

# Acetone Production as a Result of Sodium Bisulfate Preservation Using EPA Method 5035

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# Introduction

- Environmental investigation of MMR
- Explosives primary contaminants of interest
- Over 1,500 surface soil samples collected
- Over 650 subsurface soil samples

# Site Location



# Background

- Acetone and MEK initially observed at low levels in 1997 using Method 5030 (< 20 ppb)
- Upon switch to Method 5035 (sodium bisulfate preservation) high levels of acetone and MEK observed ( > 100 ppb)

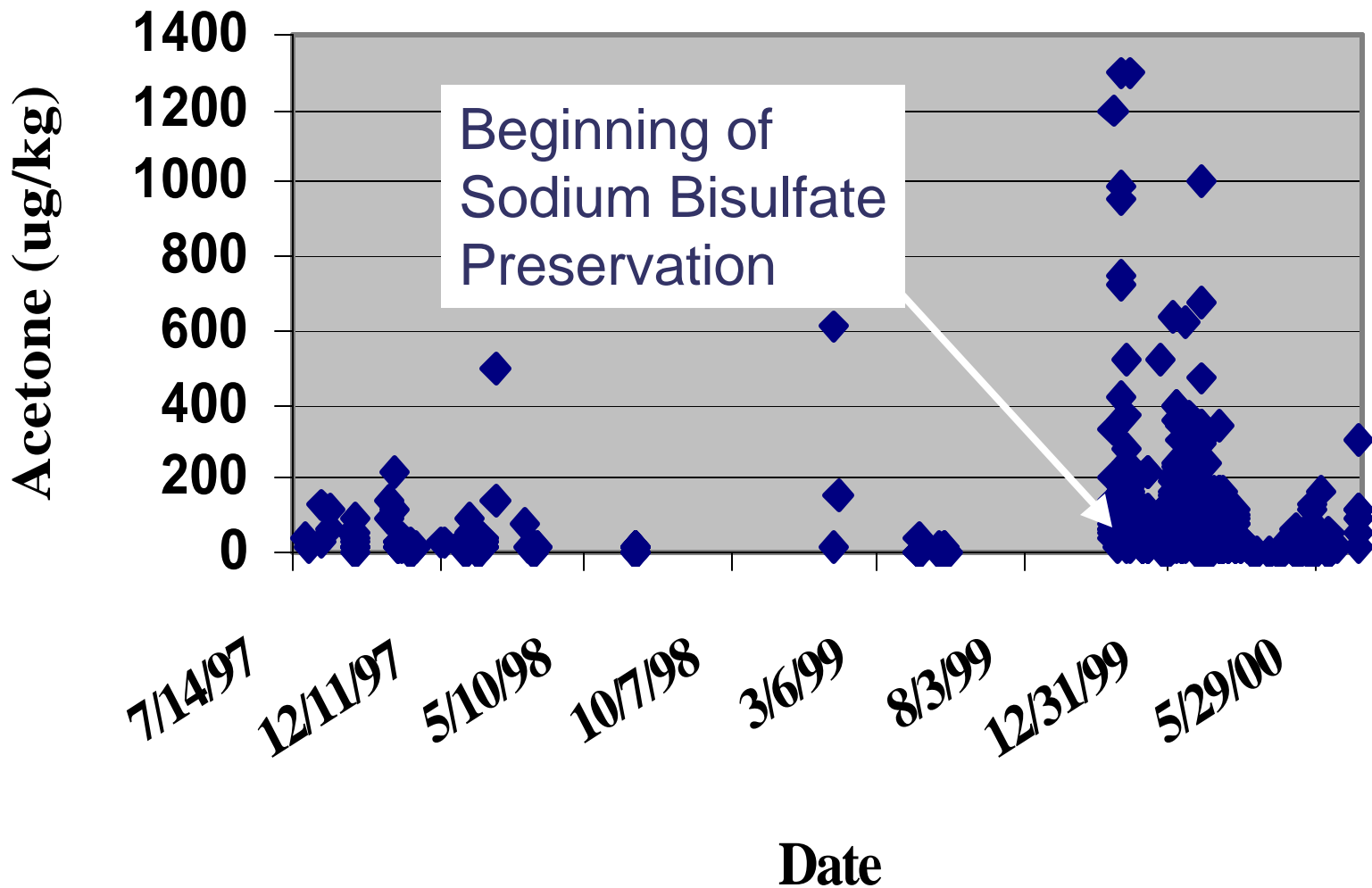
## Method 5030 Issues

- Significant volatilization loss
- Potential for biodegradation
- MADEP recognition of Method 5030 shortcomings resulted in adoption of Method 5035 in early 1999

## Method 5035 Options

- Methanol Preservation
- Sodium Bisulfate Preservation
- Deionized water
- No preservative, special sampler

# Acetone in Project Samples



# Potential Acetone Sources

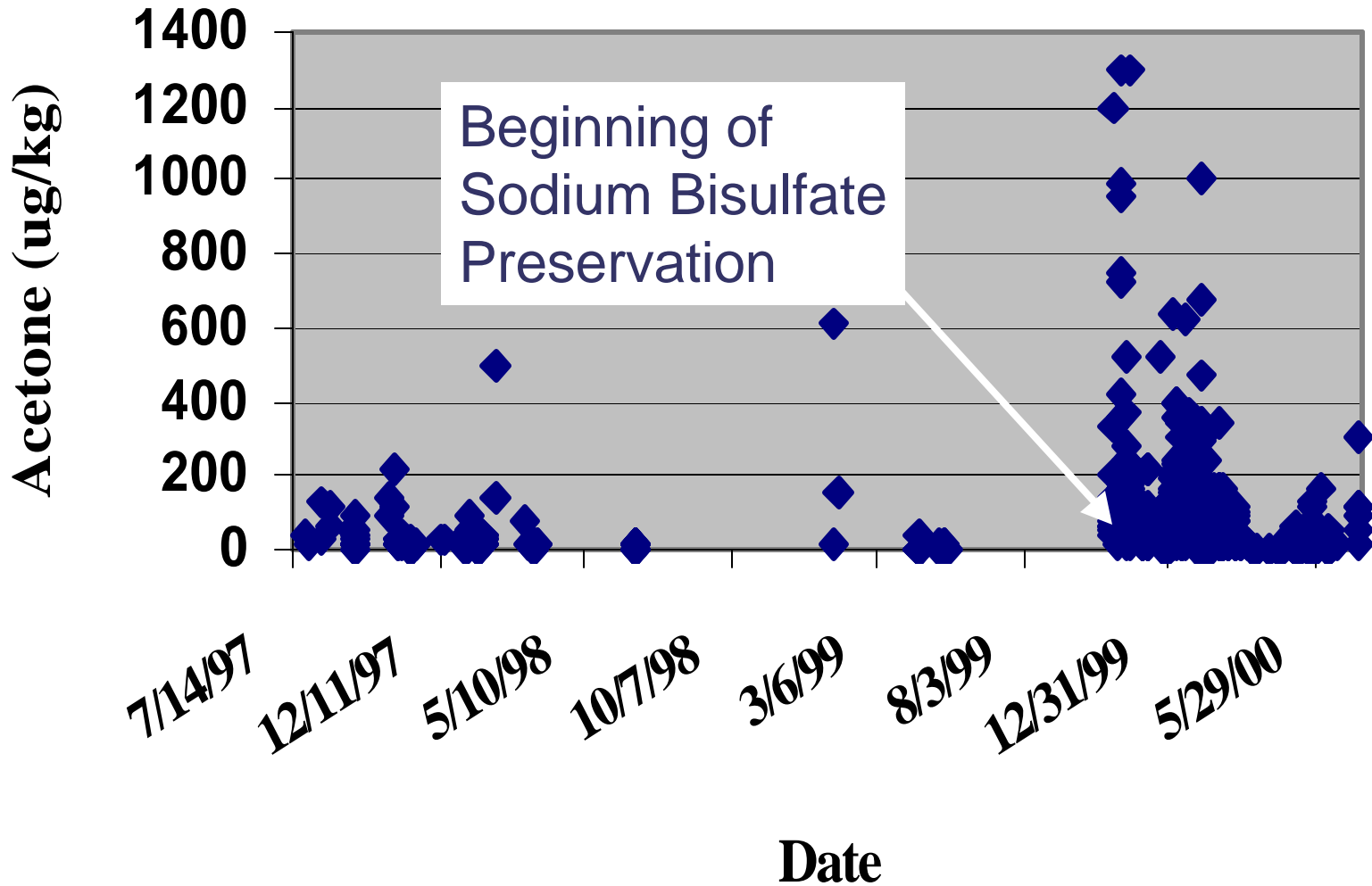
- Site contamination
- Matrix effect
- Instrument effect
- Laboratory cross-contamination
- Field contamination
- Chemical reactions in sample



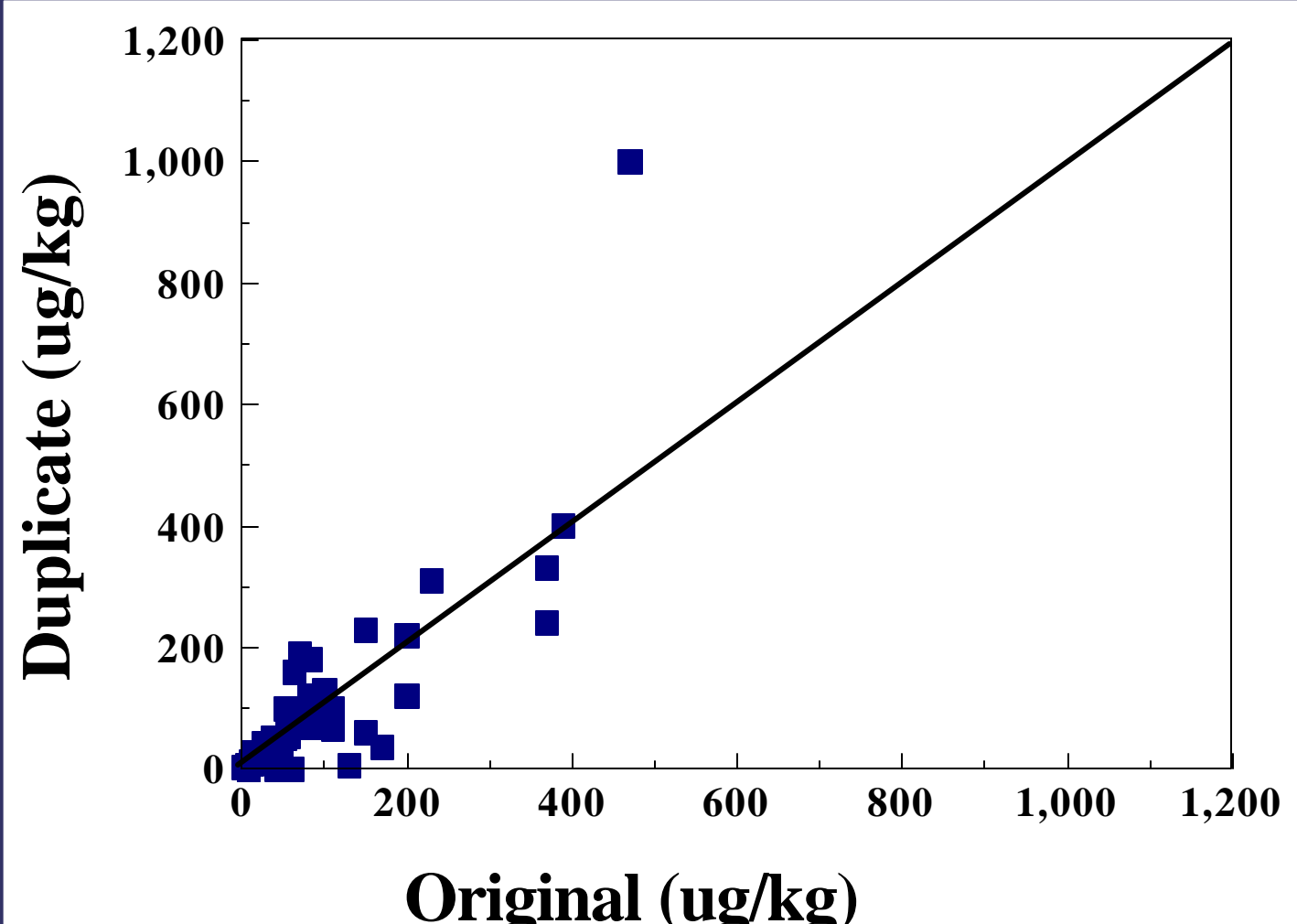
## Incidental Sources of Acetone

- HPLC Grade Methanol - 11 and 14 ug/L
- Antifreeze - 360 ug/L
- Electrical Tape - 5 ug/L
- Ambient air in field - 6 ug/L
- Sharpies - 4 ug/L

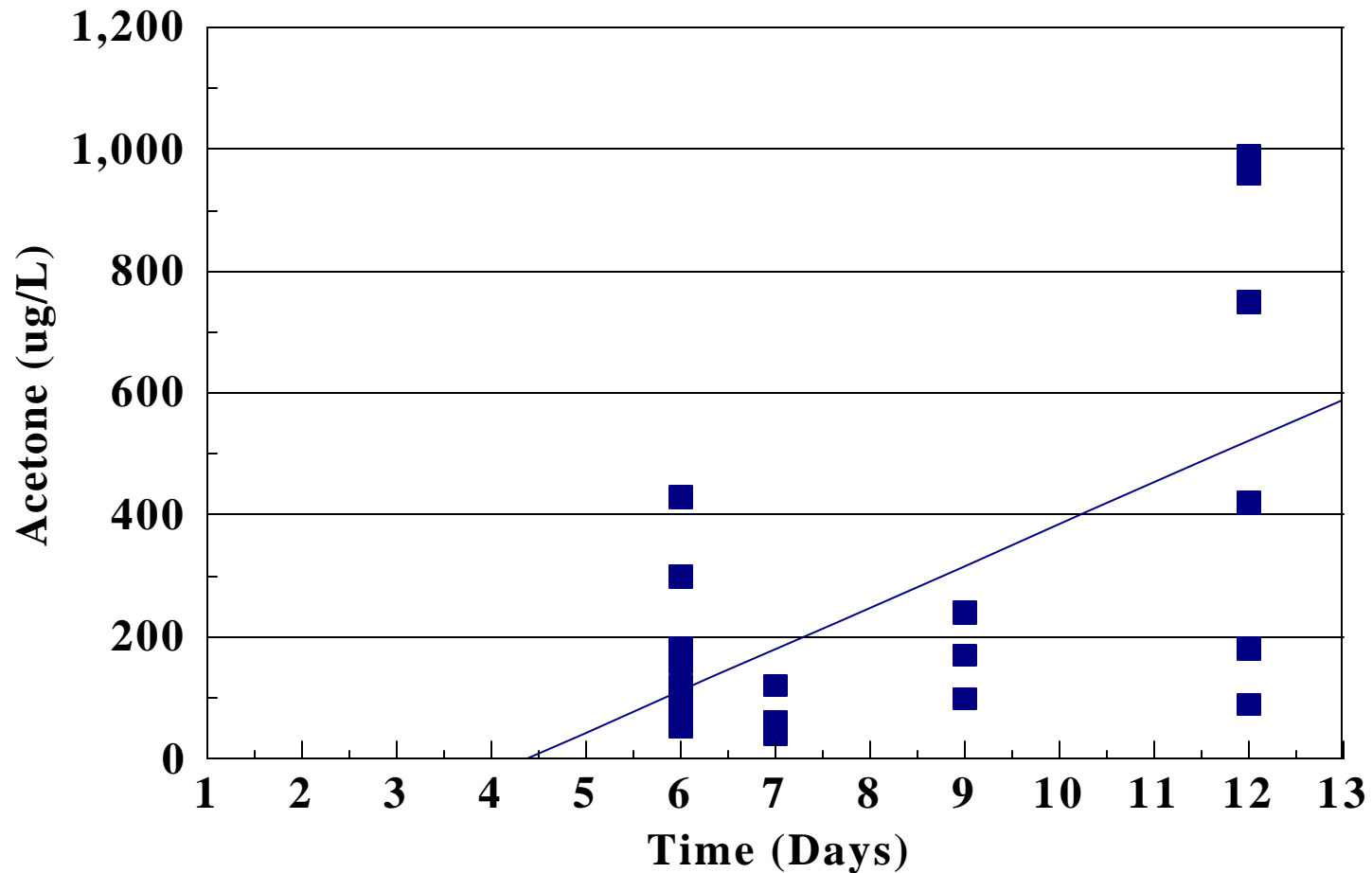
# Acetone in Project Samples



# Acetone Levels in Field Duplicates



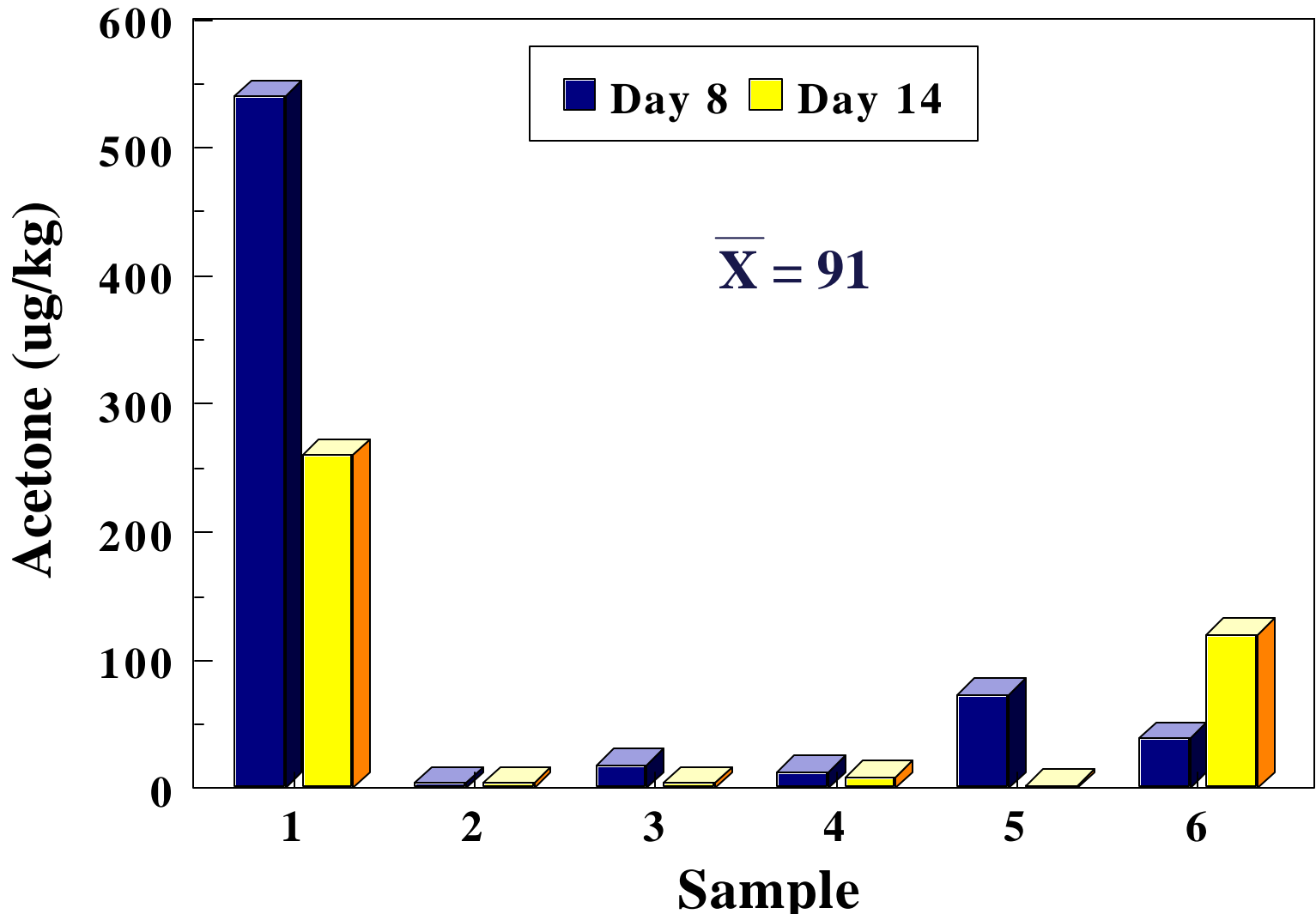
# Acetone in Site Samples vs Contact Time with Sodium Bisulfate



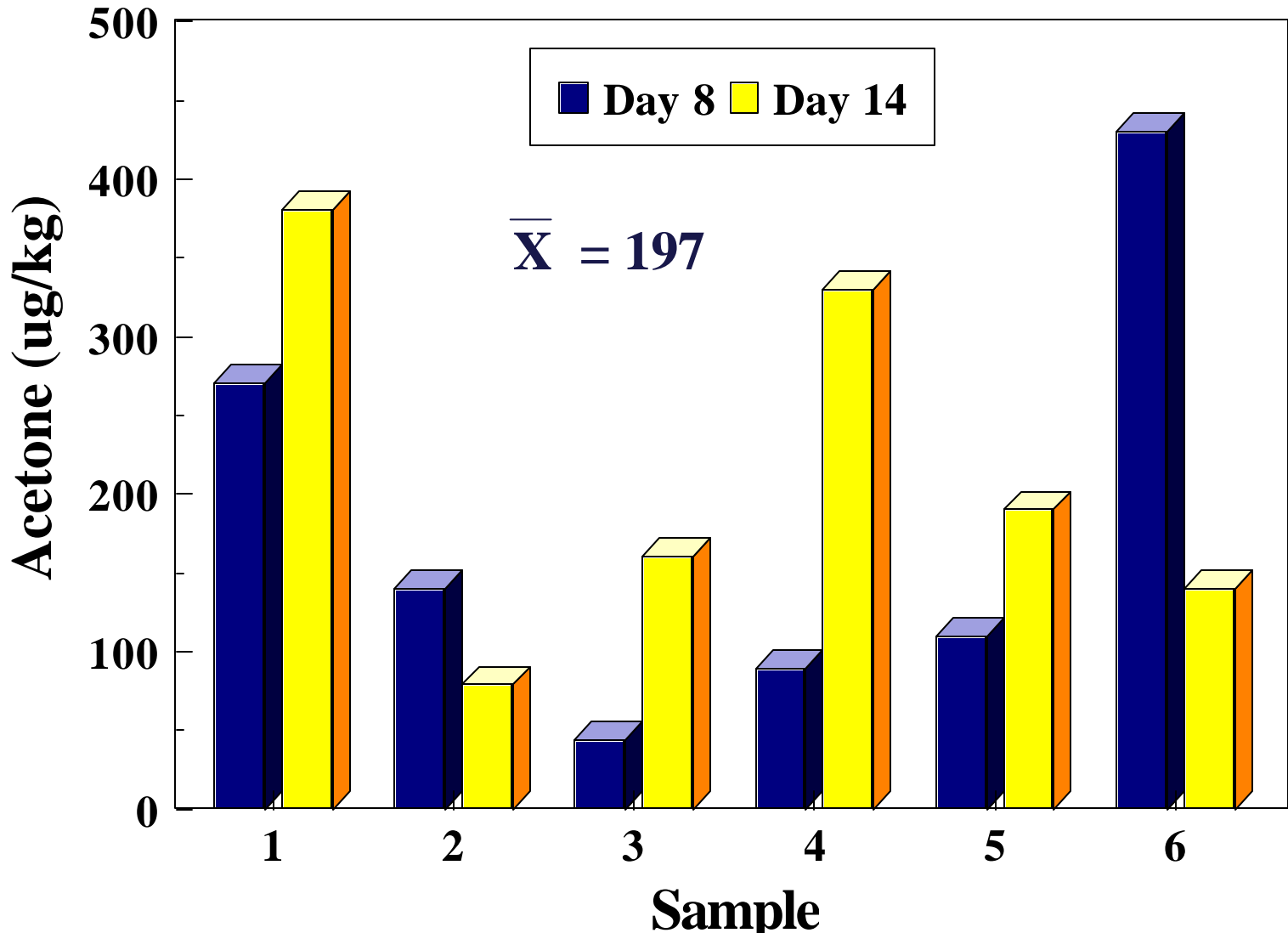
# Preliminary Evaluation

- Deionized Water
- Sodium Bisulfate

# Deionized Water Preserved Samples



# Sodium Bisulfate Preserved Samples



# Sodium Bisulfate Preservation Observations

- Increased frequency of detection of acetone and MEK
- Higher concentrations of acetone and MEK



# Soil Preservation Methods Evaluated

- No preservative (Method 5030)
- Deionized Water
- Frozen Deionized Water
- Sodium Bisulfate
- Sodium Bicarbonate
- Methanol

# Soil Properties

- Uncontaminated Site Soil w/ native plant material  
Organic Loam

Initial pH = 5.22

Moisture content = 19 %

Sand

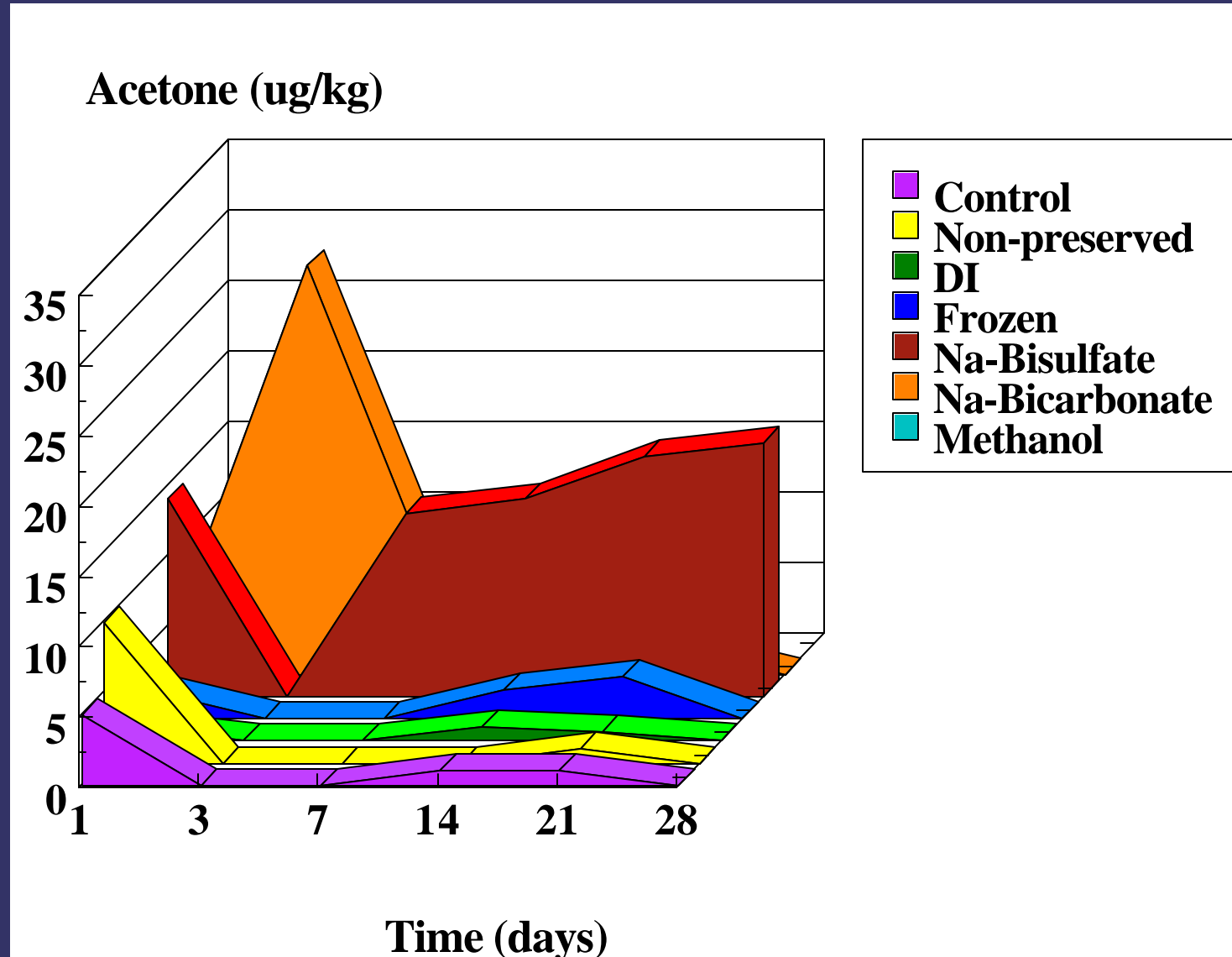
Initial pH = 6.00

Moisture content = < 10 %

- Control Sample - organic free sand

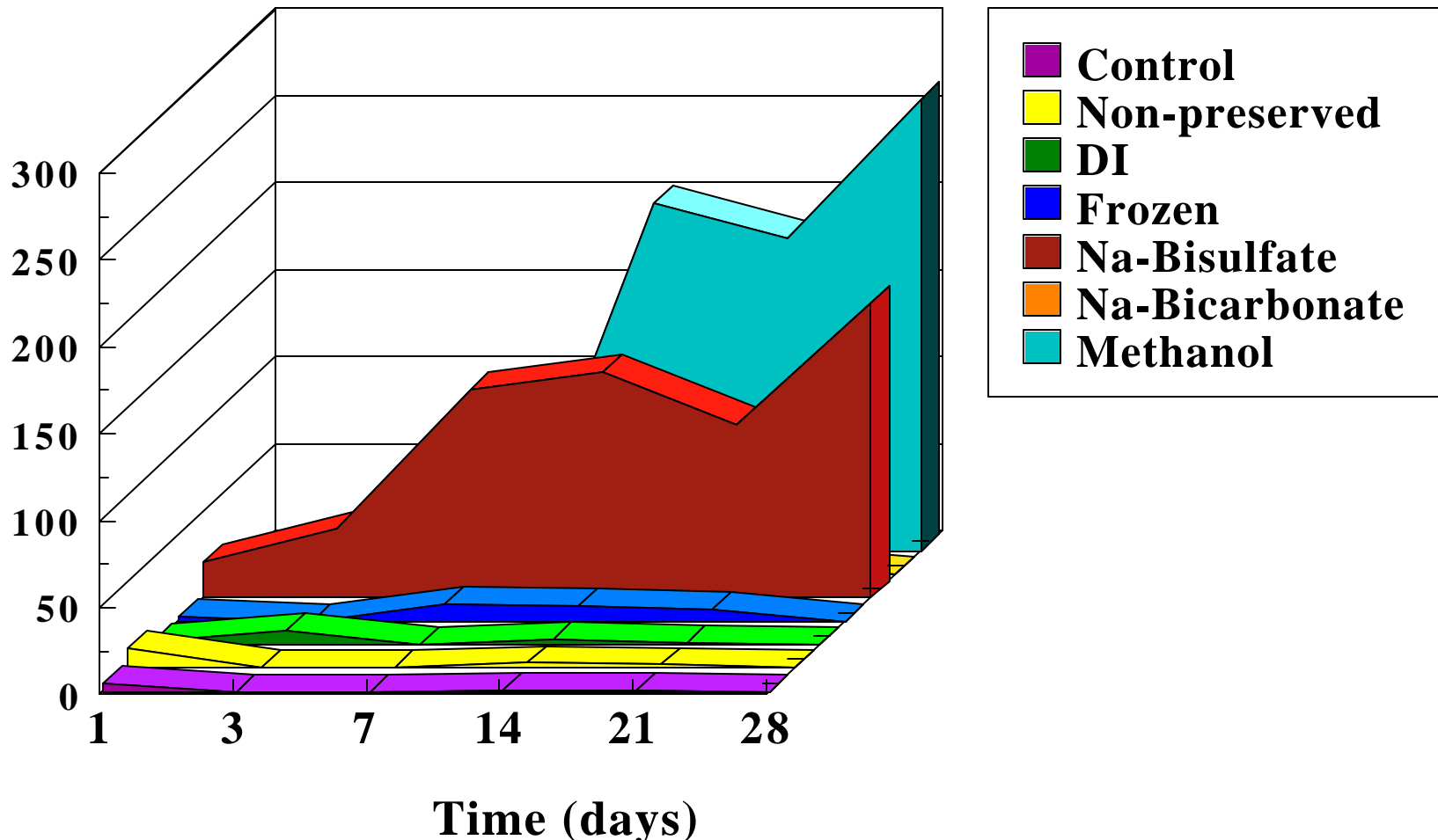


# Preservation Methods - Sand



# Preservation Methods - Organic Loam

Acetone (ug/kg)



# Multiple Regression Analysis

- **Detected acetone concentrations may depend on**
  - Concentration of organic carbon (OC) in the sample
- **Sample holding time (HT) 490 samples analyzed for acetone**
  - 490 HT measurements
  - 177 samples also analyzed for OC
- **Distributions of acetone concentrations, OC concentrations, and HT appear skewed**
- **Log-transformed data were used in regression analysis**

# Results of Simple Linear Regression

- **Significant correlation between acetone and OC ( $p < 0.001$ )**
  - $R^2 = 0.16$  (explains 16% of the variability in acetone concentrations)
- **Significant correlation between acetone and HT ( $p < 0.001$ )**
  - $R^2 = 0.04$  (explains 4% of the variability in acetone concentrations)

# Results of Multiple Regression Analysis

- **Acetone = 2.43\*[HT<sup>0.371</sup>]\*[OC<sup>0.308</sup>]**
- **p < 0.001**
- **Adjusted multiple R<sup>2</sup> = 0.22 (explains 22% of the variability in acetone concentrations)**
- **Holding time and organic carbon concentrations account for some of the variation in acetone concentrations**
- **Much of the variability remains unexplained**
- **Other variables may also influence acetone concentration**

## Conclusions

- Acetone production appears related to organic content and may result from oxidation of natural occurring waxes or humic material
- If acetone is a potential site contaminant sodium bisulfate should not be used
- Freezing of samples may be a preferred alternative



# Recommendations

- EPA reevaluate the appropriateness of sodium bisulfate
- Study of plant material and aliphatic hydrocarbons

