

2007 AGU Fall Meeting, 13 December
San Francisco, California

Trace Perchlorate in Background Ground Water and Local Precipitation, Northern Rio Grande Basin, New Mexico

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11.15.07

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Acknowledgements

- DOE
- Los Alamos National Laboratory
- New Mexico Environment Department –
Hazardous Waster Bureau
- EPA Region 6

Objectives:

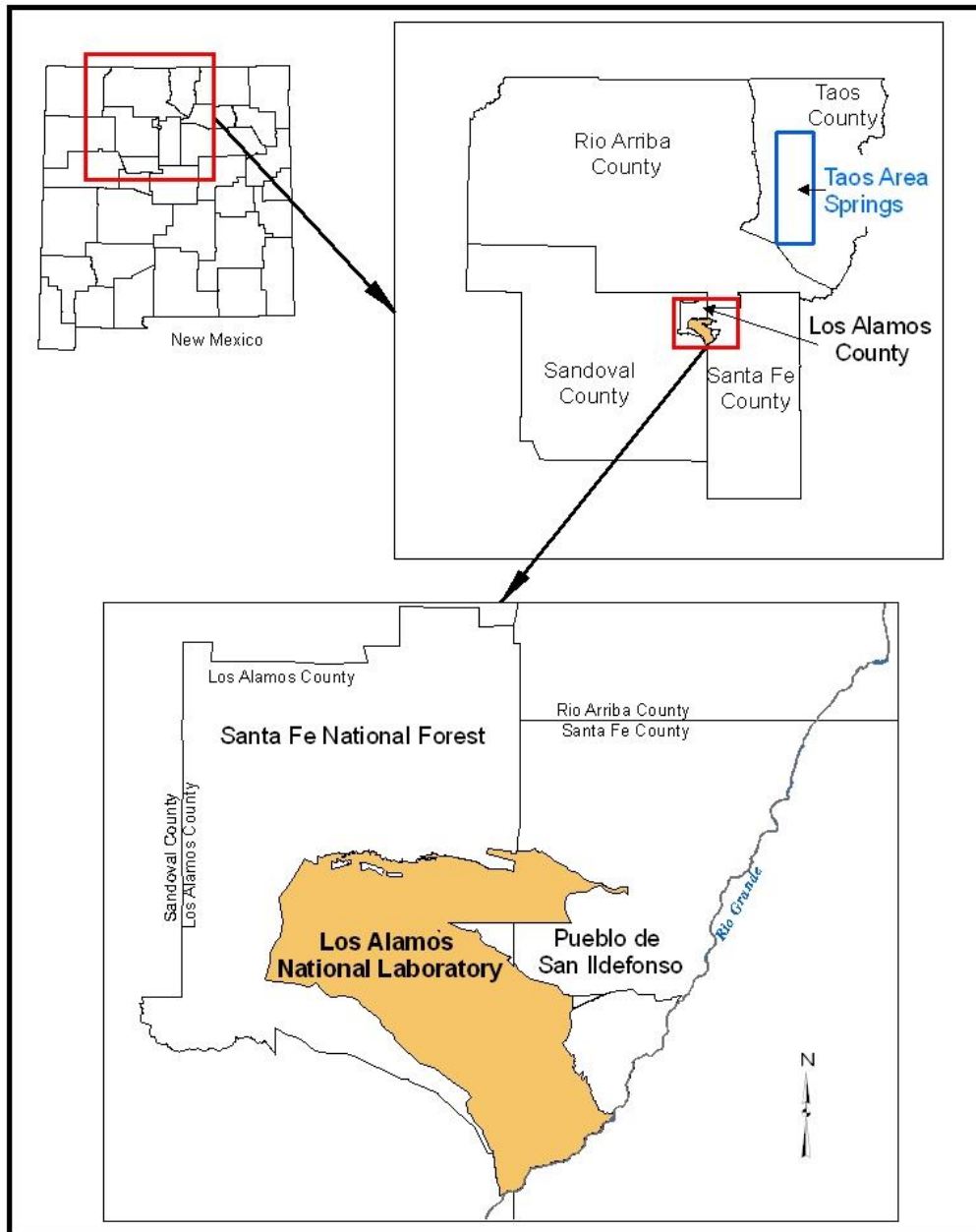
- **Determine background concentrations**
- **Determine variability and spatial distributions**
- **Assess any correlations**
- **Determine the presence or absence precipitation**

Recent studies:

- Balaji Rao, et al., 2007
- Srinath Rajagopalan, et al., 2006
- Neil Plummer, et al., 2006
- Purnendu Dasgupta, et al., 2005
- W. Andrew Jackson, et al., 2005

Analytical Methods

- **Perchlorate**, LC/MS/MS and IC/MS/MS w/ DL's from 0.05 to 0.01 $\mu\text{g/L}$
- **Tritium**, low-level electrolytic enrichment and ingrowth
- **Carbon-14**, accelerator mass spectrometry
- **Stable isotopes**, isotope ratio mass spectrometry
- **Anions**, ion chromatography
- **Metals**, inductively couple (argon) plasma-optical emission spectroscopy (ICP-OES) and inductively couple (argon) plasma-mass spectrometry (ICP-MS)
- **Total carbonate alkalinity**, titration

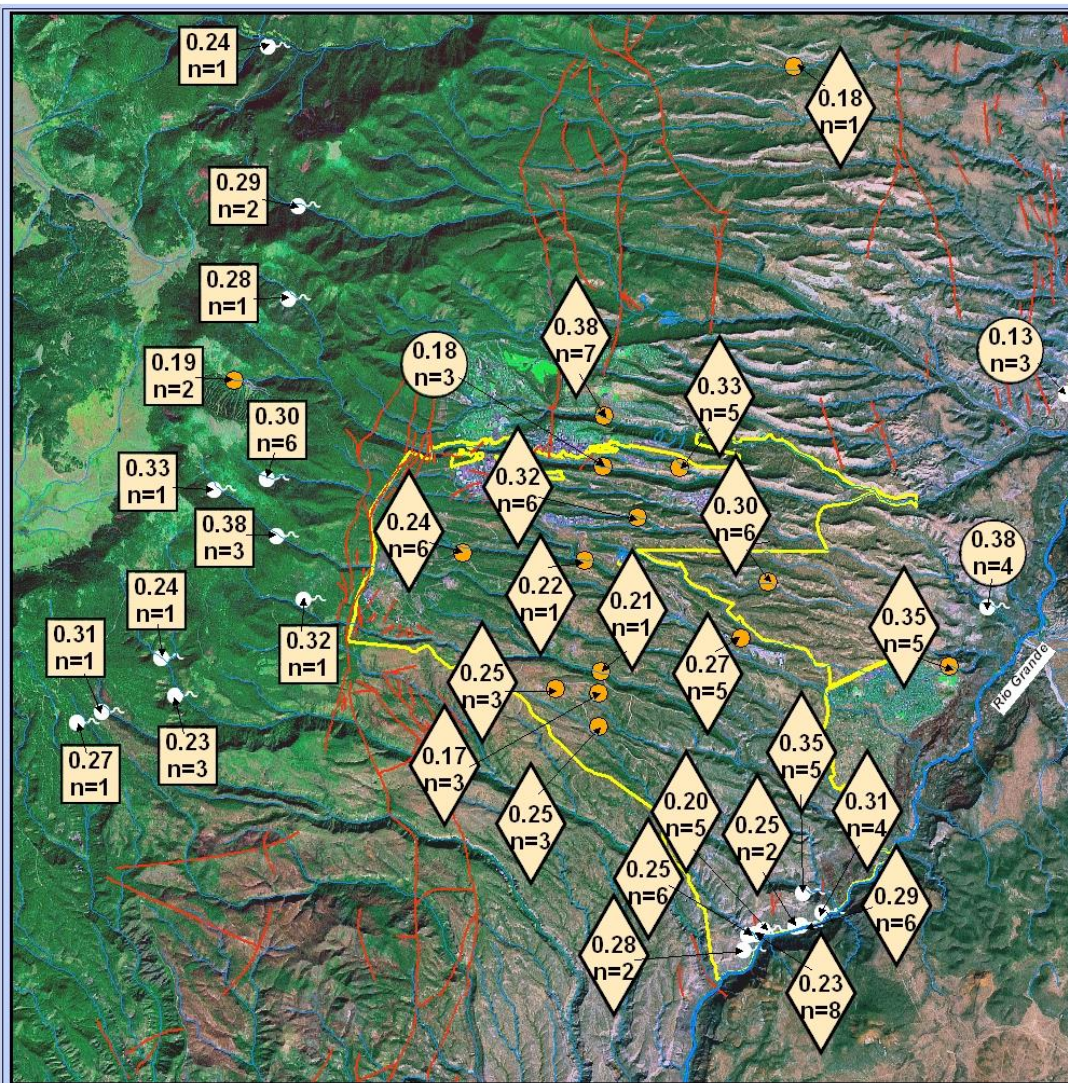


Study Area for Background Perchlorate in Ground Water

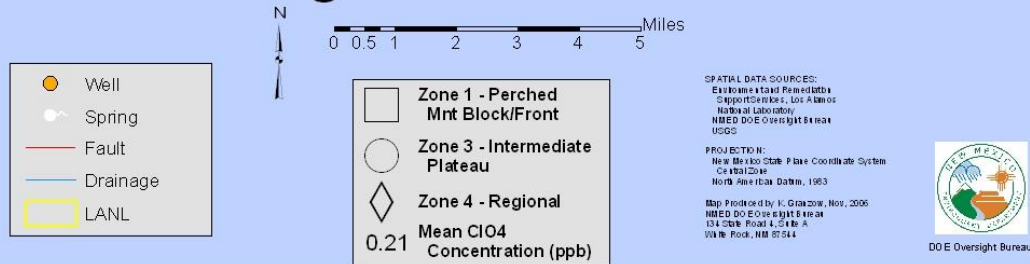




Concentration, Variability and Distributions



Mean Background Perchlorate Values



"W"

"E"



13 results
Two detections at 0.010 and 0.021 µg/L - DL at 0.001 µg/L;

| |
|-----------|
| Tuff |
| Basalts |
| Dacite |
| Sediments |

3100 m
2900 m
2700 m
2500 m
2300 m
2100 m
1900 m
1700 m
1500 m

Zone 1

23 results
Mean - 0.28 µg/L (+/-0.05)
Maximum - 0.44 µg/L

10 results
Mean - 0.23 µg/L (+/-0.13)
Maximum - 0.45 µg/L

Zone 3

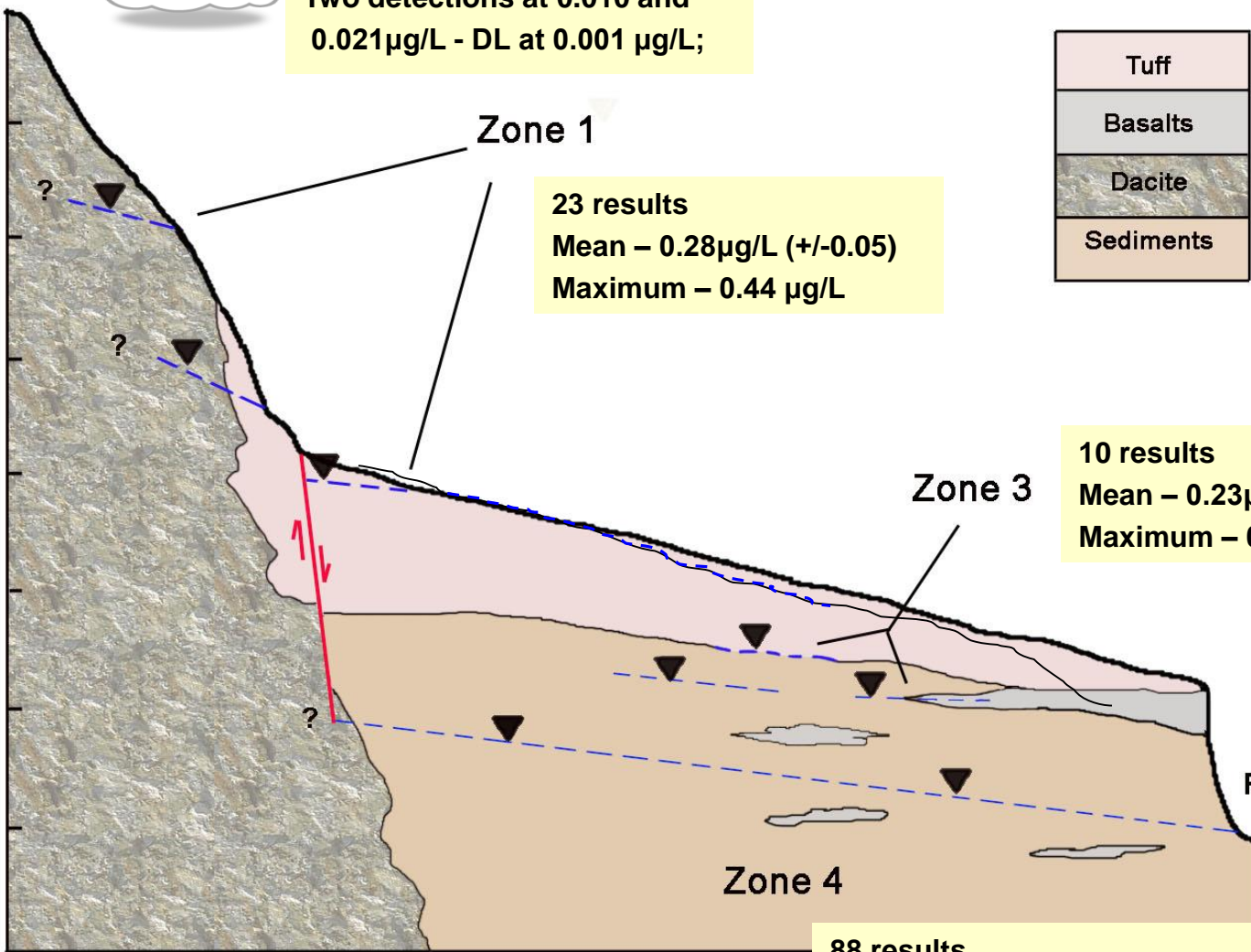
Zone 4

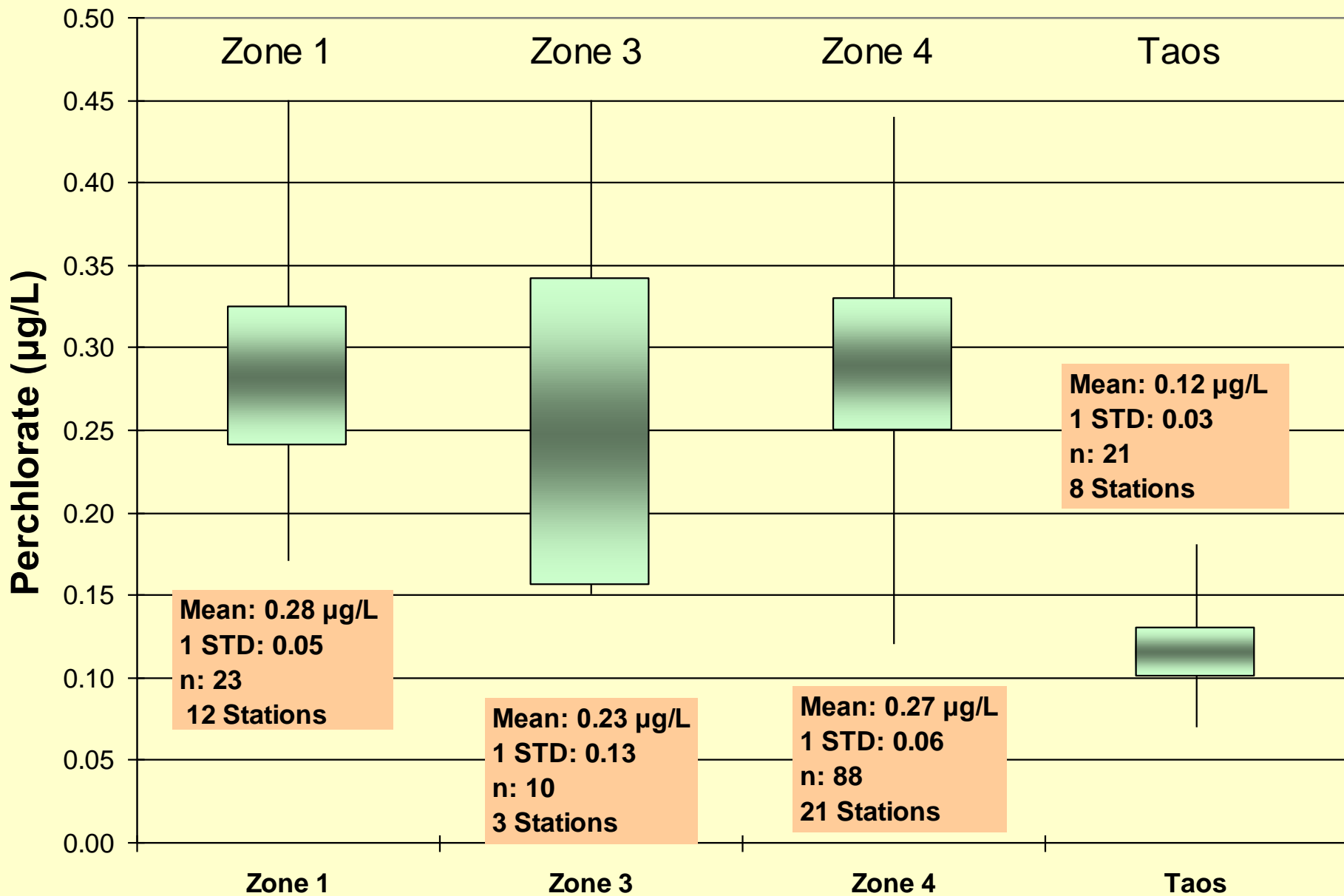
Rio Grande

10x VE

1 cm = 1000 m

88 results
Mean - 0.27 µg/L (+/-0.06)
Maximum - 0.44 µg/L

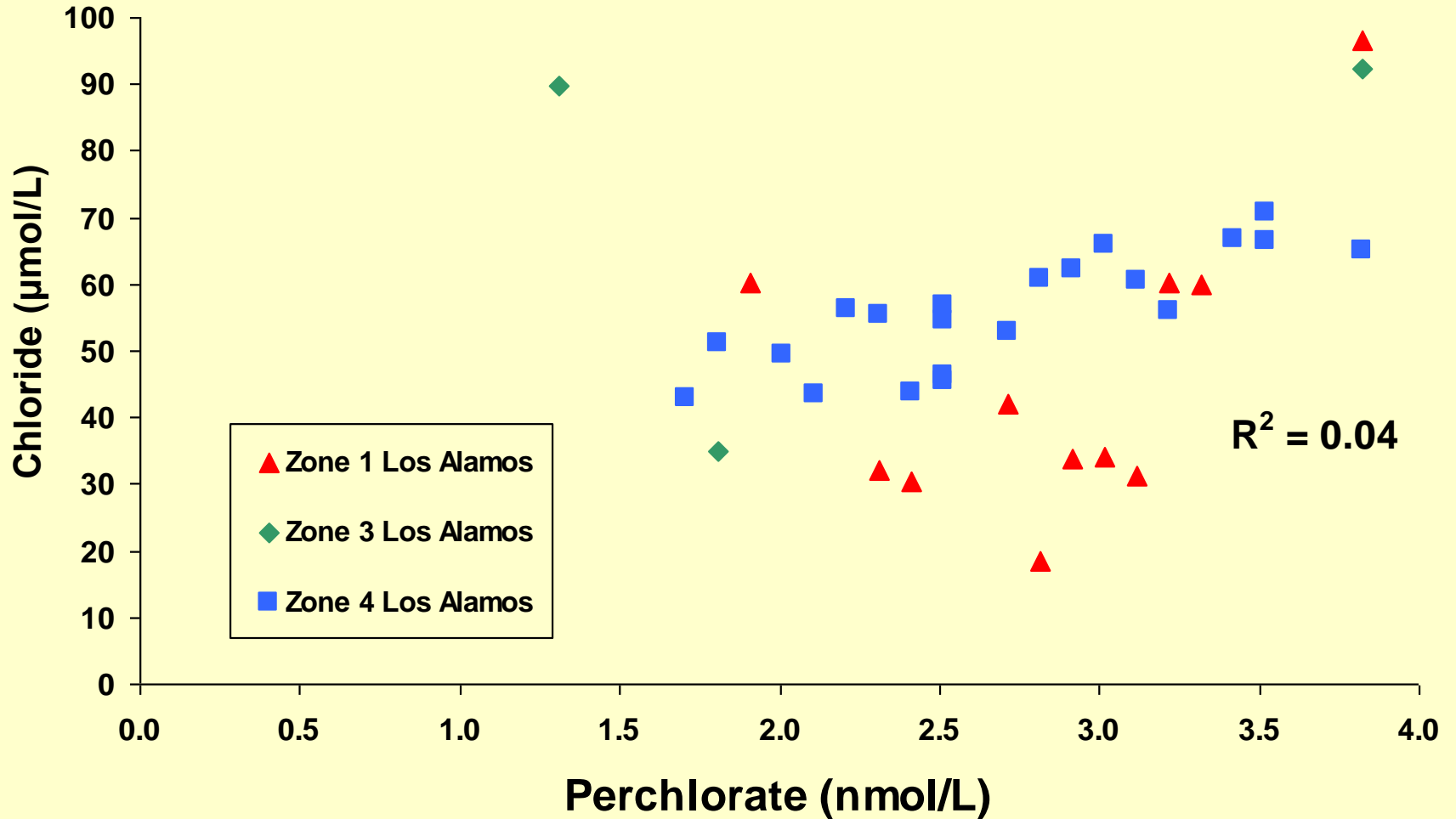




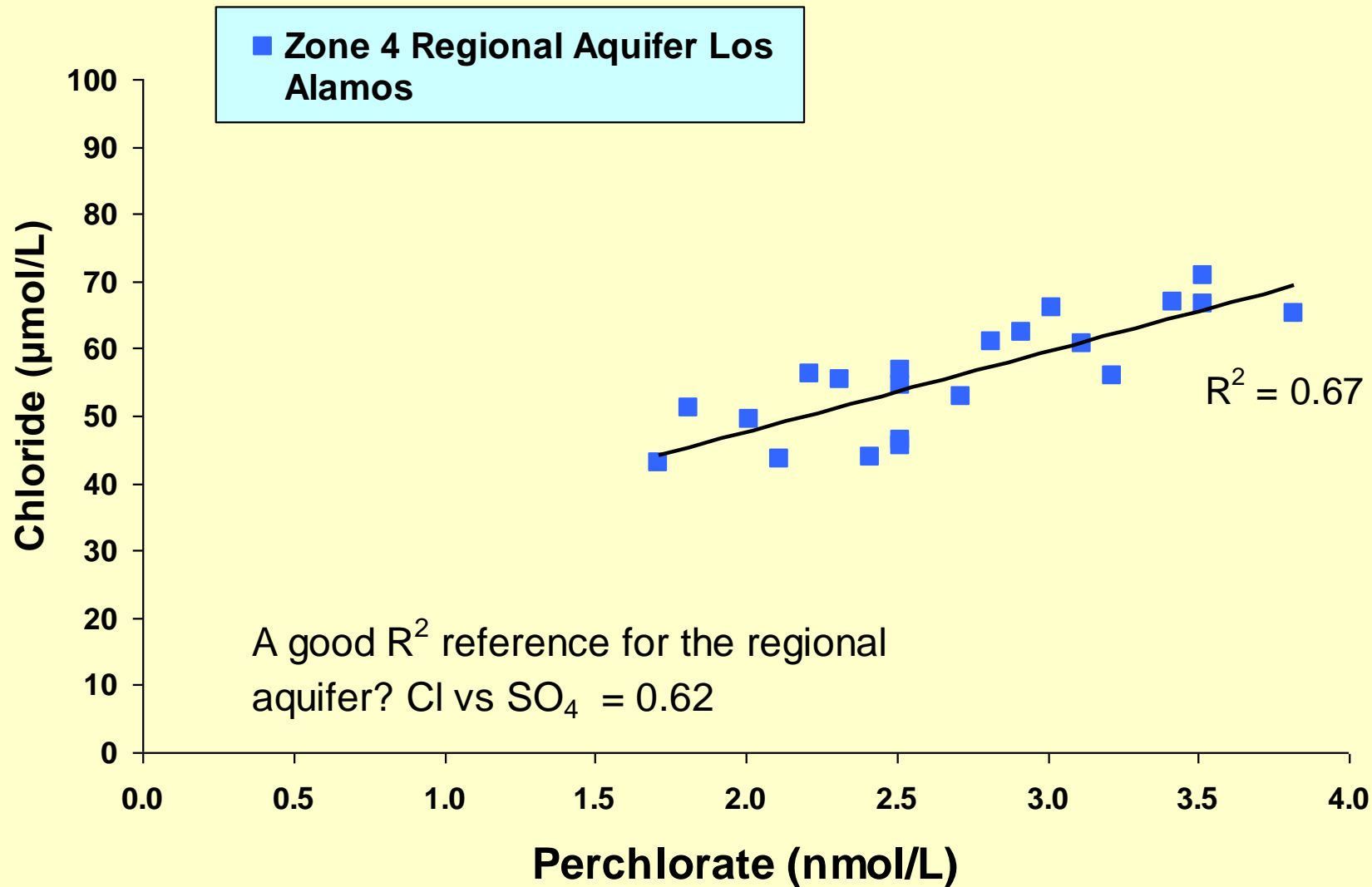
Correlations

Perchlorate vs Chloride - Background

Los Alamos Ground-Water System

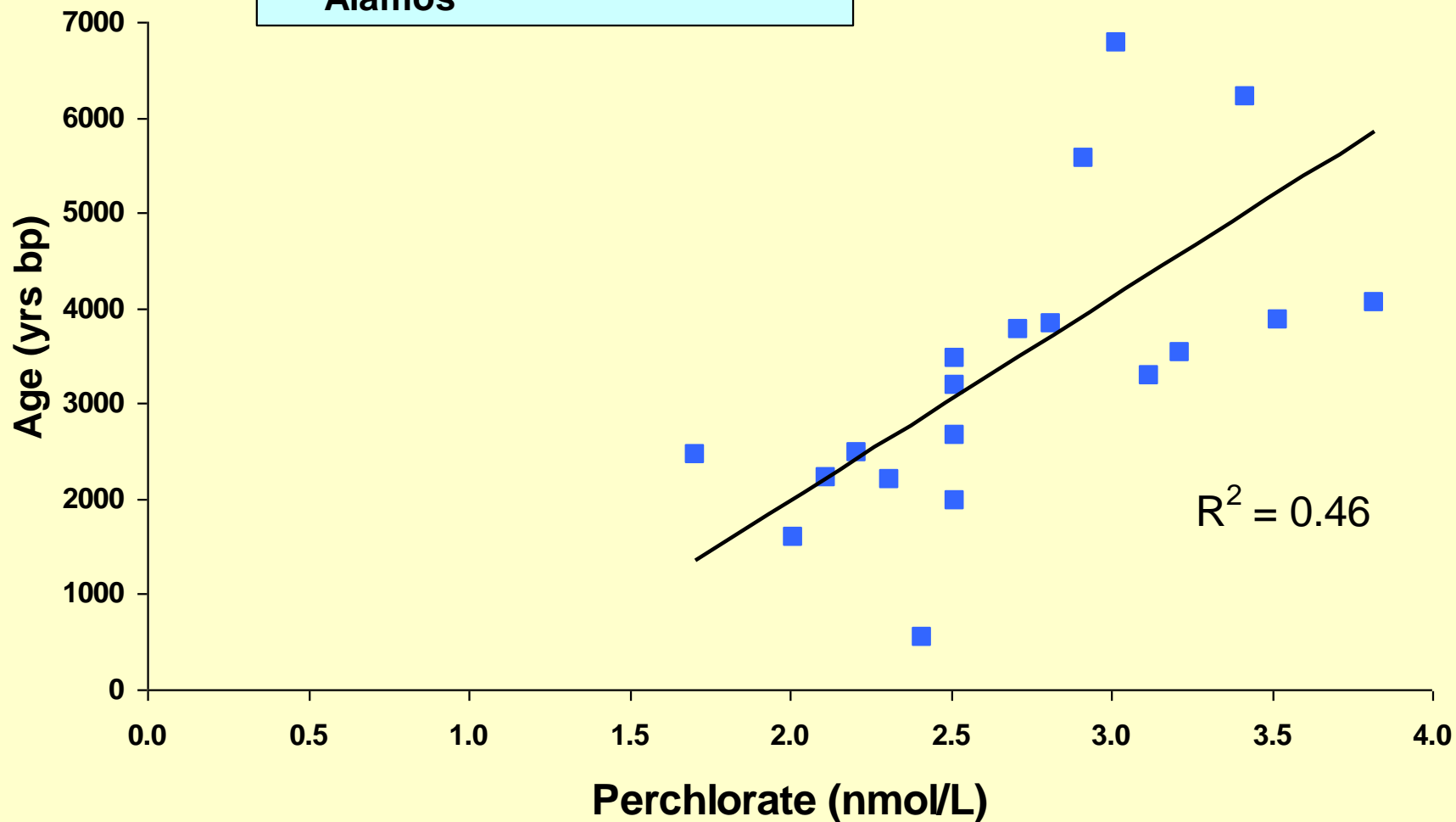


Perchlorate vs Chloride - Background



Perchlorate vs Age - Background

■ Zone 4 Regional Aquifer Los Alamos



Other Correlations for the Los Alamos Regional Aquifer:

- **Perchlorate vs Sulfate $R^2 = 0.51$**
- **Perchlorate vs Nitrate $R^2 = 0.07$**
- **Chloride vs Deuterium $R^2 = 0.45$**
- **Chloride vs Age $R^2 = 0.53$**

Summary

- Naturally occurring perchlorate is present in the ground-water system at Los Alamos;
- Concentrations are consistent from the recharge zones (modern age) to the discharge (submodern age) zones;
- Perchlorate is probably generated through evapotranspiration processes near the soil-bedrock interface then flushed during snowmelt percolation into the bedrock; and
- Perchlorate in precipitation?