

### Preliminary Evaluation of Perchlorate in Youthful Ground Waters and Precipitation in the Los Alamos Area

Michael R. Dale, Kim P. Granzow, Steve M. Yanicak, and David Englert, New Mexico Environment Department, DOE Oversight Bureau

#### ABSTRACT

Perchlorate has been detected in the local drinking-water aquifer for several years at levels ranging from about 3 parts per billion (ppb) to the sub-ppb level (<1), with most detections less than 1 ppb. A study recently conducted by the Laboratory and New Mexico Environment Department's DOE Oversight Bureau suggests that perchlorate appears to be present in deep ground waters of northern New Mexico. As a result of this investigation, the Oversight Bureau and Laboratory scientists began an initial phase of an investigation to determine if perchlorate is present in the early stages of the local hydrologic cycle. Local background ground-water and precipitation samples were analyzed for perchlorate and major-ion chemistry. Ground-water samples were collected at four background (non-human impacted) springs west of the Laboratory in the Sierra de Los Valles. Recharge to these springs is probably from the eastern rim of the Valles Caldera through surface-water infiltration, seepage and lateral flow from west to east. Presence of tritium suggests that water from two of the springs are of an age of less than 50 years. Two precipitation samples were collected in the Sangre de Cristo and Jemez Mountains that represent the 2002-2003 snowpack. Three thunderstorm samples were collected in the Los Alamos area during this year's monsoon season.

Major-ion chemistry results show that the springs are chemically free of the more conservative and mobile man-made contaminants such as road salt, sewage, etc. The chemical composition of precipitation samples match that of data collected from previous studies in the area, free of any elevated concentrations of chloride, nitrate or sulfate. Perchlorate concentrations were measured through a new analytical method having a detection limit of 0.05 ppb, and a quantification limit of 0.20 ppb. Prior to the development of this new method, detection limits were in the 4 ppb or higher range using ion chromatography. Perchlorate was not detected in the precipitation samples at levels greater than 0.05 ppb. Perchlorate was detected, however, at each spring at concentrations ranging from 0.23 to 0.33 ppb and averaging 0.27 ppb with a 1 standard deviation of +0.05 ppb. These data indicate that perchlorate is not present in the local precipitation but does occur in the early stage of the local hydrologic cycle at very consistent levels. These data also suggest that perchlorate may be pervasive throughout the environment at very low levels. The low-level detections of perchlorate recently found in the deep ground waters of northern New Mexico, including the Los Alamos area, may be within the normal background range, and not related to any contaminant source. Further work is needed to determine a more statistically defensible background distribution for perchlorate.

<sup>1</sup> - New Mexico Environment Department, DOE Oversight Bureau

**Figure 1 - Low-level perchlorate and major-ion chemistry results for background springs and local precipitation in the Los Alamos area during 2003.**

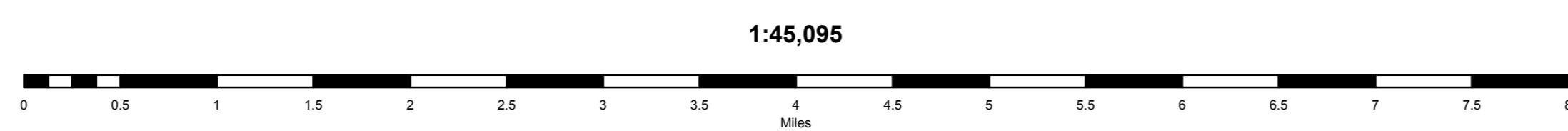
STATION ID	Date	LAB	Perchlorate (µMOSM)		Major Ions (mg/L)										Trace Metals (µg/L)														
			Result	MDL	Ca	Mg	K	Na	Cl	ClO <sub>4</sub> (C)	CO <sub>3</sub>	CO <sub>2</sub>	F	Br	CO <sub>3</sub>	HCO <sub>3</sub>	Hardness CaCO <sub>3</sub>	Field TDS	Field pH	Field TEMP	Al	As	B	Ba	Li	Mn	Si	Sr	U
<b>Springs</b>																													
Campsite Spring	8/25/2003	GEL	0.28	0.05	2.02	5.59	1.83	1.46	9.23	1.22	<0.5	<10	0.02	0.14	0	48.4	21.5	43.5	7.73	14.9	0.020	0.0006	0.007	0.002	<0.001	0.010	26.8	0.020	0.006
PC Spring	8/22/2003	GEL	0.23	0.05	0.20	7.30	3.00	2.47	4.07	0.70	<0.5	<10	0.01	0.05	0	45.8	30.6	41.9	7.39	9.9	0.031	0.0002	0.002	0.023	0.002	<0.001	19.8	0.068	<0.001
CDV-5.0 Spring	8/20/2003	GEL	0.33	0.05	0.20	9.34	3.38	2.59	5.31	1.83	<0.5	<10	0.02	0.07	0	51.3	37.2	54.4	7.40	8.8	0.059	0.0003	0.004	0.026	0.002	0.001	20.2	0.082	<0.001
Barbara's Spring	8/19/2003	GEL	0.23	0.05	0.20	5.10	0.92	0.20	10.70	1.18	<0.5	<10	<0.01	0.14	0	44.2	16.5	39.1	7.00	15.6	0.013	0.0005	0.006	0.001	0.033	<0.001	32.2	0.023	0.003
<b>Precipitation</b>																													
<b>Snow Pack</b>																													
Pajarito Mt snow pack	2002-2003	STL	ND	0.06	0.20	0.35	0.05	0.52	0.05	0.14	<2	<10	<0.01	<0.01	0	2.5	1.1	NT	5.59	15.2	0.008	<0.0002	<0.0002	0.002	<0.001	0.010	0.03	0.002	0.002
Aspen Peak snow pack	2002-2003	STL	ND	0.06	0.20	0.51	0.03	0.09	0.17	0.56	<2	<10	<0.01	<0.01	0	3.7	1.4	NT	6.36	11.8	0.009	<0.0002	<0.0002	0.001	<0.001	0.003	0.03	0.002	<0.001
<b>Rain</b>																													
TA-21	8/11/2003	GEL	ND	0.05	0.20	0.88	0.16	0.25	3.52	0.26	<0.5	<10	<0.01	<0.01	0	<0.8	2.9	7.7	4.78	19.3	0.003	0.005	0.004	<0.001	0.019	0.33	0.007	<0.001	
TA-21	8/17/2003	GEL	ND	0.05	0.20	0.63	0.11	0.14	1.78	0.14	<0.5	<10	<0.01	<0.01	0	<0.8	2.0	9.9	4.85	18.3	0.078	<0.0002	0.003	0.003	<0.001	0.018	0.18	0.005	0.002
TA-8/9	8/23/2003	GEL	ND	0.05	0.20	0.74	0.09	0.16	0.07	0.14	<0.5	<10	<0.01	<0.01	0	<0.8	2.2	6.0	5.78	24.7	0.033	<0.0002	0.001	0.006	<0.001	0.046	0.06	0.003	<0.001

Perchlorate (µMOSM) results provided by General Engineering Laboratories and Servotest Laboratories, Method 0884-0304A. All other data provided by EUSA. Ca, Mg, K, Na, Cl, CO<sub>3</sub>, CO<sub>2</sub>, F, Br, CO<sub>3</sub>, HCO<sub>3</sub> by ion chromatography, Method 314. NT - not detected. Pajarito Mt snow pack sample collected on 8/19/03. Aspen Peak snow pack sample collected on 8/18/03.

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Well  
 Snow Pack Sample  
 Precipitation Sample  
 Spring  
 Drainage  
 LANE

Background ClO<sub>4</sub> Sampling Location (2003 unless otherwise noted)  
 2003 ClO<sub>4</sub> PE or Other ClO<sub>4</sub> Sampling Location (2002)



DATA SOURCES:  
 RWS Remediation Services Project  
 Los Alamos National Laboratory  
 NMEQ DOE Oversight Bureau

PROJECTION:  
 New Mexico State Plane Coordinate System,  
 Central Zone  
 North American Datum, 1983

Map produced by K. Granzow, October, 2003  
 NMEQ DOE Oversight Bureau  
 104 State Road #, Suite #  
 White Stock, NM 87054

