



**HYDROCARBON SEEP REPORT  
FLY CREEK PROJECT  
SAND WASH BASIN, COLORADO**

**PREPARED FOR:**

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## **INTRODUCTION**

Cedar Ridge LLC is developing conventional and coal bed methane (CBM) gas fields near Slater, Colorado. There are pre-existing gas and oil seeps in the area. This study was undertaken to survey the seeps and sample the largest for chemistry and stable isotopes.

The study area includes portions of Colorado and Wyoming near the towns of Slater, Colorado and Savery, Wyoming. Sections 34, 35, and 36 in Township 13 north, Range 89 west. Sections 31 and 32 in Township 13 north, Range 88 west. Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 16, 22, 23, 24 25, 26 and 27 in Township 12 north, Range 89 west. Sections 5, 6, 7, 8, 17 and 18 in Township 12 north, Range 88 west. The study area encompassed 27 square miles.

## **LITERATURE REVIEW**

1863- The first coal mine in the Little Snake Coal Field was east of Sulphur by the Overland Stage Company (Campbell 1910). This is north of the study area. Campbell (1910) is a good history of the early coal mines. Methane gas was found in several of the mines. Water springs were discussed issuing from the Mesaverde Formation, Lewis Formation contact and the Bishop Conglomerate. Shallow dug water wells into alluvial sources were also discussed. Some were usable, but several were much worse quality than the nearby surface stream.

1871- The first geologic expedition to the area was the Fortieth Parallel Expedition in 1871 and 1872 (King et al. 1874). The expedition traversed the Little Snake Valley from east to west. They described general surficial geology identifying coal. The coal was important for nearby supply to the transcontinental railroad (1869) just north of the study area. No oil or gas seeps were recorded.

1879- The Robidoux family settled in the Little Snake Valley in 1879. They moved to their current property in 1928 which includes the Robidoux oil and gas seeps into a channel of the Little Snake River. The family knew of the seep when they first came to the valley in 1879 (Robidoux 2003). The family collected oil from the seep for lubrication, but never made use of the gas. The flow of oil was intermittent and the flow of gas was fairly constant. They also observed gas bubbles in most ponds and meander cutoffs due to decomposing vegetation. The Robidoux family traces its genealogy to the famous Mr. Antoine Robidoux who set up trading forts in Colorado and Utah during Spanish/Mexican times starting in 1828 (Reyher 2002).

1890's- Mr. Ellsworth (Elzy) Lay tries to locate a well for oil and gas somewhere in the Little Snake Valley area (Kelly 1938). Mr. Lay was a member of the Wild Bunch outlaw gang headed by Mr. George LeRoy Parker (Butch Cassidy). In later years Mr. Lay managed ranches for the Calverly family in the Little Snake Valley (Kelly 1938). The author has also heard that this well was in the Hiawatha gas field to the west of the study area. The author has also seen stock certificates of the Mutual Oil Company in the Savery Museum.

1918- Oil and gas seeps are shown in Routt County on a map of Colorado (CGS 1918). Due to the scale and size of the symbol it is difficult to determine if the seeps of the Little Snake Valley are indicated or the seeps of the Elk River Valley to the south.

1970's- A series of coal studies were made by the USDOI Geological Survey under the direction of C. S. Venable Barclay (See References). Mr. Bill Hanson was a field geologist who observed the Robidoux seeps and the gas seeps north of Savery, Wyoming near the Boyer Ranch (Hanson 2003). None of these seeps were described in the references.

1982- The area was mapped for surficial geology (Madole 1982, Tweto 1982).

2004- Cedar Ridge LLC had oil analyses conducted of a Niobrara (Mancos Shale Formation) oil well in the Sierra Madre field, a nearby Deep Creek Sandstone (Lower Mesa Verde Group) oil well, and the Robidoux oil seep (Pencor 2003). The conclusion was that all three samples were derived from a common source. The likely source was marine shale of upper Cretaceous or lower Tertiary age. The Niobrara (Mancos) sample was not degraded by bacteria. The other two samples were severely altered by bacteria.

The indicated vertical migration pathway was from the Mancos marine shale source, into the calcareous Niobrara zone within the Mancos, upward into the Deep Creek Sandstone of the lower Mesa Verde Group, and further upward into the Robidoux Seep of the upper Mesa Verde Group.

## **SURVEYING AND SAMPLING**

Seeps were surveyed with the help of Mr. Jubal Terry of Skyline Resources, Wheatridge, Colorado. His local knowledge was valuable with the contact and observations of local residents. Likely seepage areas were surveyed by hiking, direct observation, and location by a handheld Global Positioning System (GPS) instrument. Daily reports with GPS coordinates are located in the Appendix.

The seep indicators were direct observation of bubbles or oil sheens, dead vegetation, accumulated asphalt, and black iron sulfite accumulations. Gas seepage from decomposing vegetation (biogenic) was generally in stock ponds and meander cut offs with intermittent bubbles and the absence of black iron sulfite accumulations. Gas from deeper sources that were formed from higher temperatures and pressures (thermogenic), were a steadier flow commonly accompanied by rainbow oil sheen's on the water surface. Dead vegetation was commonly associated with seeps due to the reduction of soil oxygen. However vegetation mortality can have many causes. Commonly black iron sulfite was present due to the anaerobic conditions. Either type of seepage can have an associated hydrogen sulfide odor.

2003 June 3- Met the Robidoux's. Hiked the Robidoux and Little Robidoux seeps north of Moffat County Road. Big seep in middle of the Little Snake River. Large amount of gas flow over a wide area. Large oil sheen on the river with asphalt.

Fly Gulch was hiked from the headwaters to the confluence with the Little Snake River. An old coal mine was identified near the confluence that was leaking water and had a hydrogen sulfide odor.

Observed two stock ponds that bubbled intermittently with some black iron sulfite around edges. These two ponds were classified as biogenic.

2003 June 4- Hiked Mr. Lee Robinson's irrigated field near Savery, Wyoming. A dug pit bubbles small steady gas flow. The flood irrigation allowed identification of a much larger area that was seeping gas. A small area of vegetation was dead. One area with a rainbow sheen observed.

Observed roadside seep in pond north of Savery, Wyoming to the west of the Savery Creek Road. Only the pond bubbles even though water from irrigation covers other areas. Probable biogenic seep.

Observed roadside seep further north of Savery to the north and west of the Savery Creek Road. Multiple steady gas flow vents with strong hydrogen sulfide odor.

2003 June 5- Hiked Rye Grass Gulch from main road to confluence with Little Snake River. No seepage observed. A coal seam was observed sub cropping into the north side of the Little Snake River just downstream of the confluence.

Observed sodic soil area south of Wyoming Highway 70. No seepage noted.

Observe old coal mine near mouth of Savery Creek on Thomas property.

Observe water spring with rainbow sheen east of Wyoming Highway 70. No accumulated asphalt deposits so probably iron bacteria. No gas bubbles.

Meet Mr. Espy. Observed gassy water well west of Slater Creek Road on his property. Water and gas are flowing up outside the casing into a field creating a vegetation dead area.

Observed Slater Creek with no indications.

2003 June 3- Hiked area north of Robidoux's and the Little Snake River. No indications of seepage.

Hiked Big and Little Robidoux seeps for GPS coordinates.

2003 August 7- Sampled Big Robidoux seep and CBM#1 for COGCC water quality list, BETX, and stable isotopes (seep only). Hiked Big and Little Robidoux seeps for GPS Coordinates.

All samples were taken of raw water after separation and before any treatment. Field parameters included temperature (Bimetal Thermometer), pH (Hanna Pocket), and specific conductance (Hanna Pocket). Specific conductance and pH were field calibrated using standard solutions. Field measurements are listed in the Appendix. A gas sample of the Big Robidoux Seep was taken using the inverted bottle method.

## ANALYSES

The samples for the COGCC analyses list and BETX were delivered to ACZ Laboratories, Steamboat Springs, Colorado. The gas sample for stable isotope analyses was sent to Zymax Laboratories, San Luis Obispo, California.

## WATER CHEMISTRY

The pH of the Big Robidoux Seep sample was 8.1 and the CBM #1 sample was 8.2. These are essentially the same and could be from the same source.

The total dissolved solids concentration of the Big Robidoux Seep sample was 2,460 mg/l and the CBM #1 sample was 2,460 mg/l. These are essentially the same and could be from the same source. This level is too high for drinking water, but could be used as stock water. The level was classified as moderately saline.

The sodium concentration of the Big Robidoux Seep sample was 999 mg/l and the CBM #1 sample was 993 mg/l. These are essentially the same and could be from the same source.

The potassium concentration of the Big Robidoux Seep sample was 6.2 mg/l and the CBM #1 sample was 5.0 mg/l. These are essentially the same and could be from the same source.

The calcium concentration of the Big Robidoux Seep sample was 3.7 mg/l and the CBM #1 sample was 4.6 mg/l. These are essentially the same and could be from the same source.

The magnesium concentration of the Big Robidoux Seep sample was 1.5 mg/l and the CBM #1 sample was 1.5 mg/l. These are essentially the same and could be from the same source.

Sodium was the predominate positive ion (cation) at a level of 99.3% for the Big Robidoux Seep sample and 99.2% for the CBM #1. These are essentially the same and could be from the same source.

The bicarbonate concentration of the Big Robidoux Seep sample was 2,270 mg/l and the CBM #1 sample was 2,310 mg/l. These are essentially the same and could be from the same source.

The chloride concentration of the Big Robidoux Seep sample was 77 mg/l and the CBM #1 sample was 56 mg/l. These are essentially the same and could be from the same source.

The sulfate concentration of the Big Robidoux Seep sample was <10 mg/l and the CBM #1 sample was <10 mg/l. These are essentially the same and could be from the same source.

The fluoride concentration of the Big Robidoux Seep sample was 7.5 mg/l and the CBM #1 sample was 7.5 mg/l. These are essentially the same and could be from the same source. This level is very high so the water is unfit for drinking water.

Bicarbonate was the predominate anion at a level of 94.5% for the Big Robidoux Seep sample and 96.0% for the CBM #1 sample. These are essentially the same and could be from the same source.

All dissolved metal concentrations are at or below the detection limits. The total iron indicates the metals are adsorbed on sample sediment.

The water samples are moderately saline and appropriate for stock watering. They are a sodium-bicarbonate water type, which is typical for water that has undergone cation exchange and sulfate reduction in a formation that was deposited in fresh water. They are from the same or very similar sources due to the almost identical water chemistry and close proximity of the Big Robidoux Seep and CBM #1 well.

## **BETX**

BETX is an abbreviation for the analyses of benzene, ethyl-benzene, toluene, and xylene. Presence of these parameters indicates raw or refined petroleum products. Benzene was detected in a low concentration of 0.3 micrograms per liter in the CBM #1 well sample. All other parameters were below detection limits for both samples. These are typical results for most CBM water production.

The essential absence of BETX in the CBM#1 sample and lack of oil production indicates that the Mesa Verde coals were not the source of the oil observed at the Robidoux Seep. This matched the conclusions of the Pencor report (2003) discussed in the Literature Review Section.

These low BETX concentrations from the Robidoux Seep are surprising since the seep produces a rainbow sheen on the river, the Robidoux family used collected oil, and the seep has asphalt deposits. It is unknown why these visible indications of petroleum are not reflected in the BETX analyses. Perhaps the altering by bacteria on the migration pathway has affected the BETX concentrations.

## **DISSOLVED GASES**

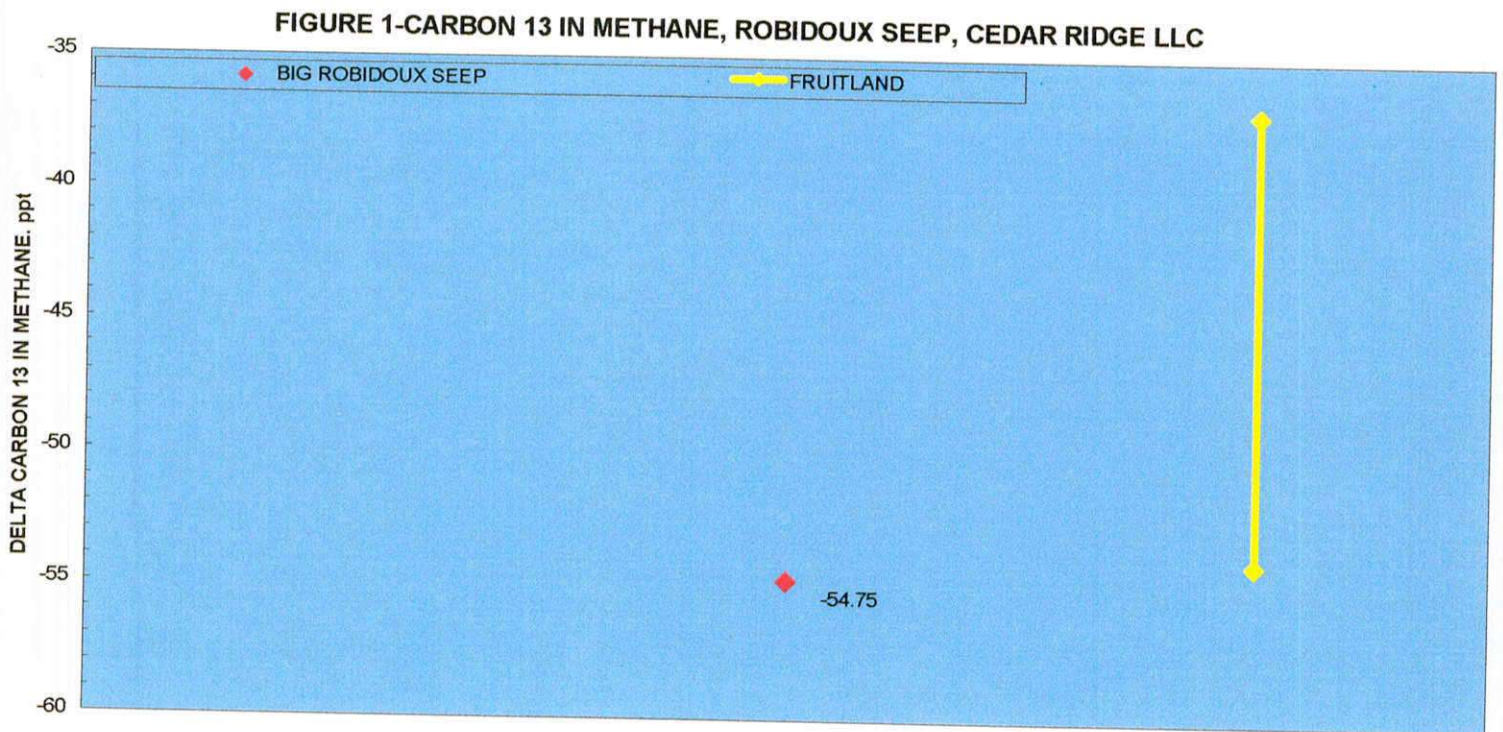
Dissolved methane ((CH<sub>4</sub>)<sub>1</sub>), ethane ((CH<sub>4</sub>)<sub>2</sub>), butane ((CH<sub>4</sub>)<sub>3</sub>), propane ((CH<sub>4</sub>)<sub>4</sub>), pentane ((CH<sub>4</sub>)<sub>5</sub>), and hexane ((CH<sub>4</sub>)<sub>6</sub>) were analyzed in each sample. The methane concentration of the Big Robidoux Seep sample was 8.8 mg/l and the CBM #1 sample was 10.6 mg/l. These are essentially the same and could be from the same source. At the altitude of the study area this is about a third of the saturation limit of 30 mg/l. The other hydrocarbon gases were not detected.

The headspace of the inverted bottle sample from the Big Robidoux sample was also analyzed for gases. Methane was found at a level of 84.1%. Carbon dioxide was found at a level of 1.51%. The atmospheric gases of nitrogen and oxygen make up the remainder at 13.1%.

# STABLE ISOTOPE RESULTS

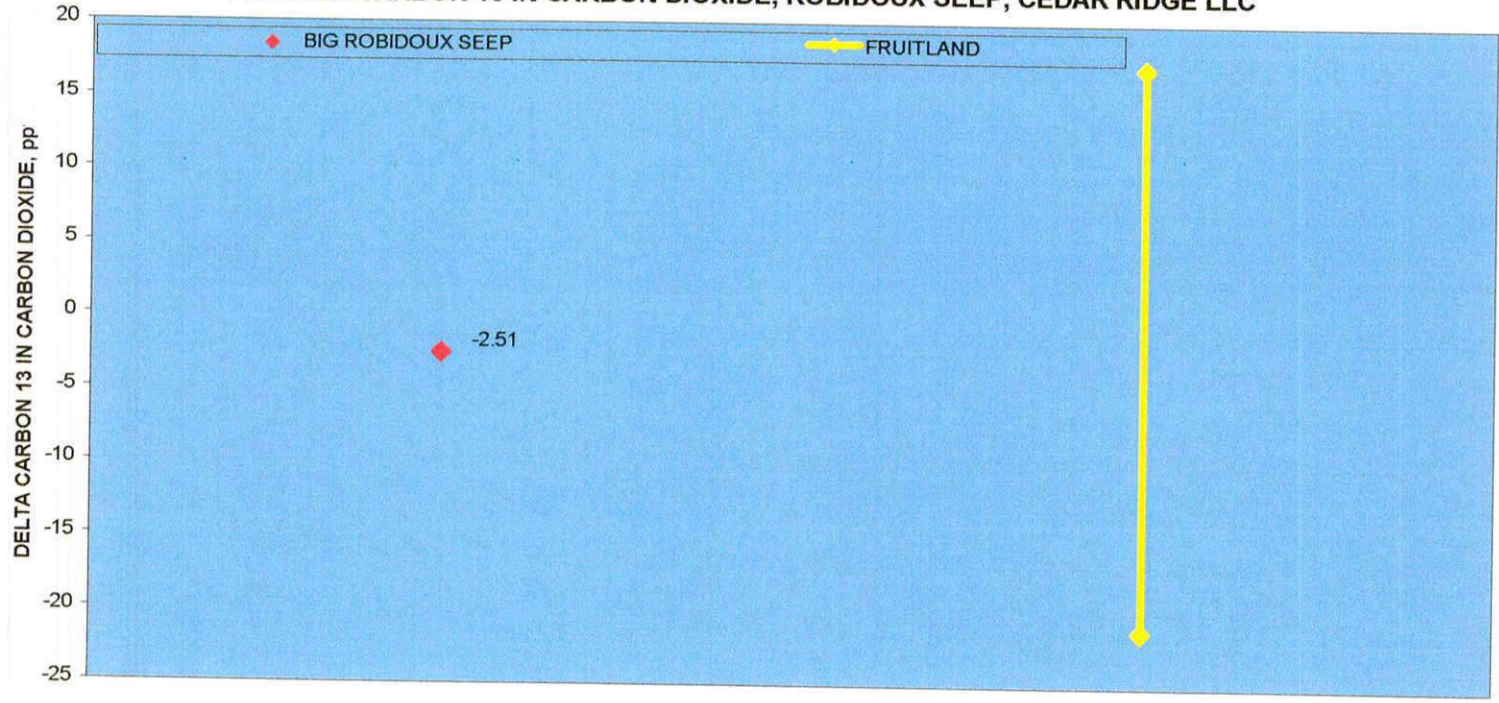
The Big Robidoux gas sample stable isotope results are discussed in comparison with the Fruitland CBM results from the San Juan Basin (Gorody, Baldwin, and Scott 2004, Oldaker 2002). The Sand Wash Basin does not have an extensive database of results for comparison.

Carbon 13 is a stable isotope of carbon with one extra neutron. The concentrations of carbon 13 in methane are plotted on Figure 1. The concentration of  $-54.75$  ppt was on the borderline of the population for the Fruitland CBM reservoir. Generally values less than  $-60$  ppt are generated by bacteria decomposition (biogenic). The range from  $-60$  to  $-55$  ppt is an area of overlap between bacteria generation and high temperature/pressure generation (thermogenic). Values more than  $-55$  ppt are generated by high temperature and pressure (thermogenic). The Fruitland CBM reservoir range of values was thermogenic. The Robidoux seep sample was classified as thermogenic. Perhaps some bacterial alteration of the carbon 13 has occurred in a similar manner to the oil migration pathway.



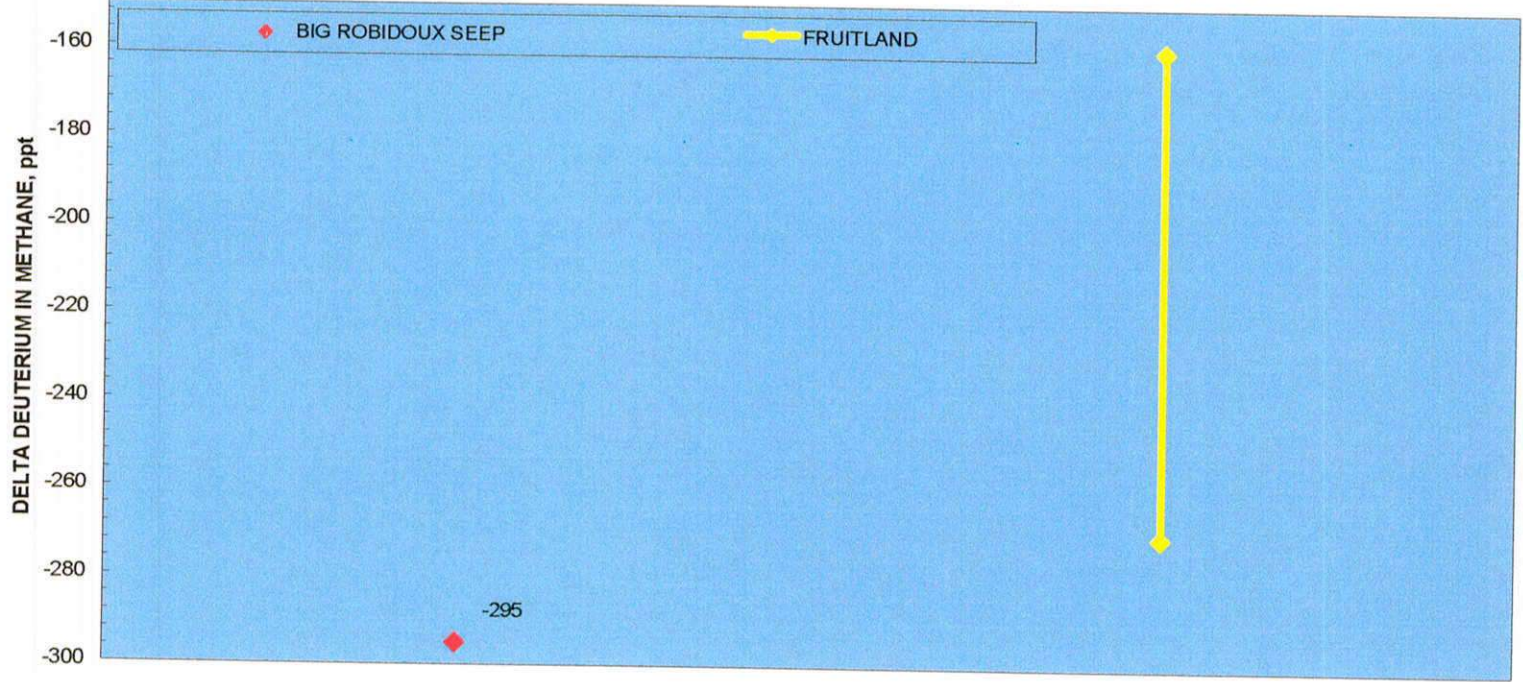
Carbon 13 is a stable isotope of carbon with one extra neutron. The concentrations of carbon 13 in carbon dioxide are plotted on Figure 2. The concentration of  $-2.51$  ppt was in the middle of the population for the Fruitland CBM reservoir. Generally values near the minimum of the range ( $-21$  ppt) indicate a shallow geo-chemical system. Values near the maximum of the range ( $+17$  ppt) indicate a deeper geo-chemical system. The Fruitland CBM reservoir range of values was from shallow to deep. The Robidoux seep sample was classified as moderately shallow.

FIGURE 2-CARBON 13 IN CARBON DIOXIDE, ROBIDOUX SEEP, CEDAR RIDGE LLC



Deuterium is a stable isotope of hydrogen with one extra neutron. The concentrations of deuterium in methane are plotted on Figure 3. The concentration of -295 ppt was less than the population for the Fruitland CBM reservoir. Generally values less than -280 ppt are generated by bacteria decomposition (biogenic). Values more than -280 ppt are generated by high temperature and pressure (thermogenic). The Fruitland CBM reservoir range of values was thermogenic. The Robidoux seep sample was classified as biogenic. Possibly the shallow depth of the system has skewed the deuterium value. Perhaps some bacterial alteration of the deuterium has occurred in a similar manner to the oil migration pathway.

FIGURE 3-DEUTERIUM (H2) IN METHANE, ROBIDOUX SEEP, CEDAR RIDGE LLC



Overall the sample was classified as shallow thermogenic. It should be noted that this single sample was being compared to values from another geologic basin. The classification may change if a database was developed for the Sand Wash Basin.

## **CONCLUSIONS**

- 1. The water samples are moderately saline and appropriate for stock watering. The samples are a sodium-bicarbonate water type, which is typical for water that has undergone cation exchange and sulfate reduction in a formation that was deposited in fresh water. They are from the same or very similar sources due to the almost identical water chemistry and close proximity of the Big Robidoux Seep and CBM #1 well.**
- 2. BETX was either not detected or the concentrations were very low despite visible indications of petroleum in both the Robidoux Seep and the CBM#1 well.**
- 3. Methane was the primary dissolved gas present without heavier hydrocarbon gases.**
- 4. Stable isotopes of methane and carbon dioxide classify the Robidoux Seep sample as shallow thermogenic.**

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# **APPENDIX**

DAILY REPORT 3 JUNE 2003  
CEDAR RIDGE LLC- FLY GULCH PROJECT

0745- Met Jubal Terry for breakfast.

1000- Onsite, met Duane Hiss. Ferry cars to Fly Gulch. Hike gulch for signs of gas seeps. Checked two fault zones. No dead vegetation, no seeps observed. One old coal mine adit that is leaking water with hydrogen sulfide smell, water has created a bog with sedge vegetation.

Map Location GS1: 40 deg, 59', 42" north, 107 deg, 18', 42" west (5 satellites).

1300- Met Duane Hiss, had lunch.

Met Albert and Evelyn Robidoux. Possible small gas seep further up Fly Gulch.

Robidoux Seep- River has broken through slough so now under water. His father was born in 1879 and knew of the seep. They moved to current location in 1928. Gas flow is not very variable. Oil flow is variable. They used it as lubricant.

Almost all the sloughs bubble some.

They are related to Antoine Robidoux who set up trading posts in the early 1800's.  
Interested in Beeler genealogy.

1430- Examined multiple gas seeps with vegetation changes just to the west of the Robidoux seep in muddy bottom land. I will do GPS later to save time with Jubal.

1500- Possible oil seep with fresh water spring near highway. Some accumulation in creek,

Map Location GS2: 41 deg, 00', 48" north, 107 deg, 21', 13" west (3 satellites).

1545- Pond/spring on fault. Biogenic gas due to non-specific nature and black iron sulfite in bottom.

Map Location GS3: 41 deg, 00', 58" north, 107 deg, 21', 38" west (5 satellites).

1630- Pond/spring on fault. Biogenic gas due to non-specific nature and black iron sulfite in bottom.

Map Location GS4: 41 deg, 00', 56" north, 107 deg, 20', 25" west (4 satellites).

Return to Steamboat Springs.

2100- Prepare daily report.

**DAILY REPORT 4 JUNE 2003  
CEDAR RIDGE LLC- FLY CREEK PROJECT**

**0730- Met Jubal Terry. Travel to site.**

**0930- Inspect seep at Lee Robinson field. He dug water pit for stock watering. A small steady gas seep with a couple intermittent seeps. Sodic soil from seep.**

**41 deg, 01', 26" N, 107 deg, 26', 06" W, 5 sats.**

**Began mapping seep extent. Almost whole area is under irrigation water, perfect for mapping.**

**41 deg, 01', 28" N, 107 deg, 25', 56" W, 3 sats.**

**Dead Spot, 41 deg, 01', 24" N, 107 deg, 25', 52" W, 3 sats.**

**Intermittent Seep w/dead veg., 41 deg, 01', 21" N, 107 deg, 26', 00" W, 4 sats.**

**20 ft by 50 ft area w/ lateral, steady gas with lazy flow in ditch**

**Map Location GS5: South edge, 41 deg, 01', 24" N, 107 deg, 26', 02" W, 4 sats.**

**North edge, 41 deg, 01', 23" N, 107 deg, 26', 05" W, 3 sats.**

**Steady vigorous seep,**

**Map Location GS6: 41 deg, 01', 23" N, 107 deg, 26', 02" W, 5 sats.**

**Next ditch to east, no seeps.**

**Steady gas seep w/several vents, s. rainbow scum,**

**Map Location GS7: 41 deg, 01', 27" N, 107 deg, 26', 08" W, 3 sats.**

**Another as above,**

**Map Location GS8: 41 deg, 01', 27" N, 107 deg, 26', 07" W, 5 sats.**

**Foamers, 41 deg, 01', 27" N, 107', 26', 07" W, 4 sats.**

**Lazy gas seeps, 41 deg, 01', 27" N, 107 deg, 26', 08" W, 5 sats.**

**Foamers, 41 deg, 01', 27" N, 107 deg, 26', 08" W, 4 sats.**

**Foamer, 41 deg, 01', 27" N, 107 deg, 26', 07" W, 5 sats.**

**More dead spots further west with no visible seeps. Ditches do not have any seeps.**

**Lunch at Savery store. Met Kris Thomas.**

**1300- Roadside seep in pond, up Savery Ck road. Multiple vents, no black sediment, some vents vigorous, possible dug out spring, dead vegetation on hillside above pond. Why only in pond on one side of road? Lots of water on east side of road with no bubbles or indications.**

**41 deg, 03', 23" N, 107 deg, 24', 49" W, 3 sats.**

**Visit Taylor well.**

**1400- Black roadside bog, with sulphur smell. 2 main vents with steady vigorous flow. Other intermittent seeps. Jubal says zone in basal coals.**

**Map Location GS9: 41 deg, 05', 54" N, 107 deg, 22', 48" W, 6 sats.**

**Thunderstorms. Visited Little Snake Valley Museum. Impressive. Mutual Oil Co. Stock certificate.**

**DAILY REPORT 5 JUNE 2003  
CEDAR RIDGE LLC- FLY CREEK PROJECT**

**0730- Met Jubal Terry, Traveled to site.**

**0930- Hiked Rye Grass Gulch to the Little Snake River. Gulch had slight water flow. No indications of gas seeps.**

**Hiked to 40 deg, 00', 07" N, 107 deg, 20', 55" W, 4 sats. Stopped by river cutting into valley wall. Coal seam exposed on north side of river. Possible seep site to be investigated at low water. Across from red trailer house with other 2 story gray house w/flag.**

**Hiked back to trucks at 40 deg, 00', 42" N, 107 deg, 19', 56" W, 6 sats.**

**1200- Checked sodic soil area at 40 deg, 00', 12" N, 107 deg, 21', 48" W, 6 sats.  
No other indications.**

**Lunch- Savery store.**

**1330- Check Thomas area on Savery Ck., Old coal mine on property.**

**Check east of roadside seep, no bubbles.**

**Met Jim Espy.**

**Gassy water well on Slater Ck. road. Flowing water and gas from annulas into field creating sodic area.**

**Map Location GS10: 40 deg, 59', 39" N, 107 deg, 22', 45" W, 5 sats.**

**Checked Slater Ck. to gap with no indications.**

**DAILY REPORT 6 JUNE 2003  
CEDAR RIDGE LLC- FLY CREEK PROJECT**

**0730- Met Jubal Terry. Traveled to site.**

**0930- Drive in to north of Robidoux. Rough roads with some cross country.**

**Dead tree near confluence of Little Snake and Robidoux seep slough. 41 deg, 59', 42" N, 107 deg, 20', 01" W, 3 sats. Lots of standing water through area without bubbles. Returned to trucks at 40 deg, 59', 50" N, 107 deg, 19', 52" W, 4 sats.**

**Lunch- Jubal heads back to Denver.**

**At Big Robidoux seep. River has broken into slough covering seep. Poorly visible. Mapping will have to wait for low water.**

**Map Location GS 11: 40 deg, 59', 37" N, 107 deg, 19' 52" W, 4 sats.**

**Mapped Little Robidoux seep.**

**Intermittent bubbler in lateral, 40 deg, 59', 34" N, 107 deg, 20', 08" W, 6 sats.**

**Main line of seeps is 13 vents with steady flow.**

**One end is Map Location GS12: 40 deg, 59', 30" N, 107 deg, 20', 08" W, 4 sats,**

**to other end Map Location GS13: 40 deg, 59', 34" N, 107 deg, 20', 06" W, 4 sats.**

**Some white salt deposits with possible asphalt.**

**Dead spot, 40 deg, 59', 34" N, 107 deg, 20', 05" W, 5 sats.**

**Four dead spots, 40 deg, 59', 34" N, 107 deg, 20', 05" W, 6 sats.**

**Walking irrigation ditch back to truck, no bubbles. 40 deg, 59', 36" N, 107 deg, 20', 16" W, 6 sats.**

**DAILY REPORT 7 AUGUST 2003  
CEDAR RIDGE- FLY GULCH**

**0800- Call lab to set up bottles.**

**0830- Pick up bottles.**

**1100- At site. Met Mrs. Robidoux for access permission. Met John Thomas.**

**1245- Sampled CBM #1. T=75.4 F, pH=8.4, EC=1,700 uS/cm, H<sub>2</sub>S<0.1 mg/l. No visible oil & grease, no sand some rubber bits, clear, vs. orange, no odor. Took COGCC, dissolved methane, and BTEX.**

**1330- Begin sampling Robidoux Seep, T=82.9 F, pH=8.4, EC=1,400 uS/cm, H<sub>2</sub>S<0.1 mg/l. Visible rainbows of oil & grease, no sand, vs turbid, gray, no odor. Took COGCC, dissolved methane, BTEX, and gas sample.**

**1500- Began mapping big Robidoux seep.**

**Numerous 20-30 gas seeps with oil. 3 sats.**

**Map Location GS14: 40 degrees, 59', 37" N, 107 degrees, 19', 58" W**

**Numerous 20-30 gas seeps with oil. 5 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 54" W**

**Numerous 20-30 gas seeps with oil. 5 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 53" W**

**Numerous 20-30 gas seeps with oil. Main gas vent. Continuous gas flow that is episodic to a roar. 5 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 58" W**

**Main oil vent. 3 sats.**

**40 degrees, 59', 38" N**

**107 degrees, 19', 52" W**

**Downstream, 6 gas seeps with oil. 4 sats.**

**40 degrees, 59', 38" N**

**107 degrees, 19', 53" W**

**No more seeps downstream to the Grieve property line. 3 sats.**

**40 degrees, 59', 38" N**

**107 degrees, 19', 54" W**

**Upstream of main seep. Numerous 10-20 gas seeps with oil. 5 sats.**

**40 degrees, 59', 35" N**

**107 degrees, 19', 51" W**

**Numerous 20-30 gas seeps. 7 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 51" W**

**Numerous 15 gas seeps. 5 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 51" W**

**1 gas seep. 5 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 50" W**

**5 gas seeps. 6 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 50" W**

**2 gas seeps. 3 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 51" W**

**1 gas seep. 3 sats.**

**40 degrees, 59', 37" N**

**107 degrees, 19', 50" W**

**At a ford. Went and relocated truck.**

**5-10 intermittent gas seeps. 3 sats.**

**40 degrees, 59', 39" N**

**107 degrees, 19', 50" W**

**3-5 continuous gas seeps. 5 sats.**

**40 degrees, 59', 39" N**

**107 degrees, 19', 50" W**

**1 intermittent gas seep. 3 sats.**

**40 degrees, 59', 40" N**

**107 degrees, 19', 50" W**

**4 intermittent gas seeps. 4 sats.**

**40 degrees, 59', 40" N**

107 degrees, 19', 50" W

2 oil stained areas. 3 sats.

40 degrees, 59', 40" N

107 degrees, 19', 49" W

Out of slough into main river channel. No seeps downstream to  
4 sats.

40 degrees, 59', 45" N

107 degrees, 19', 50" W

Head upstream

3-5 intermittent gas seeps. 4 sats.

40 degrees, 59', 41" N

107 degrees, 19', 44" W

1 continuous gas seep, 1 intermittent gas seep. 4 sats.

40 degrees, 59', 40" N

107 degrees, 19', 44" W

No seeps upstream to

3 sats.

40 degrees, 59', 47" N

107 degrees, 19', 41" W

Return to truck.





02544802

# ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

## Analytical Report

Terry Logan  
Cedar Ridge, LLC  
P.O. BOX 3524  
Durango, CO 81302

August 27, 2003

cc: Paul Oldaker

Project ID:  
ACZ Project ID: L42420

Terry Logan:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on August 08, 2003. This project has been assigned to ACZ's project number, L42420. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 10.0. The enclosed results relate only to the samples received under L42420. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

This report shall be used or copied only in it's entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after September 27, 2003. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than \$10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years. Please notify your Project Manager if you have other needs.

If you have any questions, please contact your Project Manager or Customer Service Representative.

27/Aug/03

Tony Antalek, Project Manager, has reviewed and accepted this report in its entirety.



Cedar Ridge, LLC

Project ID:

Sample ID: CBM#1

ACZ Sample ID: L42420-01

Date Sampled: 08/07/03 12:45

Date Received: 08/08/03

Sample Matrix: ~~Ground Water~~ ILES COAL WATER

### Metals Analysis

Parameter	EPA Method	Result	Qual. No.	Units	MDL	PQL	Date	Analyst
Barium, dissolved	M200.7 ICP	0.153		mg/L	0.006	0.02	08/16/03 13:31	wfg
Boron, total	M200.7 ICP	1.18		mg/L	0.01	0.05	08/15/03 20:30	wfg
Calcium, dissolved	M200.7 ICP	4.6		mg/L	0.2	1	08/12/03 20:25	wfg
Iron, dissolved	M200.7 ICP		U	mg/L	0.01	0.05	08/12/03 20:25	wfg
Iron, total	M200.7 ICP	5.69		mg/L	0.01	0.05	08/15/03 20:30	wfg
Magnesium, dissolved	M200.7 ICP	1.5		mg/L	0.2	1	08/12/03 20:25	wfg
Manganese, dissolved	M200.7 ICP	0.017	B	mg/L	0.005	0.03	08/12/03 20:25	wfg
Potassium, dissolved	M200.7 ICP	5.0		mg/L	0.3	1	08/12/03 20:25	wfg
Selenium, dissolved	SM 3114 C, AA-Hydride		U	mg/L	0.001	0.005	08/15/03 15:25	ms
Sodium, dissolved	M200.7 ICP	993		mg/L	0.6	2	08/16/03 13:31	wfg

### Metals Prep

Parameter	EPA Method	Result	Qual. No.	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP						08/13/03 10:52	scp

Cedar Ridge, LLC

Project ID:

Sample ID: CBM#1

ACZ Sample ID: L42420-01

Date Sampled: 08/07/03 12:45

Date Received: 08/08/03

Sample Matrix: Ground Water

Wet Chemistry

Parameter	REF Method	Result	Qual	Units	MDL	EQ	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration							
Bicarbonate as CaCO3		2310		mg/L	2	10	08/21/03 0:00	lms
Carbonate as CaCO3			U	mg/L	2	10	08/21/03 0:00	lms
Hydroxide as CaCO3			U	mg/L	2	10	08/21/03 0:00	lms
Total Alkalinity		2310		mg/L	2	10	08/21/03 0:00	lms
Cation-Anion Balance	Calculation							
Cation-Anion Balance		-4.5		%			08/25/03 0:00	calc
Sum of Anions		48.4		meq/L	0.1	0.5	08/25/03 0:00	calc
Sum of Cations		44.2		meq/L	0.1	0.5	08/25/03 0:00	calc
Chloride	M325.2 - Colorimetric	56		mg/L	1	5	08/14/03 12:55	ksj
Conductivity @25C	M120.1 - Meter	3800		umhos/cm	1	10	08/26/03 14:48	mah
Fluoride	SM4500F-C	7.5	*	mg/L	0.1	0.5	08/20/03 21:00	mah
Hardness as CaCO3	SM2340B - Calculation	18		mg/L	1	7	08/25/03 0:00	calc
Lab Filtration	SM 3030 B						08/09/03 10:28	kmc
Lab Filtration & Acidification	SM 3030 B						08/11/03 11:41	dln
Nitrate as N, dissolved	Calculation: NO3NO2 minus NO2	0.02	B	mg/L	0.02	0.1	08/25/03 0:00	calc
Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	0.03	B	mg/L	0.02	0.1	08/08/03 17:36	kmc
Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction	0.01	B	mg/L	0.01	0.05	08/08/03 17:36	kmc
pH (lab)	M150.1 - Electrometric	8.2	H	units	0.1	0.1	08/26/03 12:15	jjc
Residue, Filterable (TDS) @180C	M160.1 - Gravimetric	2470		mg/L	10	20	08/14/03 17:58	mah
Sodium Absorption Ratio in Water	USGS - I1738-78	104			0.03	0.15	08/25/03 0:00	calc
Sulfate	M375.3 - Gravimetric	10	B	mg/L	10	50	08/22/03 10:31	leb
TDS (calculated)	Calculation	2460		mg/L	10	50	08/25/03 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.00					08/25/03 0:00	calc

Cedar Ridge, LLC  
 Project ID:  
 Sample ID: ROBIDOUX SEEP

ACZ Sample ID: L42420-02  
 Date Sampled: 08/07/03 13:30  
 Date Received: 08/08/03  
 Sample Matrix: Ground Water

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Barium, dissolved	M200.7 ICP	0.245			mg/L	0.006	0.02	08/16/03 13:34	wfg
Boron, total	M200.7 ICP	1.19			mg/L	0.01	0.05	08/15/03 20:34	wfg
Calcium, dissolved	M200.7 ICP	3.7			mg/L	0.2	1	08/12/03 20:29	wfg
Iron, dissolved	M200.7 ICP		U		mg/L	0.01	0.05	08/12/03 20:29	wfg
Iron, total	M200.7 ICP	0.18			mg/L	0.01	0.05	08/15/03 20:34	wfg
Magnesium, dissolved	M200.7 ICP	1.5			mg/L	0.2	1	08/12/03 20:29	wfg
Manganese, dissolved	M200.7 ICP		U		mg/L	0.005	0.03	08/12/03 20:29	wfg
Potassium, dissolved	M200.7 ICP	6.2			mg/L	0.3	1	08/12/03 20:29	wfg
Selenium, dissolved	SM 3114 C, AA-Hydride		U		mg/L	0.001	0.005	08/15/03 15:27	ms
Sodium, dissolved	M200.7 ICP	999			mg/L	0.6	2	08/16/03 13:34	wfg

Metals Prep

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Total Hot Plate Digestion	M200.2 ICP							08/13/03 10:55	scp

Cedar Ridge, LLC

Project ID:

Sample ID: ROBIDOUX SEEP

ACZ Sample ID: L42420-02

Date Sampled: 08/07/03 13:30

Date Received: 08/08/03

Sample Matrix: Ground Water

Wet Chemistry

Parameter	EPAMethod	Result	Qual	XC	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		2270	H	*	mg/L	2	10	08/26/03 0:00	lms
Carbonate as CaCO3			UH	*	mg/L	2	10	08/26/03 0:00	lms
Hydroxide as CaCO3			UH	*	mg/L	2	10	08/26/03 0:00	lms
Total Alkalinity		2270	H	*	mg/L	2	10	08/26/03 0:00	lms
Cation-Anion Balance	Calculation								
Cation-Anion Balance		-3.9			%			08/25/03 0:00	calc
Sum of Anions		48.0			meq/L	0.1	0.5	08/25/03 0:00	calc
Sum of Cations		44.4			meq/L	0.1	0.5	08/25/03 0:00	calc
Chloride	M325.2 - Colorimetric	77			mg/L	1	5	08/14/03 12:56	ksj
Conductivity @25C	M120.1 - Meter	3900			umhos/cm	1	10	08/26/03 14:49	mah
Fluoride	SM4500F-C	7.5		*	mg/L	0.1	0.5	08/20/03 21:02	mah
Hardness as CaCO3	SM2340B - Calculation	15			mg/L	1	7	08/25/03 0:00	calc
Lab Filtration	SM 3030 B							08/09/03 10:29	kmc
Lab Filtration & Acidification	SM 3030 B							08/11/03 11:45	dln
Nitrate as N, dissolved	Calculation: NO3NO2 minus NO2		U		mg/L	0.02	0.1	08/25/03 0:00	calc
Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction		U		mg/L	0.02	0.1	08/08/03 17:37	kmc
Nitrite as N, dissolved	M353.2 - Automated Cadmium Reduction		U		mg/L	0.01	0.05	08/08/03 17:37	kmc
pH (lab)	M150.1 - Electrometric	8.1	H		units	0.1	0.1	08/26/03 8:08	lms
Residue, Filterable (TDS) @180C	M160.1 - Gravimetric	2520			mg/L	10	20	08/14/03 17:59	mah
Sodium Absorption Ratio in Water	USGS - I1738-78	112				0.03	0.15	08/25/03 0:00	calc
Sulfate	M375.3 - Gravimetric		U		mg/L	10	50	08/22/03 10:33	leb
TDS (calculated)	Calculation	2460			mg/L	10	50	08/25/03 0:00	calc
TDS (ratio - measured/calculated)	Calculation	1.02						08/25/03 0:00	calc

### Report Header Explanations

<i>Batch</i>	A distinct set of samples analyzed at a specific time
<i>Found</i>	Value of the QC Type of interest
<i>Limit</i>	Upper limit for RPD, in %.
<i>Lower</i>	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
<i>MDL</i>	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
<i>PCN/SCN</i>	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
<i>PQL</i>	Practical Quantitation Limit, typically 5 times the MDL.
<i>QC</i>	True Value of the Control Sample or the amount added to the Spike
<i>Rec</i>	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
<i>RPD</i>	Relative Percent Difference, calculation used for Duplicate QC Types
<i>Upper</i>	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
<i>Sample</i>	Value of the Sample of interest

### QC Sample Types

<i>AS</i>	Analytical Spike (Post Digestion)	<i>LCSWD</i>	Laboratory Control Sample - Water Duplicate
<i>ASD</i>	Analytical Spike (Post Digestion) Duplicate	<i>LFB</i>	Laboratory Fortified Blank
<i>CCB</i>	Continuing Calibration Blank	<i>LFM</i>	Laboratory Fortified Matrix
<i>CCV</i>	Continuing Calibration Verification standard	<i>LFMD</i>	Laboratory Fortified Matrix Duplicate
<i>DUP</i>	Sample Duplicate	<i>LRB</i>	Laboratory Reagent Blank
<i>ICB</i>	Initial Calibration Blank	<i>MS</i>	Matrix Spike
<i>ICV</i>	Initial Calibration Verification standard	<i>MSD</i>	Matrix Spike Duplicate
<i>ICSAB</i>	Inter-element Correction Standard - A plus B solutions	<i>PBS</i>	Prep Blank - Soil
<i>LCSS</i>	Laboratory Control Sample - Soil	<i>PBW</i>	Prep Blank - Water
<i>LCSSD</i>	Laboratory Control Sample - Soil Duplicate	<i>PQV</i>	Practical Quantitation Verification standard
<i>LCSW</i>	Laboratory Control Sample - Water	<i>SDL</i>	Serial Dilution

### QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

### ACZ Qualifiers (Qual)

<i>B</i>	Analyte concentration detected at a value between MDL and PQL.
<i>H</i>	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
<i>R</i>	Poor spike recovery accepted because the other spike in the set fell within the given limits.
<i>T</i>	High Relative Percent Difference (RPD) accepted because sample concentrations are less than 10x the MDL.
<i>U</i>	Analyte was analyzed for but not detected at the indicated MDL
<i>V</i>	High blank data accepted because sample concentration is 10 times higher than blank concentration
<i>W</i>	Poor recovery for Silver quality control is accepted because Silver often precipitates with Chloride.
<i>X</i>	Quality control sample is out of control.
<i>Z</i>	Poor spike recovery is accepted because sample concentration is four times greater than spike concentration.

### Method References

- (1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
- (2) EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
- (3) EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
- (5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
- (6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

### Comments

- (1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
- (2) Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
- (3) Animal matrices for Inorganic analyses are reported on an "as received" basis.

Cedar Ridge, LLC

ACZ Project ID: L42420

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L42420-01	WG160837	Fluoride	SM4500F-C	M2	Matrix spike recovery was low, the method control sample recovery was acceptable.
L42420-02	WG161034	Bicarbonate as CaCO3	SM2320B - Titration	C4	Confirmatory analysis was past holding time.
		Carbonate as CaCO3	SM2320B - Titration	C4	Confirmatory analysis was past holding time.
	WG160837	Fluoride	SM4500F-C	M2	Matrix spike recovery was low, the method control sample recovery was acceptable.
	WG161034	Hydroxide as CaCO3	SM2320B - Titration	C4	Confirmatory analysis was past holding time.
		Total Alkalinity	SM2320B - Titration	C4	Confirmatory analysis was past holding time.

Cedar Ridge, LLC  
 Project ID:  
 Sample ID:       CBM#1

ACZ Sample ID: **L42420-01**  
 Date Sampled: 08/07/03 12:45  
 Date Received: 08/08/03  
 Sample Matrix: Ground Water

**Benzene, Toluene, Ethylbenzene & Xylene**

Analysis Method: **M8021B GC/PID**  
 Extract Method: **Method**

Analyst: *km*  
 Extract Date: 08/12/03 19:06  
 Analysis Date: 08/12/03 19:06  
 Dilution Factor: 1

## Compound

Compound	CAS	Result	Unit	Conc	Limit
Benzene	000071-43-2	0.3	J ug/L	0.3	1
Ethylbenzene	000100-41-4		U ug/L	0.2	1
m p Xylene	01330 20 7		U ug/L	0.4	2
o Xylene	00095-47-6		U ug/L	0.2	1
Toluene	000108-88-3		U ug/L	0.2	1

## Surrogate Recoveries

Compound	CAS	% Recovered	Target	Actual
Bromofluorobenzene	000460-00-4	95.3	%	84 114

Cedar Ridge, LLC  
Project ID:  
Sample ID: CBM#1

ACZ Sample ID: L42420-01  
Date Sampled: 08/07/03 12:45  
Date Received: 08/08/03  
Sample Matrix: Ground Water

**Hydrocarbon Gas (C1 to C6)**

Analysis Method: GC/FID  
Extract Method: Method

Analyst: *jj*  
Extract Date: 08/13/03 14:58  
Analysis Date: 08/13/03 14:58  
Dilution Factor: 200

Compound

Compound	CAS	Result	Unit	Conc	Lim
Butane	000106-97-8	U	mg/L	1	1
Ethane	000074-84-0	U	mg/L	1	1
Hexane	000110-54-3	U	mg/L	1	1
Methane	000074-82-8	10.6	mg/L	0.4	0.4
Pentane	000109-66-0	U	mg/L	1	1
Propane	000074-98-6	U	mg/L	1	1

Cedar Ridge, LLC  
 Project ID:  
 Sample ID: ROBIDOUX SEEP

ACZ Sample ID: L42420-02  
 Date Sampled: 08/07/03 13:30  
 Date Received: 08/08/03  
 Sample Matrix: Ground Water

Benzene, Toluene, Ethylbenzene, m,p Xylene

Analysis Method: M8021B GC/PID  
 Extract Method: Method

Analyst: km  
 Extract Date: 08/12/03 19:48  
 Analysis Date: 08/12/03 19:48  
 Dilution Factor: 1

Compound

Compound	Result	Q/A	XC	Units	Min	Max
Benzene	000071-43-2	U		ug/L	0.3	1
Ethylbenzene	000100-41-4	U		ug/L	0.2	1
m p Xylene	01330 20 7	U		ug/L	0.4	2
o Xylene	00095-47- 6	U		ug/L	0.2	1
Toluene	000108-88-3	U		ug/L	0.2	1

Surrogate Recoveries

Surrogate	Recovery	%	Limit	Min	Max
Bromofluorobenzene	000460-00-4	96.8	%	84	114

Cedar Ridge, LLC

Project ID:

Sample ID: ROBIDOUX SEEP

ACZ Sample ID: L42420-02

Date Sampled: 08/07/03 13:30

Date Received: 08/08/03

Sample Matrix: Ground Water

### Hydrocarbon Gas (C1 to C6)

Analysis Method: GC/FID

Extract Method: Method

Analyst: *jj*

Extract Date: 08/13/03 15:05

Analysis Date: 08/13/03 15:05

Dilution Factor: 200

Compound

Compound	CAS	Result	Unit	Min	Max
Butane	000106-97-8	U	mg/L	1	1
Ethane	000074-84-0	U	mg/L	1	1
Hexane	000110-54-3	U	mg/L	1	1
Methane	000074-82-8	8.8	mg/L	0.4	0.4
Pentane	000109-66-0	U	mg/L	1	1
Propane	000074-98-6	U	mg/L	1	1

Cedar Ridge, LLC

Project ID:

Sample ID: TB080603-01

ACZ Sample ID: L42420-03

Date Sampled: 08/06/03 0:00

Date Received: 08/08/03

Sample Matrix: Ground Water

**Benzene, Toluene, Ethylbenzene & Xylene**

Analysis Method: M8021B GC/PID

Extract Method: Method

Analyst: km

Extract Date: 08/12/03 21:13

Analysis Date: 08/12/03 21:13

Dilution Factor: 1

## Compound

Compound	CAS	Result	Unit	Conc	Limit
Benzene	000071-43-2	U	ug/L	0.3	1
Ethylbenzene	000100-41-4	U	ug/L	0.2	1
m p Xylene	01330 20 7	U	ug/L	0.4	2
o Xylene	00095-47-6	U	ug/L	0.2	1
Toluene	000108-88-3	U	ug/L	0.2	1

## Surrogate Recoveries

Surrogate	CAS	% Recovery	Conc	Limit
Bromofluorobenzene	000460-00-4	93.4	%	84 114



### Report Header Explanations

<i>Batch</i>	A distinct set of samples analyzed at a specific time
<i>Found</i>	Value of the QC Type of interest
<i>Limit</i>	Upper limit for RPD, in %.
<i>Lower</i>	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
<i>LCL</i>	Lower Control Limit
<i>MDL</i>	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
<i>PCN/SCN</i>	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
<i>PQL</i>	Practical Quantitation Limit
<i>QC</i>	True Value of the Control Sample or the amount added to the Spike
<i>Rec</i>	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
<i>RPD</i>	Relative Percent Difference, calculation used for Duplicate QC Types
<i>Upper</i>	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
<i>UCL</i>	Upper Control Limit
<i>Sample</i>	Value of the Sample of interest

### QC Sample Types

<i>SURR</i>	Surrogate	<i>LFM</i>	Laboratory Fortified Matrix
<i>INTS</i>	Internal Standard	<i>LFMD</i>	Laboratory Fortified Matrix Duplicate
<i>DUP</i>	Sample Duplicate	<i>LRB</i>	Laboratory Reagent Blank
<i>LCSS</i>	Laboratory Control Sample - Soil	<i>MS/MSD</i>	Matrix Spike/Matrix Spike Duplicate
<i>LCSW</i>	Laboratory Control Sample - Water	<i>PBS</i>	Prep Blank - Soil
<i>LFB</i>	Laboratory Fortified Blank	<i>PBW</i>	Prep Blank - Water

### QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.

### ACZ Qualifiers (Qual)

B	Analyte detected in daily blank
H	Analysis exceeded method hold time.
J	Analyte concentration detected at a value between MDL and PQL
R	Poor spike recovery accepted because the other spike in the set fell within the given limits.
T	High Relative Percent Difference (RPD) accepted because sample concentrations are less than 10x the MDL.
U	Analyte was analyzed for but not detected at the indicated MDL
V	High blank data accepted because sample concentration is 10 times higher than blank concentration
W	Poor recovery for Silver quality control is accepted because Silver often precipitates with Chloride.
X	Quality control sample is out of control.
Z	Poor spike recovery is accepted because sample concentration is four times greater than spike concentration.
P	Analyte concentration differs from second detector by more than 40%.
E	Analyte concentration is estimated due to result exceeding calibration range.
M	Analyte concentration is estimated due to matrix interferences.

### Method References

- (1) EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
- (2) EPA 600/4-90/020. Methods for the Determination of Organic Compounds in Drinking Water (I), July 1990.
- (3) EPA 600/R-92/129. Methods for the Determination of Organic Compounds in Drinking Water (II), July 1990.
- (5) EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December, 1996.
- (6) Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

### Comments

- (1) QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
- (2) Organic analyses are reported on an "as received" basis.

Cedar Ridge, LLC

ACZ Project ID: L42420

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
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No extended qualifiers associated with this analysis

Cedar Ridge, LLC

ACZ Project ID: L42420  
 Date Received: 8/8/2003  
 Received By: CORYD

**Receipt Verification**

- 1) Does this project require special handling procedures such as CLP protocol?
- 2) Are the custody seals on the cooler intact?
- 3) Are the custody seals on the sample containers intact?
- 4) Is there a Chain of Custody or other directive shipping papers present?
- 5) Is the Chain of Custody complete?
- 6) Is the Chain of Custody in agreement with the samples received?
- 7) Is there enough sample for all requested analyses?
- 8) Are all samples within holding times for requested analyses?
- 9) Were all sample containers received intact?
- 10) Are the temperature blanks present?
- 11) Are the trip blanks (VOA and/or Cyanide) present?
- 12) Are samples requiring no headspace, headspace free?
- 13) Do the samples that require a Foreign Soils Permit have one?

YES	NO	NA
		✓
		✓
		✓
✓		
✓		
✓		
✓		
✓		
✓		
✓		
✓		
		✓

**Exceptions (If you answered no to any of the above questions please describe)**

N/A

**Contact (For any discrepancies the client must be contacted)**

N/A

**Shipping Containers**

Cooler Id	Temp (°C)	Rad (µR/hr)
walk-in	26.2	12

**Notes**

Cedar Ridge, LLC

ACZ Project ID: L42420  
 Date Received: 8/8/2003  
 Received By: CORYD

**Sample Container Preservation**

SAMPLE	CLIENT ID	R < 2	G < 2	Y < 2	YG < 2	B < 2	BG < 2	O < 2	T > 12	P > 12	N/A	RAD
L42420-01	CBM#1	Y			Y							
L42420-02	ROBIDOUX SEEP	Y			Y							
L42420-03	TB080603-01										√	
L42420-15	TB080703-01										√	



**PARAMETER LIST  
CEDAR RIDGE- FLY GULCH PROJECT**

**pH  
Electrical Conductivity**

**Total Dissolved Solids**

**Sodium  
Potassium  
Calcium  
Magnesium  
Sodium Adsorption Ratio**

**Alkalinity  
Bicarbonate  
Carbonate  
Hydroxide  
Chloride  
Sulfate  
Flouride**

**Nitrate-Nitrite**

**Barium, dissolved  
Boron, total  
Iron, total  
Iron, dissolved  
Manganese, dissolved  
Selenium, dissolved**

**Benzene  
Toluene  
Ethylbenzene  
Xylenes, total**

**Methane, dissolved  
Ethane, dissolved  
Butane, dissolved**

REPORT OF ANALYTICAL RESULTS



Client: Terry Logan  
 Ceder Ridge LLC  
 P.O. Box 3524  
 Durango, CO 81302-3524

Lab Number: 32745  
 Received: 08/12/03  
 Matrix: Vapor

Project: Fly Gulch  
 Project Number:  
 Collected by: Paul Olkaker

Sample Description: See Below  
 Analyzed: 09/05/03  
 Method: off line, dual inlet

$\delta^{13}\text{C}$ $\delta\text{D}$				
LAB NUMBER	SAMPLE DESCRIPTION	METHANE $\delta^{13}\text{C}$ ‰	CO <sub>2</sub> $\delta^{13}\text{C}$ ‰	METHANE $\delta\text{D}$ ‰
32745-1	ROBIDOUX SEEP	-54.75	-2.51	-295
32745-1-R	ROBIDOUX SEEP	-54.72	-2.58	-296

R=duplicate.

Submitted by,  
 ZymaX FORENSICS

Dachun Zhang, Ph.D.  
 Director, Stable Isotopes

32745c.xls  
 DZ/xd

RECEIVED  
 SEP 10 2003  
 BY: CR-OT

QUALITY ASSURANCE REPORT



Client: Terry Logan  
 Ceder Ridge LLC  
 P.O. Box 3524  
 Durango, CO 81302-3524

Lab Number: 32745  
 Analyzed: 09/05/03  
 Method: off line, dual inlet

QA DATA FOR  $\delta^{13}C$

STANDARD	RV	RV <sub>D</sub>	ACCEPTANCE LIMIT ‰
ET	-29.43	-29.41	± 0.2

QA DATA FOR  $\delta D$

STANDARD	RV	RV <sub>D</sub>	ACCEPTANCE LIMIT ‰
ET	-154	-153	± 0.2

RV = Known reference value for laboratory working standard

RV<sub>D</sub> = Daily measurement of reference value

ET = Ethane gas

Submitted by,  
 ZymaX FORENSICS

Dachun Zhang, Ph.D.  
 Director, Stable Isotopes

32745c.xls  
 DZ/xd

REPORT OF ANALYTICAL RESULTS

Client: Terry Logan  
Ceder Ridge LLC  
P.O. Box 3524  
Durango, CO 81302-3524

Lab Number: 32745-1  
Collected: 08/08/03  
Received: 08/12/03  
Matrix: Vapor

Project: Fly Gulch  
Project Number:  
Collected by: Paul Olkaker

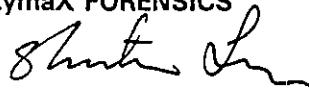
Sample Description: ROBIDOUX SEEP  
Analyzed: 08/25/03  
Method: GC/TCD

SELECTED FIXED GAS CONCENTRATIONS

CONSTITUENT	HEADSPACE	O <sub>2</sub> + Ar	N <sub>2</sub>	CH <sub>4</sub>	CO	CO <sub>2</sub>
	VOLUME (mL)	% VOLUME				
Fixed Gases	1,023	2.80	10.3	84.1	<0.05	1.51
Detection Limit:		0.05	0.05	0.05	0.05	0.05

32745-1g.xls  
STL/dag

Submitted by,  
ZymaX FORENSICS



Shan-Tan Lu, Ph.D.  
Director, Petroleum Geochemistry

QUALITY ASSURANCE REPORT

Client: Terry Logan  
 Ceder Ridge LLC  
 P.O. Box 3524  
 Durango, CO 81302-3524

Lab Number: 32745-1  
 Analyzed: 08/25/03  
 Method: GC/TCD

QA DATA FOR FIXED GASES

ANALYTES	RF x 10 <sup>5</sup>	RF <sub>D</sub> x 10 <sup>5</sup>	%D	ACCEPTANCE
				LIMIT %
O <sub>2</sub> + Ar	0.3360	0.3265	-2.84	± 10
N <sub>2</sub>	0.3430	0.3149	-8.20	± 10
CH <sub>4</sub>	0.3070	0.2851	-7.14	± 10
CO	0.3400	0.344	1.18	± 10
CO <sub>2</sub>	0.2190	0.2061	-5.90	± 10

RF = Mean response factor from 3 point calibration

RF<sub>D</sub> = Daily calibration standard response factor

% D = % Difference

Calibration file: fg174.cal

Submitted by,  
 ZymaX FORENSICS



Shan-Tan Lu, Ph.D.  
 Director, Petroleum Geochemistry

32745-1g.xls  
 STL/dag

QUALITY ASSURANCE REPORT

Client: Terry Logan  
Ceder Ridge LLC  
P.O. Box 3524  
Durango, CO 81302-3524

Lab Number: 32745 -1  
Analyzed: 08/25/03  
Method: GC/FID

QA DATA FOR C<sub>1</sub>-C<sub>5</sub> ANALYSES

ANALYTES	RF x 10 <sup>5</sup>	RF <sub>D</sub> x 10 <sup>5</sup>	%D	ACCEPTANCE
				LIMIT %
C <sub>1</sub>	0.1680	0.1519	-9.58	± 10
C <sub>2</sub> /C <sub>2</sub> <sup>m</sup>	0.3410	0.3125	-8.35	± 10
C <sub>3</sub>	0.5310	0.4952	-6.75	± 10
i-C <sub>4</sub>	0.7150	0.6911	-3.34	± 10
n-C <sub>4</sub>	0.7460	0.7140	-4.29	± 10
i-C <sub>5</sub>	1.0400	0.9927	-4.54	± 10
n-C <sub>5</sub>	1.0600	1.0381	-2.07	± 10

<sup>m</sup> = Mean response factor from 3 point calibration

RF<sub>D</sub> = Daily calibration standard response factor

% D = % Difference

Calibration file: c1c5m307(32bit).cal

Submitted by,  
ZymaX FORENSICS



Shan-Tan Lu, Ph.D.  
Director, Petroleum Geochemistry

REPORT OF ANALYTICAL RESULTS

Client: Terry Logan  
Ceder Ridge LLC  
P.O. Box 3524  
Durango, CO 81302-3524

Lab Number: 32745 -1  
Collected: 08/08/03  
Received: 08/12/03  
Matrix: Vapor

Project: Fly Gulch  
Project Number:  
Collected by: Paul Olkaker

Sample Description: ROBIDOUX SEEP  
Analyzed: 08/25/03  
Method: GC/FID

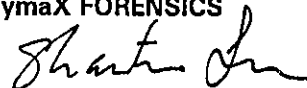
C<sub>1</sub>-C<sub>5</sub> HYDROCARBON CONCENTRATIONS

CONSTITUENT	HEADSPACE VOLUME (mL)	C <sub>1</sub> ppmv	C <sub>2</sub> = ppmv	C <sub>2</sub> ppmv	C <sub>3</sub> ppmv	i-C <sub>4</sub> ppmv	n-C <sub>4</sub> ppmv	i-C <sub>5</sub> ppmv	n-C <sub>5</sub> ppmv
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C <sub>1</sub> -C <sub>5</sub> Hydrocarbons	1,023	790,000	<10	<10	<10	<10	<10	<10	<10
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Detection Limit:		10	10	10	10	10	10	10	10
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Submitted by,  
ZymaX FORENSICS



Shan-Tan Lu, Ph.D.  
Director, Petroleum Geochemistry

