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July 5, 2006

Dan Santantonio, Ph.D.
Regulatory Compliance/Joint Superfund Project Manager
Utilities Division
City of Las Cruces
680 N. Motel Boulevard
Las Cruces, New Mexico 88004

Re: Source of naturally occurring uranium in the Mesilla Basin within the City of Las Cruces area

Dear Dr. Santantonio:

John Shomaker & Associates, Inc. (JSAI) has performed a preliminary literature review and investigation on the source of naturally occurring uranium in the Mesilla Basin along the Interstate 25 (I-25) corridor.

The literature review identified several publications by the New Mexico Energy Research Development Institute on the Las Cruces East Mesa Geothermal Field near Tortugas Mountain. The primary reference describing the occurrence of natural uranium concentrations in Mesilla Basin ground water is Whittier et al. (1985). A copy of the reference is enclosed. A list of other relative publications reviewed is attached.

Sources of Uranium

Uranium is typically concentrated in the felsic end of the igneous series, such as granite, thereby suggesting uranium from weathered rock would likely come from the igneous rocks of the Organ Mountains. There are three primary natural deposits of uraninite (the chief ore mineral for uranium) (Nash et al., 1981):

1. hydrothermal veins (possibly found in the monzonite rocks of the Organ Mountains)

2. flat lying deposits in bedded sedimentary rocks, such as the Santa Fe Group sediments that filled the Mesilla and Jornada Basins

3. pyritic conglomerate beds of Precambrian-age (not likely in the area)

Occurrence of Uranium in Ground Water

Uranium minerals are dissolved into ground water by oxidation, and dissolved uranium is commonly precipitated in reducing (oxygen poor) environments. Formation of uranium ore deposits, commonly known as "role front deposits," occurs in unconsolidated sediments or sandstones containing lenses of organic matter.

The geothermal water upwelling along the Jornada Horst contains low uranium concentrations, as determined by sampling at the Old Las Cruces Landfill (JSAI, 2005) and the East Mesa Geothermal Well Field (Whittier et al., 1985).

Whittier et al. (1985) performed a detailed analysis of uranium concentrations in ground water from the Mesilla Basin, Jornada Basin, and geothermal upwelling. They found that high uranium concentrations overlie the cone of depression in the water table that occurs along I-25, and suggested the two phenomena are related. Whittier et al. (1985) also noted increasing uranium concentrations during continued pumping of water wells at New Mexico State University. The source of uranium is possibly related to layers of organic material in the alluvium, where it was accumulated over time by filtration of ground water containing low uranium concentrations. When the water table is lowered below uranium-rich organic deposits, the chemical environment becomes more oxidizing and uranium is released. The organic material is most likely preserved in floodplain deposits and clayey sediments associated with buried oxbow lakes (Whittier et al., 1985).

The distribution of ground-water uranium concentrations in the Las Cruces area is shown on the enclosed map (Fig. 1). The uranium concentration contours were adopted from figure 5 in Whittier et al. (1985), and refined to reflect the recent data obtained from City Wells 10, 19, 20, 21, 24, 38, and 44. The uranium data are easily contoured, and an area of high concentrations is defined along the western side of Interstate 25 from City Well 21 to the area of New Mexico State University (NMSU). City Well 61 has not revealed elevated uranium, although it is located in an area that should have greater than 50 micrograms per liter (µg/L). City Well 61 is completed much deeper in the aquifer (total depth is 1,070 ft) than the adjacent wells (total depth typically less than 600 ft), which may explain the difference.

A graph of time-series uranium concentration trends in selected City wells is shown as Figure 2. There are no trends that would indicate increasing uranium concentrations over time, although some seasonal trends may be inferred and potentially related to pumping cycles.

Other water-quality data from City wells and from the monitoring network at the Griggs and Walnut Site were reviewed for characteristics or trends that may be correlated to observed uranium concentrations. No significant changes in general chemistry at individual wells could be determined. Dissolved oxygen and temperature data from the Griggs and Walnut Site multi-port wells did reveal significant trends that would indicate alternating oxidizing and reducing environments or geothermal gradients.

Conclusions

The zone of naturally occurring elevated uranium can easily be defined laterally with the existing data; although, the vertical distribution and source of uranium appears to be not well understood. The following conclusions were drawn from the literature review and understanding of available data:

1. Elevated uranium concentrations are localized in an area of the Mesilla Basin trending along the west side of I-25 from City Well 21 to NMSU (see Fig. 1).
2. The source of naturally occurring uranium appears to be from localized oxygen-poor stratigraphic intervals containing organic material, such as over-bank and oxbow lake deposits associated with the (1) the Rio Grande alluvium, or (2) Santa Fe Group sediments.
3. The lack of elevated uranium from City Well 61 suggests the source of uranium is in the shallow aquifer where dewatering and oxidation of uranium rich sediments occurs. Similar occurrence of elevated uranium occurs in the Española Basin between Española and Santa Fe, where the shallow aquifer contains naturally occurring concentrations of elevated dissolved uranium (>100 µg/L).
4. There maybe other geologic controls that would explain the observed distribution of elevated uranium, such as areas of geochemical mixing along fault zones. The zone of elevated uranium shown on Figure 1 also correlates with the area of significant inflow of geothermal water along the west side of the Jornada Horst (see Fig. 1).
5. Elevated uranium concentrations in City wells do not appear to be increasing over time (Fig. 2); although, there appears to be some seasonal variation potentially related to pumping cycles.

Recommendations

JSAI recommends additional investigation to better understand the occurrence of elevated uranium that may help develop operational procedures to mitigate production of elevated uranium from affected City wells and also help in the design of treatment systems.

1. Develop a geologic model of the zone of elevated uranium using available lithologic and geophysical logs.
2. Perform additional uranium sampling on selected monitor wells at the Griggs and Walnut Site.
3. Perform discrete-zone sampling on City Wells 38 and 44. Also perform sampling program on Wells 10 and 44, where samples are collected at various pumping rates (step-drawdown test).

If you have any questions or comments, please let us know.

Sincerely,

JOHN SHOMAKER & ASSOCIATES, INC.

Steven T. Finch, Jr.
V.P., Senior Geochemist/Hydrogeologist

STF:sf

Enclosures:
Figures 1 and 2
Copy of report prepared by Whittier et al. (1985)

References

JSAI (John Shomaker & Associates, Inc.), 2005, Annual ground-water monitoring report for year 2004, Las Cruces Landfill, Las Cruces, New Mexico: consultant's report prepared by John Shomaker & Associates, Inc. for the City of Las Cruces, 21 p.

Gross, J., and Iceman, L., 1983, Subsurface investigations for the area surrounding Tortugas Mountain, Doña Ana County, New Mexico: New Mexico Energy Research and Development Institute, NMERDI 2-67-2238(2), 50 p.

Hawley, J.W., and Kennedy, J.F., 2004, Creation of a digital hydrogeologic framework model of the Mesilla Basin and Southern Jornada del Muerto Basin: New Mexico Water Resources Research Institute Technical Completion Report No. 332, 105 p. plus CD.

King, W.E., Hawley, J.W., Taylor, A.M., and Wilson, R.P., 1971, Geology and ground-water resources of central and western Doña Ana County, New Mexico: Hydrologic Report 1, Water Resources Research Institute in cooperation with New Mexico State Bureau of Mineral and Mineral Resources, 64 p. plus plate.

Lohse, R.L., Schoenmackers, R., Whittier, J., and Gross, J.T., 1985, Geothermal low-temperature reservoir assessment in northern Doña Ana County, New Mexico: New Mexico Energy Research and Development Institute, NMERDI 2-71-4220, 150 p.

Nash, J.T., Granger, H.C., and Adams, S.S., 1981, Geology and concepts of genesis of important types of uranium deposits: Economic Geology, Seventy-Fifth Anniversary Volume, edited by B.J. Skinner, The Economic Geology Publishing Company, El Paso, Texas, pp. 63-116.

Whittier, J., Gross, J., Cochran, J., and Iceman, L., 1985, Uranium disequilibrium investigation of the Las Cruces East Mesa Geothermal Field: New Mexico Energy Research and Development Institute, NMERDI 2-67-2238(3), 50 p.

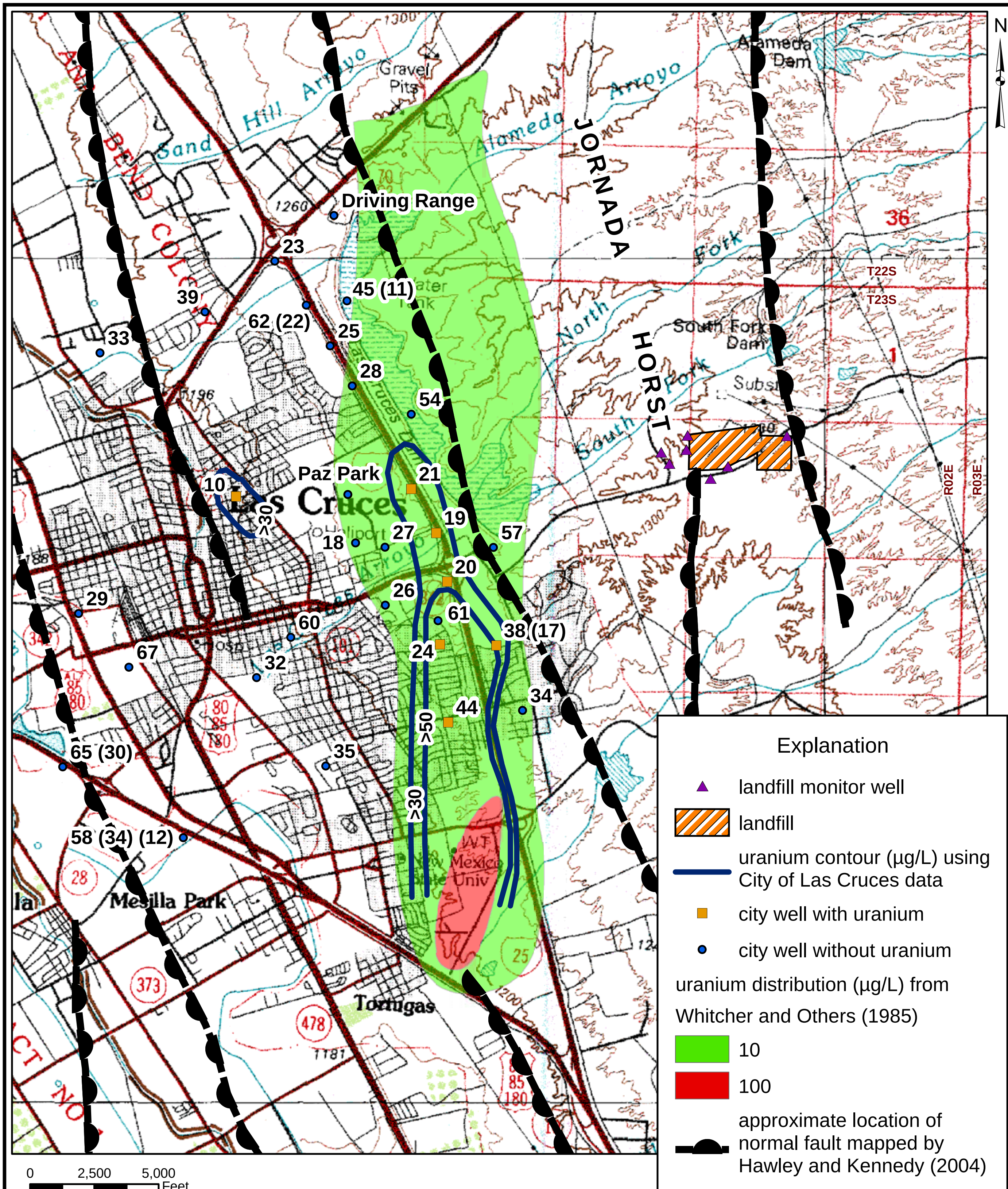

Figure 1. Map of Las Cruces area showing uranium concentration contours and distribution, and faults mapped by Hawley and Kennedy (2004).

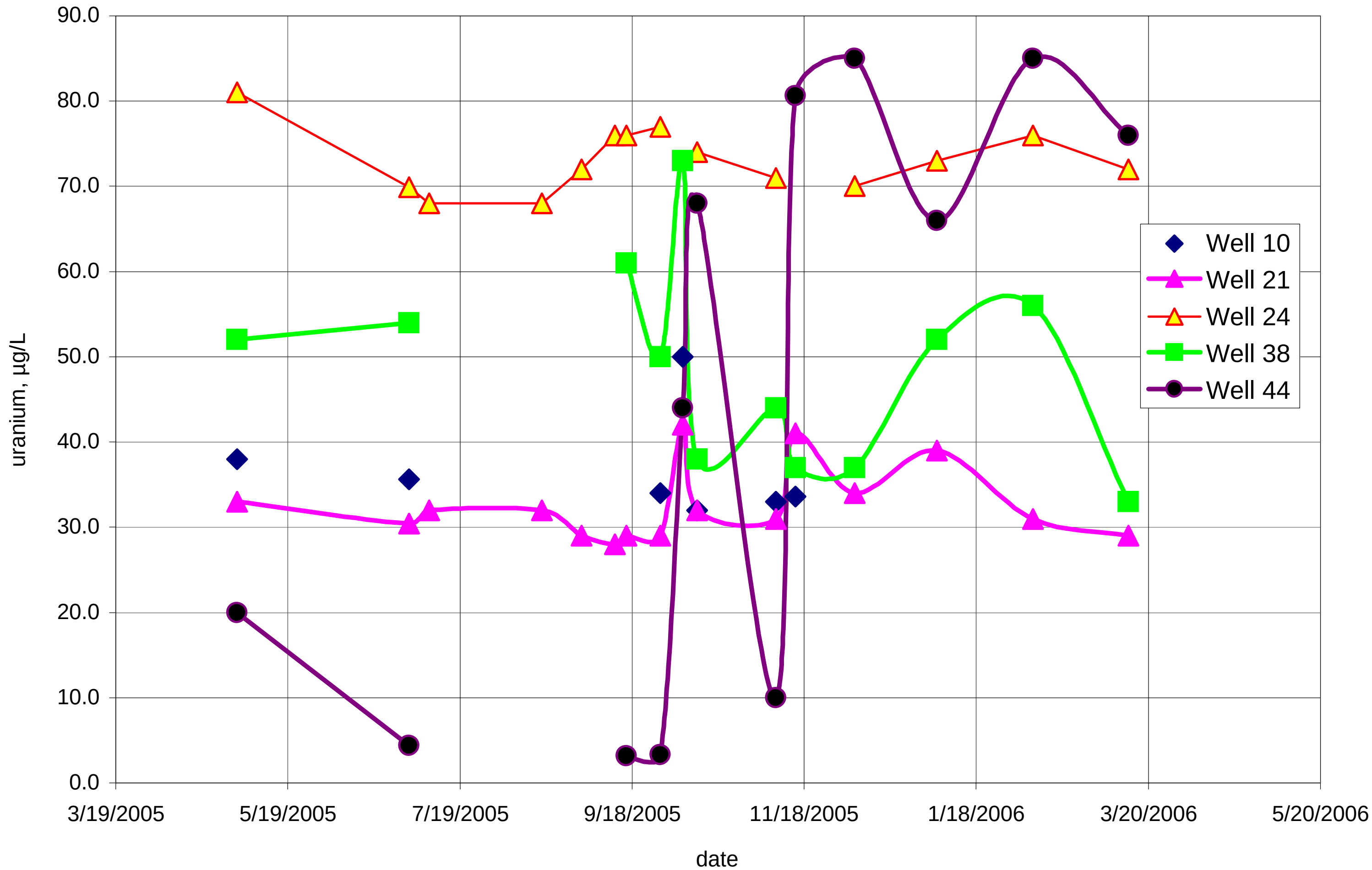

Figure 2. Graph showing time-series data for City of Las Cruces water-supply wells with elevated uranium.

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