

Incoming
C0070005

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From: "Belcher, Austin" <ABelcher2@archcoal.com>
To: Jim Smith <jimdsmith@utah.gov>
CC: "Galecki, Gregg" <GGalecki@archcoal.com>
Date: 4/26/2010 7:15 AM
Subject: RE: Isotopic data from 2008
Attachments: FINAL Skyline 2ndQ2009 response letter.pdf

Jim,

I changed the time the samples were collected by one minute and that seemed to fix the 'sample type already exists' error. The new error that is showing up is that the analyses are negative values but an error comes up saying 'parameter value cannot be less than the MDL. Let me know how I can fix it, I have tried everything.

We have also been reviewing the quarterly water monitoring memos. We feel there could be some clarity given to the reliability checks. I have attached a report by Erik Petersen that we would like to have attached to our 2nd qtr 2009 memo. We also feel that the conclusion of sample collecting and lab analysis needing more scrutiny is resolved with weekly meter calibration and a state certification for the lab. Please give me a call if you have any questions.

Thank you,

Austin R. Belcher
Environmental Engineer
Canyon Fuel Company, LLC
Skyline Mine
(435)448-2668

-----Original Message-----

From: Jim Smith [mailto:jimdsmith@utah.gov]
Sent: Thursday, April 22, 2010 8:29 AM
To: Belcher, Austin
Subject: RE: Isotopic data from 2008

It seems this has happened before. Try changing the time of collection by one minute.

JIM

>>> "Belcher, Austin" <ABelcher2@archcoal.com> 4/16/2010 2:44 PM >>>

Jim, just some more information that I neglected to provide, the sample dates are 9/28/2008 and 10/29/2008 with corresponding lab ID's of 6640 and 7460.

Austin R. Belcher
Environmental Engineer
Canyon Fuel Company, LLC
Skyline Mine
(435)448-2668

-----Original Message-----

From: Jim Smith [mailto:jimdsmith@utah.gov]
Sent: Tuesday, March 02, 2010 10:01 AM
To: Belcher, Austin
Subject: Isotopic data from 2008

Dustin,

It appears that the O-18, C-14, and deuterium data for 3rd and 4th quarters 2008 have not been submitted to the database. Does Skyline have those results? If so, please submit them.

Thanks,

JIM

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PETERSEN HYDROLOGIC

15 April 2010

Mr. Gregg Galecki
Canyon Fuel Company, LLC
Skyline Mine
HC 35 Box 380
Helper, Utah 84526

15 April 2009

Gregg,

At your request, I have evaluated the January 25, 2009 Water Quality Memorandum from James D. Smith of the Utah Division of Oil, Gas and Mining (Division) regarding the 2009 second quarter water monitoring, Canyon Fuel Company, L LC, Skyline Mine, C/007/0005, Task ID #3312. The Division's memo evaluates the completeness of the water monitoring activities and submittals to the Division by Skyline Mine. The Division also presents an analysis of various chemical parameters for the purpose of evaluating the reliability of the submitted water monitoring information.

In their memo, the Division indicates that "an analysis and explanation of the inconsistencies by the Permittee would help to increase the confidence in the procedures used for sample collection and analysis". The purpose of this letter report is to address the specific water quality analysis issues discussed in the Division's memo.

Overview

The Division's memo utilizes two techniques to evaluate the reliability of the water monitoring information submitted to the Division by Skyline Mine. These include:

- 1) an evaluation of the relationship between total dissolved solids (TDS) and specific conductance as a check on the validity of these two parameters, and
- 2) an evaluation of selected ion ratios in the context of pre-defined ideal values as a check on the validity of various solute species.

Electrical conductance (conductivity) is the ability of a substance to conduct an electric current. The presence of charged ionic species in a solution makes the solution conductive. As ion concentrations increase, there is a corresponding increase in the conductance of the solution. Consequently, the measurement of conductance provides an indication of ion concentration (Hem, 1985). Instruments used to measure specific conductance may produce accuracy and precision from ± 2 to ± 5 percent (Hem, 1985). As part of Skyline Mine's water monitoring plan, specific conductance measurements are performed in the field and reported quarterly to the Division.

Total dissolved solids (TDS) is a measurement of the total amount of solids (mass per unit volume) remaining when a filtered water sample is evaporated to dryness under heat (typically 180°C). In principle, it is equivalent to the sum of all the dissolved constituents, with bicarbonate converted to equivalent carbonate. However, measured TDS often does not correspond well with the TDS calculated by summing the dissolved constituents (Drever, 1988). This is often due to various chemical changes that can occur to chemical species as heating and desiccation of the water takes place (such as, for example, the conversion of some bicarbonate to CO_2). As part of Skyline Mine's water monitoring plan, laboratory determined TDS values are reported quarterly to the Division.

Conductivity cannot be converted precisely to salinity (TDS) unless the proportions of the different ions contributing to the conductivity are known (Drever, 1988). This is largely because some heavier ions contribute disproportionately to TDS relative to other lighter ions with similar electrical charge. As an example, as shown below, a sulfate ion,

with a formula weight of 96.1 and an ionic charge of 2 is more than two times heavier than a calcium ion, which also has a charge of 2. The sulfate ion is almost 4 times heavier than a magnesium ion, which also has a charge of 2. Thus, a solution dominated by heavy dissolved ions will likely have a higher TDS/conductivity ratio than will a solution of equivalent specific conductance that is dominated by lighter ions with the same ionic charge.

Solute	Ionic charge	Molecular weight
Ca ²⁺	+2	40.1
Mg ²⁺	+2	24.3
SO ₄ ²⁻	-2	96.1

The ionic mobility of an ion, which is a largely a function of the ions charge, its size, and the way it interacts with the solvent also affects the way the ion contributes to the conductance of a solution in which it is present. This is because, in order to conduct an electric current, solute ions actually must move through the solution to transfer charges, and the degree to which an ion may accomplish this is a function of its ionic mobility (Hem, 1985).

In solutions of a single salt, it is usually possible to develop a good empirical relationship between the TDS and the specific conductivity values of solutions at varying concentrations of the salt. It should be noted, however, that even for solutions of single salts, the relationship between TDS and specific conductance may be non-linear (Hem, 1985). The ratio of TDS to specific conductance of a solution (such as a natural water) containing multiple dissolved salts is considerably more complicated. As indicated by Hem (1985),

“Natural waters are not simple solutions. They contain a variety of both ionic and undissociated species, and the amounts and proportions of each may range widely. When applied to natural water, therefore, the conductance determination cannot be expected to be simply related to ion concentrations or to dissolved solids. Some water sources, however, can display well-defined sources.”

Accordingly, while it may be useful to evaluate the TDS/conductivity ratios of waters from a unique source with a reasonably constant solute geochemical type, it is probably not very useful to evaluate TDS/conductivity trends from multiple natural water sources together. Additionally, because of the typical seasonal nature of groundwater recharge in the Wasatch Plateau environment (i.e. a large influx of low-TDS recharge water during the springtime snowmelt event) both the geochemical type and TDS concentrations of waters from a unique source often display marked seasonal variability (i.e. lower TDS concentrations during high flow periods, and higher TDS concentrations during baseflow conditions – sometimes with differing dominant ions seasonally). Similarly, because of the nature of surface-water flow regimes in the Wasatch Plateau, TDS concentrations are often lower in the high-flow season (when the water is largely derived from low-TDS snow melt) and higher in the low-flow season when groundwater discharge (which is often higher in TDS) dominates the flow in the stream. On other occasions, where runoff from seasonal snowmelt or from torrential precipitation events is large, increased TDS concentrations are sometimes observed in streams. This condition is commonly attributable to interactions between the high-energy surface flows and soluble minerals in near surface sediments.

Reliability Checks

TDS/Specific conductivity

In its memo, the Division presents the results of reliability checks it performed using an analysis of TDS/conductivity ratios for 43 samples of natural waters from the Skyline Mine 2nd quarter monitoring information. As described above, it is anticipated that the TDS/conductivity ratios of natural waters with disparate solute geochemical types and solute concentrations would be variable. Accordingly, the degree of scatter in the TDS/specific conductivity plot for the 2nd quarter 2009 samples is not unanticipated. Similarly, the plot of total cations and specific conductivity shows good correlation between these parameters.

At the gross level, these data are useful in evaluating the reliability of TDS and/or specific conductance values reported to the Division by Skyline Mine (i.e. individual samples with TDS/specific conductivity ratios outside the typical range likely warrant additional scrutiny).

Ionic ratios

In its memo, the Division presents the results of reliability checks it performed based on ionic ratios for 26 samples from the 2nd quarter 2009 monitoring information for which the necessary laboratory water quality information was available. While it is of often of value to analyze changes in selected ionic ratios at individual monitoring sites over time (as these may show important changes to water quality parameters), the use of pre-established "ideal ionic ratios" is probably not useful in this context. Waters in the Skyline Mine and adjacent area acquire their geochemical composition through chemical interactions with the geochemical environment with which they come into contact. Because of the variability of the geochemical environment, water residence times, water flow rates and volumes, flow pathways, and other factors, waters of varying geochemical types exist. Accordingly, while there may be ideal ranges for the ratios of some ionic species in a water with respect to a designated use, the concept of an ideal range for the ratio does not have any apparent scientific meaning in the waters in the Skyline Mine and adjacent area. For this reason, there is no apparent basis to conclude that waters with ionic ratios "outside the ideal range" suggest systematic errors in field water quality or laboratory analysis.

Conclusions

- The laboratory reported calculated cation-anion balance percentage in a laboratory analysis (that includes all major ions) is probably the most useful parameter to evaluate the reliability of major ion laboratory analyses. This is because of the theoretical requirement that the sum of the cation species, (expressed in milliequivalents per liter) must approximately equal the sum of anion species in a natural water. Appreciable deviation from equality of these two

terms (typically by more than about 5%) suggests the likelihood of laboratory or sampling error and indicates that additional scrutiny of the laboratory results may be warranted).

- Evaluation of the TDS/conductivity ratio for monitoring sites for which both TDS and specific conductance data are collected is useful for evaluating the gross reliability of the TDS and conductance values (i.e. appreciable deviations from typical ranges suggest the need to further evaluate the reliability of the reported TDS or specific conductance values). It is important to note that changes in the TDS/conductivity ratio at individual monitoring sites can occur for many different reasons as noted above. Changes in these ratios at individual monitoring sites commonly reflect changes to the physical geochemistry of the water source and do not necessarily indicate sampling or analytical error.
- Analysis of long-term trends of specific conductance for individual sites is useful in evaluating potential changes to water quality (evaluated together with climatic and other factors). Where appreciable, unexplained variations in specific conductance relative to baseline and previous operational values are noted at a monitoring site, the collection and analysis of samples for laboratory water quality parameters may then be implemented to further evaluate changes to water quality.
- There is no apparent scientific basis for the evaluation of ion ratios in waters in the Skyline Mine permit and adjacent area as a reliability check for water-quality data. As described previously, the solute geochemical types and TDS concentrations of waters in the Skyline Mine area are variable as a result of several different factors. While it may be true that there are ideal ionic ratios in waters as relating to a specific use of that water, or where simple, well-defined geochemical regimes control solute geochemical compositions, there are no ideal ionic ratios for natural waters in the Skyline Mine area in the scientific sense.

Mr. Gregg Galecki
Page 7 of 7

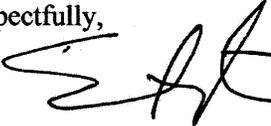
To maximize the reliability and usefulness of the water monitoring data submitted by the mine to the Division, it is indeed important that the validity of these data be verified on an ongoing basis. Based on the second quarter 2009 water monitoring information submitted to the Division and the information provided by the Division in their technical memo, it seems probable that the observed variability in the geochemical characteristics of the sampled waters as pointed out by the Division are primarily attributable to variability in the physical characteristics of the waters and not to analytical error. While there are always inherent margins of error in both field water-quality data collection activities and laboratory analytical activities, and field and laboratory errors do occasionally occur, it does not appear that there are inconsistencies or unacceptable levels of error in the 2nd quarter water monitoring data that could be attributed to improper procedures used for sample collection and analysis.

References Cited

- Drever, J.I., 1988, The geochemistry of natural waters, Prentice Hall, Inc., Simon & Schuster, Englewood Cliffs, New Jersey, 437 p.
- Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural water, United States Geological Survey Water Supply Paper 2254.

Please feel free to contact me should you have any questions in this regard.

Respectfully,


Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah PG No. 5373615-2250

