UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map for 21 water samples from domestic wells and springs near the Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas, Cibola and Catron Counties, New Mexico

By

John B. McHugh* and Gary A. Nowlan*

Open-File Report 89-15

*U.S. Geological Survey, DFC, Box 25046, MS 973, Denver, CO 80225

1989

CONTENTS

ILLUSTRATIONS

TABLES

STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of analyses of water samples collected as part of a geochemical survey of the Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas, Cibola and Catron Counties, New Mexico.

INTRODUCTION

From June to September, 1987, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Rimrock (NM-020-007), Sand Canyon (NM-020-008), Little Rimrock (NM-020-009), and Pinyon (NM-020-010) Wilderness Study Areas, Cibola County, New Mexico. Routine sample media for the reconnaissance survey were minus-80-mesh (0.17-mm) stream-sediment samples, heavy-mineral-concentrate samples derived from stream sediment and water samples. Results of analyses of the stream-sediment and concentrate samples are tabulated by Bullock and others (1989). Results from the analysis of water samples are presented in this report.

Streams in the study area are ephemeral and most were dry when the reconnaissance geochemical survey was in progress. A few natural springs are located in the study area and windmills are sparsely scattered throughout.

The study area (fig. 1) is located in the south-central part of Cibola County and extends into the northern margin of Catron County. The study area is 15-40 mi south of Grants, New Mexico. Access is from New Mexico Highway 117. The Acoma Indian Reservation adjoins the study area on the east. The recently created El Malpais National Monument lies on the west side of the study area. House Resolution 403, which established the national monument December 31, 1987, also created the Cebolla Wilderness comprising approximately the area included in the Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas.

Topography of the study area consists primarily of sandstone-capped mesas cut by canyons and arroyos. The largest natural arch in New Mexico, La Ventana, is located along Highway 117 in the Rimrock Wilderness Study Area (plate 1). Elevations range from about 6,900 to almost 8,400 ft. Much of the study area is forested with old growth pinyon-juniper, but stands of ponderosa pine are common. The forests are interspersed with open grasslands.

Geology of most of the study area is presented on a 1:62,500-scale map by Maxwell (1986). In brief, bedrock geology of the study area is comprised of a generally flat-lying sequence of sandstones and shales ranging in age from Middle Jurassic to Upper Cretaceous. In map view, the Upper Cretaceous strata overwhelmingly predominate at the surface. However, the highest and most spectacular cliffs are generally formed in Middle Jurassic Zuni Sandstone. Massive landslide deposits form the slopes between most mesas and intervening valleys. Mineral deposits have not been recognized in the study area except for coal (Bigsby and Maxwell, 1981).

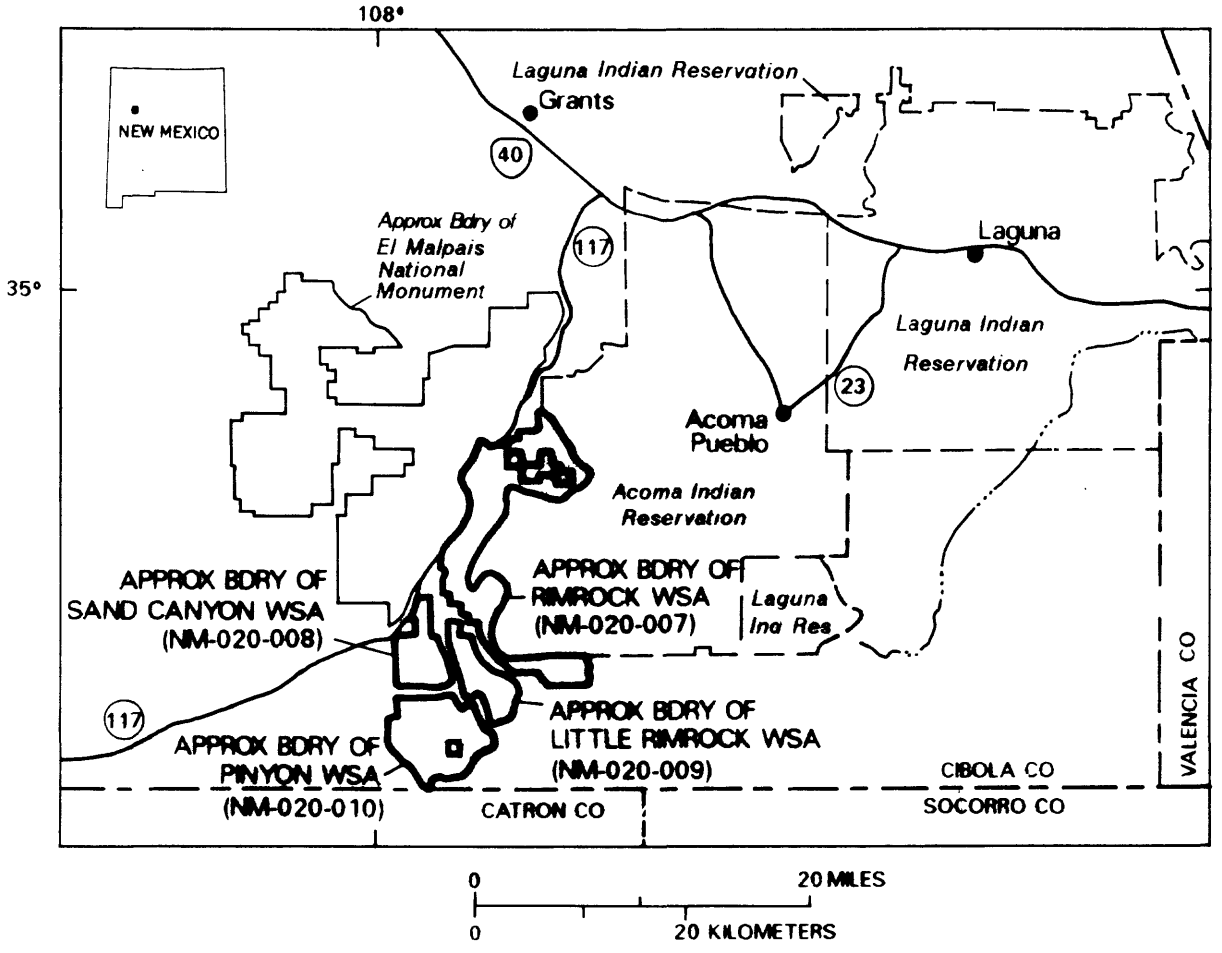

Figure 1. Index map showing location of the Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas, Cibola and Catron Counties, New Mexico

SAMPLING TECHNIQUES

Samples were collected from 18 flowing wells and 3 springs (plate 1). Locations and other information about the sampled wells and springs are listed in table 1. Fifty ml of water from each source were filtered through a 0.45-micron membrane filter into an acid-rinsed polyethylene bottle and were then acidified to approximately pH 2 with ultrapure, concentrated nitric acid. In addition, a new 250-ml bottle was filled with untreated water.

ANALYTICAL TECHNIQUES

Water temperature and pH were measured at the sample site. All other analyses were done in the U.S. Geological Survey laboratory in Denver, Colorado. Alkalinity, sulfate, chloride, fluoride, nitrate, uranium, and specific conductance were determined using the untreated sample.

Alkalinity is a term used to indicate the total acid-neutralizable constituents in water. Generally the alkalinity is due to carbonate and bicarbonate ions. Calcium, magnesium, sodium, potassium, silica, iron, manganese, arsenic, cobalt, copper, molybdenum, and zinc were determined using the acidified-filtered sample. A complete list of analytical techniques used and a reference for each are listed in table 2.

RESULTS

Sample localities for the 21 samples are shown on plate 1. The analytical results of the 21 constituents that were determined for these samples are shown in table 3. The latitude and longitude for each sample locality are also shown in table 3.

The results of the charge balance shown in table 3 for the 21 samples show good accuracy for the analyses. Because ionic solutions are electrically neutral, comparing the sums of the charges for cations against anions checks the accuracy of the analyses. All of the samples are shown to be within 6 percent of electrical neutrality.

DATA STORAGE SYSTEM

Upon completion of the analytical work, the results were entered into a U.S. Geological Survey computer data base called PLUTO. This data base contains both descriptive geological information and analytical data. Any or all of this information may be retrieved and converted to a binary form (STATPAC, VanTrump and Miesch, 1977) for computerized statistical analysis or publication.

ACKNOWLEDGMENTS

We thank the following landowners for access to their property: Pueblo of Acoma, King Ranch, and Buddy Majors. Garcia Chino of the Pueblo of Acoma provided valuable assistance and guidance during some portions of the fieldwork and Bob Lee of the King Ranch provided useful information.

REFERENCES CITED

Bigsby, P.R., and Maxwell, C.H., 1981, Mineral resource potential of El Malpais Instant Study Area and adjacent areas, Valencia [Cibola] County, New Mexico: U.S. Geological Survey Open-File Report 81-557, 23 p., 1 plate, scale 1:62,500.

Bullock, J.H., Jr., Roemer, T.A., and Nowlan, G.A., 1989, Analytical results and sample locality map for stream-sediment and heavy-mineral-concentrate samples from the Rimrock (NM-020-007), Sand Canyon (NM-020-008), Little Rimrock (NM-020-009), Pinyon (NM-020-010), and Petaca Pinta (NM-020-014) Wilderness Study Areas, Cibola County, New Mexico: U.S. Geological Survey Open-File Report 89-007, 24 p.

Fishman, J.J., and Pyen, G., 1979, Determination of selected anions in water by ion chromatography: U.S. Geological Survey Water Resources Investigations 79-101, 30 p.

Maxwell, C.H., 1986, Geologic map of El Malpais lava field and surrounding areas, Cibola County, New Mexico: U.S. Geological Survey Miscellaneous Investigations Series Map I-1595, scale 1:62,500.

Orion Research, Inc., 1978, Analytical methods guide, 9th ed.: Cambridge, Massachusetts, 48 p.

Perkin-Elmer Corporation,1976, Analytical methods for atomic-absorption spectrophotometry: Norwalk, Connecticut, Perkin-Elmer Corporation, 586 p.

Perkin-Elmer Corporation, 1977, Analytical methods for atomic-absorption spectrophotometry, using the HGA graphite furnace: Norwalk, Connecticut, Perkin-Elmer Corporation, 208 p.

Scintrex Corporation, 1979, UA-3 Uranium Analyzer: Toronto, Canada, 45 p.

Skougstad, M.W., Fishman, M.J., Friedmann, L.C., Erdmann, D.E., and Duncan, S.S., eds., 1979, Methods for determination of inorganic substances in water and fluvial sediments: Techniques of Water Resources Investigations of the U.S. Geological Survey, chapter A1, 26 p.

VanTrump, George, Jr., and Miesch, A.T., 1977, The U.S. Geological Survey RASS-STATPAC system for management and statistical reduction of geochemical data: Computers and Geosciences, v. 3, p. 475-488.

TABLE 1.--Locations, names, collection dates, and other information for 21 well- and spring-water samples from near the Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas, Cibola and Catron Counties, New Mexico

[All well-water samples flowed through galvanized pipe]

Site	Location				Name	Date of sample collection	Remarks
	Township	Range	Section	Quarter section			
3501	5 N	10 W	12	NW	Cebolla Spring	8-31-87	No metal observed in contact with spring. Flowing estimated 1 gallon per minute.
3502	5 N	10 W	12	NW	Little Cebolla Spring	8-31-87	No metal observed in contact with spring although covered with galvanized sheet metal. Flowing estimated 1 quart per minute.
3503	5 N	9 W	10	NW	Hughes Place	8-31-87	
3504	5 N	10 W	23	SE	---[a]	8-31-87	
3505	5 N	10 W	27	NE	Woods No. 2 windmill	8-31-87	
3506	6 N	10 W	20	NW	Sand Canyon windmill	8-31-87	
3507	6 N	10 W	7	NE	Henson No. 2 windmill	8-31-87	
3508	7 N	9 W	9	SW	Cebollita Spring	9-1-87	No metal observed in contact with spring. Flowing estimated 1 gallon per minute.
3509	8 N	10 W	24	NE	---[a]	9-1-87	
3510	6 N	10 W	20	SE	Henson No. 1 windmill	9-2-87	
3511	5 N	11 W	26	SW	Cedar windmill	9-2-87	
3512	4 N	11 W	11	NE	Schoolhouse windmill	9-2-87	Approximately 500 ft deep.
3513	4 N	10 W	8	SW	Pens windmill	9-2-87	
3514	4 N	10 W	18	SW	Bonine windmill	9-2-87	
3515	4 N	10 W	17	SW	Buck windmill[b]	9-2-87	Approximately 125 ft deep.
3516	6 N	10 W	6	NW	Number 6 windmill[b]	9-4-87	
3517	6 N	11 W	34	SW	Head windmill	9-4-87	
3518	5 N	11 W	15	NE	Indian windmill	9-4-87	
3519	6 N	11 W	34	NW	Point windmill	9-4-87	
3520	7 N	10 W	20	SE	North windmill	9-6-87	
3521	7 N	10 W	22	NW	Witch windmill[b]	9-6-87	Approximately 500 ft deep.

[a]Name unknown to authors.

[b]Name of well from Bob Lee of King Ranch.

TABLE 2.--Analytical methods used for water analyses, Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas Cibola and Cation Counties, New Mexico

Constituents	Method	Reference
Alkalinity	Gran's plot potentiometric titration	Orion Research, Inc., 1978.
Sulfate, chloride, fluoride, and nitrate	Ion chromatography	Fishman and Pyen, 1979.
Uranium	Laser-excited fluorescence	Scintrex Corp., 1979.
Specific conductance	Conductivity bridge	Skougstad and others, 1979, p. 545.
Calcium, magnesium, sodium, potassium, silica, iron, manganese, and zinc	Flame atomic-absorption spectrophotometry	Perkin-Elmer Corp., 1976.
Arsenic, cobalt, copper, and molybdenum	Flameless atomic-absorption spectrophotometry	Perkin-Elmer Corp., 1977.

TABLE 3.--Results of analyses of water samples from the Rimrock, Sand Canyon, Little Rimrock, and Pinyon Wilderness Study Areas, Cibola and Catron Counties, New Mexico

[<, less than value shown. Ca, Mg, Na, K, SiO2, SO4, Cl, F, NO3, Fe, and Mn in mg/L; Zn, Cu, As, Mo, Co, and U in ug/L. Alk, alkalinity in mg/L; Cond, specific conductance in uS; Temp, temperature in degrees Celsius; Chg bal, charge balance]

Sample	Latitude	Longitude	Ca	Mg	Na	K	SiO2	Alk	SO4	Cl	F
3501	34 40 45	107 50 58	46.0	21.0	35	2.2	28	277	48	23.0	.29
3502	34 40 42	107 50 47	44.0	20.0	33	2.3	28	259	50	25.0	.28
3503	34 40 39	107 46 48	340.0	90.0	100	4.1	15	301	1,250	10.0	1.60
3504	34 38 40	107 51 8	280.0	120.0	510	7.3	10	566	1,600	115.0	2.60
3505	34 37 57	107 52 33	152.0	33.0	340	5.6	12	522	660	48.0	1.40
3506	34 44 11	107 55 14	138.0	49.0	160	2.3	19	439	450	18.0	1.10
3507	34 45 48	107 55 43	82.0	41.0	120	3.3	17	404	260	11.0	.67
3508	34 50 33	107 47 44	49.0	23.0	31	2.1	29	254	59	30.0	.24
3509	34 54 57	107 50 19	81.0	38.0	46	2.6	10	257	280	8.5	.43
3510	34 43 49	107 54 43	178.0	66.0	210	2.9	18	446	750	12.0	1.20
3511	34 37 44	107 58 9	148.0	54.0	140	3.0	14	209	620	21.0	.82
3512	34 35 25	107 57 22	6.1	1.7	310	1.0	10	589	110	20.0	4.00
3513	34 35 3	107 54 51	112.0	36.0	460	2.3	10	540	740	55.0	<.10
3514	34 33 54	107 55 57	52.0	18.0	460	3.3	11	412	700	33.0	1.70
3515	34 34 9	107 54 56	130.0	35.0	440	4.9	10	468	820	55.0	1.70
3516	34 46 55	107 56 7	41.0	17.0	15	2.1	15	253	20	1.9	.50
3517	34 42 5	107 59 12	36.0	9.5	22	1.0	18	162	34	13.0	.24
3518	34 39 48	107 58 33	26.0	9.8	170	2.1	13	342	165	16.0	.68
3519	34 42 29	107 59 29	47.0	11.0	52	1.6	14	268	58	10.0	.24
3520	34 49 0	107 54 39	105.0	21.0	30	2.0	14	405	78	10.0	.35
3521	34 49 29	107 53 5	57.0	51.0	34	2.9	10	318	170	8.8	.48

Sample	NO3	Fe	Mn	Zn	Cu	As	Mo	Co	U	Cond	pH	Temp	Chg bal
3501	.26	.01	.01	24	<1.0	1.0	<1.0	<1.0	1.20	550	7.3	14.0	-5.2
3502	.34	.01	.01	30	<1.0	<1.0	1.2	1.0	1.10	540	7.4	14.0	-5.8
3503	<.10	5.10	.22	145	1.1	1.8	9.4	2.0	.80	2,100	7.2	14.0	-4.1
3504	1.20	2.30	.22	265	1.2	1.8	16.0	3.3	5.40	3,100	6.9	13.0	.4
3505	<.10	1.60	.33	105	1.1	1.6	3.3	1.7	<.10	1,950	7.5	13.0	3.1
3506	.63	.16	.18	110	1.2	1.0	2.1	1.8	5.00	1,420	7.1	14.5	2.4
3507	1.90	.56	.02	460	<1.0	2.2	1.0	1.1	3.00	1,100	7.4	14.5	1.6
3508	1.10	<.01	<.01	86	<1.0	1.0	<1.0	<1.0	1.50	570	7.4	12.5	-4.2
3509	.26	.81	.03	82	<1.0	<1.0	1.0	<1.0	2.60	830	7.7	15.0	-5.3
3510	<.10	2.70	1.00	54	<1.0	1.5	4.5	2.3	3.00	1,750	7.4	15.5	.6
3511	<.10	.34	.03	1,400	<1.0	1.2	3.7	2.4	3.80	1,400	7.6	17.0	3.1
3512	.21	.03	.01	385	2.3	1.3	<1.0	1.0	.12	1,080	8.5	16.0	4.6
3513	<.10	.07	.01	930	17.0	3.5	2.0	2.2	4.60	2,200	7.6	13.0	5.2
3514	1.00	.29	.06	68	1.6	6.0	<1.0	2.6	.12	2,000	7.5	12.5	3.9
3515	.28	.34	.18	70	1.2	3.2	1.9	2.0	.50	2,200	7.3	12.5	4.1
3516	1.70	2.10	.05	95	1.8	<1.0	<1.0	1.3	1.00	420	7.4	14.5	-5.6
3517	4.00	.03	.01	285	1.6	<1.0	1.0	<1.0	1.40	380	7.7	13.0	-3.2
3518	.17	.06	.02	670	4.1	1.0	1.6	<1.0	.20	850	7.8	14.0	.1
3519	3.90	.03	<.01	44	3.5	<1.0	<1.0	<1.0	6.00	540	7.6	11.0	-3.4
3520	5.10	.41	.03	660	1.4	<1.0	3.2	1.4	3.60	760	7.5	16.5	-1.7
3521	2.80	1.50	.05	160	<1.0	<1.0	4.6	<1.0	6.20	780	7.7	14.0	-2.4