Reconnaissance Survey of Radionuclides and Arsenic in Water from Municipal Supply Wells, Houston, Texas

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In cooperation with the City of Houston, Texas

U.S. Department of the Interior
U.S. Geological Survey

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PRESENTATION OUTLINE

1. Description of reconnaissance survey
2. Study area
3. Hydrologic units in aquifer system
4. Chemistry of water & water types from wells sampled
5. Radionuclides
6. Arsenic and arsenic speciation
7. Summary

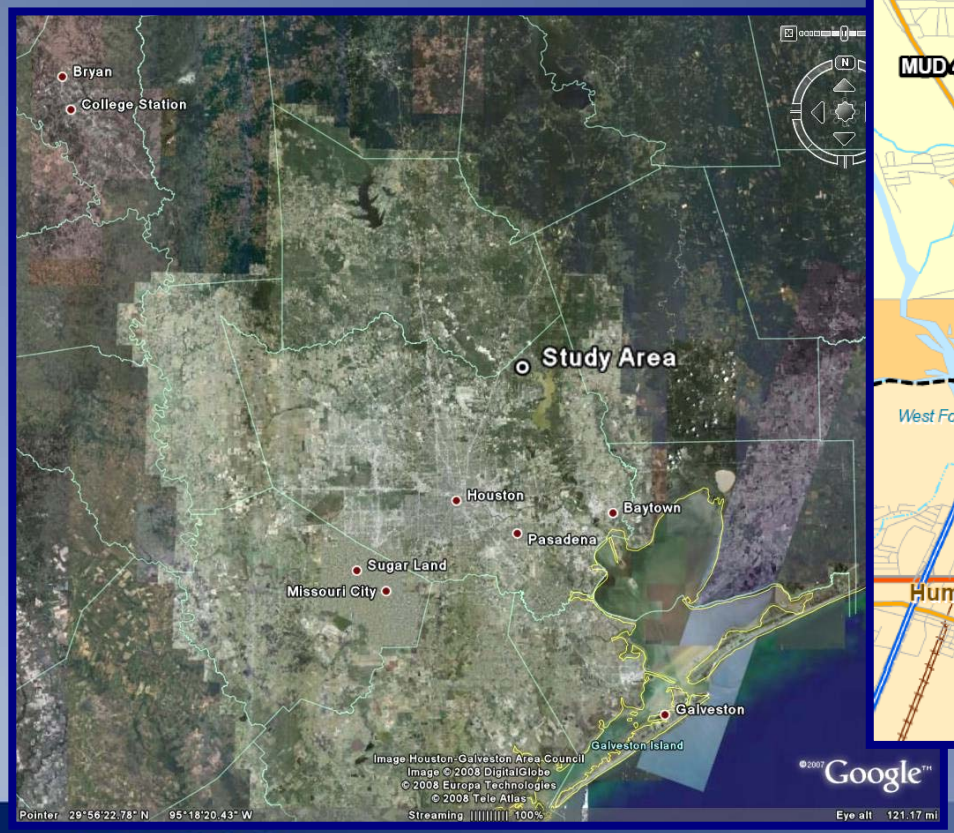
RECONNAISSANCE SURVEY

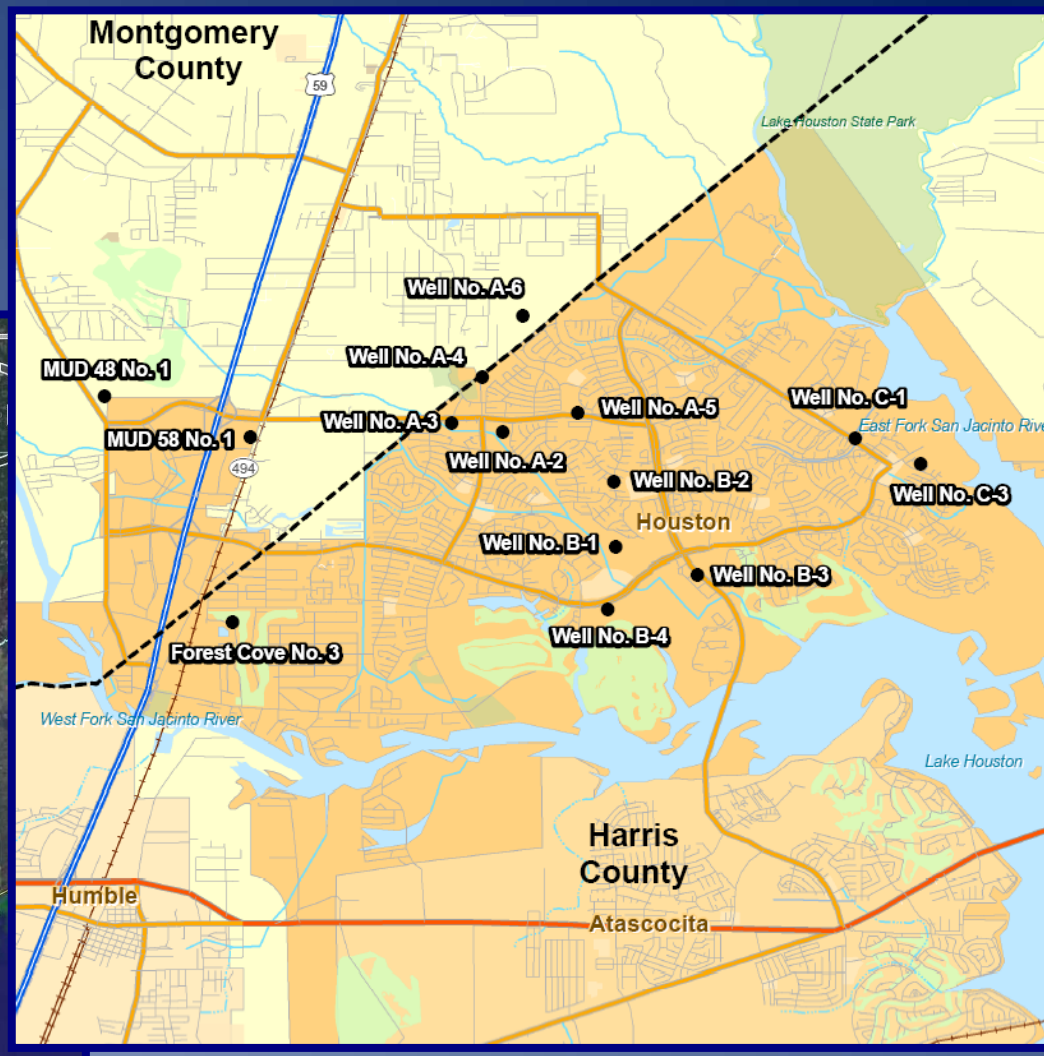
- During summer 2007, sampled 14 wells northeast of Houston
- Wells completed in the Evangeline aquifer of the Gulf Coast Aquifer System.
- Part of ongoing research to
  - Determine concentrations of radionuclides and arsenic
  - Their spatial extent
  - Associated geochemical conditions conducive for transport of these constituents

RECONNAISSANCE SURVEY

- Collected samples for analysis of
  - Major ions
  - Radionuclides- radon-222, radium-226, radium-228, gross alpha 72hr, gross alpha 30day, gross beta 72hr, gross beta 30 day, tritium
  - Arsenic and arsenic speciation
- Measured in field
  - Temperature, dissolved oxygen, pH, specific conductance, turbidity
  - Oxidation-reduction (redox) potential
  - Total sulfides

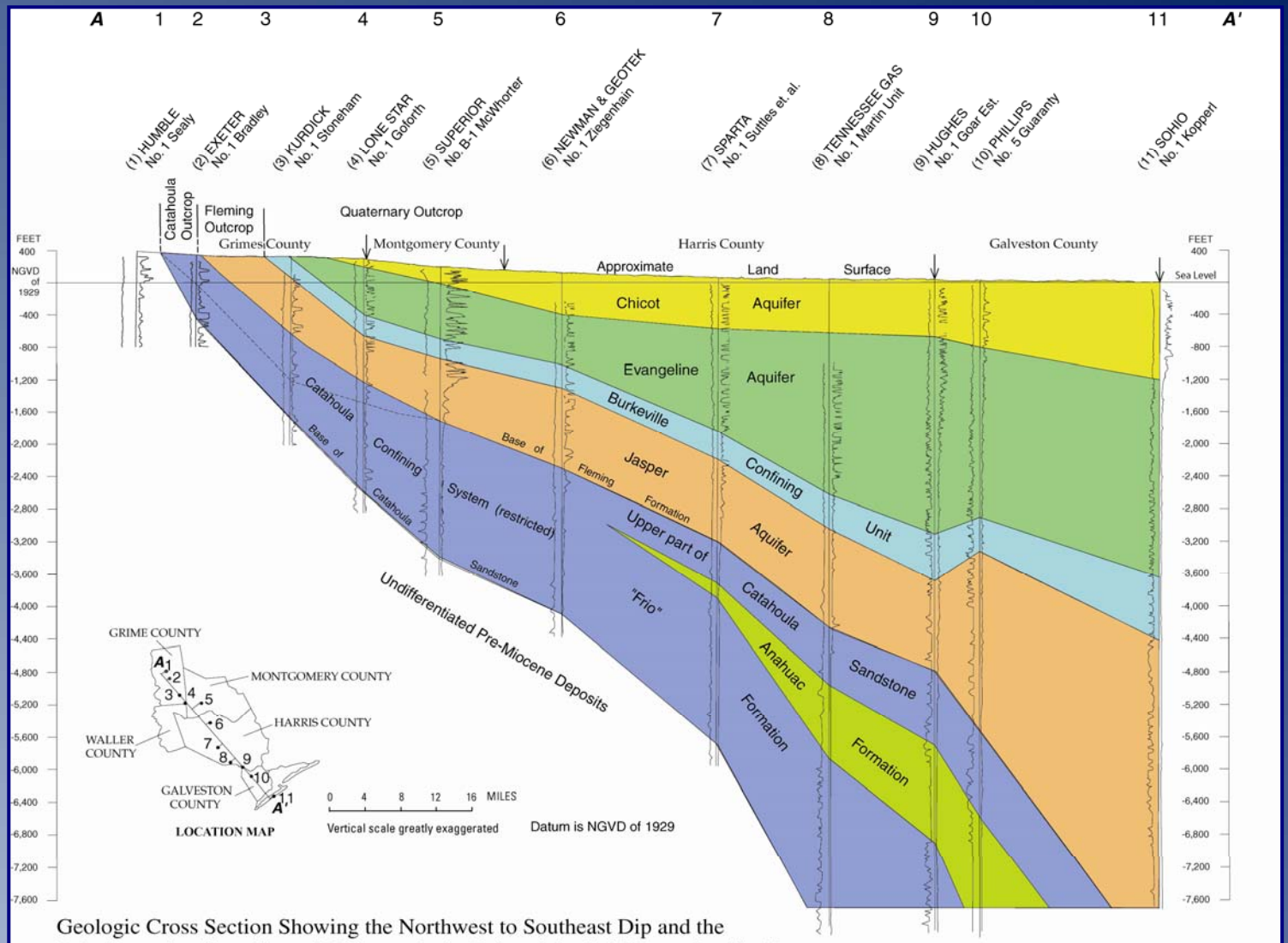
STUDY AREA





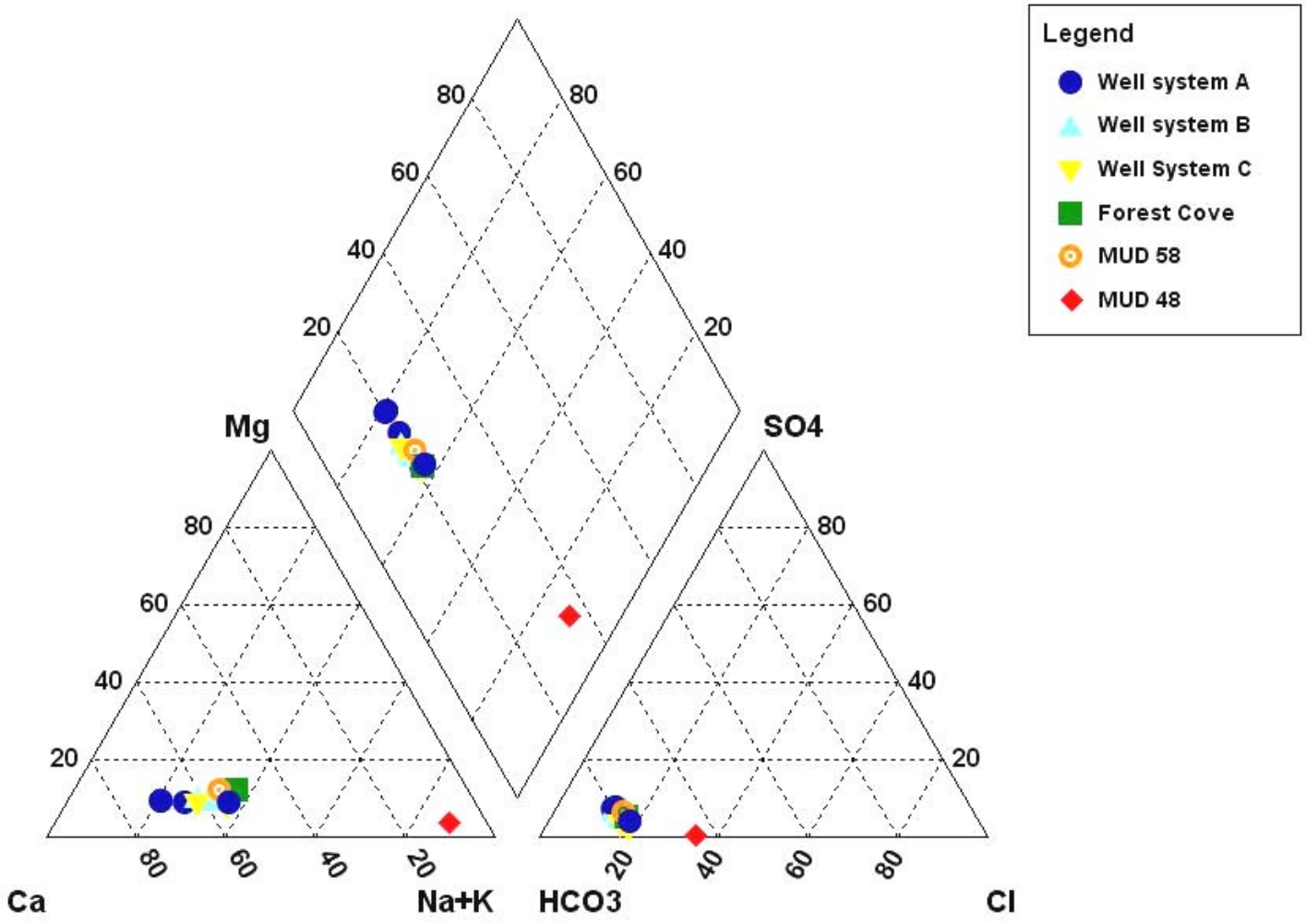
USGS

GEOLOGIC SECTION



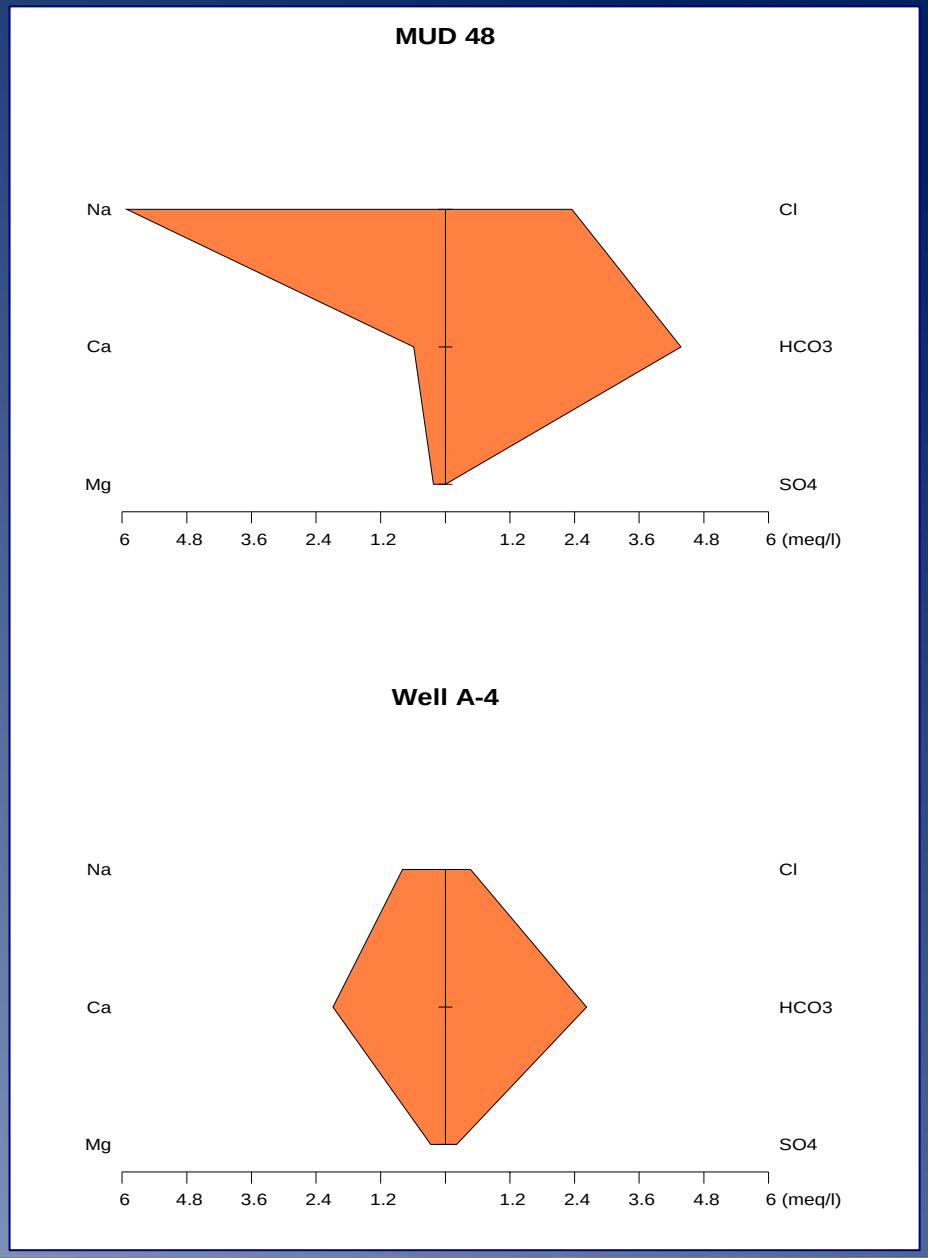
Geologic Cross Section Showing the Northwest to Southeast Dip and the Relation to Stratigraphic and Hydrogeologic Units of the Gulf Coast Aquifer System.
(Modified from Baker E.T., Jr., 1986, Hydrology of the Jasper aquifer in the southeast Texas Coastal Plain: Texas Water Development Board Report 295)

WATER CHEMISTRY

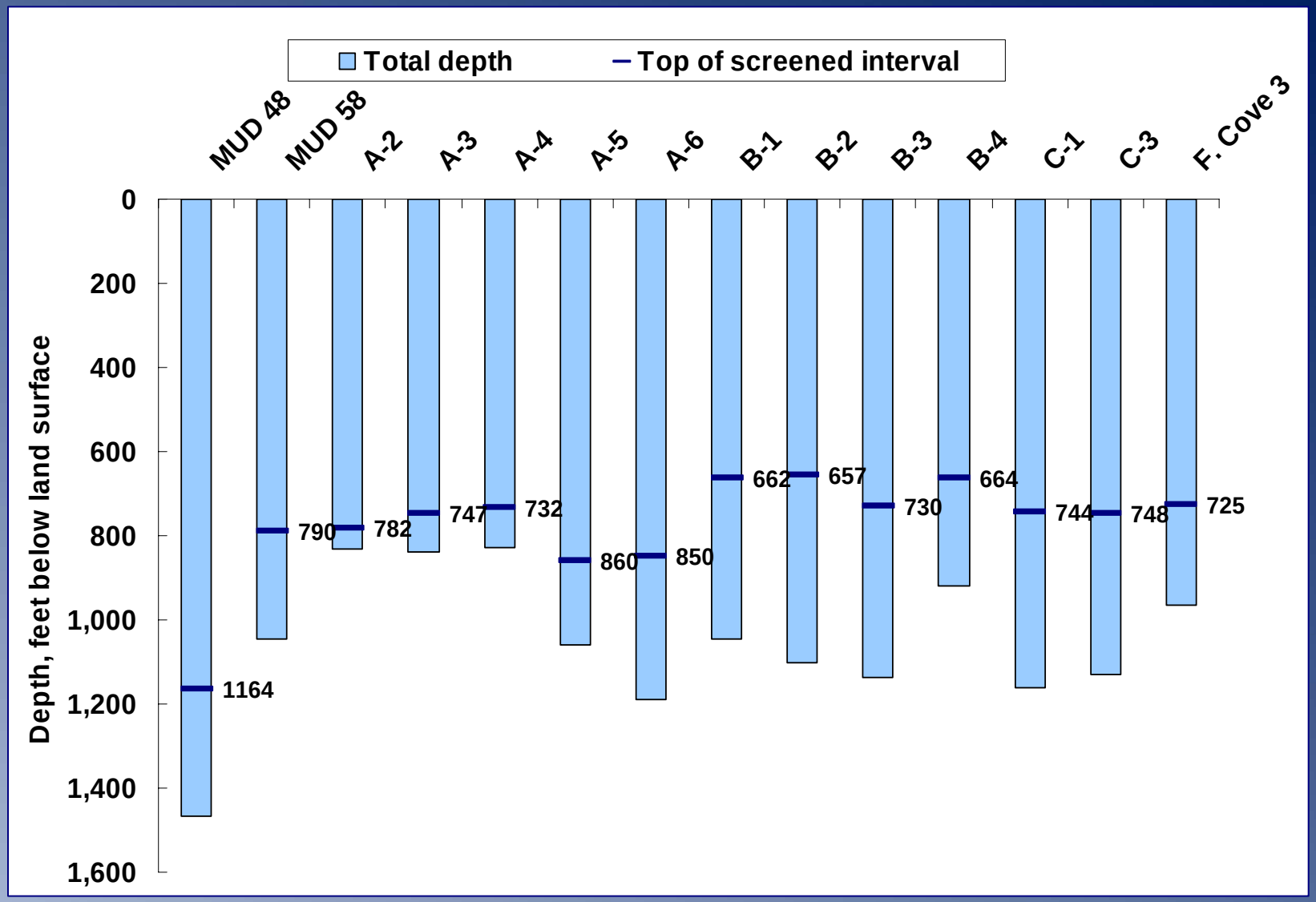


WATER TYPES

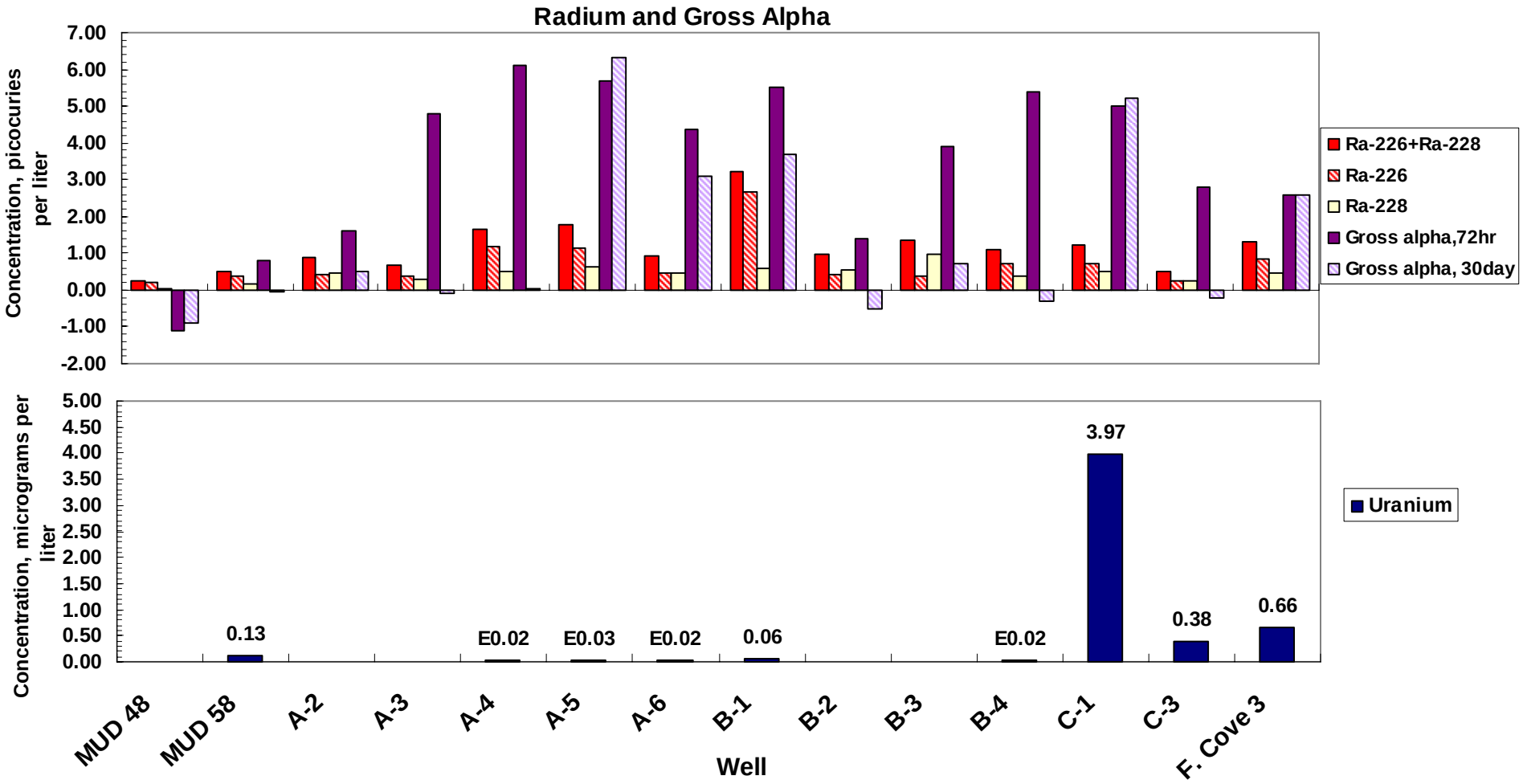
- Water from MUD 48 well, Na-HCO3-Cl
  - Screen interval is below the total depth of the other wells.
  - Highest As conc.
- Water from 11 wells, Ca-Na-HCO3
- Water from 2 wells, Ca-HCO3
- Apparent age of water from every well > 70 years
  - Maximum tritium, 0.3 +/- 0.58 picocuries per liter



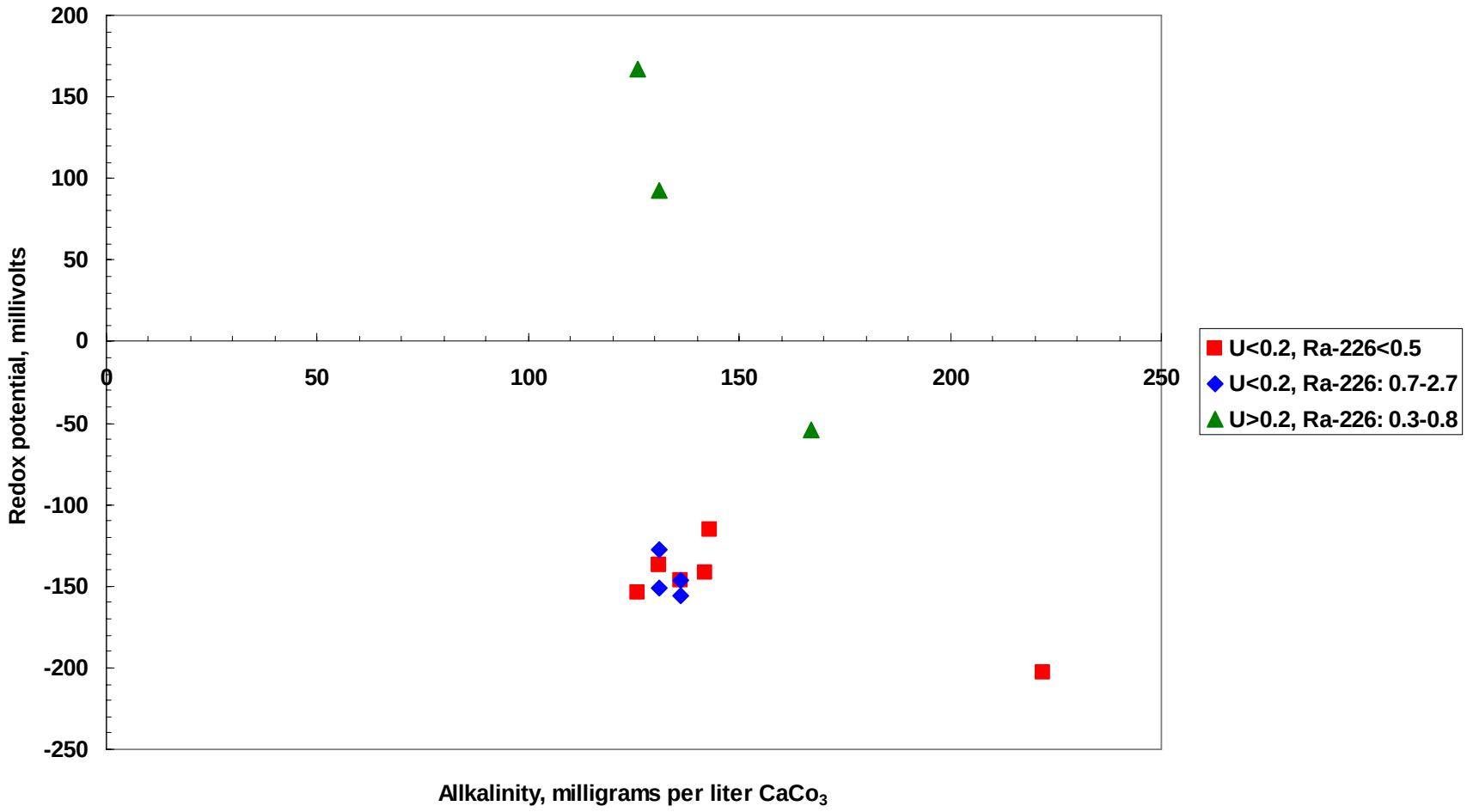
WELL DEPTHS


Total depth
Top of screened interval
MUD 48
MUD 58
A-2
A-3
A-4
A-5
A-6
B-1
B-2
B-3
B-4
C-1
C-3
F. Cove 3
Depth, feet below land surface
0
200
400
600
800
1,000
1,200
1,400
1,600
1164
790
782
747
732
860
850
662
657
730
664
744
748
725

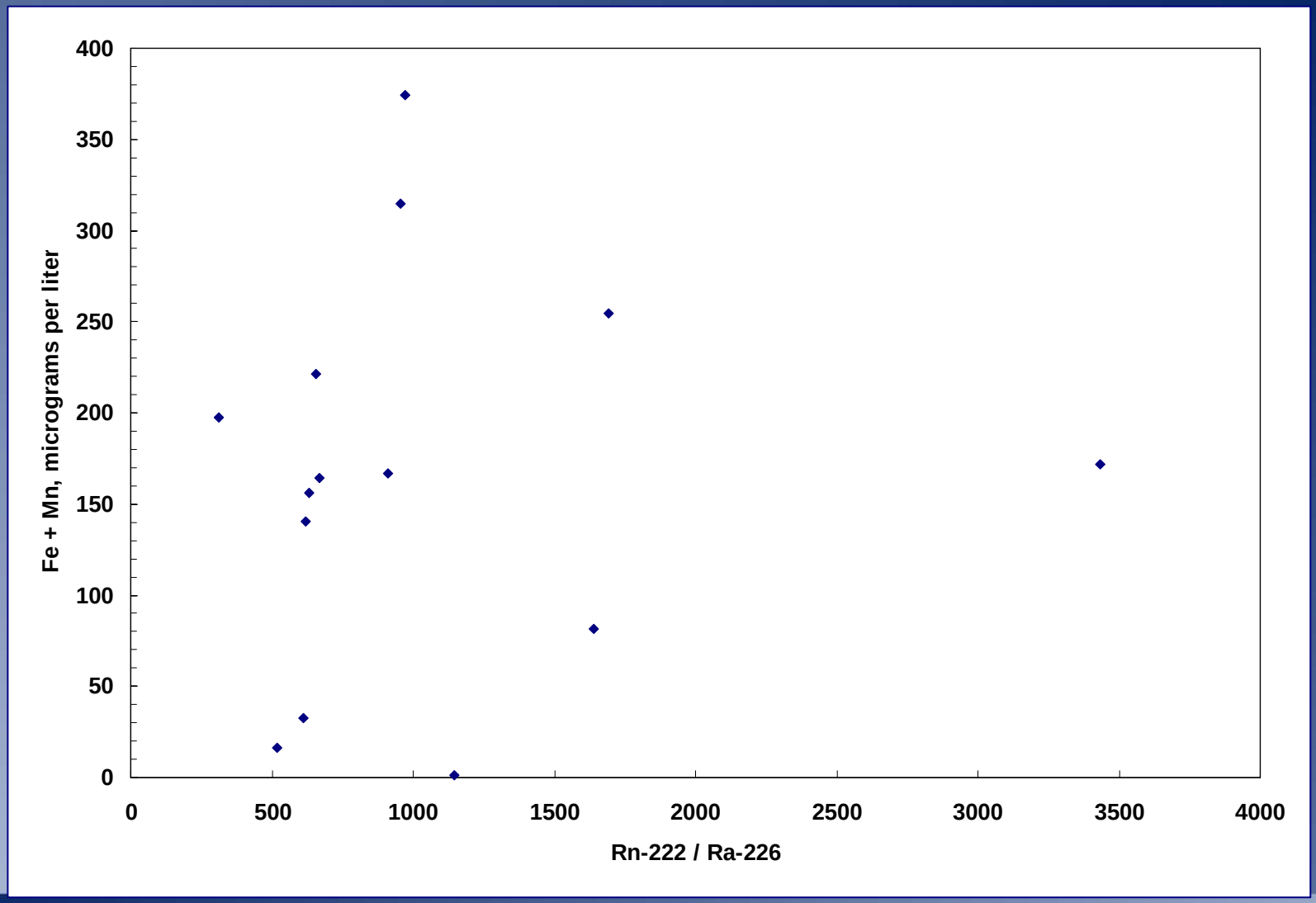
RADIONUCLIDES



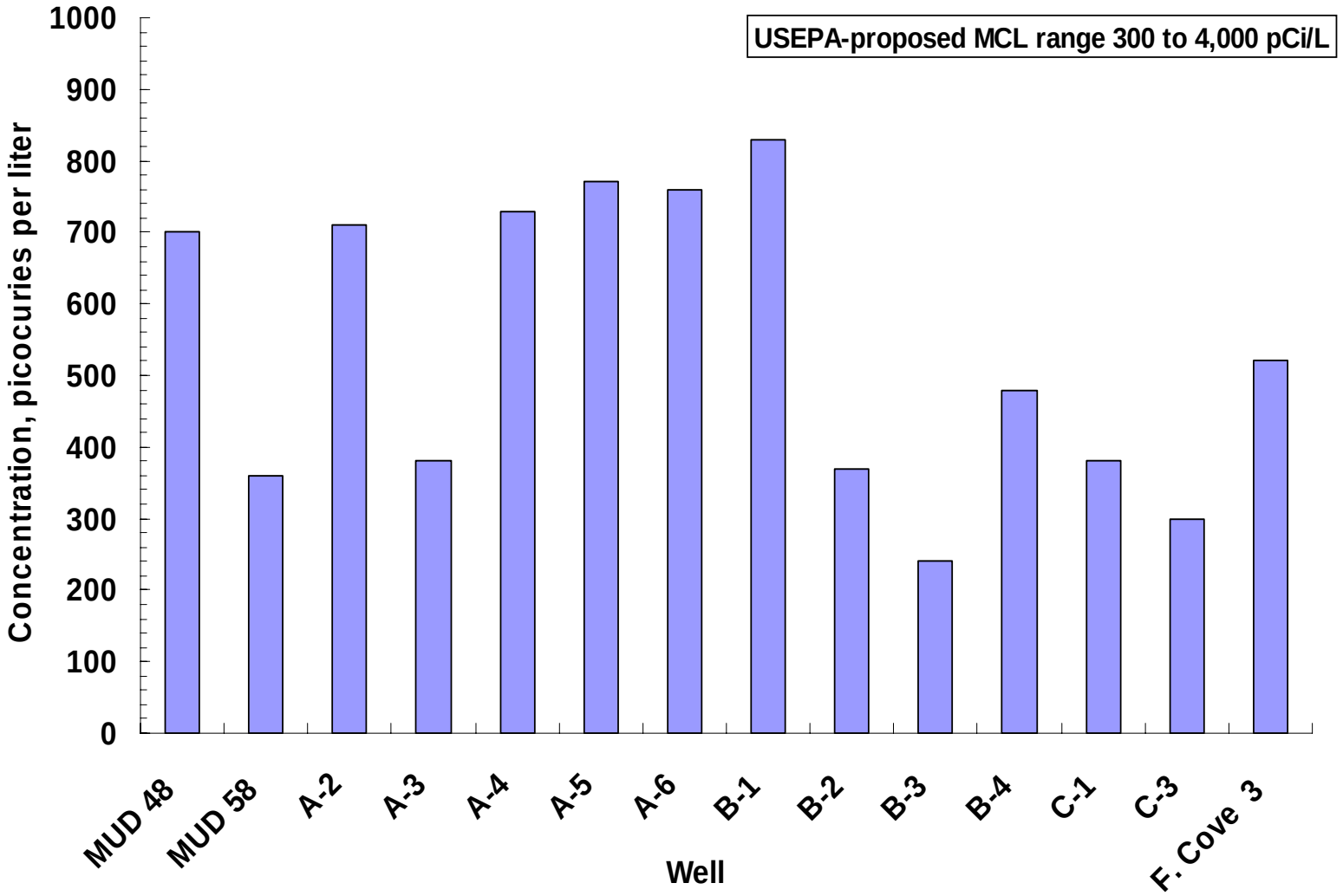
URANIUM AND RADIUM-226 OCCURRENCE



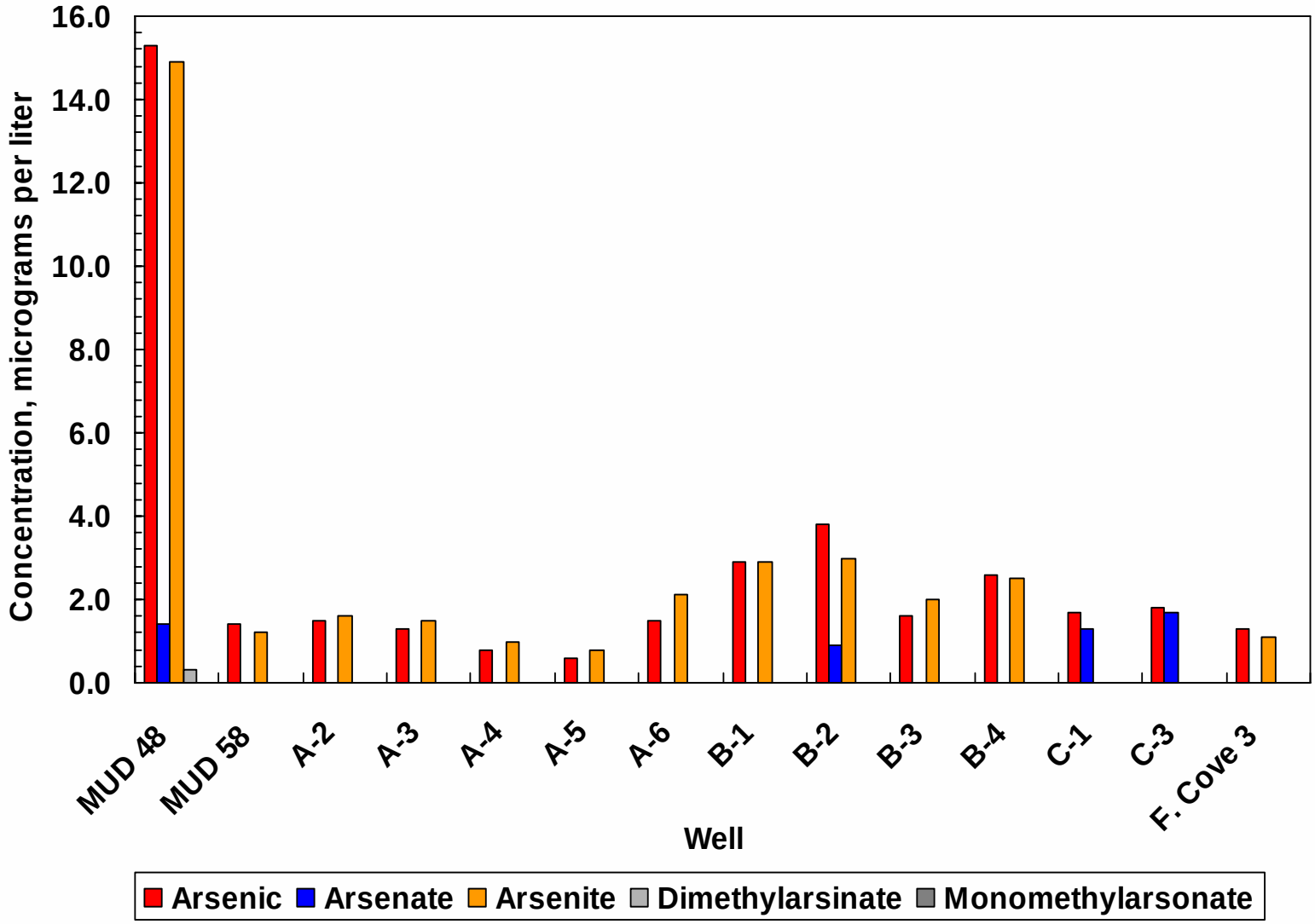
Relation between Rn-222/Ra-226 and Fe+Mn



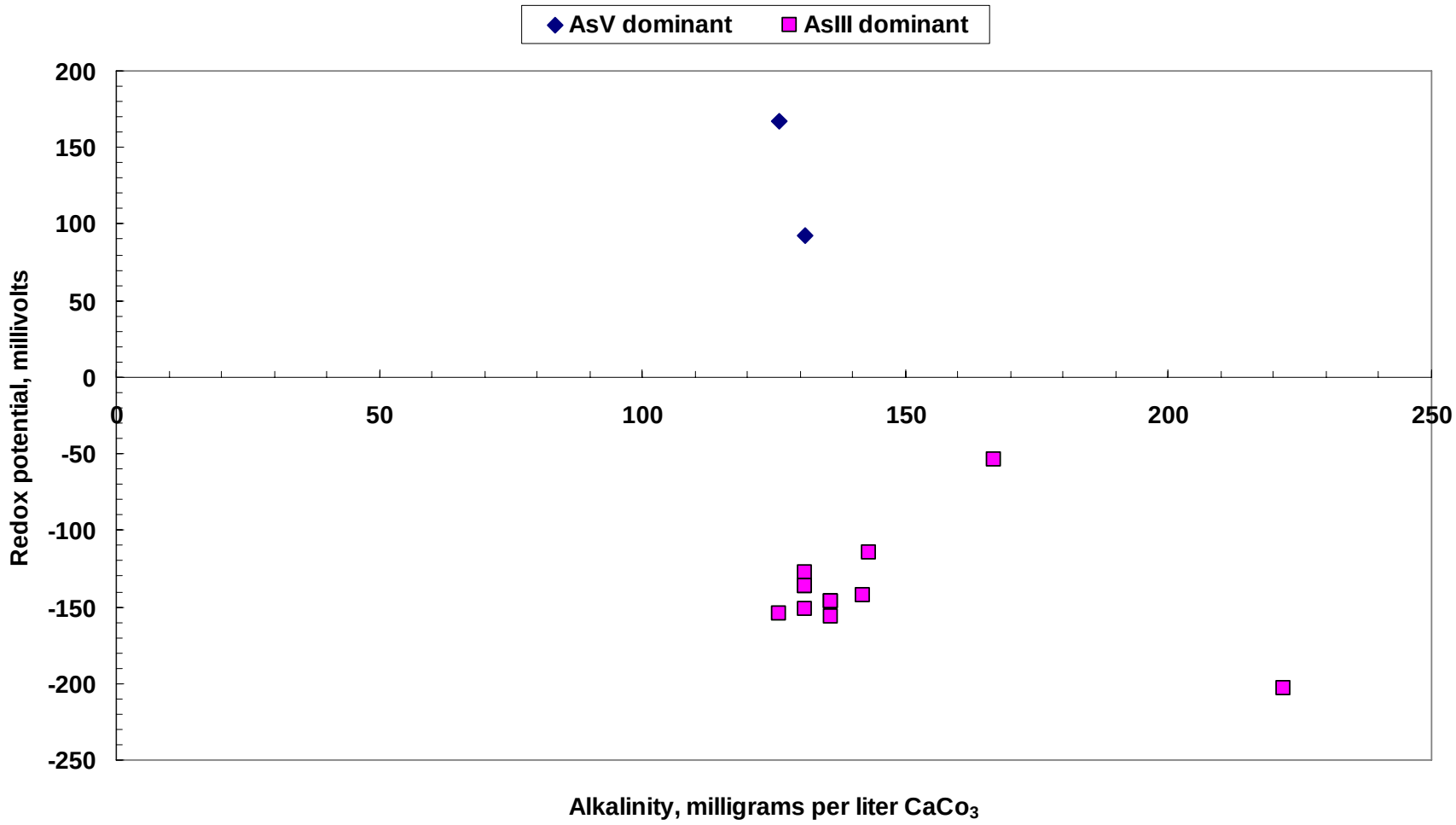
RADON


USEPA-proposed MCL range 300 to 4,000 pCi/L
Concentration, picocuries per liter
1000
900
800
700
600
500
400
300
200
100
0
MUD 48
MUD 58
A-2
A-3
A-4
A-5
A-6
B-1
B-2
B-3
B-4
C-1
C-3
F. Cove 3
Well

ARSENIC SPECIATION



OCCURRENCE OF ARSENIC SPECIES



SUMMARY

- Chemistry of ground water
  - Na-HCO3-Cl water type and Ca-Na-HCO3 water type
  - Primarily, water from reducing and slightly alkaline environments
- Tritium analyses indicate
  - Apparent age of water > 70 years
  - Residence time of ground water long enough for geochemical reactions
- Uranium present in oxidizing environments
- Radium-226 sometimes present in reducing environments. Need to know more

SUMMARY (continued)

- Rn-222/Ra-226 ratio does not correlate with Fe + Mn. Other factors besides reducing environment might affect radium mobility
- Radon-222 present, possible U-enriched silty zone
- Ra-228 low. No evidence of Ra-224 either
- Arsenic appears to be present in aquifer material, common in deltaic settings (for example Bangladesh)
  - Reducing environments - Arsenite (As III) dominant
  - Oxidizing environments - Arsenate (As V) dominant

QUESTIONS???

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