



Universal Geoscience Consulting, Inc.

Geology and Geochemistry - Energy and Environmental Consulting Services

February 10, 2004

Mr. Donald G. Mustard
Senior Environmental Engineer
BP
380 Airport Road
Durango, CO 81303

Re: Interpreted post drilling test results for the Steve Rogers well, Medina Presentacion GU A#2 well, Sec. 11, T33N-R10W.

Dear Mr. Mustard,

I have reviewed the data from samples collected by Four Corner Geosciences (FCG) on 12/03/03 from the Steve Rogers Well. On the basis of the available information, the drilling and production of the Medina Presentacion GU A#2 has not had an impact on the water in the Rogers Well. The following is a summary of my findings.

Dissolved Methane (Results from field tests) :

Dissolved gas concentrations measured on 12/03/03 were 26.13 mg/L. Such a high value is close to saturation, or the maximum amount of dissolved methane that water could hold in this area. Prior values measured on 11/3/1994, 11/9/1994, 11/6/1996, 5/21/1998, and 11/12/02 were 15, 15, 11, 23, and 19.7 mg/l respectively. Such high concentrations are a threat to safety because methane can readily combust if allowed to reach concentrations in air of between 5 and 15%. As stated in last year's letter report, this well should be treated to remove methane.

Gas Composition (Results from Isotech Lab):

Analysis of headspace gases exsolved from the water sample collected by Four Corners Geosciences on 12/03/03 indicates that 90% of the headspace gas is composed of hydrocarbons. The hydrocarbon gas was analyzed by Isotech Lab and found to contain methane (C₁) through hexane (C₆) components. C₁-C₆ hydrocarbon gas components were also detected in the sample collected on 5/21/98. The presence and the relative abundance of heavy hydrocarbons indicate that the gas has a thermogenic source. There has been no change in the hydrocarbon gas composition since the well was sampled last on 11/12/02.

The non-hydrocarbon gas measured in the sample collected on 12/03/03 is composed of modified air. Dissolved air should have a ratios of N₂/Ar and O₂/Ar of 83.60 and 22.43 respectively.

go back & look @
bradenhead tests

IID ~~595~~ 595

permit 157309

perfs 280-327

TD 327

Mustard A.

BH-7/2011 - -2psi

BH-2003 - TSTM

OK

067-08713

Corresponding ratios measured in dissolved atmospheric gases from this well were 53 and 0.69. These values are or 38% and 97% less than expected values for dissolved air, indicating that the water in this well continues to be strongly stagnant. Stagnation results from bacterial colonies that consume dissolved oxygen, dissolved natural gas, and sulfate.

The very strong sulfide odor detected while sampling on 12/03/03, and the elevated dissolved sulfide values (>0.5 mg/L) are positive indicators for the presence of sulfate reducing bacteria (SRB). Evidence of aggressive bacterial contamination has persisted since this well was originally sampled on 11/3/1994. As mentioned in last year's letter report, it is possible that the bacterial fouling will ultimately impede water from entering this well. Dissolved sulfide generated by SRB will eventually corrode plumbing fixtures. The Rogers family should consider having this well professionally treated to remove bacteria.

Isotopic Gas Composition (Results from Isotech Lab)

Paired stable carbon and deuterium isotopic values of the headspace methane collected on 12/03/03 are reported by Isotech Laboratory as -42.39 and -211.6 per mil respectively. These values are not significantly different than prior values reported from samples collected in 1998 and 2002 (see graphic plot). Although such values do indicate that the source of methane is thermogenic, there are now sufficient isotopic data available to indicate that the stable isotopic composition is somewhat altered by bacterial oxidation.

Available water well data in the 9 square mile area surrounding the Rogers well were reviewed and updated for this report. The stable isotope values of methane found dissolved in the Rogers well appear to be genetically related to the dissolved methane found in the Squires, Lincoln, and Kirk wells. These wells are all to the south and southwest of the Rogers well. The wide-spread occurrence of dissolved natural gas in all these wells indicates that it is a common contaminant of aquifers in this area.

Only one producing gas well, the Southern Ute 33-10 1-2 (Reported and erroneously referred to in a single USGS publication as the Animas 2-1) has been sampled for complete isotopic analysis. This well, approximately $1\frac{1}{2}$ miles to the north of the Rogers well, produces from the Mesaverde Formation. The reported value of stable carbon and deuterium isotope values found in this well are plotted in the figure, and they do not correspond to the value found in the Rogers well.

Based on bradenhead pressure data measured throughout this local area of the San Juan Basin, natural gas is commonly found at relatively shallow depths. Bradenhead pressures in excess of 25 psi have been documented in 12 wells in sections 1, 3, 10, 11, 12, and 15. In 1993, pressures in the 5 Bondad 33-10 were the highest in the area at a value of 115 psi. This well, located just to the south of the Rogers well, produces from the Mesaverde Formation.

Water Quality

The only significant change in the water from this well is in its chemical composition. Analysis of the trilinear diagram shown indicates that in 1994, water in this well was derived from a mixture of sodium sulfate and sodium chloride. Since then, the water composition has progressively changed until, as in 2003, it is nearly entirely composed of sodium chloride (table salt). Such a unique water composition indicates that this well no longer taps shallow, near-surface aquifers. Fluoride values measured since 1998 range in value from 8.4 to 10.1 mg/L, more than double the recommended concentration for drinking water standards of 4.0 mg/L. Such high values are typical among bedrock aquifers in the area and indicate extended aquifer residence times.

Analysis of the water chemistry is relevant to this report because it explains the apparent increase in dissolved methane concentrations since 1994. As is evident from the table below, the total amount of sulfate has declined by 63% since 1994, whereas the total amount of chloride has increased by a corresponding 130%. The methane concentration has also increased by 136% from 11 mg/L to 26 mg/L, in direct proportion with the increase in chloride. Therefore, it is the chloride-bearing water that carries the methane. Over the years, the amount of sodium sulfate water available to dilute the methane-carrying water has decreased in direct proportion to the observed increase in both chloride and methane.

| Primary Diagram Title | | | Trilinear Diagram | | | | | | | | | |
|---|-----|--------|---------------------------------|---|-----|---|------|----|-----|------|-----|-----|
| Secondary Diagram Title | | | Historic Data Rogers Water Well | | | | | | | | | |
| Cation / Anion Data: Milligrams Per Liter (Parts Per Million) | | | | | | | | | | | | |
| Id | Sym | Color | X | Y | Na | K | Ca | Mg | Cl | HC03 | C03 | S04 |
| 11/94 | ● | Red | | | 236 | 0 | 7.5 | 0 | 129 | 120 | 10 | 185 |
| 11/96 | ● | Yellow | | | 249 | 0 | 8.2 | 0 | 165 | 113 | 12 | 185 |
| 5/98 | ● | Orange | | | 248 | 0 | 8.1 | 0 | 252 | 101 | 4 | 96 |
| 11/02 | ● | Green | | | 282 | 0 | 10.5 | 0 | 254 | 126 | 14 | 104 |
| 12/03 | ● | Blue | | | 266 | 0 | 9.8 | 0 | 296 | 119 | 0 | 68 |

Conclusions

Recent measurements made from samples collected at the Rogers water well indicate that the amount of dissolved gas has increased by 6.43 mg/L since the well was sampled last year. This value is near the maximum amount of methane that water could hold at ambient atmospheric pressure in the area, and is 3.13 mg/L higher than the maximum value measured in 1998. The hydrocarbon gas composition has not changed significantly since it was sampled in 1998. It is composed of bacterially-altered thermogenic gas. Because dissolved natural gas was present in the well prior to the drilling of the Medina Presentacion GU A#2, operations related to the drilling and production of this well cannot be responsible for the gases found.

BP operates 3 wells in the immediate area surrounding the Rogers well, and these should be sampled to obtain an isotopic and hydrocarbon composition signature of the thermogenic gases

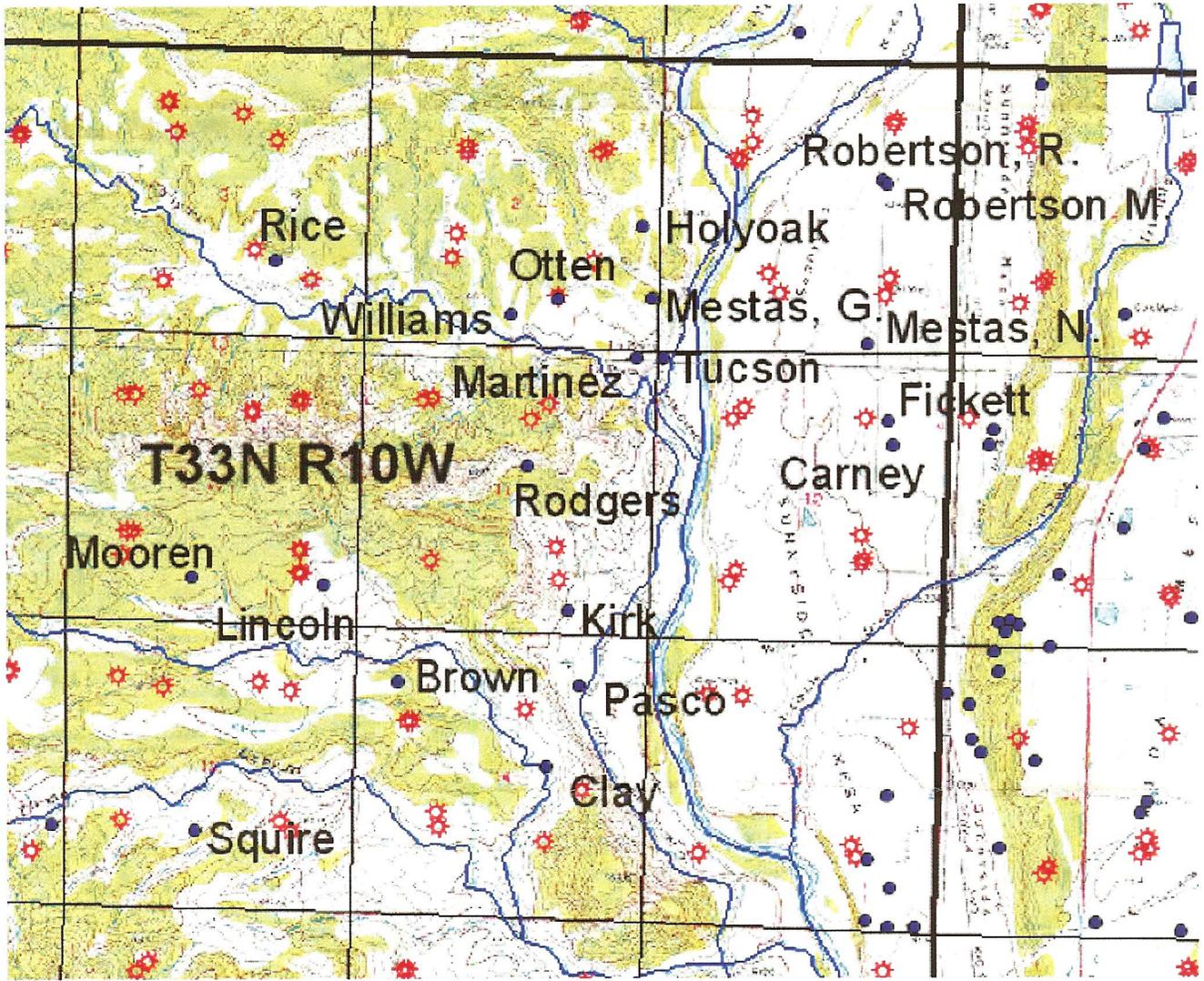
produced in the area. These wells are the 3-11 Animas (05-067-07036), the Medina Presentacion GU A#1 (05-067-07471), and the Medina Presentacion GU A#2 (05-067-08713).

Please do not hesitate to call me if you have any questions regarding this report.

Sincerely,

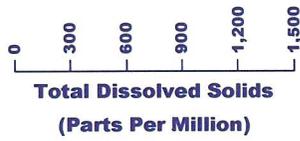
A handwritten signature in black ink, reading "Anthony W. Gorody". The signature is written in a cursive style and is positioned above a vertical line that serves as a separator between the signature and the typed name below.

Anthony W. Gorody, Ph.D., CPG-9798
President

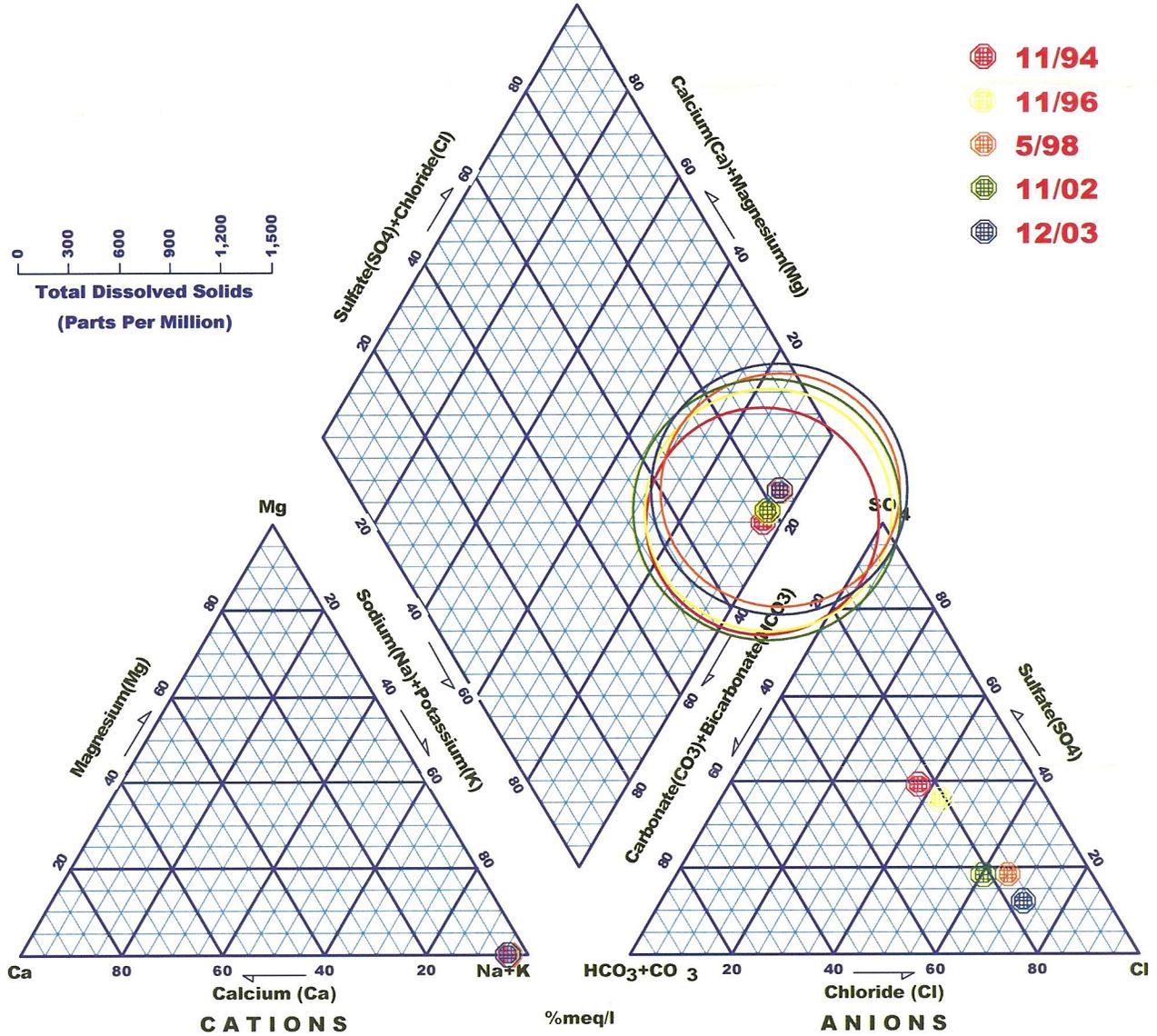


Trilinear Diagram

Historic Data Rogers Water Well



- 11/94**
- 11/96**
- 5/98**
- 11/02**
- 12/03**



STABLE ISOTOPES OF METHANE 9 section area surrounding Rogers Well

