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Date: APR 11 2013
Refer To: EP2013-0068

John Kieling, Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Subject: Evaluation to Determine the Cause of Reducing Conditions Observed in Regional Aquifer Monitoring Wells R-54 and R-61

Dear Mr. Kieling:

The purpose of this letter is to inform the New Mexico Environment Department of the results of an evaluation Los Alamos National Laboratory (the Laboratory) conducted to determine the cause of the reducing conditions observed in regional aquifer monitoring wells R-54 and R-61. The issue was discussed with David Cobrain and members of his staff on January 29 and April 3, 2013. Samples collected at the end of the post-installation aquifer test at each of these two wells exhibited water-quality characteristics indicative of ambient groundwater conditions (and the presence of contaminant chromium at R-61) as expressed in field parameters and fixed-laboratory analytical data. Evidence of reducing conditions appeared later from routine periodic sampling rounds conducted after dedicated sampling systems were set in each of the wells. Reducing conditions were expressed in R-61 as substantially elevated dissolved iron and manganese concentrations and low or nondetected concentrations of dissolved chromium which had been measured at 16.8 µg/L in the first samples collected at the end of the aquifer test. Similar conditions were also present in data from R-54.

The evaluation involved laboratory analysis of archived cuttings from these two wells. In addition to analysis of cuttings, two specific products that were considered to be potential causes of the reducing condition were also analyzed. The products are BioLube RD biodegradable heavy duty rock drill fluid (hammer oil) and Mobil Rarus SHC 1026 (compressor oil). Sample of both hammer oil and compressor oil were collected from parent containers containing the pure products used during the drilling of R-61.

The pure product compressor oil and hammer oil samples were prepared as reference standards by General Engineering Laboratory (GEL) and analyzed using U.S. Environmental Protection Agency (EPA) Method 8015 for extractable diesel range organic (DRO) hydrocarbons. Preparing individual petroleum product reference standards using organic solvents such as methylene chloride allows the suspected parent products to be directly compared with the environmental samples. The use of

these pure-product reference standards ensures accurate identification of petroleum product contamination by chromatographic pattern matching ("fingerprinting") and establishes retention-time windows for those petroleum products. Petroleum products in environmental samples can then be identified by pattern matching with reference product chromatograms generated on the same day and analyzed on the same analytical instrument as the reference samples. The sources and nature of pure petroleum products impart unique physical chemical characteristics on their chemical signatures or fingerprints. When petroleum products are found in the environment, their fingerprints can be used to identify different sources of contamination. The pure product chemical signature does not, however, take into account alteration of the chemical composition of the pure product in the environment.

Environmental samples contain some fraction of naturally occurring organic matter. After the sample is extracted, this naturally occurring organic matter may yield hydrocarbons and nonhydrocarbons with the same boiling-point fraction as the pure product. The sample extract contains both the naturally occurring organic matter and the organic hydrocarbon contamination.

Cuttings samples from R-54 and R-61 and the hammer oil were extracted and analyzed at GEL by EPA Method 8015 for extractable range organics. The R-54 and R-61 cuttings were analyzed on the same day using the same instrument. On a different day, R-54 cuttings sample and the hammer oil were analyzed in the same analytical batch using the same instrument.

The diesel range chromatograms for hammer oil and compressor oil products were examined against the results of the cuttings samples collected from R-54 and R-61. The chromatograms for the compressor oil do not match the results of the cuttings samples. Figure 1 (attached) shows the total petroleum hydrocarbons (TPH)–DRO chromatographs for hammer oil and R-54 overlaid. The R-54 core sample chromatograph is black, and the hammer oil chromatograph is red. The chromatograms were overlaid using only the 0 time for alignment. No other graphic manipulations were made. The two chromatograms show high correlation: all the peaks for the hammer oil are also present in the R-54 sample. The presence of a few unmatched peaks in R-54 cuttings sample can be explained by the existence of trace concentrations of one or more additional analytes in the R-54 cuttings sample. These unknown analytes may be from naturally occurring organic matter but are not likely associated with Laboratory-related contaminants in groundwater based on a history of nondetects for organic compounds in groundwater samples at these wells, especially in the initial samples collected after drilling.

Figure 2 (attached) shows the TPH-DRO chromatographs for R-54 and R-61 overlaid. The R-54 cuttings sample chromatograph is gray, and the R-61 chromatograph is blue. The chromatographs were overlaid using only the 0 time for alignment. No other graphic manipulations were made. The match of peaks at key positions across the chromatograph indicates that the organic compound present in the cuttings is the same in both wells, confirming hammer oil is the organic compound present in both R-54 and R-61.

This evaluation indicates that reducing conditions observed in wells R-54 and R-61 are likely the result of hammer oil in the aquifer surrounding the well screen. The exact mechanism for how the hammer oil was introduced into the aquifer is unknown. Although not specifically addressed as part of evaluation described above, similar reducing conditions are also present at well R-55i.

If you have any questions, please contact Steve Paris at (505) 606-0915 (smparis@lanl.gov) or Hai Shen at (505) 665-5046 (hai.shen@nnsa.doe.gov).

Sincerely,

Jeff Mousseau, Associate Director
Environmental Programs
Los Alamos National Laboratory

Sincerely,

Peter Maggiore, Assistant Manager
Environmental Projects Office
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JM/PM/CD/SM:sm

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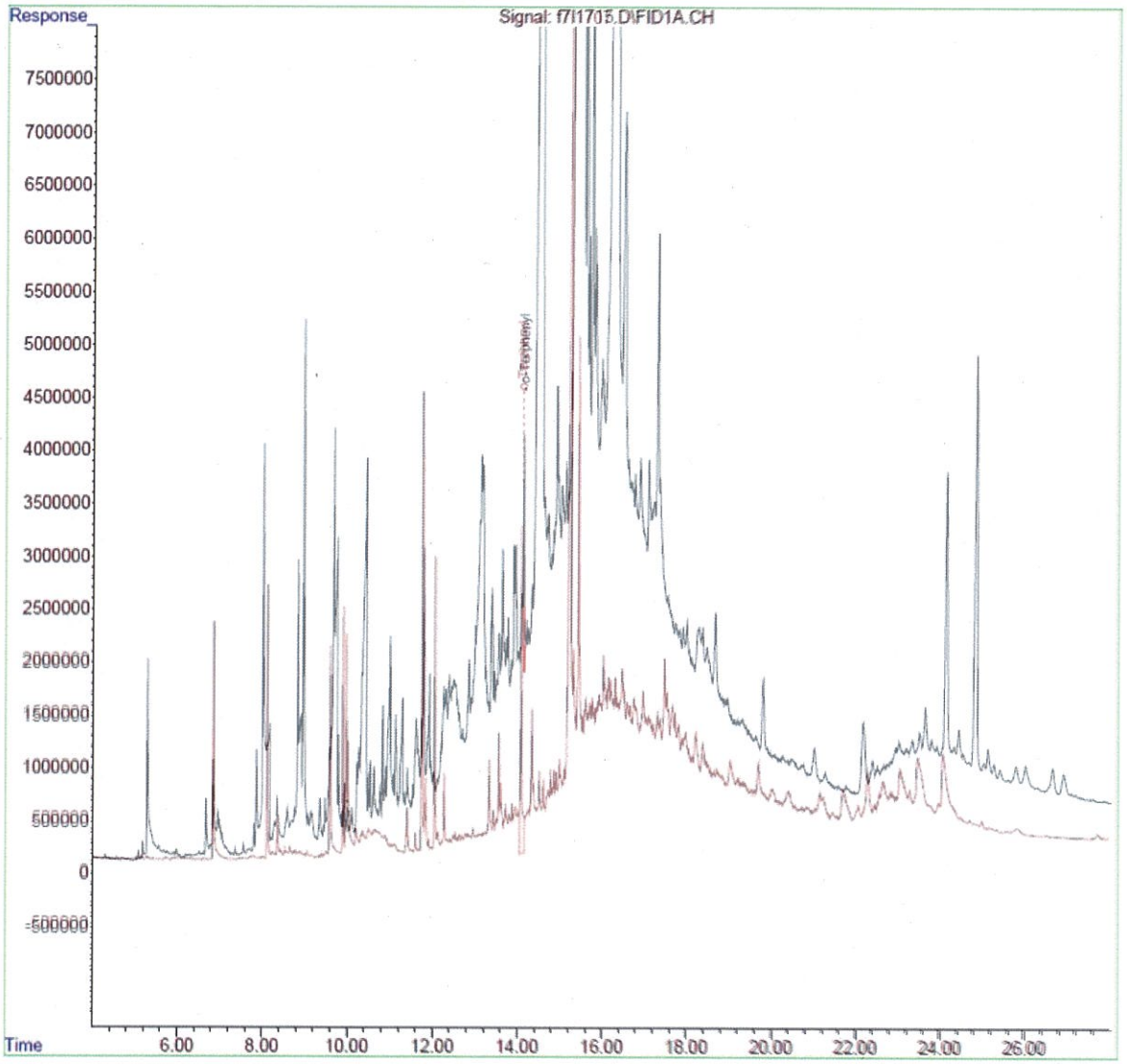


Figure 1 **TPH-DRO chromatographs for samples of hammer oil and R-54 cuttings**

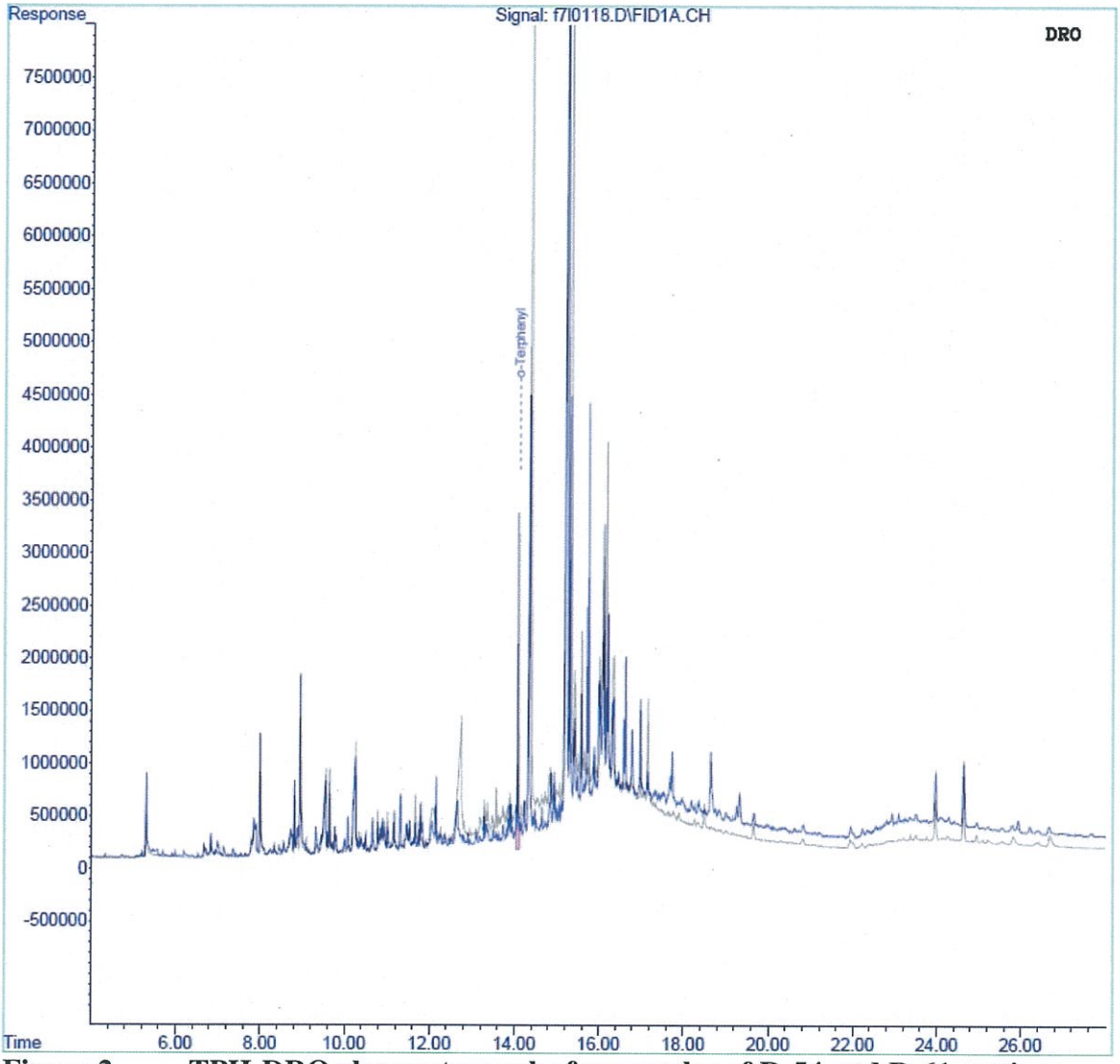


Figure 2 TPH-DRO chromatographs for samples of R-54 and R-61 cuttings