Studying Degradation of Atrazine in Groundwater

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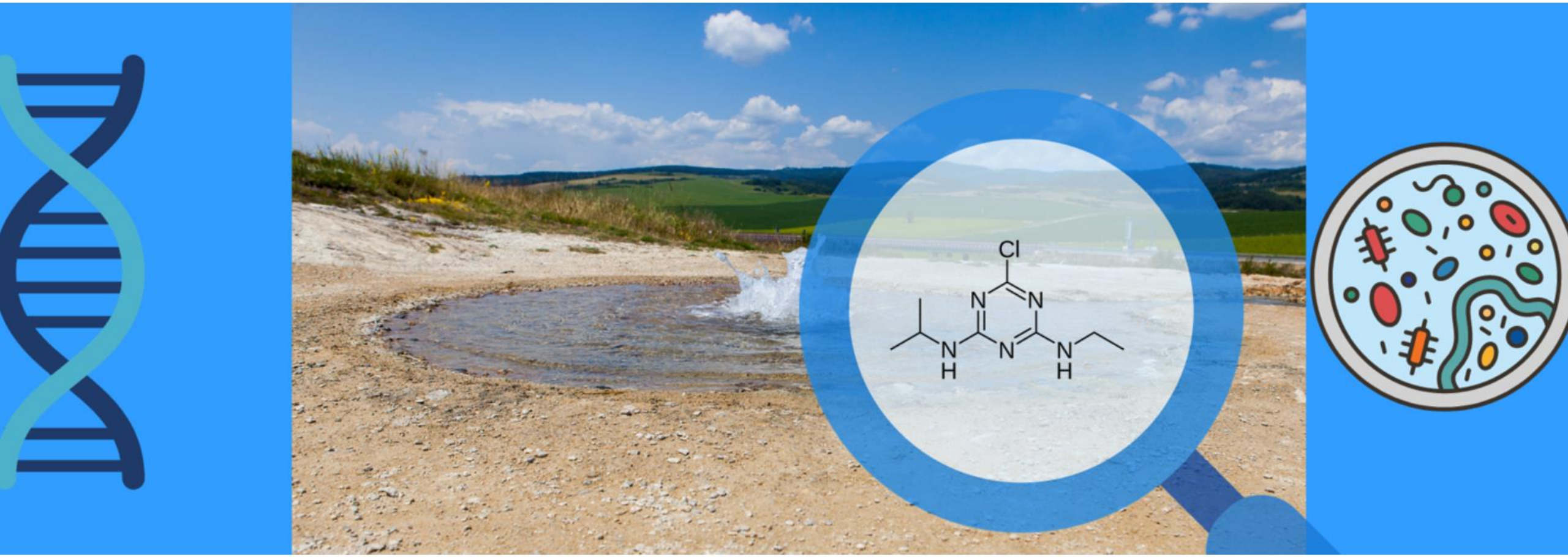

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INTROUDCTION

- Atrazine is one of the most widely used herbicide , used for controlling weed.

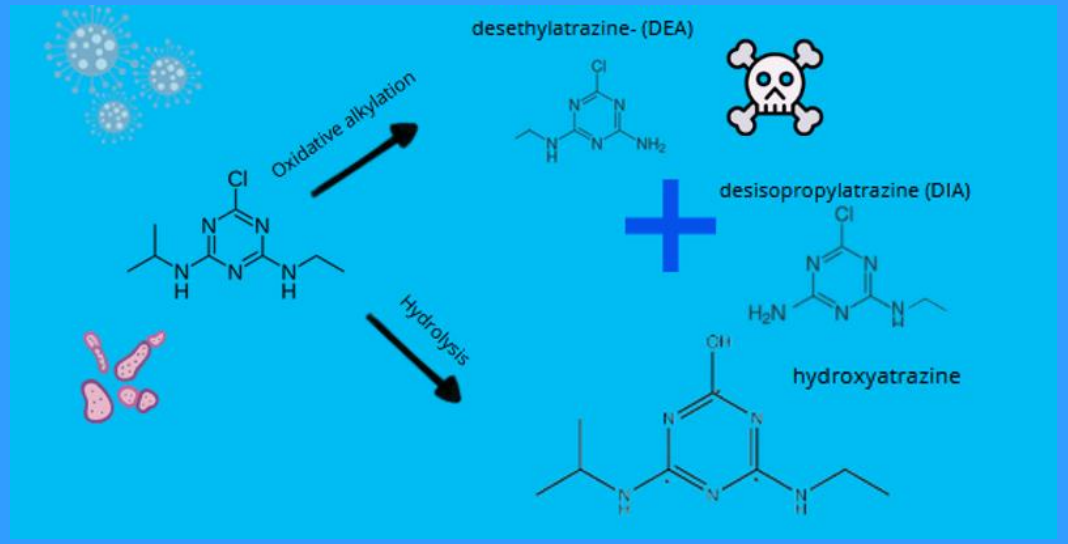
Physiochemical characteristics of atrazine	
Molecular weight	215.68 gmol-1
Density	1.187 gcm-3 at 20°C
Water solubility	33 mgL-1 at 20°C
Boiling point	200 °C

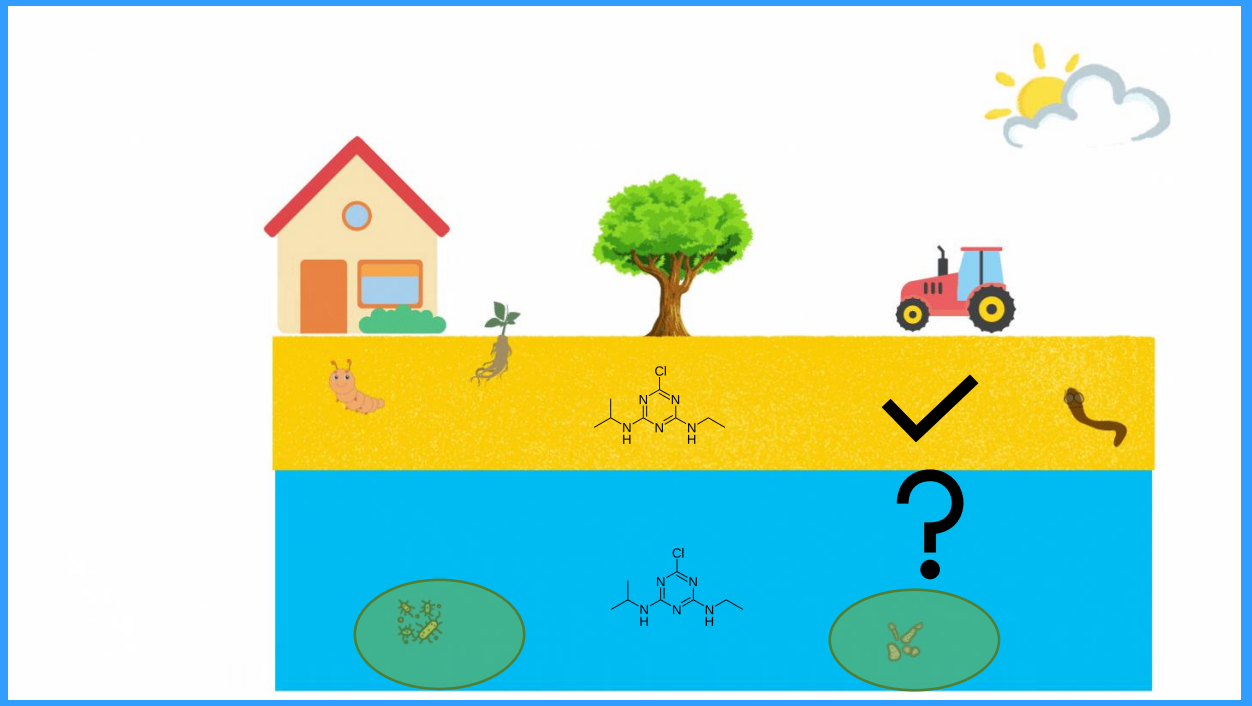
- Atrazine is associated with relatively high levels of chronic toxicity.

- Atrazine and its metabolites are highly persistent in the environment even for many years after the termination of its application.

RESEARCH QUESTIONS AND OBJECTIVE

- ☆ It can potentially be degraded in soil but is it being degraded in groundwater ?
- ☆ Can we identify atrazine degrading bacteria in groundwater?
- ☆ Are we able to determine its dominate degradation pathways ?





Work plan

GROUNDWATER SAMPLES

Is there degradation potential in groundwater

Microcosm experiment

Determine degradation potential of GW cultures

DNA , PCR , qPCR and NGS to identify and quantify Atrazine degrading Bacteria and atzA and trzN gens

Determine isotope enrichment trend for groundwater Bacteria by GC-IRMS

qPCR to quantify atzA and trzN for the field samples

Is there evidence for ongoing in-situ degradation

SPE to increase Atz concentration and Purifyit from other contaminants

Extracted sample is analyzed by LC-MS to determine degradation products

Further purification process by HPLC-FC and TurboVap

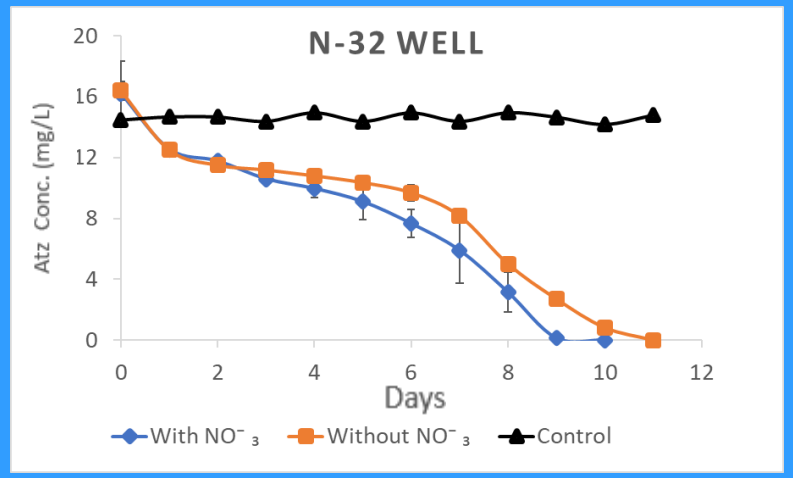
Extracted Sample is analyzed by GC-IRMS to measure isotope fractionation for N and C

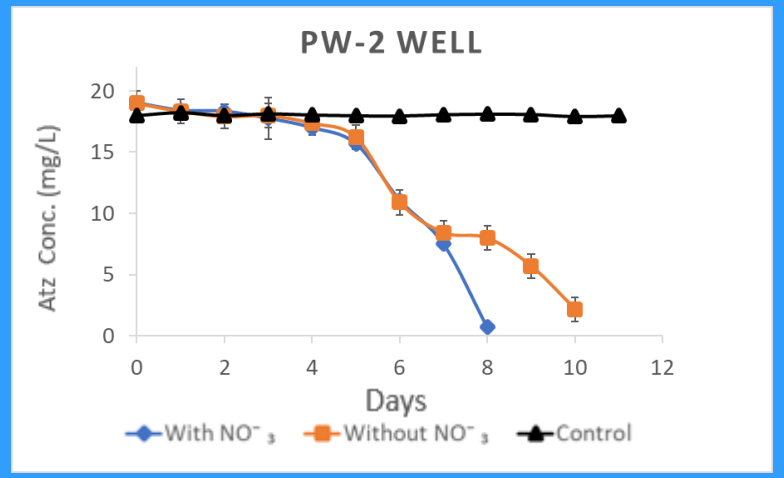
make a comparison with commercial Atz to identify Atz biodegradtion

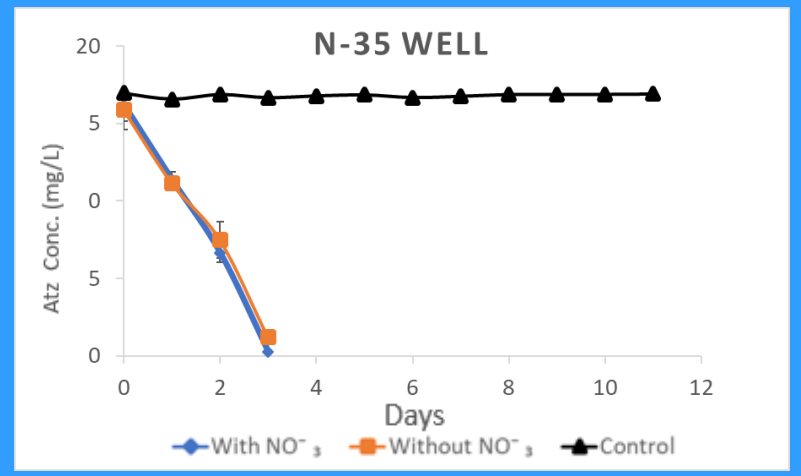
RESULTS

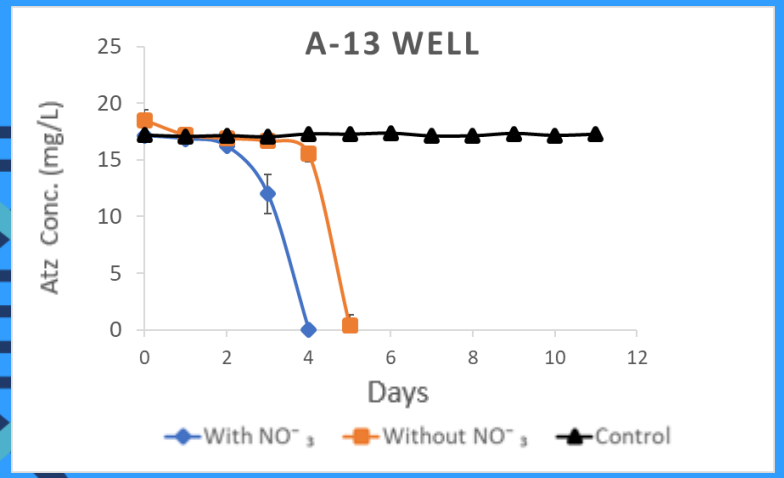
Determine Degradation Potential of Groundwater Culture

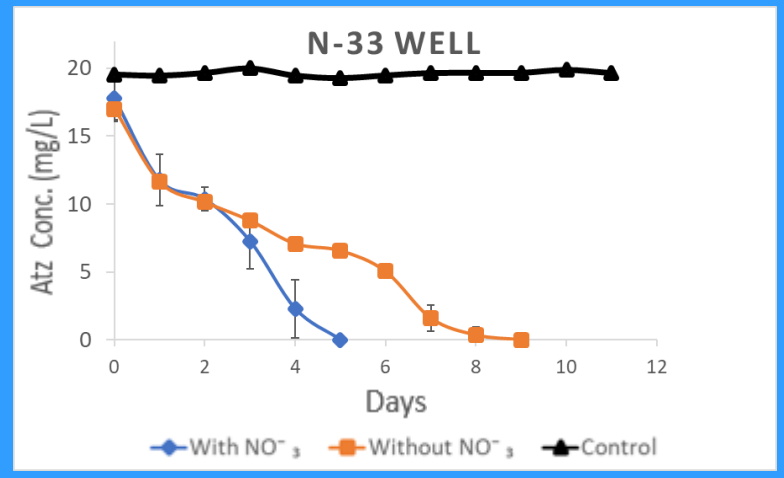
- Microcosm experiments showed complete degradation of atrazine within 4-12 days.
- However nitrate concentration in the site are variable between 0-50 mg/L.

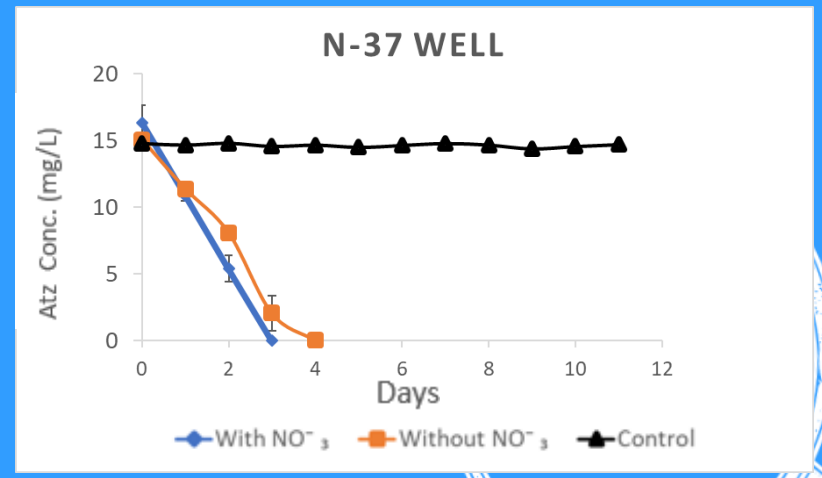








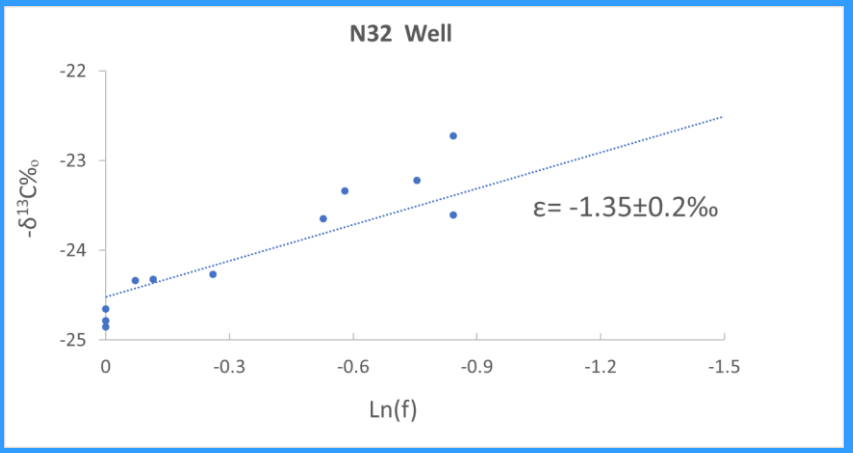


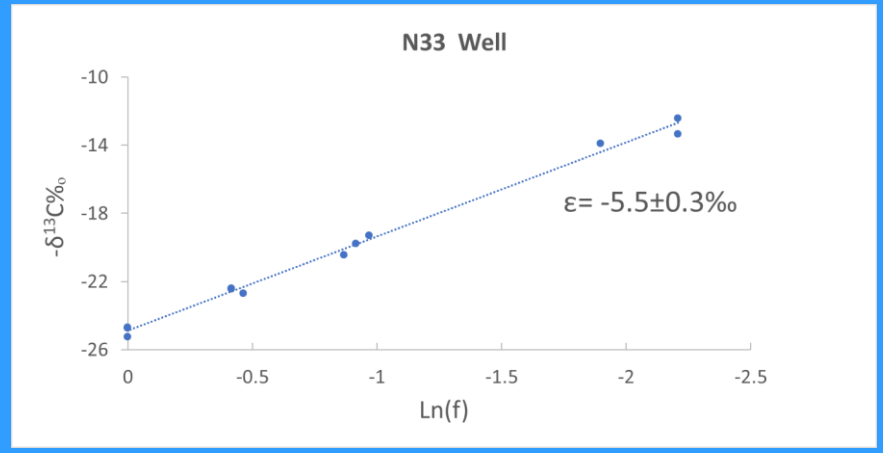


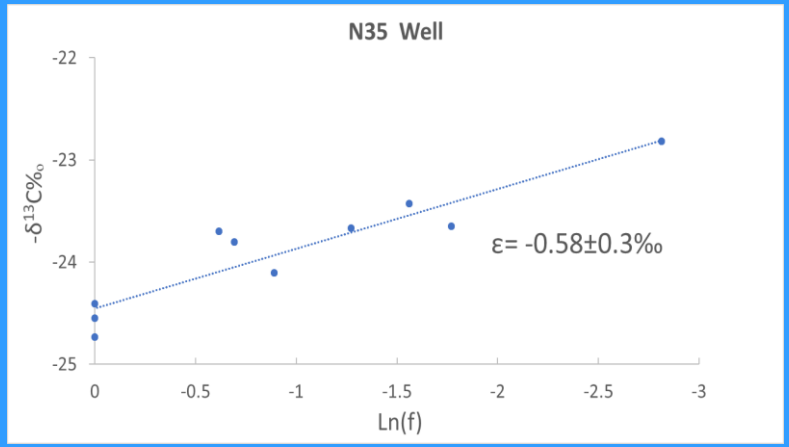
RESULTS

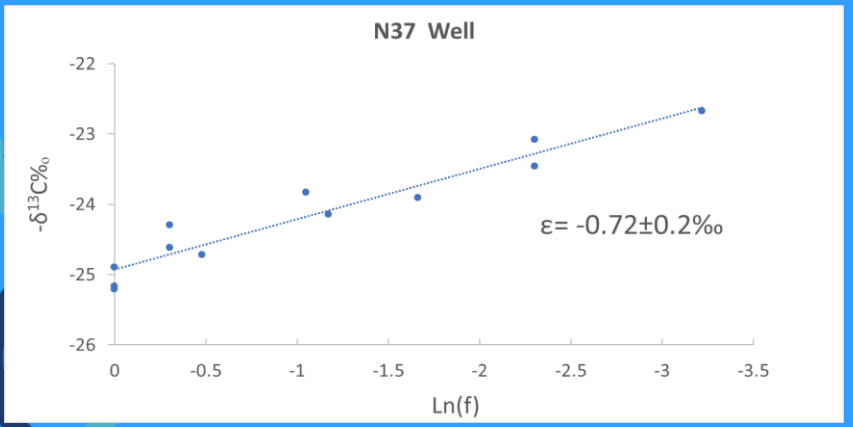
Carbon Isotope Enrichment in Atrazine Degradation by Groundwater Cultures

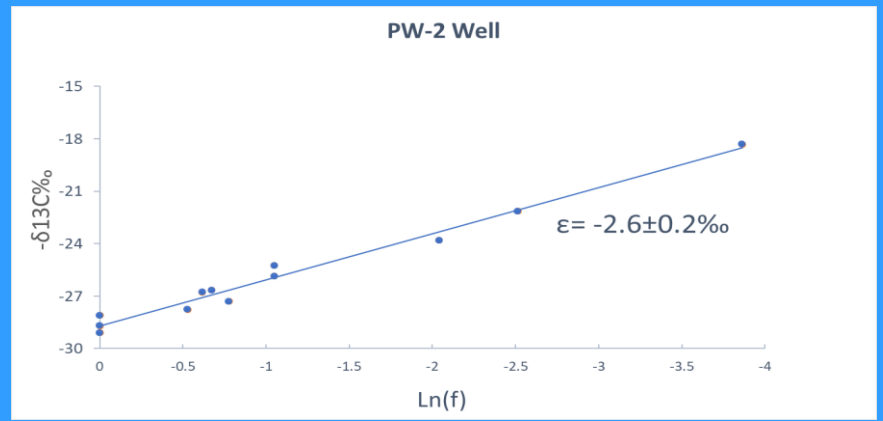
- Enrichment cultures derived from six wells were grown in large volume (1L) in triplicates.
- Samples were extracted along the degradation process and analyzed isotopically for δ13C.
- It matches Meyer 2009 (-1.8 to -5.4‰)

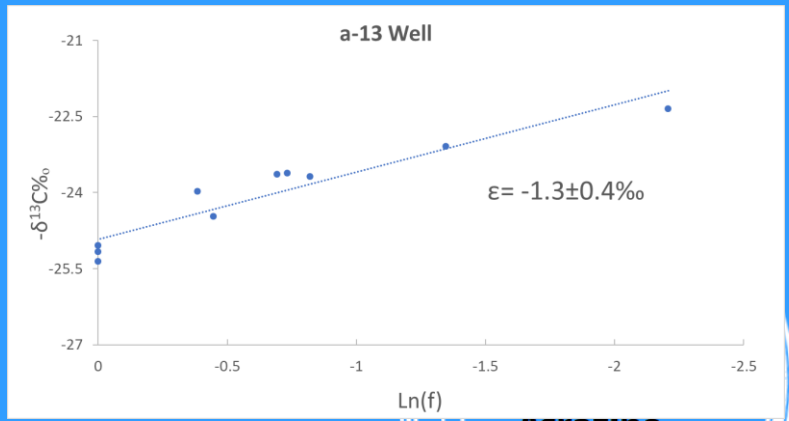






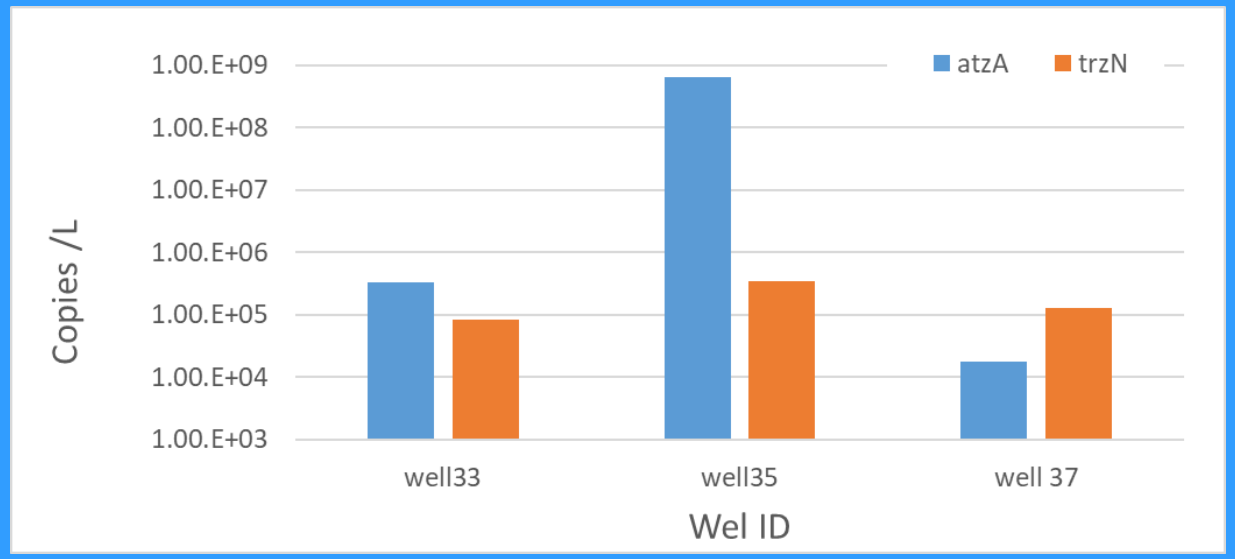


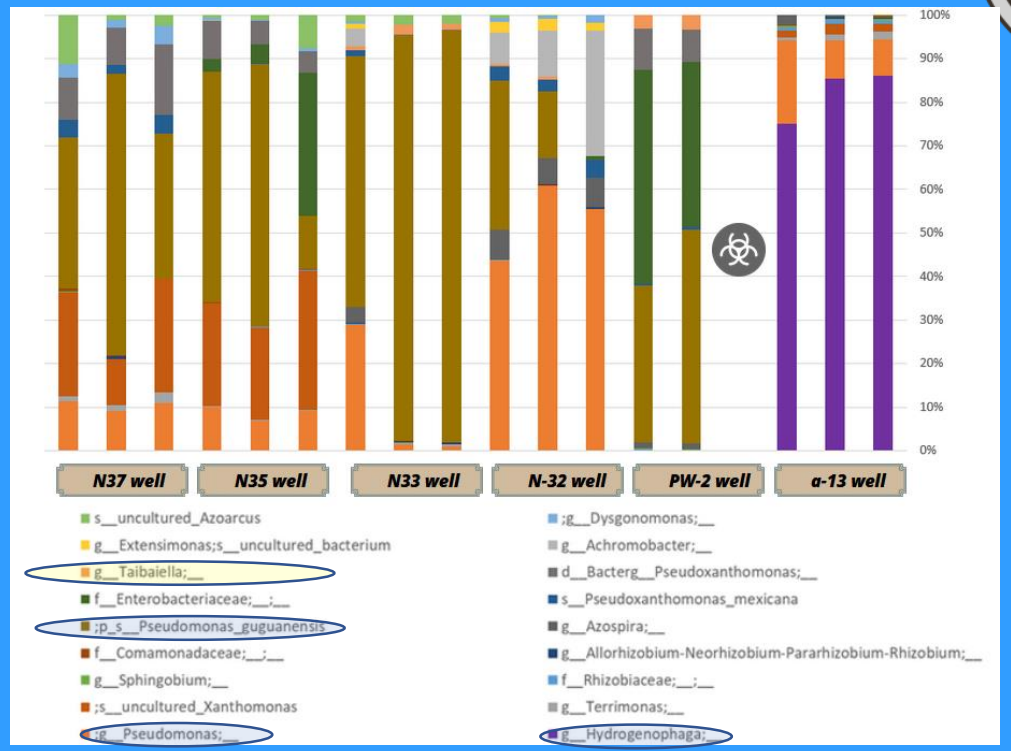


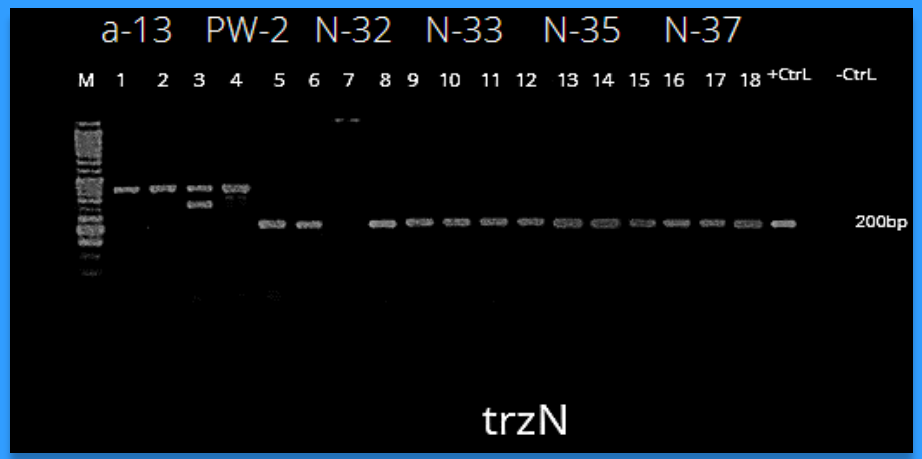


Atrazine

RESULTS
Identify and Quantify Atrazine Degrading Bacteria

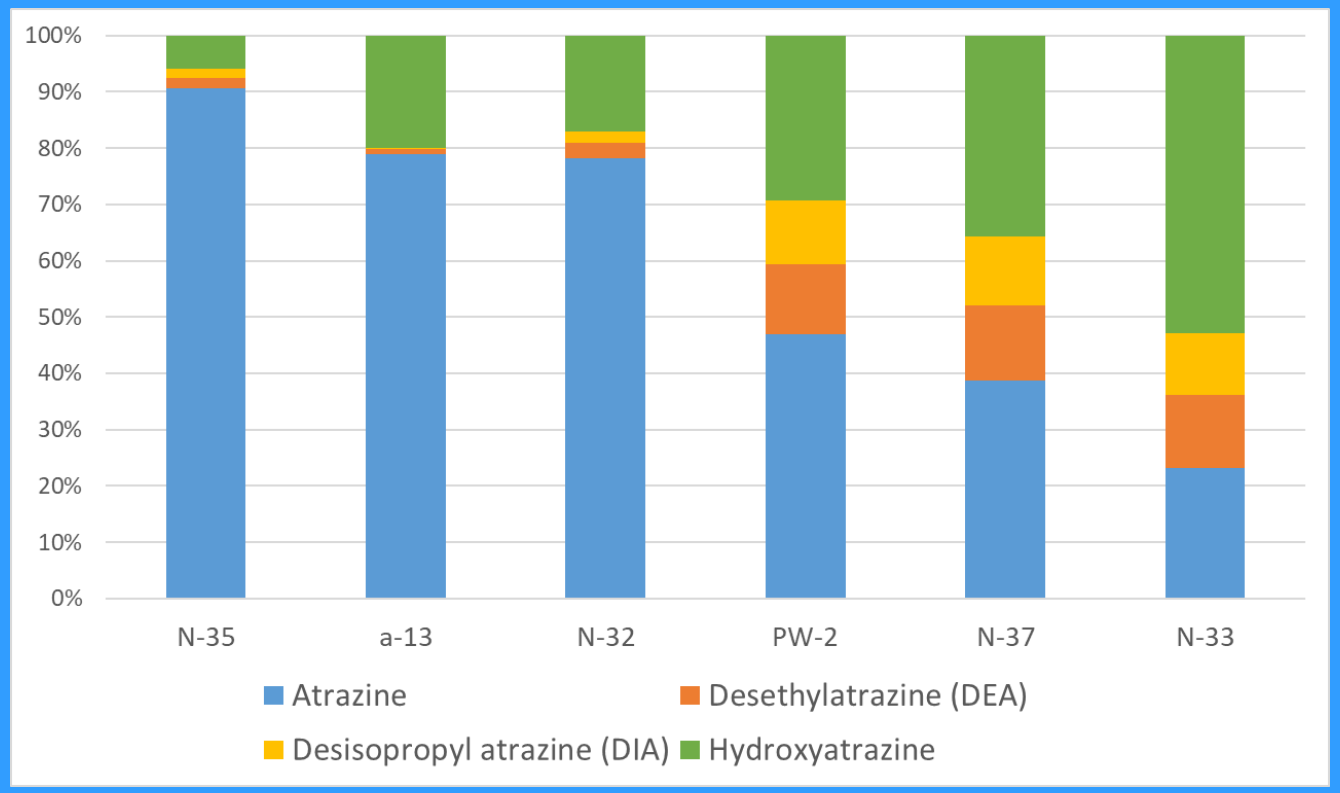


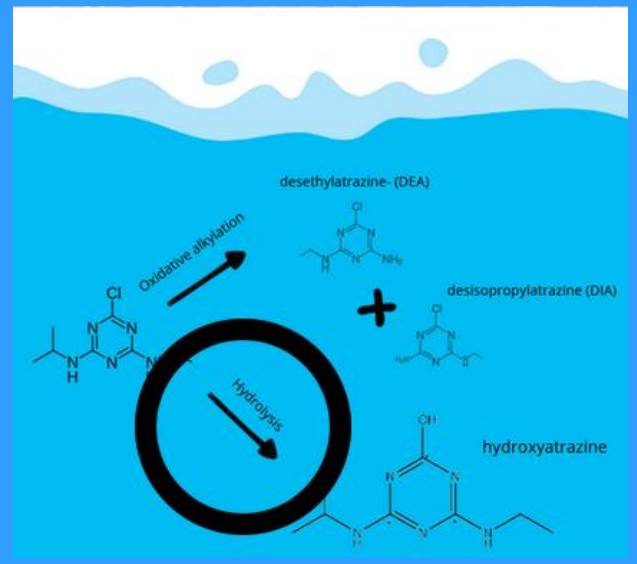




RESULTS
Evidence For Ongoing Degradation in The Field – LC-MS

	Atrazine	Desethylatrazine (DEA)	Desisopropyl atrazine (DIA)	Hydroxyatrazine	Residual Fraction
a-13	30.8	0.39	0.04	7.8	0.79
N-32	40.4	1.39	1.04	8.8	0.16
N-33	4.3	2.39	2.04	9.8	0.07
N-35	165.6	3.39	3.04	10.8	0.98
N-37	12.8	4.39	4.04	11.8	0.07
PW-2	20.6	5.39	5.04	12.8	0.27

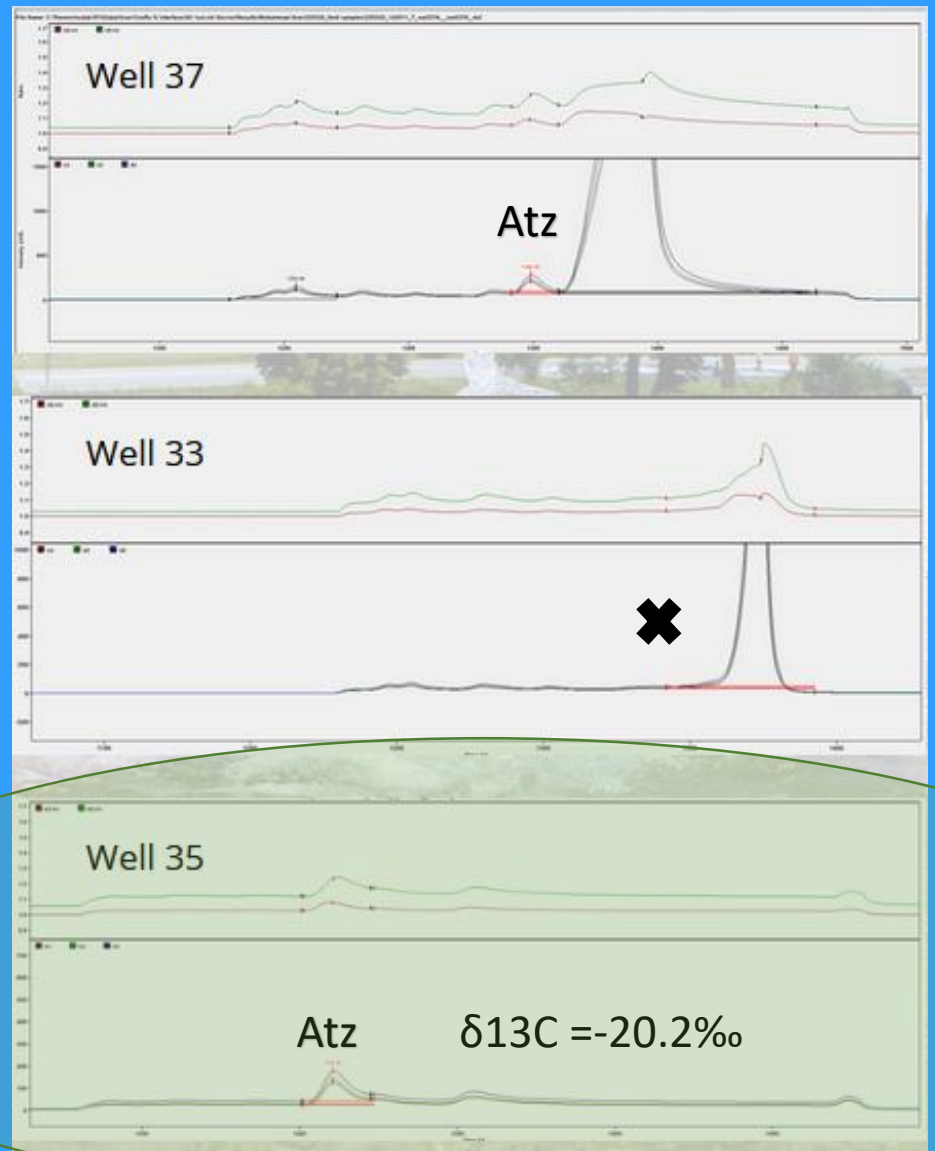




RESULTS

Evidence For Ongoing Degradation in The Field – GC-IRMS

☆ Carbon Isotope fractionation for field samples could not be measured.



δ13C =-26.2‰

CONCLUSION

- Broad potential for atrazine degradation in the contaminated site was presented . This potential may be accelerated in the presence of nitrate.
- PCR results in the enrichment cultures and qPCR results in groundwater showing the presence of both atzA and trzN genes - genes that are responsible to atrazine in transformation to hydroxyatrazine.
- Results presented significantly different carbon isotope effects between indigenous cultures of varying wells (-0.58 to -5.5‰) which agrees with the range found by Meyer et al(2009).
- The detection of hydroxyatrazine in groundwater indicates ongoing degradation in the site and the hydrolysis pathway is dominating.

Acknowledgment

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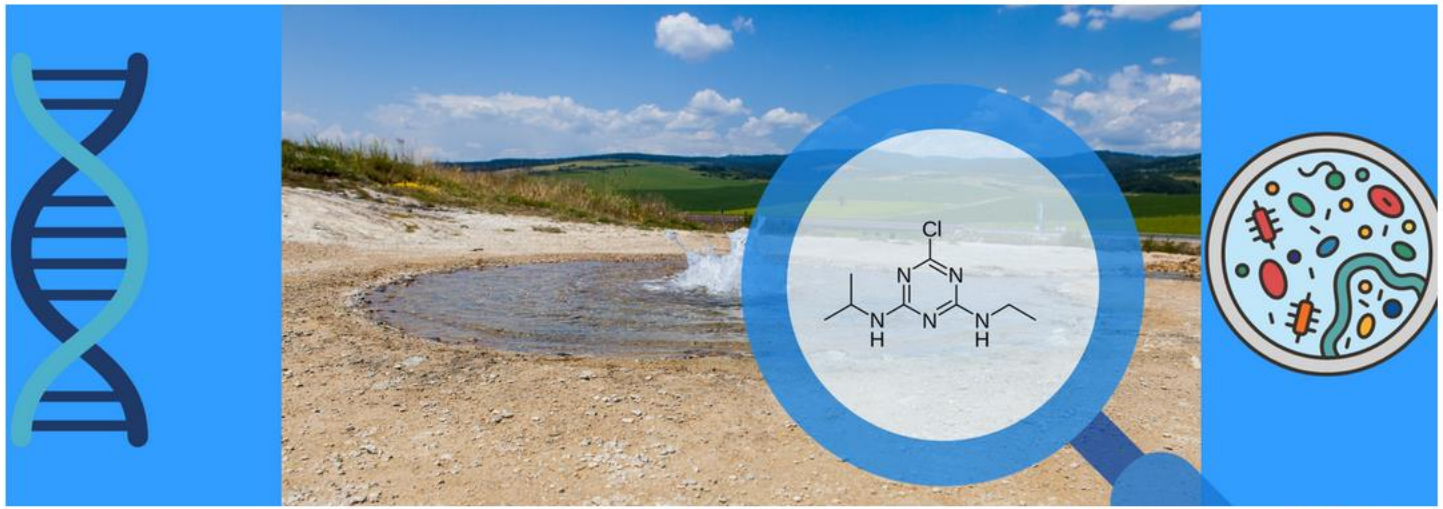

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