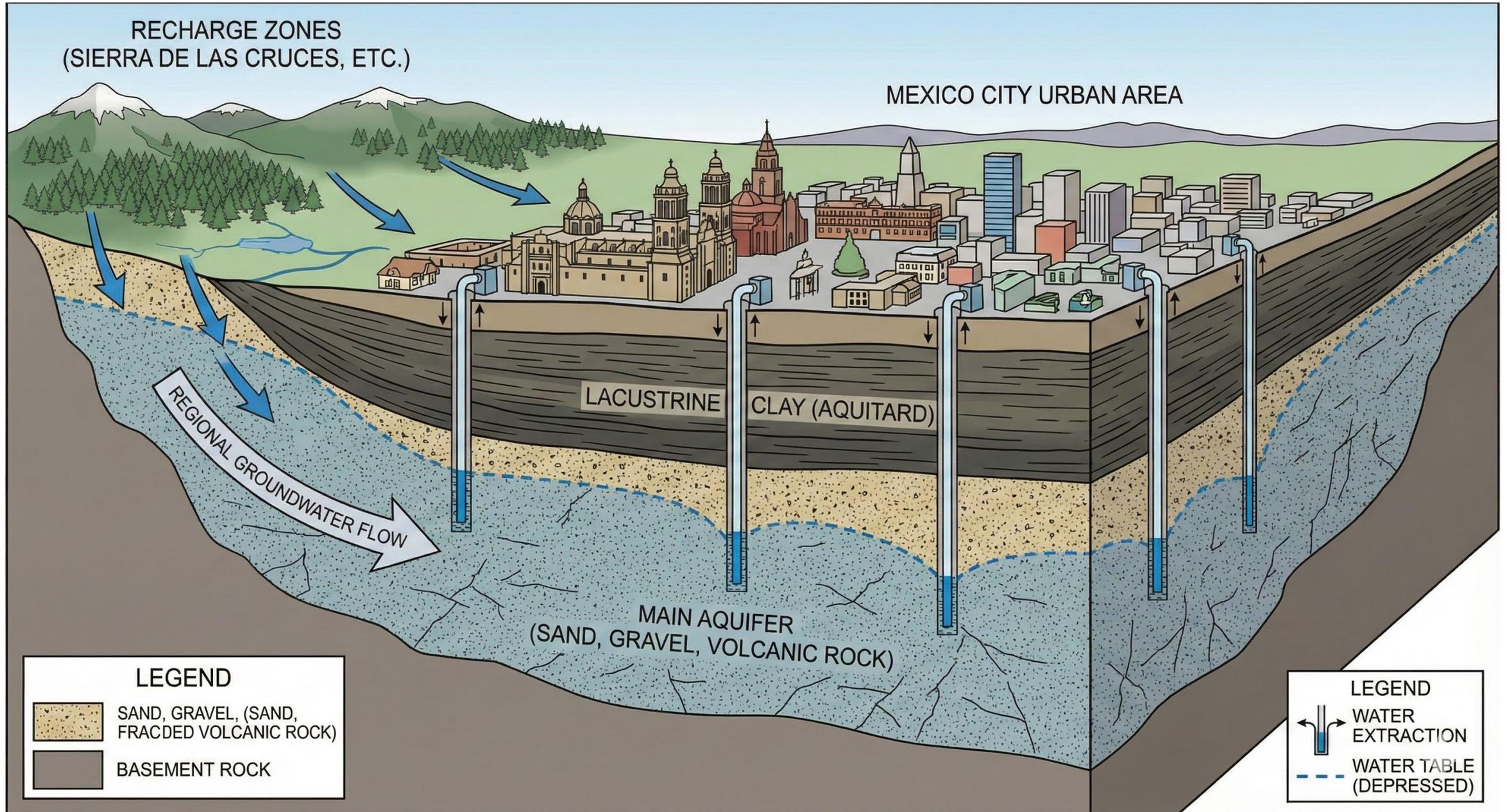
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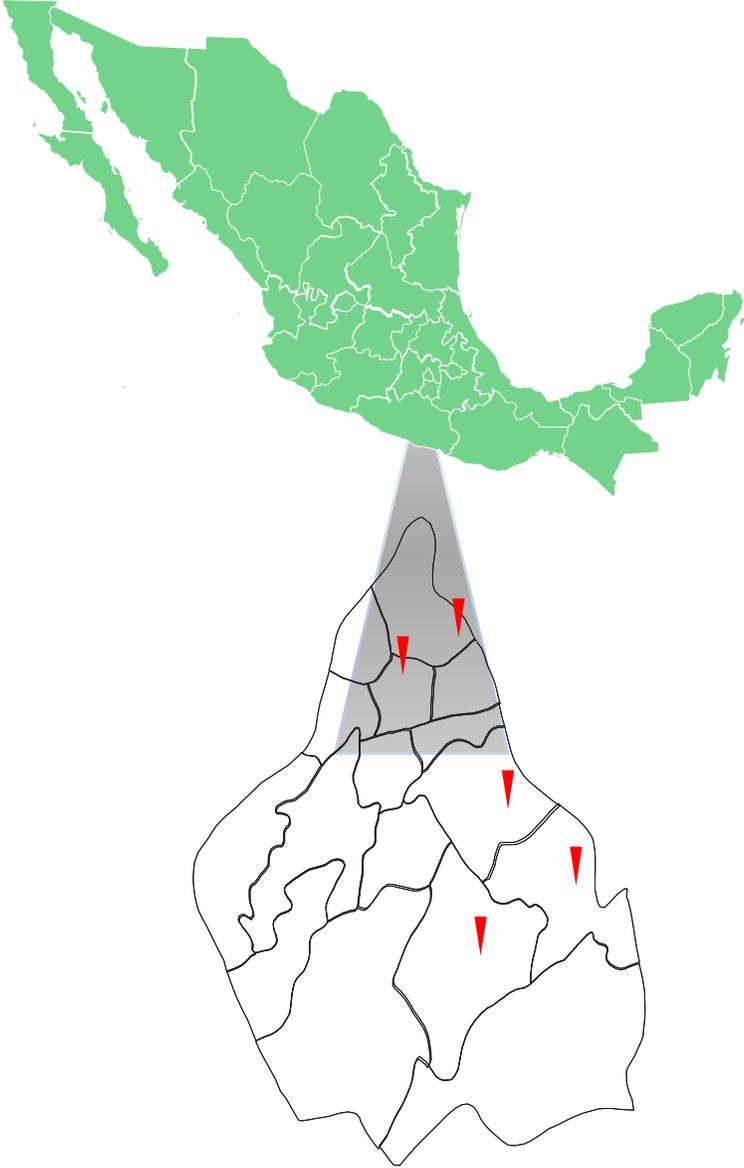
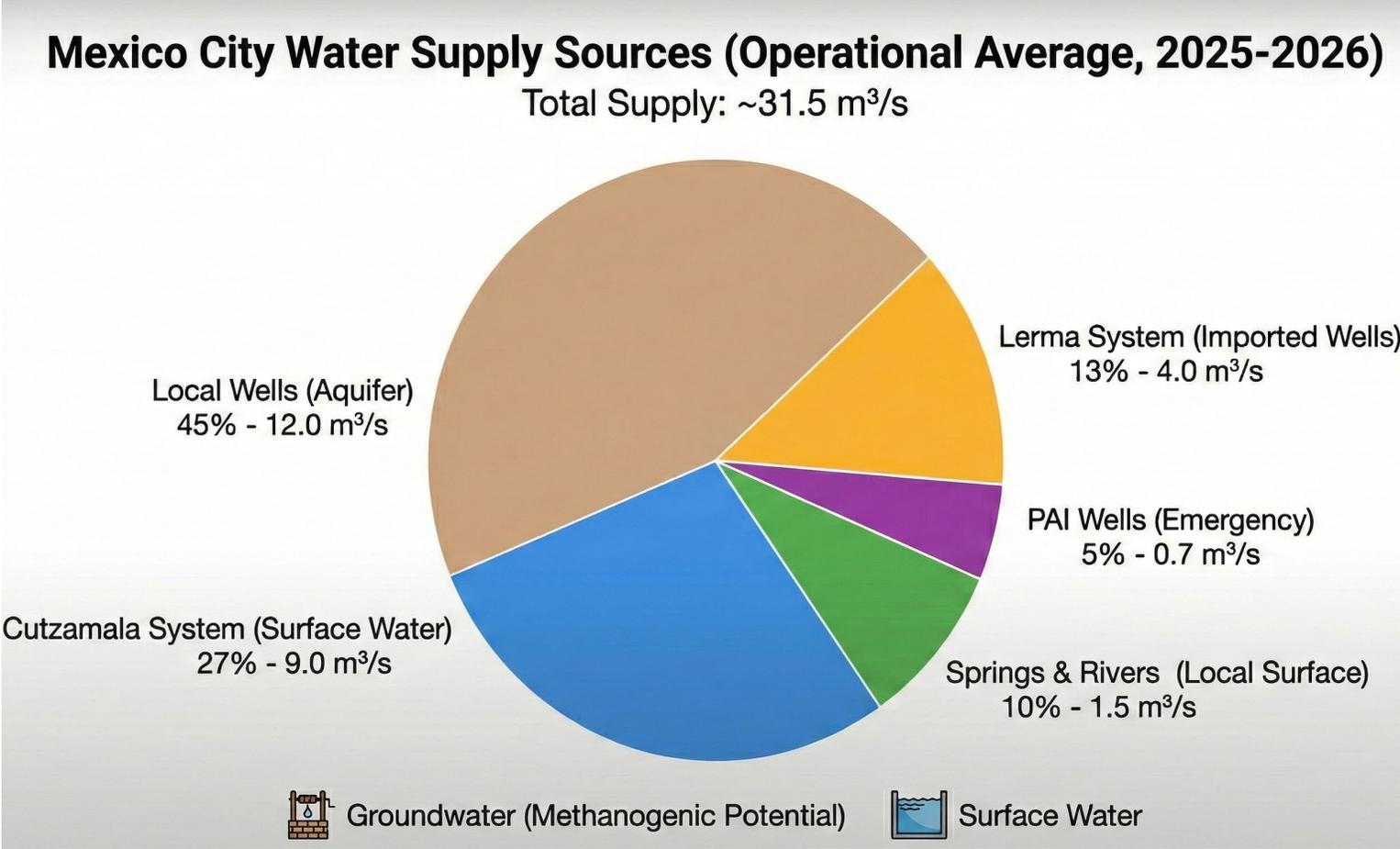
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# A structurally complex and overexploited aquifer system

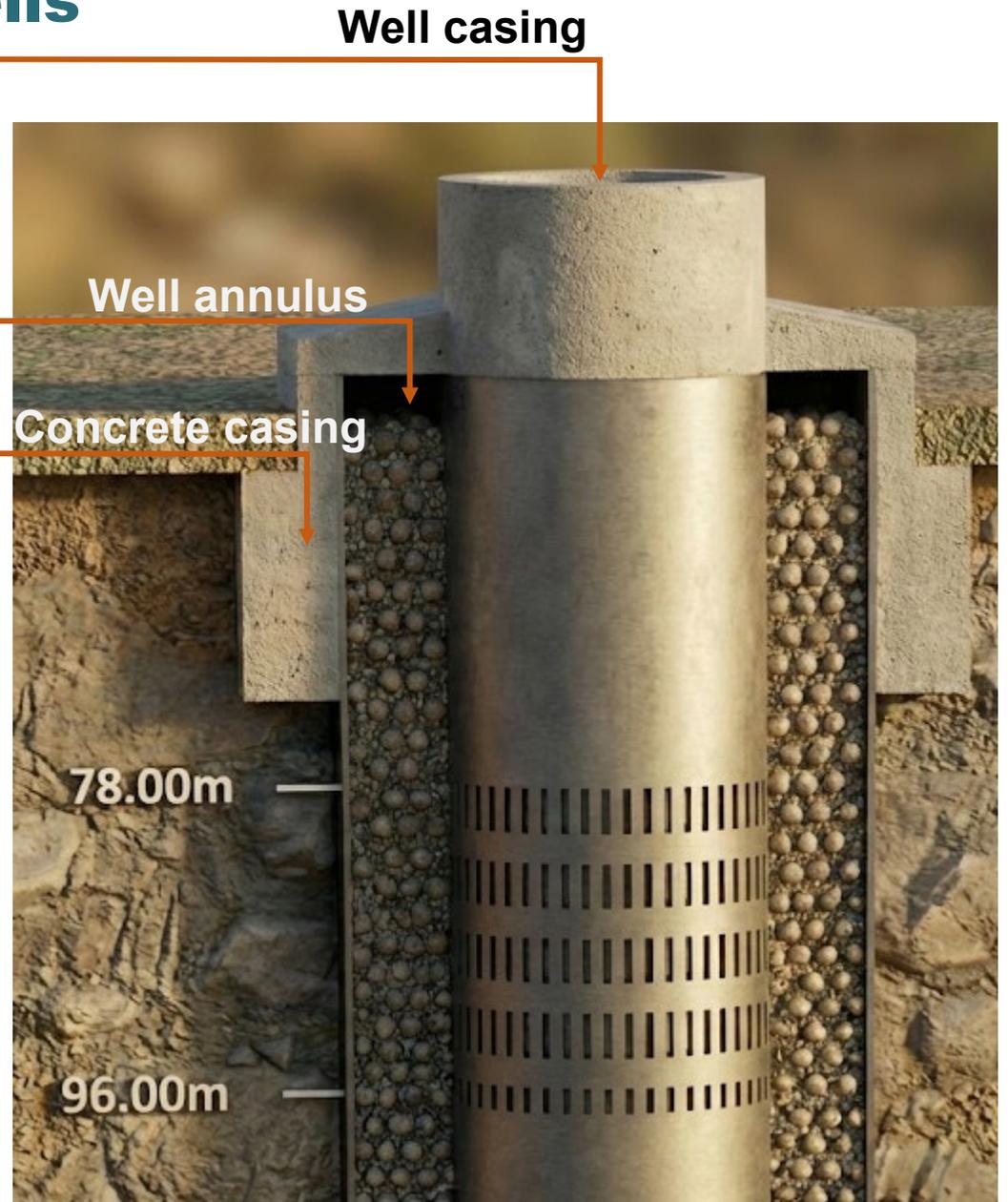


# The Urban Water Crisis & Deep Extraction



We focused on **five wells** preselected in collaboration with Mexico city water operator (SACMEX)

# Measurement locations within the wells



Our measurement platform

# Adapted methods to measure CH<sub>4</sub> and CO<sub>2</sub> used in the groundwater wells

- Direct Well Casing Emissions
- Down-well methane concentration profiles up to 40 m depth
- Well Annulus Emissions through an adapted skirt chamber method (Thalasso,2023).
- Dissolved gas (CH<sub>4</sub>, CO<sub>2</sub>) in groundwater through headspace equilibration method.
- Gas origin and composition (gas chromatography)



# Results

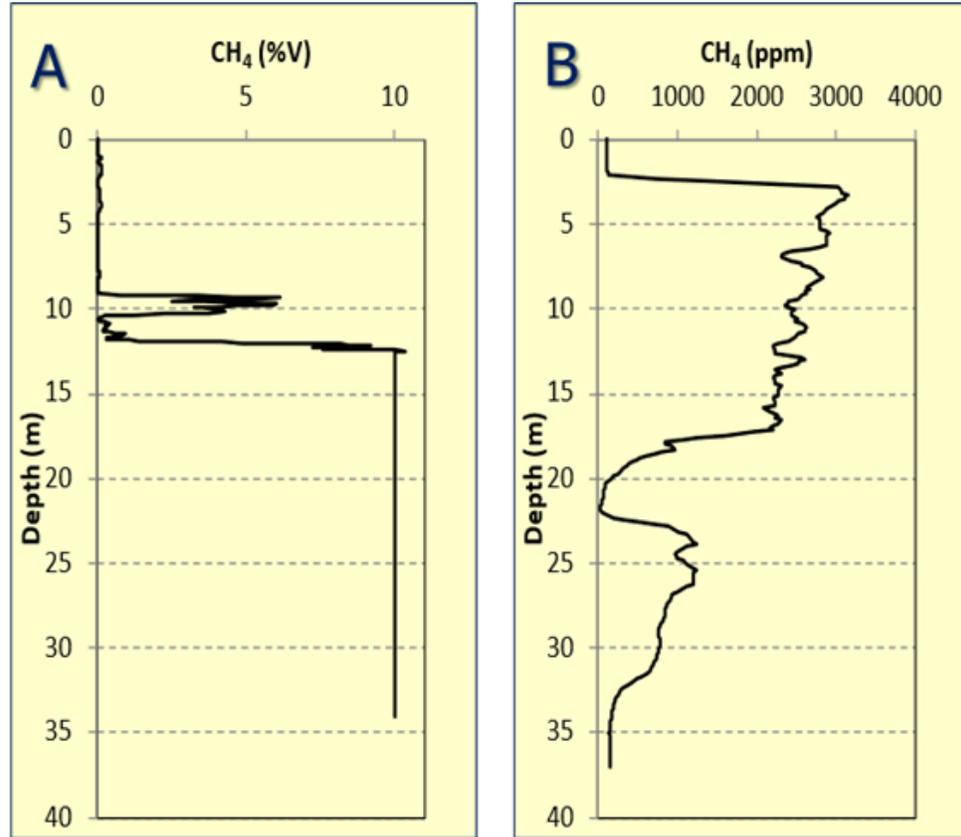


Figure 1. Vertical Profiles of CH<sub>4</sub> Southeast-A well (A) and East -A well (B)

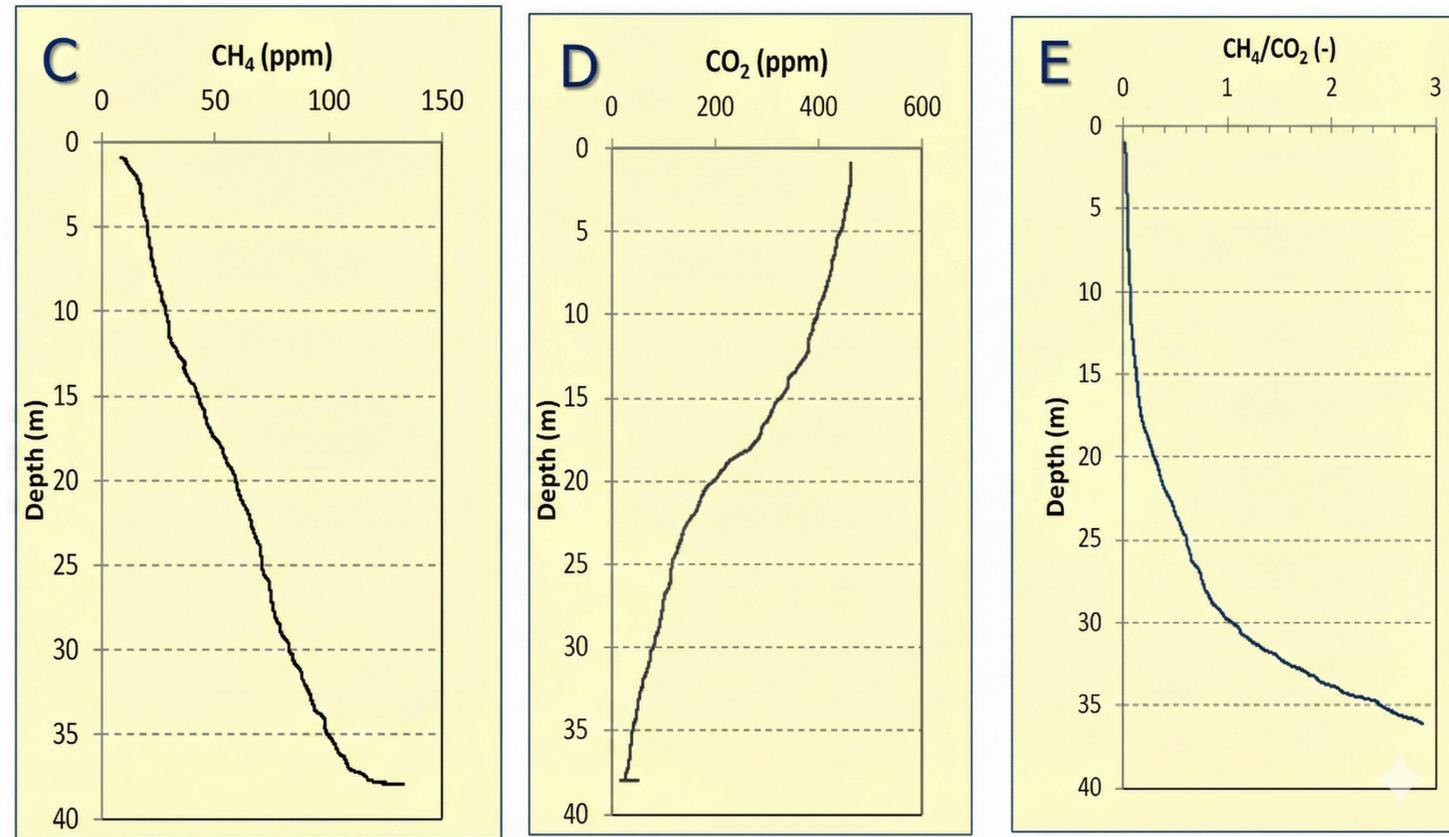
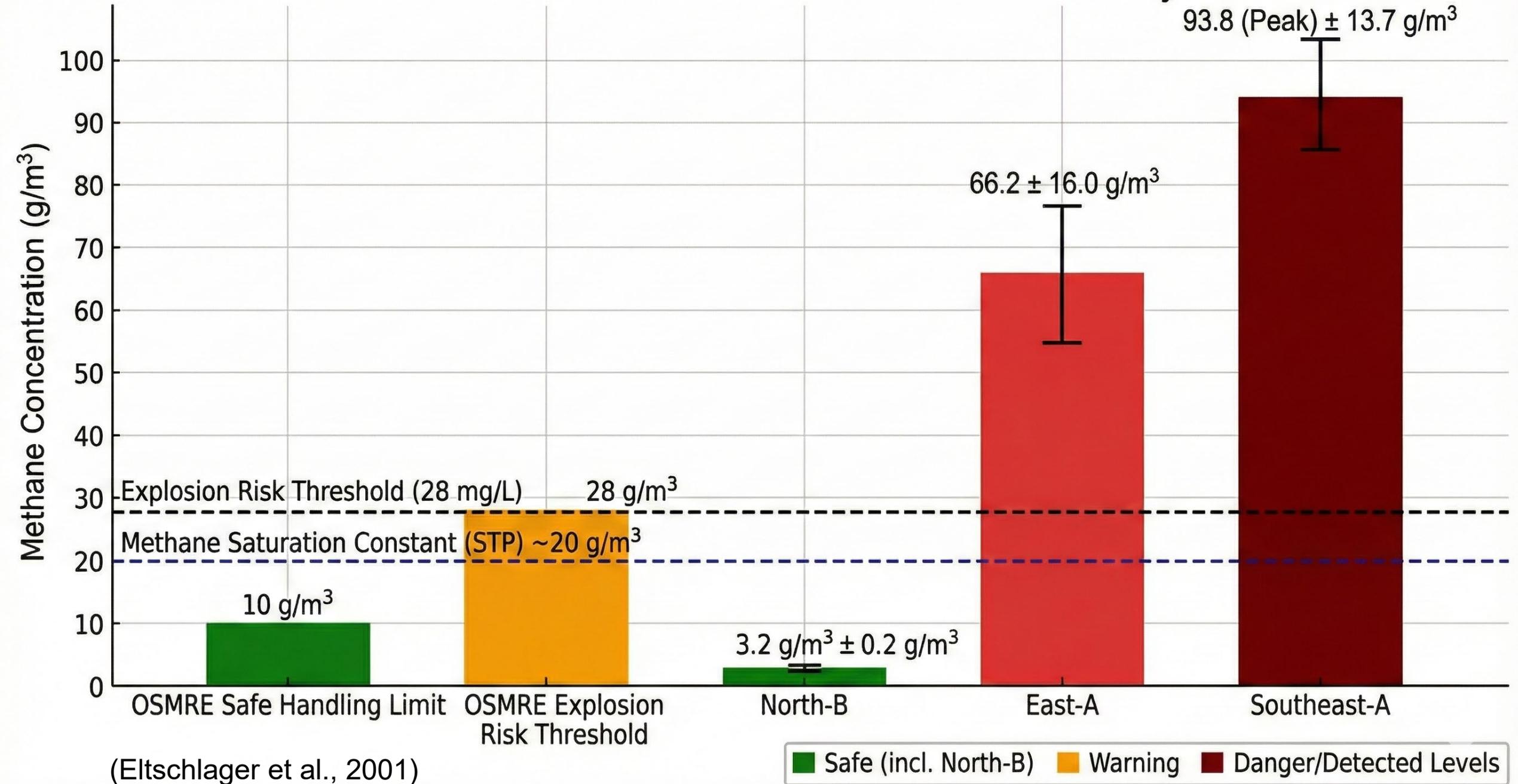
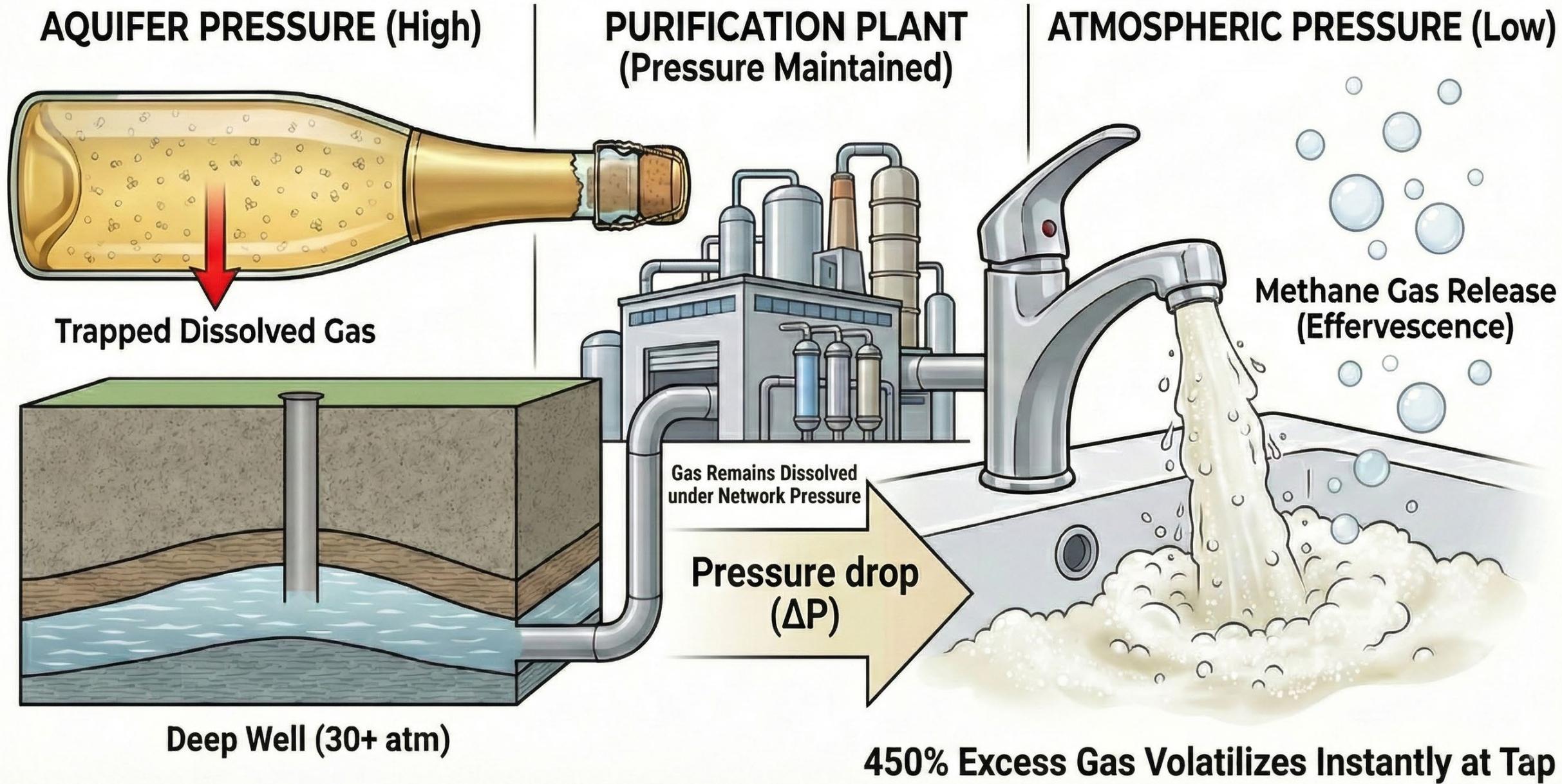


Figure 2. Vertical Profiles of CH<sub>4</sub>, CO<sub>2</sub>, and CH<sub>4</sub>/CO<sub>2</sub> ratio versus Depth in the North B well.

# Detected Dissolved Methane Concentrations vs. Safety Thresholds

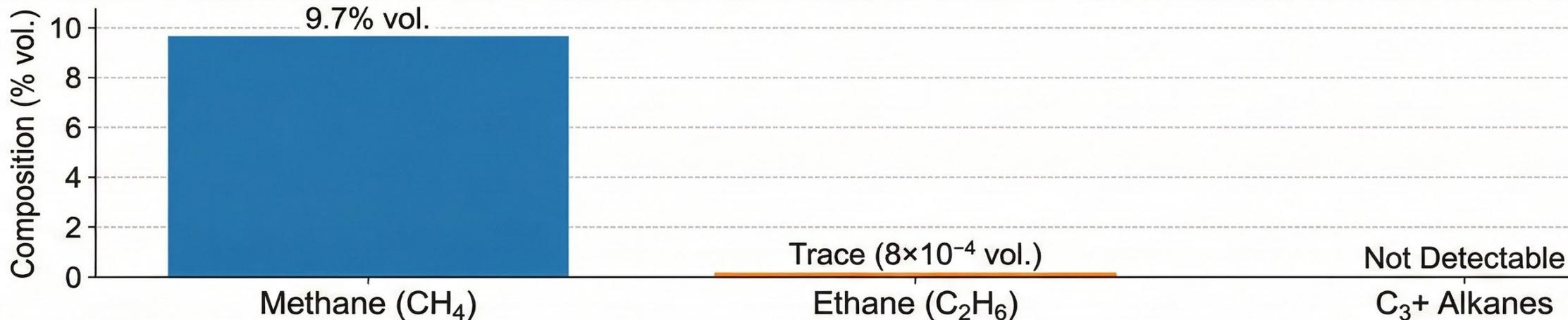


# THE "CHAMPAGNE EFFECT": SUPERSATURATION & RELEASE



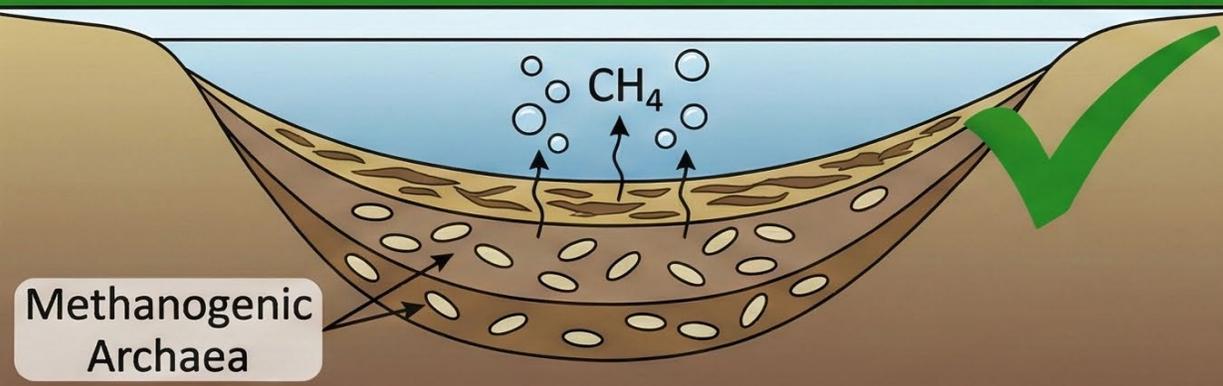
# Chemical Characterization & Gas Origin

## GAS COMPOSITION OF SOUTHEAST-A WELL



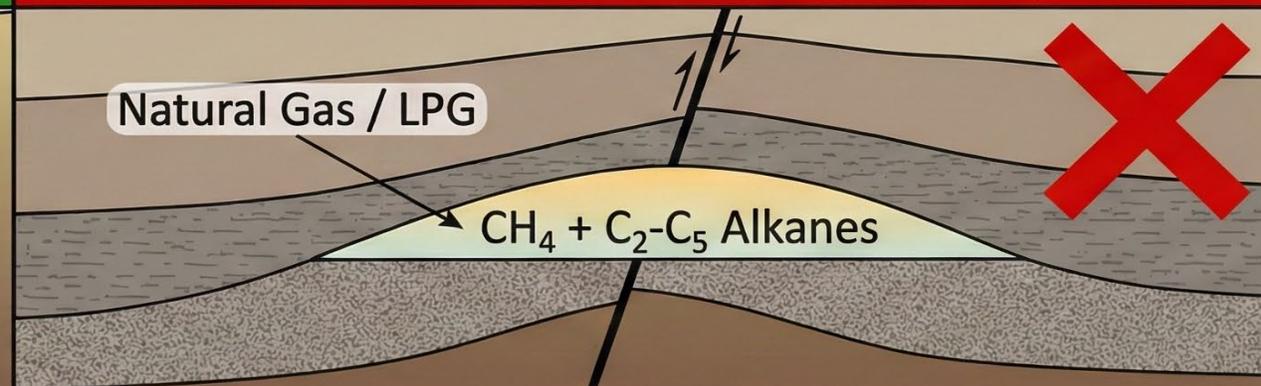
## ORIGIN OF CH<sub>4</sub>: BIOGENIC VS. THERMOGENIC

### BIOGENIC ORIGIN (Supported by Data)



Decomposition of organic matter in lacustrine sediments.  
Dominant CH<sub>4</sub>, negligible C<sub>2</sub>+.

### THERMOGENIC ORIGIN (Ruled Out)



Deep subsurface processes.  
Contains significant Ethane & higher alkanes.

**CONCLUSION:** The dominance of methane and absence of C<sub>2</sub>-C<sub>5</sub> alkanes strongly suggests a biogenic origin for the gas.

# STYLIZED GAS CHROMATOGRAM (General Pattern for Most Wells)

Detector Signal (Arbitrary Units)

**Methane (CH<sub>4</sub>)**

Dominant Peak  
(e.g., ~9.7% in Southeast-A)

**Expected Region for Ethane (C<sub>2</sub>)  
& Propane (C<sub>3</sub>) Alkanes**

**ABSENT / NEGLIGIBLE**

**Unidentified  
Non-Alkane VOCs (>C<sub>3</sub>)**

Significant peaks in all wells  
except Southeast-A

Retention Time (Increasing →)

**INTERPRETATION:** The chromatogram shows methane dominance and the lack of thermogenic alkanes (C<sub>2</sub>-C<sub>3</sub>). The later peaks indicate the presence of other, heavier organic compounds of unknown identity.

# Final Remarks

## 1. Methane Presence & Risk:

- Methane (CH<sub>4</sub>) is confirmed in some CDMX potable water wells.
- East-A & Southeast-A show concerning levels. Southeast-A has CH<sub>4</sub> concentrations exceeding the lower explosive limit within the well.
- Dissolved CH<sub>4</sub> in both wells surpasses safe thresholds, posing risks to downstream treatment units.
- North-A requires further study due to significant well-annulus emissions and incomplete data.

## 2. Mitigation & Recovery Potential:

- High emission levels in Southeast-A & East-A wells suggest a need for recovery or mitigation.
- Potential methane recovery is estimated at 12.4 kg/h and 5.4-8.8 kg/h respectively.

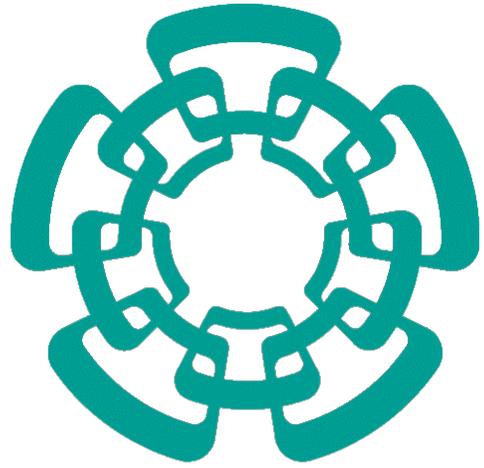
## 3. Methane Origin & Composition:

- Absence of ethane and C3-C5 alkanes points to a biogenic origin (microbial).
- Unknown organic compounds were detected in several wells, necessitating detailed GC-MS analysis.

## 4. Systemic Action & Further Study:

- Systematize risk assessment for CH<sub>4</sub> in wells using rapid detection methods (concentration profiles, routine dissolved CH<sub>4</sub> analysis).
- High CO<sub>2</sub> in North-A,B suggests subsurface microbial activity; a focused water quality study on biological processes is recommended.

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# Thank You

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