

# **13<sup>th</sup> Annual Española Basin Technical Advisory Group (EBTAG) Workshop & Field Trip**

*May 13, 2014*

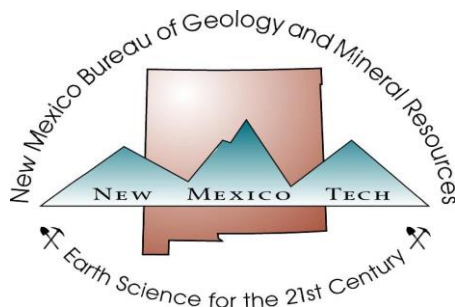
*Santa Fe Community College, Santa Fe, New Mexico*

## **Open-file Report 565**

By  
Charles Nylander, editor

### **New Mexico Bureau of Geology and Mineral Resources**

New Mexico Institute of Mining & Technology  
Socorro, New Mexico 87801



June 2014

# **Program with Abstracts**

**13<sup>th</sup> Annual Española Basin Technical Advisory Group (EBTAG)**

**Workshop & Field Trip**

*May 13, 2014*

*Santa Fe Community College, Santa Fe, New Mexico*

**Charles Nylander, *editor***

# 13<sup>th</sup> ANNUAL ESPAÑOLA BASIN TECHNICAL ADVISORY GROUP (EBTAG) WORKSHOP AND FIELD TRIP

MAY 13, 2014

Santa Fe Community College, in the Jemez Rooms of the Main Administration Building

From	To	Agenda
7:45 - a.m.	8:30 a.m.	<b>Registration:</b> (\$20 due at the door, cash only; pick up badges, programs and sign-in; poster set-up/viewing)
8:30 - a.m.	8:45 a.m.	<b>Meeting begins with Welcome and Introductory remarks:</b> <b>"What is EBTAG and why do we have an Annual EBTAG Workshop?"</b> — Charlie Nylander, Chair, EBTAG
8:45 - a.m.	9:00 a.m.	<b>New Insights on the Tectonics in the Northern Albuquerque, Santo Domingo and Espanola Basins from Hydrocarbon Exploration between 1972 and 2014</b> — Bruce A. Black
9:00 - a.m.	9:25 a.m.	<b>Lithologic and hydrologic characteristics of Tesuque Formation piedmont deposits in the Santa Fe area, New Mexico</b> — Daniel Koning, Peggy Johnson, and John Hawley
9:25 - a.m.	9:50 a.m.	<b>Speculations on Deep Aquifer Potential in the Santa Fe Vicinity</b> — Jack Frost
9:50 - a.m.	10:20 a.m.	— <b>Coffee Break</b>
10:20 - a.m.	10:45 a.m.	<b>Overview of Hydrogeologic Conceptual Models of the Española Basin, 1907 to Current</b> — Steve Finch
10:45 - a.m.	11:10 a.m.	<b>Structure of groundwater flow in the Espanola basin Buckman Wellfield and Its Relation to Groundwater beneath Los Alamos National Laboratory</b> — Velimir vesselinov
11:10 - a.m.	11:35 a.m.	<b>What wells would you use if you were modeling the groundwater of the Espanola Basin? A collaborative approach between OSE and the public to facilitate access to well information</b> — Christina Noftsker
11:35 - a.m.	12:00 p.m.	<del>Managing Water Resources in La Cienega and the lower Santa Fe River through applied Hydro, Geo and Hydrogeology</del> [withdrawn] — Kyle S Harwood
12:00 - p.m.	1:00 p.m.	— <b>Lunch Break</b> — (food available for purchase in the cafeteria down the hall)

8:00 - 1:00 **Posters:** (*bring more if you can*)  
a.m. p.m.

**Comparison of Hardness Based and Biotic Ligand Model Instantaneous Water Quality Criteria estimates for Copper and Zinc in Storm Water Runoff**

— Armand Groffman, Amanda White, Daria Cuthbertson, Anita Lavadie, Paul Mark, Scott Tobiason, and David De Forest

**Booth: 1**

**Groundwater Uranium Isotope Ratios in the Espanola Basin**

— Dennis McQuillan, Stephen Wiman, Patrick Longmire, Hakim Boukhalfa, Becky Coel-Roback, Walter Drew, and Virginia T. McLemore

**Booth: 2**

1:30 - 4:30 **Optional Field Trip: *Lithofacies of the Santa Fe Group***

p.m. p.m. — Dan Koning and Adam Read, N.M. Bureau of Geology and Mineral Resources

*Meet on East Side of Devargas Mall Parking Lot in front of movie theatre to carpool and leave by 1:30 p.m.*

# **NEW INSIGHTS ON THE TECTONICS IN THE NORTHERN ALBUQUERQUE, SANTO DOMINGO AND ESPANOLA BASINS FROM HYDROCARBON EXPLORATION BETWEEN 1972 AND 2014**

**BRUCE A. BLACK**

Black Exploration LLC, 206 W. 38th St., Farmington, NM, 87401, [koko16@earthlink.net](mailto:koko16@earthlink.net)

Oil and gas exploration in the Santa Fe and Hagan Embayment's of the Espanola Basin, as well as the northern Albuquerque Basin from 1972 to the present, has yielded invaluable "real rock" information about not only the stratigraphy present, but the structural fabric and history of the area. Suspected but previously unknown tectonic events are apparent in the area and can be seen on reprocessed seismic. This is particularly true across the synthetic overlapping transfer zone connecting the northern Albuquerque and the southern Santo Domingo Basins. Implications for future oil and gas exploration and the "hard" data derived by drilling, if not further impeded or stopped by excessive county regulations, are large.

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# OVERVIEW OF HYDROGEOLOGIC CONCEPTUAL MODELS OF THE ESPAÑOLA BASIN, 1907 TO CURRENT

**Steve Finch**

John Shomaker & Associates, Inc., 2611 Broadbent Parkway, NE, Albuquerque, NM, 87107, United States,  
[sfinch@shomaker.com](mailto:sfinch@shomaker.com)

The hydrogeologic conceptual model of the Española Basin has evolved with better understanding of the geologic framework, and over the last decade, numerous studies have been performed to further define the hydrogeologic framework, and to investigate specific areas of the Española Basin. However, has the understanding of surface water to groundwater interactions, recharge and discharge, and aquifer responses to pumping improved? What are the most important components of the Española Basin hydrogeologic conceptual model that need improvement? Will improvement of the conceptual model significantly change our understanding of the water budget or the way we will manage water resources? These are questions that need answers for any future studies to have meaning for the water planners and administrators that will use the results.

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# SPECULATIONS ON DEEP AQUIFER POTENTIAL IN THE SANTA FE VICINITY

**Jack Frost**

New Mexico Office of the State Engineer, [jack.frost@state.nm.us](mailto:jack.frost@state.nm.us)

Although the potential for deep groundwater production in the Espanola basin is a popular topic, very little is known. No one doubts the presence of groundwater saturation. I would rather talk about what we know and how it affects anticipating a realistic economic floor to groundwater production. Topics to be discussed include: What is deep, and isn't 2000 feet deep enough? What we don't know about the pre-consolidation of the Tesuque formation, and the corresponding increase in density, decrease in permeability and diminishing yield with depth. What about flow barriers? To what degree are the deeper section and the upper, known water bearing strata connected? What are water quality expectations and how does TDS affect a "deep aquifer" designation by the Office of the State Engineer? Which hydrologist will be the first to promote and drill the first really deep well based on these considerations?

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# COMPARISON OF HARDNESS BASED AND BIOTIC LIGAND MODEL INSTANTANEOUS WATER QUALITY CRITERIA ESTIMATES FOR COPPER AND ZINC IN STORM WATER RUNOFF

Armand Groffman<sup>1</sup>, Amanda White<sup>1</sup>, Daria Cuthbertson<sup>1</sup>, Anita Lavadie<sup>1</sup>, Paul Mark<sup>2</sup>, Scott Tobiason<sup>3</sup> and David De Forest<sup>3</sup>

<sup>1</sup>Environmental Programs, Los Alamos National Laboratory, [groffman@lanl.gov](mailto:groffman@lanl.gov)

<sup>2</sup>Adalante Consultants Inc.

<sup>3</sup>Winward Environmental, LLC

The Biotic Ligand Model (BLM) is based on a gill site interaction conceptual model and predicts metal bioavailability and toxicity by incorporating metal speciation and competing cations in solution. The Environmental Protection Agency (EPA) released nationally recommended copper water quality criteria (WQC) for aquatic life based on the BLM. Although the New Mexico water quality standards allow the use of the BLM on a site specific basis, the hardness-based method to calculate copper WQC is the default statewide approach. The application of the BLM for zinc, cadmium, and aluminum WQC estimations is under investigation as well with promising results. Understanding copper bioavailability is critical for a better understanding of immediate complex environmental conditions. Using the BLM for copper is the current EPA policy and represents the current science.

Water quality samples and BLM parameters were collected during 2013 from 19 ephemeral, intermittent, and perennial stream segments on the Pajarito Plateau, north central New Mexico. Chronic and acute copper and zinc instantaneous water quality criteria (IWQC) were estimated and compared using the BLM and hardness based WQC. In most cases the copper and zinc IWQC estimated with the BLM was higher than the hardness -based IWQC. The BLM-based acute copper WQC ranged from 3.4 to 361 µg/L while the hardness based IWQC ranged from 0.5 to 12.4 µg/L. Meanwhile, acute zinc BLM-based WQC ranged from 167 to 1,138 µg/L, while hardness based IWQC for zinc ranged from 6 to 149 µg/L. In all cases the toxicity units (Cu observed/BLM IWQC) values were less than one, indicating observed copper and zinc concentrations did not exceed respective criteria levels. These findings indicate that bioavailable copper and zinc concentrations estimated by the BLM are much lower and more representative than what is estimated using the hardness-based WQC. In addition, these results suggest that in many cases the hardness-based WQC are over protective of the environment, lacking the resolution inherent to the BLM to represent complex aquatic environmental conditions. In an aqueous environment, copper and zinc complex with inorganic and organic ligands, sorption sites on suspended particulates, common ion effect, and are particularly sensitive to pH. These geochemical processes are considered by the BLM. The hardness based WQC consider only competition from magnesium and calcium, a far simpler and less accurate basis. NPDES permits and state water quality assessments would be more accurate based on the BLM for copper and zinc.



# LITHOLOGIC AND HYDROLOGIC CHARACTERISTICS OF TESUQUE FORMATION PIEDMONT DEPOSITS IN THE SANTA FE AREA, NEW MEXICO

Daniel Koning<sup>1</sup>, Peggy Johnson<sup>1</sup> and John Hawley<sup>2</sup>

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<sup>2</sup>Emeritus Senior Environmental Geologist; N.M. Bureau of Geology & Mineral Resources, P.O. Box 4370, Albuquerque, NM, 87196-4370

We summarize the lithologic character of lithosomes A and S in the Santa Fe area. A lithosome is a body of sedimentary rock, exhibiting a relatively uniform and distinctive lithologic character, that intertongues with different sedimentary rock types. Both lithosomes A and S were deposited on a piedmont by streams flowing westward out of the Sangre de Cristo Mountains between 26 and 13 million years ago. Tectonism associated with the Rio Grande rift has tilted these deposits 10-15° to the west.

Lithosome A was deposited by streams whose headwaters drained granitic rocks. It contains lenticular to ribbon-like channel-fills of pebbly sandstone interbedded with medium to thick, tabular beds of poorly sorted, clayey-silty sand. The proportion of the latter lithofacies increases to the west, where it becomes better sorted and finer-grained. The sand is arkosic and the gravel fraction contains granite with <10% quartz, quartzite, and yellowish Paleozoic siltstone. Evaluation of data from 13 pumping tests of wells screened in this unit indicate low hydraulic conductivities of 0.03-0.9 ft/day.

In contrast, lithosome S was deposited by a larger drainage associated with an ancestral Santa Fe River. Its sediment was deposited on a fluvial fan which was likely comparable to modern, large fluvial fans in the eastern San Joaquin Valley in California. This unit interfingers with lithosome A sediment to the north and south. Lithosome S is overall coarser and redder than lithosome A. Strata consist of sandstone and pebbly sandstone channel-fills interbedded with floodplain deposits of fine-grained sandstone to mudstone. Channel-fills typically display very thin to thin, horizontal to cross-stratified beds. Channel-fills are generally amalgamated (stacked on top of each other) and the widths of the resulting channel-fill complexes are greater than those of lithosome A, commonly 10s to 100s of meters. Overall texture of lithosome S is coarsest near the axis of the fluvial fan, which is approximately between Tano Ridge and the Santa River, and fines to the north, west, and south of the axis. Although relatively arkosic, its pebble and sand fraction contains appreciable (1-30%) Paleozoic and Proterozoic detritus derived from what is now the upper Pecos River drainage -- including sand grains and clasts of quartzite, sandstone, siltstone, and limestone. Lithosome S exhibits relatively high hydraulic conductivity values for coarser strata near the fan axis (0.4-23 ft/day) but values are comparable to lithosome A for finer-grained strata to the west and north of the fan axis.

Inspection of well data indicates that lithosome S coarsens up-section, in contrast to lithosome A, but there is a lower, relatively coarse tongue between the Santa Fe city well field and Tano Ridge. Lithosome S gradationally overlies a light gray to tan, 200-400 ft-thick, lower tongue of lithosome A. Basal strata of lithosome S and lithosome A are notably fine-grained near the city well field. They are interpreted to have been deposited near the axis of the Santa Fe embayment

ca. 25 Ma, on a topographically low basin floor, and intertongue westward with volcanoclastic alluvial fan deposits of lithosome E. Subsequently, lithosome S advanced westward over lithosome E fan deposits until it extended to the Santo Domingo Basin. This westward progradation probably accounts for the upward coarsening of lithosome S. Between 13.5 and 13.0 Ma, both lithosomes A and S coarsen, and the northern boundary of lithosome S shifted southward. Between ~13 and 3 Ma, piracy of the Pecos River captured what was the headwaters of the Santa Fe River, so that the drainage area of the Santa Fe River was smaller by the time of deposition of the Plio-Pleistocene Ancha Formation.

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# GROUNDWATER URANIUM ISOTOPE RATIOS IN THE ESPANOLA BASIN

**Dennis McQuillan<sup>1</sup>, Stephen Wiman<sup>2</sup>, Patrick Longmire<sup>1</sup>, Hakim Boukhalfa<sup>3</sup>, Becky Coel-Roback<sup>3</sup>, Walter Drew<sup>4</sup> and Virginia T. McLemore<sup>5</sup>**

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[dennis.mcquillan@state.nm.us](mailto:dennis.mcquillan@state.nm.us)

<sup>2</sup>Good Water Company, 933 Baca.St., Santa Fe, NM, 87505

<sup>3</sup>Los Alamos National Laboratory, PO Box 1663, MS C333, Los Alamos, NM, 87544

<sup>4</sup>Indepth Water Testing, 2019 Galisteo St., Suite G-2, Santa Fe, NM, 87505

<sup>5</sup>N.M. Bureau of Geology and Mineral Resources, 801 Leroy Pl., Socorro, NM, 87801

Low-grade uranium mineralization in the Tesuque Formation east of the Rio Grande between Española and Santa Fe was discovered in 1954, and a small amount of uranium was produced from the San Jose mining district in 1957. Carnotite, schroekingerite, and autunite occur in sandstones and conglomerates, often associated with clay galls, carbonaceous material, chert, opal and fossil bone fragments. Uranium mineralization also occurs in some pegmatites that have intruded Proterozoic rocks in the Sangre de Cristo Mountains. Within this mineralized area, elevated levels of uranium (up to 74 pCi/L = 110 µg/L) were discovered in several public water supply systems during a statewide testing initiative conducted in 1975-79. Extensive testing of private domestic water wells began in 1995 and approximately half of all wells tested in this area, to date, produced water with uranium in excess of the 30 µg/L human health standard. A significant number of wells had uranium concentrations greater than 100 µg/L, with one well measuring 1,820 µg/L. High levels of uranium in drinking water pose a risk of kidney toxicity. Some area residents have installed treatment devices to reduce uranium concentrations produced by public and private water supply wells.

Since industrial sources of uranium also exist in the Española Basin, studies were performed to determine the isotopic signatures of the uranium in groundwater. U-234 to U-238 ratios were determined for samples collected from 52 water supply wells located in the mineralized area east of the Rio Grande in 1995, and were determined to be consistent with natural uranium. An additional 13 wells in the mineralized zone were sampled in 2012 for isotopic analysis by three different laboratories. Ratios of U-234 to U-238 were similar to the naturally occurring ratios detected in the 1995 study. Ratios of U-235 to U-238 also were consistent with natural geologic sources. Manmade U-236 was not detected in any well water sample.

Uranium mineral zones have not been found in the Española Basin west of the Rio Grande, and groundwater uranium concentrations are much lower in this area. Uranium originating from historical waste discharges at Los Alamos National Laboratory (LANL) has been detected in monitoring wells drilled into shallow groundwater in canyons near the lab. This industrial uranium sometimes has an enriched ratio of U-235 to U-238, and detectable U-236, but total uranium concentrations are less than 10 µg/L. No public or private water supply wells have been impacted by uranium originating from LANL effluent.

In summary, naturally occurring uranium, sometimes far in excess of the 30 µg/L health standard, has impacted numerous water supply wells east of the Rio Grande between Española

and Santa Fe. This uranium originates from natural mineralization that occurs widely in basin fill and Proterozoic rocks. Anthropogenic uranium has been detected in shallow observation wells near LANL, but this uranium does not exceed the health standard, has not contaminated any water supply wells, and there is no indication it migrated east of the Rio Grande.

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# **WHAT WELLS WOULD YOU USE IF YOU WERE MODELING THE GROUNDWATER OF THE ESPANOLA BASIN? A COLLABORATIVE APPROACH BETWEEN OSE AND THE PUBLIC TO FACILITATE ACCESS TO WELL INFORMATION.**

**Christina Noftsker**

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The Office of the State Engineer (OSE) requires all new wells within the state of New Mexico to be permitted. All wells drilled after the 11/29/56, the date the State Engineer declared the portion of the Rio Grande basin that includes the Espanola Valley, have required permits. OSE has been populating the WATERS/NMWRRS database with surface water and groundwater permit information for over a decade. What is the quality of the wells found in the WATERS/NMWRRS database? What steps is OSE taking to improve the data quality? What suggestions do users of the WATERS/NMWRRS database have for improving access to the surface and groundwater data? Join this talk to hear OSE's progress and plans for creating access to the well data. Share with OSE your ideas on how to improve access to the WATERS/NMWRRS data.

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# **STRUCTURE OF GROUNDWATER FLOW IN THE ESPANOLA BASIN BUCKMAN WELLFIELD AND ITS RELATION TO GROUNDWATER BENEATH LOS ALAMOS NATIONAL LABORATORY**

**Velimir vesselinov**

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The regional aquifer beneath Los Alamos National Laboratory (LANL) is a complex hydrogeological system. It is a part of the large-scale regional aquifer within the Espanola basin. Based on the existing water-level data, the general direction of the groundwater flow beneath LANL is predominantly from west to east. The large-scale flow direction is controlled by areas of aquifer recharge to the west (the flanks of Sierra de los Valles and the Pajarito fault zone) and discharge to the east (the Rio Grande and the White Rock Canyon Springs). The Buckman wellfield is located just east of the Rio Grande. Understanding of the hydrogeological characteristics of the aquifer pumped by Buckman wellfield is provided by existing information related to (1) basin geology and hydrostratigraphy, (2) hydrogeologic data (pre- and post-development water levels, pumping drawdowns, spring-discharge rates, etc), (3) ground-surface subsidence, (4) groundwater geochemistry, and (5) naturally occurring stable isotopes. Analyses of these data suggest that the deep section of the regional aquifer pumped at the Buckman wellfield is in a relatively poor hydraulic connection with the Rio Grande and the aquifer beneath LANL. These conclusions can be explained by the pronounced westward-dipping stratification of the Santa Fe Group sediments near the Buckman wellfield which causes the regional aquifer to be highly anisotropic and under confined (artesian during pre-development) conditions. The aquifer properties may provide natural protection of the groundwater resources pumped by the Buckman wellfield.

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