DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1523-D
SHEET 1 OF 2

EXPLANATION

● ROCK SAMPLE LOCALITY

▲ STREAM-SEDIMENT AND PANNED-CONCENTRATE SAMPLE LOCALITY--Panned-concentrate sample numbers in table 1 contain the letter P

■ STREAM-SEDIMENT SAMPLE LOCALITY

Note: The following correlation and description of map units are for the geologic base map shown in gray.

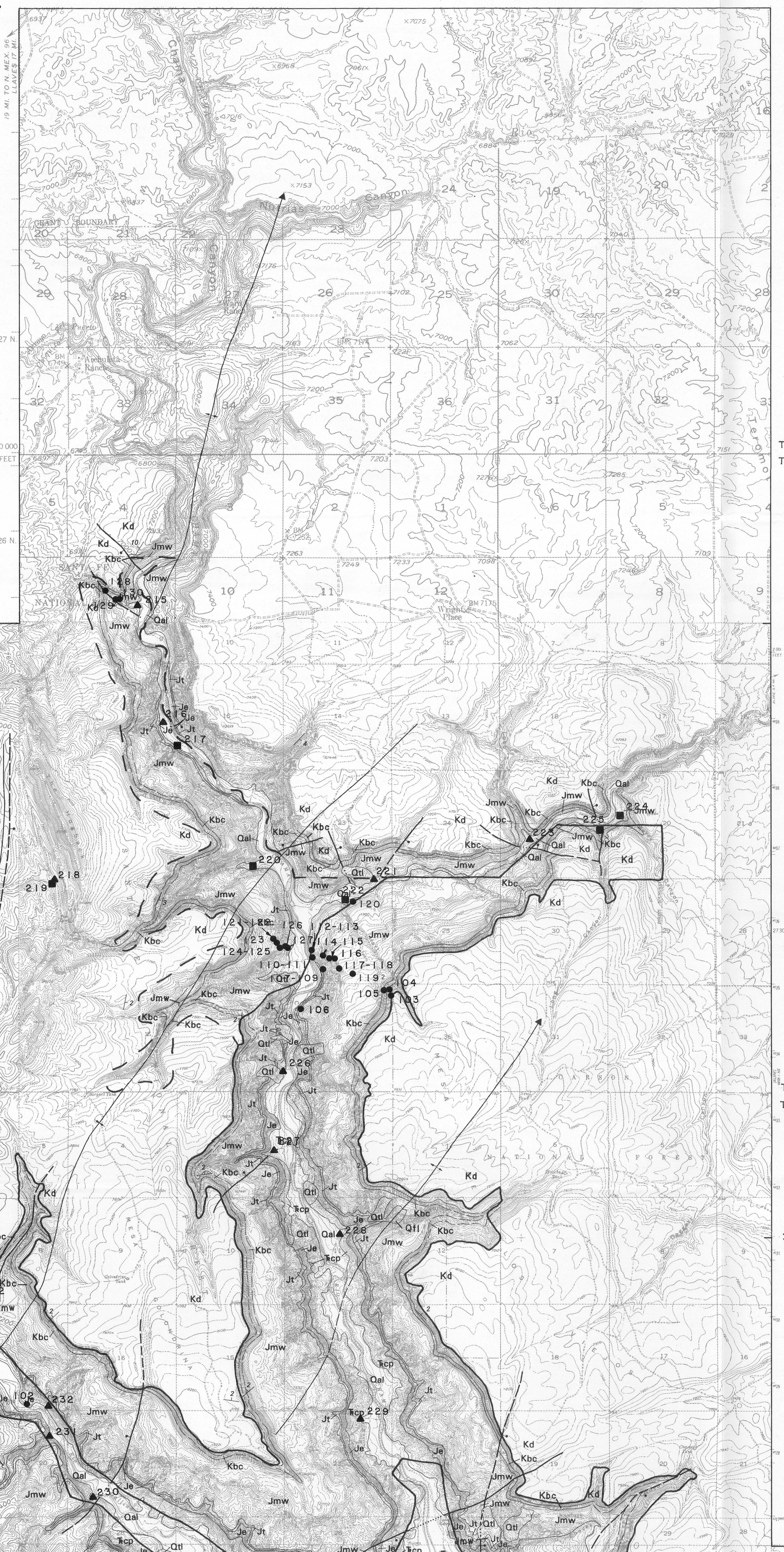
CORRELATION OF MAP UNITS

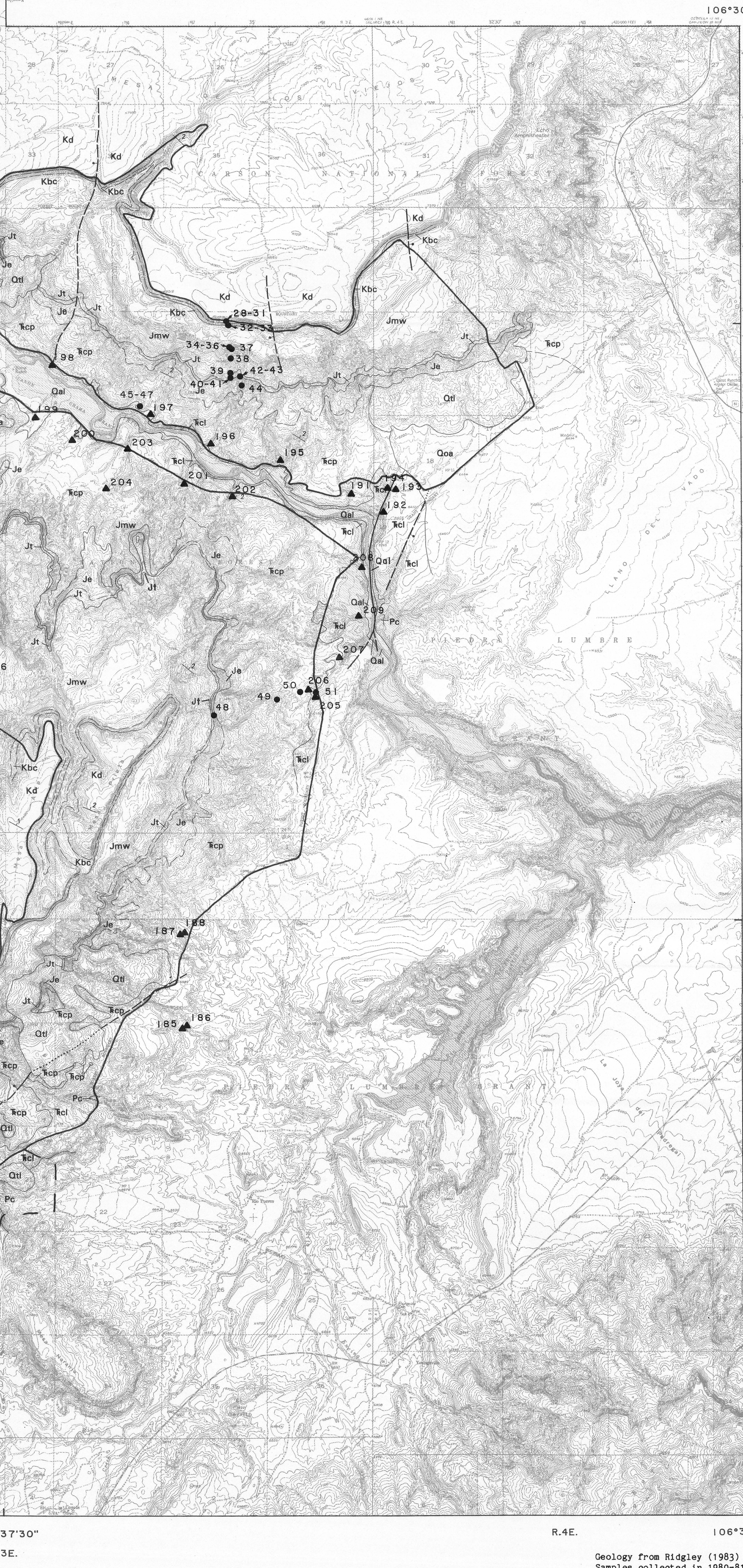
Qal, Qtl, Qoa } Holocene, Pleistocene(?) } QUATERNARY
Unconformity
Kd } Upper Cretaceous
Unconformity
Kbc } Lower Cretaceous } CRETACEOUS
Unconformity
Jmw, Jt } Upper and Middle Jurassic
Je } Middle Jurassic } JURASSIC
Unconformity
Ƭcp, Ƭcl } Upper Triassic } TRIASSIC
Unconformity
Pc } Lower Permian } PERMIAN

LIST OF MAP UNITS

Qal ALLUVIUM (QUATERNARY)
Qtl TALUS AND LANDSLIDES DEPOSITS (QUATERNARY)
Qoa OLDER ALLUVIUM (QUATERNARY)
Kd DAKOTA SANDSTONE (CRETACEOUS)--Sandstone, carbonaceous shale, and conglomerate
Kbc BURRO CANYON(?) FORMATION (CRETACEOUS)--Conglomerate, sandstone, and mudstone
Jmw MORRISON FORMATION AND WANAKAH FORMATION, UNDIFFERENTIATED (JURASSIC)--Sandstone, mudstone, claystone, limestone, and breccia
Jt TODILTO LIMESTONE (JURASSIC)--Limestone, gypsum, and minor sandstone
Je ENTRADA SANDSTONE--(JURASSIC)
Ƭcp CHINLE FORMATION (TRIASSIC)
Petrified Forest Member--Interbedded sandstone, conglomerate, siltstone, and mudstone; local limestone
Ƭcl Lower Member--Sandstone, shale, local conglomerate
Pc CUTLER FORMATION (PERMIAN)--Sandstone, siltstone, and mudstone

CONTACT--Dashed where approximately located
FAULT--Dashed where approximately located; dotted where concealed; bar and ball on downthrown side
STRIKE AND DIP OF BEDS
ANTICLINE--Showing trace of axial plane and plunge; dashed where approximately located
SYNCLINE--Showing trace of axial plane; dashed where approximately located
APPROXIMATE BOUNDARY OF CHAMA RIVER CANYON WILDERNESS
APPROXIMATE BOUNDARY OF CHAMA RIVER CANYON ROADLESS AREA





Base from U.S. Geological Survey Arroyo del Agua, Echo Amphitheater, Laguna Peak, Navajo Peak, Youngsville, 1953, 1:24,000; Llaves and Tierra Amarilla, 1955, 1:62,500.

Geology from Ridgley (1983)
Samples collected in 1980-81

SAMPLE LOCALITY MAP

SCALE 1:48 000
1 ½ 0 1 2 3 MILES
1 .5 0 1 2 3 KILOMETERS
CONTOUR INTERVAL 20 AND 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

GEOCHEMICAL MAP OF THE CHAMA RIVER CANYON WILDERNESS AND CONTIGUOUS ROADLESS AREA, RIO ARRIBA COUNTY, NEW MEXICO

By
Jennie L. Ridgley
1986

Table 1.--Analyses of samples from the Chama River Canyon Wilderness and Roadless Area, New Mexico

[All samples collected by U.S. Geological Survey were analyzed by six-step semi-quantitative spectrographic method; some samples were analyzed for U by fluorimetric method. Spectrographic analyses by B. Adrian, E. F. Cooley, and G. W. Day; fluorimetric analyses by A. Gruzensky, T. Roemer, B. Martin, and D. Kelley. Spectrographic analyses reported to nearest number in series 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, etc., which represent approximate midpoints of grouped data on a geometric scale. Number shown in parentheses under element symbol is lower limit of detection; this value is different for minus-35-mesh sediment samples. N, looked for but not detected at limit of detection; L, detected but below limit of detection; G, greater than value shown. Ag, As, Au, Bi, Cd, Sb, and W looked for but not detected. Sn detected in only a few of minus-35-mesh stream-sediment samples. Zn either not detected or detected in amounts less than limit of detection. Fe, Mg, Ca, and Ti in percent; all other elements in parts per million. Morrison Formation members (in parentheses) are: Jml, lower member; Jmw, Westwater Canyon Member; and Jmb, Brushy Basin Member. *, samples examined for mineralogy.]

Semiquantitative spectrographic analyses
Rock samples

Sample No.	Fe (0.05)	Mg (0.02)	Ca (0.05)	Ti (0.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (10)	Cu (5)	La (20)	Mo (5)	Nb (20)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	U (0.05)	Formation	Lithology
1	1	1	20	.1	5,000	30	5,000	N	5	30	15	300	N	N	5	100	5	1,000	100	100	100	3.45	Chinle---	Grit-size sandstone.
2	3	1	2	.7	1,000	200	1,000	2	30	100	30	100	N	N	50	50	20	200	100	70	500	.85	---do---	Siltstone.
3	2	.5	1	.5	500	100	700	L	5	30	5	70	N	N	10	20	5	200	50	30	700	.85	Morrison (Jml)	Sandstone.
4	3	1	.2	.5	200	200	700	3	10	50	7	100	N	N	5	30	10	200	70	50	500	1.25	---do---	Siltstone.
5	.2	1	.5	.1	50	50	500	N	N	N	L	70	N	N	5	10	N	300	20	N	50	.50	Morrison (Jmw)	Sandstone.
6	1	.1	.05	.2	50	50	500	L	N	30	7	200	N	N	5	10	N	500	50	30	200	.40	Morrison (Jmw)	Do.
7	3.0	.5	.1	.5	200	100	700	2	N	30	20	150	N	20	5	50	20	200	70	100	500	.60	Morrison (Jmb)	Siltstone.
8	.7	.1	L	.3	20	100	300	N	N	30	20	150	N	N	5	20	5	N	70	30	300	.8	---do---	Sandstone.
9	.2	.05	.05	.07	1,000	20	300	N	100	20	20	100	N	N	30	20	N	N	30	10	70	.35	Burro Canyon(?)	Do.
10	.2	.05	L	.2	30	20	300	N	N	30	5	100	N	N	5	10	N	N	30	20	200	.15	Dakota	Do.
11	1	.05	L	.7	200	30	200	N	5	10	7	70	N	L	N	20	N	N	30	30	500	.1	---do---	Do.
12	1	.05	L	.1	20	30	20	N	N	10	7	70	N	L	N	20	N	100	30	10	200	.1	---do---	Do.
13	2	.05	L	.7	20	30	20	N	N	30	7	70	N	L	5	20	10	N	30	30	G1,000	.15	---do---	Do.
14	1	.2	.07	.5	300	30	100	1	10	N	7	100	N	L	5	20	5	100	30	50	100	.35	Morrison (Jmb)	Gray-green claystone.
15	.2	.1	.1	.5	50	50	1,000	N	N	50	7	100	N	L	5	30	5	300	30	30	500	.7	Dakota---	Sandstone.
16	.2	.05	L	.1	10	10	500	N	N	N	5	70	N	N	5	10	N	N	20	10	100	.1	---do---	Do.
17	.2	.1	L	.5	20	20	700	N	N	50	7	70	N	L	N	20	5	100	30	200	300	.7	---do---	Do.
18	2	2	5	.5	700	200	1,000	2	30	150	30	150	N	L	30	30	20	300	2,000	70	500	47	Chinle---	Siltstone.
19	3	2	2	.5	500	200	1,500	1	15	100	30	70	N	L	30	50	15	500	100	50	500	.95	---do---	Shale.
20	.15	.03	.05	.07	200	10	200	N	N	N	5	70	N	N	5	20	N	300	20	10	70	.1	Dakota---	Sandstone.
21	.5	.03	L	.2	20	20	200	N	N	20	5	150	N	L	N	20	5	N	20	30	700	.35	---do---	Do.
22	.1	.05	.05	.3	10	30	200	N	N	30	7	150	N	L	N	30	5	500	20	30	500	1.05	---do---	Do.
23	.1	.05	.1	.1	10	10	200	N	N	N	L	50	N	L	N	10	N	200	20	10	300	.15	---do---	Do.
24	.2	.2	20	.07	700	10	500	N	N	N	5	70	N	N	5	30	N	200	20	10	70	.8	Wanakah---	Do.
25	.2	.5	G20	.02	700	L	100	N	N	N	5	70	7	N	N	10	N	200	20	N	20	1.5	Todilto---	Limestone.
26	1	1	G20	.1	1,000	20	100	N	N	50	15	70	15	N	20	30	5	500	70	30	100	1.5	---do---	Do.
27	.2	.1	.5	.07	100	20	300	N	N	20	7	70	N	N	5	10	N	N	20	10	70	.2	Entrada---	Sandstone.
28	.2	.05	.1	.2	20	20	200	N	N	20	7	70	N	L	5	20	N	200	20	30	300	.1	Dakota---	Do.
29	.15	.1	.05	.5	10	20	1,000	N	N	50	10	100	N	L	5	30	10	200	50	50	500	.4	---do---	Carbonaceous shale.
30	.2	.02	.2	.1	10	20	300	N	N	N	5	100	N	N	5	30	N	200	15	20	200	.25	---do---	Sandstone.
31	.5	.1	.1	.05	100	10	300	N	N	N	5	70	N	N	10	30	N	N	20	10	50	.3	---do---	Conglomeratic sandstone.
32	.15	.02	L	.05	10	15	50	N	N	N	L	150	N	N	L	10	N	N	10	30	200	.7	Burro Canyon	Sandstone.
33	.1	.05	L	.07	20	10	20	N	N	N	5	70	N	N	N	10	N	N	20	10	300	.15	---do---	Do.
34	3	.1	.05	.2	500	20	300	1	20	30	20	50	N	N	20	20	15	N	50	30	300	.85	Morrison (Jmb)	Siltstone.
35	3	.2	.05	.3	500	50	300	1	20	30	30	70	N	N	20	20	10	N	70	30	200	.35	---do---	Claystone.
36	3	1	.5	.3	500	30	700	2	10	30	10	100	N	L	20	30	10	500	50	70	200	.15	---do---	Sandstone.
37	1	.3	.1	.2	300	20	700	L	N	10	7	70	N	N	L	20	N	200	70	10	200	.4	---do---	Do.
38	1	.3	.1	.2	200	20	700	N	N	10	5	70	N	N	L	20	N	200	50	10	200	.25	Morrison (Jml)	Do.
39	1	.5	5	.2	1,000	20	700	1	5	10	7	70	N	N	5	30	5	300	30	30	200	1.4	---do---	Do.
40	.05	.5	20	.01	2,000	L	20	N	N	N	L	70	N	N	N	10	N	300	20	20	N	5.35	Wanakah---	Limestone.
41	.2	.2	10	.05	1,000	10	5,000	N	N	N	7	70	N	N	L	20	N	300	20	10	100	.65	---do---	Sandstone.
42	N	N	7	N	N	L	L	N	N	N	N	70	N	N	N	N	N	500	20	N	N	.8	Todilto---	Gypsum.
43	.05	1	20	.007	500	L	300	N	N	N	L	50	N	N	N	N	N	G5,000	20	N	N	.15	---do---	Limestone.
44	.2	.5	1	.1	200	20	1,000	N	N	N	5	70	N	N	5	20	N	200	20	10	70	3.55	Entrada---	Sandstone.
45	2	2	2	.2	700	30	5,000	1	10	50	5	70	N	N	15	20	7	200	100	30	200	2.45	Chinle---	Siltstone.
46	1	.7	20	.1	5,000	20	2,000	N	15	30	7	100	N	N	5	70	5	500	50	70	50	.55	---do---	Grit-size sandstone.
47	2	1	3	.5	1,000	70	700	2	30	100	30	70	N	N	30	70	20	300	100	70	200	.15	---do---	Shale.
48	.15	.05	.2	.05	70	20	100	N	N	N	L	70	N	N	L	10	N	100	20	10	200	1.5	Entrada---	Sandstone.
49	3	1	1	.5	500	100	500	2	15	100	30	100	N	N	30	30	10	300	100	30	300	.1	Chinle---	Shale.
50	2	1	2	.2	500	20	2,000	1	10	70	20	70	N	N	20	30	7	300	100	70	150	1.8	---do---	Sandstone.
51	.5	.2	7	.1	2,000	10	300	N	N	N	L	70	N	N	5	10	N	300	20	20	50	1.6	Chinle---	Sandstone.
52	.2	.7	G20	.05	1,500	L	100	N	N	N	5	20	L	N	N	70	N	100	30	L	20	.8	Todilto---	Limestone.
53	.3	.7	G20	.07	1,500	10	200	N	N	10	10	20	L	N	L	10	N	300	50	N	50	2.7	---do---	Sandstone.
54	.3	.7	G20	.03	1,500	N	20	N	N	N	L	20	L	L	N	10	N	300	20	N	20	26	---do---	Limestone.
55	.3	.3	15	.07	1,500	30	500	N	N	N	L	50	L	L	L	10	N	200	20	10	50	.4	Wanakah---	Sandstone.
56	2	1	2	3	500	100	500	2	L	70	30	30	L	L	10	30	7	200	100	10	500	.95	---do---	Do.
57	.2	.2	15	.07	1,500	50	500	1	L	N	5	20	L	L	5	10	N	200	30	L	50	.55	---do---	Do.
58	1	.5	15	.15	2,000	50	1,000	1	N	50	5	20	L	L	L	20	L	200	30	10	300	.3	Morrison (Jml)	Do.
59	1.5	.5	15	.15	2,000	50	500	1	N	10	5	50	L	L	L	20	L	200	30	20	500	.3	---do---	Do.
60	1	.3	.2	.15	200	50	700	1	L	10	10	20	L	L	L	20	L	200	50	L	200	.35	Morrison (Jmw)	Do.
61	2	.2	.2	.3	700	50	1,000	5	L	10	10	50	N	L	L	30	10	L	150	L	300	.55	Morrison (Jmb)	Claystone.
62	2	.5	.2	.3	700	50	700	5	N	10	10	20	N	L	L	20	10	L	100	L	300	.25	---do---	Do.
63	1	.1	.5	.2	1,000	20	1,500	2	N	L	30	30	N	L	L	20	5	100	100	L	300	.25	---do---	Sandstone.
64	.3	.2	.2	.07	20	20	300	1	N	L	5	30	N	L	L	L	L	N	50	L	50	.25	Burro Canyon	Do.
65	.7	.15	.2	.2	20	30	200	1	N	10	15	30	N	L	L	L	L	100	50	L	300	.3	---do---	Do.
66	.1	.1	.15	.07	20	10	100	L	N	10	5	30	N	L	L	L	N	N	20	L	50	.3	Dakota---	Do.
67	1	.2	.2	.1	300	50	300	1.5	L	10	10	L	N	L	5	10	5	L	50	10	300	.4	Entrada---	Do.
68	.5	.2	1.5	.1	200	50	300	1	L	10	5	L	5	L	5	20	5	L	20	10	150	.55	---do---	Sandstone.
69	.3	.7	G20	.05	500	L	70	L	N	L	10	20	N	N	L	10	N	300	50	L	20	1.8	Todilto---	Limestone.
70	.5	.5	20	.1	1,500	50	500	1	L	10	L	20	N	L	L	20	5	200	20	15	50	.2	Wanakah---	Sandstone.
71	5	1	1	.3	300	50	300	2	10	20	30	50	N	L	15	30	10	300	100	20	100	.8	Morrison (Jml)	Siltstone.
72	1	.7	10	.15	1,000	50	500	1.5	L	L	5	20	N	L	5	20	5	500	30	10	200	.25	---do---	Sandstone.
73	2	.7	.7	.2	300	20	700	2	L	5	5	20	N	L	5	20	5	500	70	10	150	.65	Morrison (Jmw)	Do.
74	5	1	1	.3	500	20	300	2	15	20	20	30	N	L	10	30	N	500	70	20	500	.4	Morrison (Jmb)	Siltstone.
75	3	.2	1	.3	500	20	500	1.5	10	20	30	50	N	L	L	20	5	200	70	15	500	.45	---do---	Sandstone.
76	3	1	1	.3	500	50	1,000	1.5	10	30	20	30	N	L	20	30	10	500	70	15	300	.95	Chinle---	Sandstone.
77	1	.5	3	.15	700	30	700	1.5	L	20	5	20	N	L	7	15	5	100	70	15	200	.5	---do---	Do.
78	5	1.5	5	.5	1,500	100	700	2	15	100	50	30	N	L	20	30	20	500	100	50	300	.85	---do---	Shale.
79	2	.7	10	.3	5,000	100	1,500	1.5	10	70	50	50	N	L	15	20	10	300	100	50	500	.5	---do---	Siltstone.
80	5	1.5	.3	.3	1,000	100	300	2	15	70	50	50	N	L	20	30	20	300	100	50	300	.72	---do---	Shale.
81	.5	.3	G20	.05	1,500	L	L	1.5	N	10	L	20	N	L	L	L	N	200	10	L	20	.5	Todilto---	Limestone.
82	3	1	2	.3	500	20	500	2	L	20	20	30	N	L	5	30	10	200	50	20	500	.2	Morrison (Jmb)	Siltstone.
83	2	.3	.2	.3	100	50	200	5	L	15	20	30	N	L	5	10	10	100	100	50	300	.45	---do---	Silicified, fine-grained sandstone.
84	.2	.1	.1	.3	50	15	50	1	L	10	5	20	N	L	5	L	5	N	50	10	200	.20	Burro Canyon	Sandstone.
85	.5	.1	.1	.3	50	50	100	1.5	L	20	20	30	N	L	5	10	7	100	100	20	500	.35	---do---	Gray sandstone.
86	5	.1	.1	.07	70	20	150	1.5	L	20	50	20	N	L	5	10	7	N	100	10	200	.45	---do---	Sandstone.
87	1	.2	.15	.5	70	100	200	1.5	L	30	20	30	N	L	L	10	7	L	50	30	1,000	.25	Dakota---	Do.
88	.1	.05	.05	.5	L	50	70	1.5	L	20	30	30	N	L	L	10	7	N	50	30	1,000	.65	---do---	Do.
89	1	.1	.1	.5	50	100	50	2	L	20	10	100	L	20	5	50	15	L	100	50	700	2.9	---do---	Carbonaceous sandstone.
90	5	1	.3	.5	300	200	300	5	15	50	70	100	N	L	30	30	20	100	100	70	300	.7	---do---	Shale.
91	5	1	.2	.5	300	200	200	5	50	70	50	100	N	L	30	50	20	100	100	70	300	.7	---do--	Claystone.
92	2	1	1	.2	300	50	2,000	5	7	30	L	50	N	N	5	30	5	100	70	15	100	.1	Cutler---	Sandstone.
93	2	7	10	.2	2,000	100	300	1.5	30	70	15	50	N	N	20	30	10	150	50	50	100	.4	---do---	Siltstone.
94	5	2	2	.5	500	100	500	1	20	100	30	50	N	L	15	30	20	150	70	50	300	.45	---do---	Do.
95	5	3	1	.5	1,000	100	500	2	30	150	70	70	N	L	50	50	20	150	100	50	150	.55	---do---	Claystone.
96	.3	.2	.1	.2	20	20	300	1	N	10	L	50	N	L	L	20	L	L	20	10	150	.1	Dakota---	Sandstone.
97	.2	.05	L	.2	20	20	200	1	N	10	L	50	N	L	L	20	N	N	20	20	50	.15	Burro Canyon	Do.
98	.2	.05	1	.03	100	20	500	1	N	L	L	50	N	L	L	20	N	N	20	10	70	.2	Entrada---	Do.
99	.2	1	G20	.02	1,000	10	100	L	N	L	7	50	N	L	L	20	N	200	20	10	20	1.7	Todilto---	Limestone.
100	1	.7	.1	.5	50	50	200	5	L	20	10	50	N	L	10	50	10	100	50	70	300	1.4	Morrison (Jmb)	Claystone.
101	.5	.1	1	.15	200	50	1,000	1	N	20	5	50	N	L	L	20	L	100	30	15	300	.9	Morrison (Jmw)	Sandstone.
102	1	.2	2	.1	300	100	200	1.5	L	10	10	20	N	L	L	10	5	N	50	10	300	.4	Entrada---	Do.
103	3	.2	.15	.5	50	100	300	1	L	20	5	30	N	L	L	30	7	300	70	20	700	.4	Dakota---	Do.
104	1.5	.07	1	.1	20	50	70	L	L	10	5	20	N	L	L	L	N	L	20	10	200	.25	---do---	Do.
105	.2	.1	.05	.1	50	50	150	L	L	10	L	20	N	L	L	L	5	N	30	10	500	.35	Burro Canyon	Do.
106	.5	.5	15	.07	1,000	20	300	L	L	10	L	20	N	L	L	10	N	200	20	10	70	.25	Wanakah---	Sandstone.
107	.5	.7	10	.2	700	30	300	1	L	150	5	20	N	L	L	20	5	200	20	10	700	.45	---do---	Do.
108	5	.7	15	.07	1,000	20	300	L	L	10	5	20	N	L	L	20	L	200	20	15	300	.6	Morrison (Jml)	Do.
109	.7	.7	G20	.07	2,000	10	70	L	N	15	5	20	N	L	N	20	5	200	20	20	100	1.6	---do---	Do.
110	L	.02	15	.007	L	N	N	N	N	L	N	N	N	L	N	N	N	300	10	L	N	.05	Todilto---	Gypsum.
111	1	.7	G20	.1	1,000	10	300	1	L	10	20	20	L	L	15	20	5	5,000	100	10	100	.9	---do---	Limestone.
112	.5	.1	1	.07	300	50	300	1	L	10	20	20	L	L	10	L	N	100	30	10	150	.25	Entrada---	Sandstone.
113	.2	.7	G20	.05	700	L	200	N	N	L	5	20	L	N	N	L	N	500	20	L	20	1	Todilto---	Gypsiferous limestone.
114	3	.3	.7	.5	300	200	300	1	L	30	5	50	L	L	N	20	7	100	100	20	1,000	.5	Morrison (Jml)	Sandstone.
115	5	1	.7	.5	300	150	300	2	15	20	30	70	L	L	15	30	20	200	100	70	300	.95	---do---	Shale.
116	1.5	.2	5	.2	1,000	20	500	1.5	L	10	5	30	L	L	5	20	L	300	50	20	200	.35	Morrison (Jmw)	Sandstone.
117	2	.5	1.5	.3	700	20	1,500	1.5	L	10	10	30	L	L	7	20	10	200	50	20	200	.25	Morrison (Jmb)	Claystone.
118	.5	.1	1	.1	500	20	500	1	L	N	5	20	L	L	5	L	N	100	20	L	150	.25	---do---	Sandstone.
119	2	.5	1	.3	200	100	3,000	1.5	L	30	15	200	L	N	L	20	10	100	50	70	500	.4	---do---	Claystone.
120	.7	.5	.2	.1	200	50	1,500	1	L	10	L	50	N	L	L	20	L	150	30	10	200	.1	---do---	Sandstone.
121	.5	.2	3	.1	1,000	30	1,500	1	L	10	5	50	N	L	L	20	L	150	20	15	100	.1	Morrison (Jmb)	Do.
122	.7	.3	.7	.1	150	30	500	1.5	L	10	5	50	N	L	L	20	L	100	20	10	200	.25	Morrison (Jmw)	Do.
123	.7	.3	.5	.1	150	30	700	1	L	L	L	50	N	L	L	20	L	100	20	10	100	.2	---do---	Do.
124	.7	.3	1.5	.1	300	20	2,000	1	N	L	5	50	N	L	L	20	N	200	20	10	70	.1	Morrison (Jml)	Do.
125	1	.3	1	.15	150	30	1,000	1	N	L	5	50	N	L	L	20	N	100	30	10	100	.15	---do---	Do.
126	1	.5	1.5	.2	200	50	1,000	1	N	L	5	50	N	L	L	20	N	100	30	20	200	.2	---do---	Do.
127	1	1	20	.05	1,000	20	300	1	L	20	10	50	N	L	5	30	L	200	50	20	50	1.5	Wanakah---	Do.
128	1	.5	L	.3	100	70	300	5	15	20	20	50	N	L	10	20	10	L	50	30	200	1	Burro Canyon	Do.
129	1.	.2	.15	.7	150	20	500	1	L	20	5	50	N	L	10	20	5	N	100	20	1,000	.7	Morrison (Jmb)	Do.
130	.5	.2	5	.1	1,000	20	500	1	L	L	5	50	N	L	L	20	L	150	20	20	50	.35	---do---	Do.

Dry stream-sediment samples, minus 80 mesh

Sample No.	Fe (0.05)	Mg (0.02)	Ca (0.05)	Ti (0.002)	Mn (10)	B (10)	Ba (20)	Be (1)	Co (5)	Cr (10)	Cu (5)	La (20)	Mo (5)	Nb (20)	Ni (5)	Pb (10)	Sc (5)	Sr (100)	V (10)	Y (10)	Zr (10)	U (0.05)
131	1	.7	.5	.3	700	200	1,500	1	10	200	10	100	N	L	5	30	5	300	70	50	500	.9
132	1	.2	.2	.2	500	20	1,000	1	5	10	5	100	N	L	5	20	L	200	50	20	500	.6
133	2	.5	.5	.5	700	30	700	1	5	50	15	100	N	L	N	20	5	300	70	30	500	.95
134	2	.5	.5	.5	500	50	700	1	5	30	7	100	N	L	5	50	5	200	70	30	500	.95
135	3	.5	.05	.5	700	50	700	2	15	50	20	100	N	L	5	30	10	200	70	50	500	.35
136	3	1	2	.5	700	100	1,000	1	15	70	20	100	N	L	30	30	10	300	70	50	300	.5
137	1	.5	2	.3	500	100	700	1	5	30	10	100	N	L	10	30	5	200	70	30	300	.25
138	2	1	3	.5	700	100	1,500	1	10	70	20	100	N	L	20	30	10	300	70	30	300	.65
139	1	1	3	.5	700	100	700	1	5	50	20	100	N	L	20	30	5	300	70	30	300	.5
140	2	1	3	.5	700	200	1,000	1	5	50	15	100	N	L	30	20	5	200	70	30	300	.35
141	2	1	5	.3	700	100	1,000	1	5	50	20	100	N	L	15	50	5	300	70	30	300	.5
142	1	.7	2	.3	300	100	700	L	5	50	7	100	N	L	10	20	5	N	70	30	300	.4
143	1	.7	2	.3	500	100	1,000	L	5	50	7	70	N	L	5	30	5	100	70	30	300	.4
144	1	.7	2	.3	300	100	700	1	5	50	10	70	N	L	5	30	5	200	50	30	300	.6
145	1	.7	2	.2	300	200	700	L	5	50	7	70	N	L	10	20	5	100	50	20	300	.4
146	1	.5	2	.2	300	30	1,000	L	5	30	7	70	N	L	10	30	5	100	50	20	300	.45
147	1	.7	2	.3	500	20	700	1	10	50	20	70	N	L	15	30	7	200	50	30	300	.5
148	1	.7	2	.3	500	200	1,000	L	5	30	10	70	N	L	10	30	5	300	70	30	200	.85
149	2	1	2	.5	700	200	1,000	1	10	70	20	70	N	L	20	30	10	300	70	30	500	3.
150	1	.5	2	.2	500	100	700	L	5	30	7	70	N	L	10	30	5	200	50	20	200	.5
151	.5	.1	.5	.1	200	30	2,000	N	N	N	5	70	N	L	L	20	L	200	30	15	500	.25
152	1	1	2	.2	500	30	500	L	5	50	20	70	N	L	15	50	5	200	30	15	100	.58
153	1	.1	.5	.3	300	15	1,000	L	5	30	5	100	N	L	5	30	L	200	50	30	1,000	.7
154	2	.5	.5	.3	300	30	1,000	L	5	30	5	70	N	L	L	30	N	200	50	20	500	.75
155	1	.5	1	.3	500	30	1,500	1	5	30	7	70	N	L	5	30	L	200	50	30	500	.35
156	1	.2	.5	.1	200	20	700	L	N	N	5	70	N	L	5	30	L	200	30	20	200	.25
157	1	.2	1	.3	500	20	1,000	L	N	N	7	70	N	L	5	30	N	200	30	20	500	.35
158	1	.2	.5	.2	300	20	1,000	L	N	N	5	70	N	L	L	20	N	100	30	10	500	.3
159	.5	.2	1	.1	300	20	700	L	N	30	7	70	N	L	5	30	N	100	20	15	300	.25
160	1	.2	1	.2	300	30	1,500	L	N	10	7	70	N	L	5	30	N	200	50	20	300	.3
161	1	.2	2	.15	300	30	1,000	L	5	10	7	70	N	L	5	30	L	200	50	100	300	.5
162	1	.5	2	.2	300	20	700	1	5	30	7	70	N	L	15	30	L	100	50	20	300	.7
163	1	.5	1	.2	300	20	700	L	N	30	7	70	N	L	5	20	L	200	30	15	200	.75
164	2	1	2	.3	300	10	1,000	1	5	30	15	70	N	L	15	30	10	200	50	20	200	1
165	1	1	3	.3	500	100	700	1	5	30	10	70	N	N	15	30	5	300	70	30	300	.65
166	1	1	3	.3	300	100	1,000	1	5	30	10	70	N	N	10	30	5	300	70	30	300	.45
167	2	1	5	.3	500	100	1,000	1	5	50	15	70	N	N	15	30	10	300	70	30	300	.6
168	2	.7	.5	.5	500	100	1,000	2	5	50	15	100	N	L	15	50	10	200	70	30	300	1.4
169	2	.5	.3	.3	500	100	1,000	1	5	50	15	100	N	L	5	50	5	200	70	30	300	.65
170	2	.2	.5	.3	300	50	1,000	1	5	20	7	70	N	L	N	20	N	200	70	30	700	.55
171	1	.2	.2	.2	300	50	700	1	5	10	5	70	N	L	N	20	N	100	70	20	300	1.4
172	1	.3	.3	.2	300	100	700	1	5	10	7	70	N	L	N	20	N	100	50	30	300	.8
173	2	1	3	.2	700	50	1,000	2	5	20	10	70	N	L	10	50	7	1,000	50	20	300	2.2
174	1	.5	2	.2	300	50	1,500	1	5	30	7	70	N	L	5	30	N	300	50	20	300	1.7
175	1	1	2	.2	500	50	700	2	5	20	15	70	N	L	10	50	5	1,000	70	20	200	3
176	1	.7	1	.2	500	20	1,000	1	5	10	7	70	N	L	5	30	N	300	70	30	300	1.1
177	1	.2	1	.2	300	20	1,000	N	5	10	5	70	N	L	5	30	N	100	70	30	300	.55
178	1	.5	2	.2	300	50	700	N	5	10	7	70	N	L	N	30	N	100	50	20	500	.6
179	1	.5	2	.1	200	30	700	N	5	30	5	70	N	L	5	20	N	100	30	15	300	.35
180	2	.5	1	.2	300	20	1,500	N	5	30	7	70	N	L	N	30	5	100	70	20	300	.55
181	.5	.1	.5	.07	100	10	200	N	N	30	7	20	N	N	5	30	N	N	30	10	200	.25
182	1	.2	.5	.1	300	20	1,500	L	N	N	5	50	N	N	N	10	N	100	50	15	500	.5
183	1	.2	1	.1	300	20	700	1	5	N	7	70	N	N	5	10	N	100	30	15	300	.4
184	1	.2	2	.1	300	10	700	N	5	30	5	70	N	N	5	N	N	100	30	15	300	.25
185	3	1	1.5	.5	700	100	700	2	10	70	30	30	N	L	20	20	10	200	100	30	500	.6
186	1	.3	1.5	.15	300	50	700	1.5	L	10	10	30	N	L	5	10	L	200	50	10	300	.45
187	2	.7	2	.3	500	50	700	2	L	20	15	30	N	L	10	30	5	300	70	20	500	.45
188	2	.5	1.5	.3	300	50	1,000	1.5	L	20	7	30	N	L	L	20	5	200	70	20	300	.3
189	3	.7	2	.3	700	70	1,000	1.5	L	100	20	50	N	L	10	30	7	200	100	20	500	.55
190	2	.5	2	.3	700	100	1,000	1.5	L	20	15	50	N	L	10	20	7	150	100	20	500	.4
191	2	.7	1.5	.3	500	100	1,000	2	L	30	15	30	N	L	10	20	7	200	100	20	300	.9
192	1.5	.5	1.5	.3	500	70	700	2	L	20	15	30	N	L	5	20	5	200	70	10	500	.7
193	2	.7	1.5	.3	500	100	1,000	2	L	50	20	50	N	L	L	20	7	200	100	20	700	.75
194	2	.7	2	.3	500	100	1,000	2	L	50	20	30	N	L	15	20	7	200	100	20	500	.8
195	2	.7	1.5	.3	500	50	1,000	2	L	50	10	30	N	L	5	20	7	200	70	20	500	.7
196	2	1	1.5	.3	500	100	700	2	L	50	20	30	N	L	10	20	10	200	100	20	500	.6
197	2	.7	1.5	.3	500	70	1,500	1.5	L	50	20	30	N	L	10	20	7	300	100	20	500	.55
198	2	.7	1.5	.3	500	50	1,000	2	L	20	10	30	N	L	5	20	5	300	70	20	300	.85
199	2	.7	2	.3	500	100	1,000	1.5	L	50	15	50	N	L	10	20	7	200	70	20	500	.5
200	3	1	3	.3	700	100	1,000	2	L	70	20	50	N	L	15	30	10	200	100	20	300	.6
201	2	1	3	.3	500	100	1,000	2	L	150	20	50	N	L	10	20	7	200	100	20	500	1
202	3	.7	2	.3	500	100	1,000	2	L	100	20	50	N	L	20	10	7	200	100	20	500	.9
203	3	.7	2	.3	500	100	1,000	2	L	50	15	50	N	L	5	20	7	200	100	20	500	.75
204	3	1	3	.3	1,000	100	1,500	2	L	50	20	50	N	L	L	30	10	300	100	20	1,000	.6
205	3	1	2	.3	1,000	100	1,500	2	L	70	20	50	N	L	10	20	10	200	100	20	500	.9
206	3	1	3	.3	1,000	100	1,500	2	L	50	50	50	N	L	5	20	7	200	100	20	700	.9
207	2	1	2	.3	1,000	100	1,500	2	L	50	20	50	N	L	5	20	7	200	100	20	300	.6
208	2	.7	1.5	.3	500	50	700	1.5	L	30	15	30	N	L	10	20	7	200	100	20	300	.55
209	2	1	3	.3	700	100	700	1.5	10	50	20	30	N	L	15	20	7	200	100	20	300	.55
210	3	1	3	.3	700	100	700	1.5	10	50	20	50	N	L	15	20	7	200	100	20	300	.7
211	5	1	3	.5	1,000	150	1,000	2	10	100	50	30	N	L	30	30	10	200	200	50	500	1
212	1.5	.5	1	.2	200	50	700	1.5	L	10	5	30	N	L	5	20	5	200	50	10	500	.2
213	2	.5	1.5	.3	300	100	700	1.5	L	20	7	30	N	L	L	20	5	200	70	20	500	.55
214	2	.5	2	.3	300	100	1,000	1.5	L	30	10	50	N	L	L	20	5	200	70	20	1,000	.55
215	3	.7	2	.3	500	70	1,500	2	L	70	20	50	N	L	15	30	7	200	100	20	500	.5
216	3	.7	1.5	.3	500	50	1,500	2	L	20	20	50	N	L	10	30	7	200	100	20	300	.4
217	3	.5	1.5	.3	500	50	1,500	1.5	L	20	10	30	N	L	10	20	7	200	100	20	1,000	.2
218	5	.7	1	.5	500	100	1,000	2	10	70	30	50	N	L	20	30	10	150	100	20	500	.6
219	5	.7	1.5	.5	1,000	100	1,000	2	15	100	30	50	N	L	20	50	10	100	100	30	500	.5
220	3	.7	2	.3	500	70	700	1.5	10	20	20	50	N	L	10	30	7	100	100	20	500	.25
221	3	.5	.7	.3	500	100	300	1.5	L	20	20	50	N	L	10	20	7	100	100	20	500	.1
222	3	.5	2	.3	700	50	500	1.5	10	30	20	30	N	L	10	20	5	200	100	20	500	.65
223	2	.5	2	.3	300	70	300	1.5	L	30	20	20	N	L	10	20	7	200	100	20	500	.75
224	1.5	.5	.2	.3	150	100	500	1.5	L	30	20	30	N	L	5	20	10	200	70	20	500	5
225	2	.5	.2	.3	1,500	100	300	5	20	30	20	30	N	L	20	20	7	200	70	20	500	1.3
226	3	1	1.5	.5	700	100	1,000	2	L	30	20	50	N	L	L	30	10	200	100	30	700	.6
227	1.5	.5	1.5	.3	500	70	1,000	L	L	70	10	30	N	L	L	20	5	200	50	20	300	.4
228	1	.2	.5	.2	200	20	1,000	1	L	10	5	50	N	L	10	20	5	150	50	20	200	.4
229	1.5	.3	3	.2	300	50	1,000	1	L	20	10	50	N	L	20	20	5	150	50	20	500	.4
230	1.5	.3	1	.2	200	50	1,000	1	L	10	5	50	N	L	L	20	5	150	50	20	500	.25
231	1	5	1.5	2	200	50	1,000	1	L	10	5	50	N	L	L	20	5	150	50	20	500	.34
232	1	.3	1	.3	200	50	1,000	1	L	10	5	50	N	L	L	20	5	150	50	20	500	.3

Dry stream-sediment samples, minus 35 mesh

Sample No.	Fe (0.1)	Mg (0.05)	Ca (0.1)	Ti (0.005)	Mn (20)	B (20)	Ba (50)	Be (2)	Co (10)	Cr (20)	Cu (10)	La (50)	Mo (10)	Nb (50)	Ni (10)	Pb (20)	Sc (10)	Sn (20)	Sr (200)	V (20)	Y (20)	Zr (20)
131P	5	.2	1	.5	1,000	200	G5,000	N	L	150	15	70	N	L	10	20	L	N	G5,000	100	100	G1,000
135P	1.5	.15	L	1	300	70	G5,000	N	L	100	20	L	N	L	10	20	L	N	5,000	50	10	G1,000
136P	1	.2	2	.5	500	50	G5,000	N	L	L	20	L	N	L	L	20	L	N	G5,000	50	100	G1,000
137P	1	.2	2	.7	300	50	G5,000	N	L	300	20	L	N	L	L	30	L	N	G5,000	50	100	G1,000
138P	.7	.2	2	.5	300	50	G5,000	N	L	L	15	L	N	L	L	L	L	N	G5,000	50	100	G1,000
139P*	.7	.1	1.5	.3	300	50	G5,000	N	L	30	15	L	N	L	L	20	L	N	G5,000	50	100	G1,000
140P	1	.2	3	.7	500	100	G5,000	N	L	30	20	50	N	L	L	L	L	N	G5,000	50	70	G1,000
141P	1	.1	1.5	.3	300	50	G5,000	N	L	20	20	L	N	L	L	70	L	N	G5,000	50	100	G1,000
142P	3	.2	1.5	G1.	500	500	G5,000	N	L	700	20	50	N	50	10	20	20	200	G5,000	100	200	G1,000
143P*	3	.15	3	G1.	200	150	G5,000	N	L	50	20	50	N	L	10	L	50	N	G5,000	70	500	G1,000
144P	2	.2	2	.7	300	50	G5,000	N	L	50	20	50	N	L	10	L	L	N	G5,000	70	100	G1,000
145P	2	.2	2	1	300	100	G5,000	N	L	20	20	L	N	L	10	L	10	N	G5,000	100	100	G1,000
146P*	2	.2	2	1	300	150	G5,000	N	L	200	20	50	N	L	10	L	10	N	G5,000	70	150	G1,000
147P*	2	.15	1	1	500	200	G5,000	N	L	200	20	50	N	L	L	L	10	N	G5,000	70	200	G1,000
148P	1.5	.15	2	1	200	50	G5,000	N	L	50	20	50	N	L	L	L	L	N	G5,000	70	100	G1,000
149P	1.5	.2	3	.7	500	200	G5,000	N	L	30	30	L	N	L	L	50	L	N	G5,000	100	50	G1,000
150P	1	.15	.7	1	300	200	G5,000	N	L	100	20	L	N	L	L	L	L	N	G5,000	70	70	G1,000
151P*	2	.05	.7	.7	200	50	G5,000	N	L	70	10	L	N	L	L	L	20	N	G5,000	50	300	G1,000
152P	2	.2	.5	1	300	100	G5,000	N	L	100	10	L	N	L	10	L	20	N	G5,000	50	200	G1,000
153P*	5	.1	5	G1	500	100	G5,000	N	L	50	10	100	N	L	10	L	20	N	G5,000	100	500	G1,000
154P	5	.1	5	G1	300	70	G5,000	N	L	50	20	100	N	L	10	L	50	N	G5,000	100	500	G1,000
155P	2	.1	1.5	.7	300	50	G5,000	N	L	20	10	50	N	L	L	150	10	50	G5,000	50	100	G1,000
156P	3	.1	.5	G1	300	300	G5,000	N	L	150	10	100	N	50	10	20	20	N	G5,000	100	100	G1,000
157P	5	.1	3	G1	700	100	G5,000	N	L	100	20	100	N	L	10	20	20	N	G5,000	100	300	G1,000
158P*	5	.15	1	G1	700	200	G5,000	N	L	100	10	100	N	50	10	20	L	N	G5,000	100	100	G1,000
159P	5	.15	.5	G1	3,000	200	G5,000	N	L	1,000	10	L	N	L	L	L	20	N	G5,000	100	200	G1,000
160P	1	.1	2	.7	200	20	G5,000	N	L	N	10	50	N	L	L	L	L	N	G5,000	50	100	G1,000
161P	2	.1	2	G1	500	100	G5,000	N	L	100	10	L	N	L	L	20	20	N	G5,000	70	200	G1,000
162P	3	.1	1	.1	500	100	G5,000	N	L	50	20	L	N	L	10	L	20	N	G5,000	70	300	G1,000
163P	2	.1	3	G1	500	50	G5,000	N	L	20	20	70	N	L	L	L	L	N	G5,000	70	200	G1,000
164P	2	.1	2	1	500	20	G5,000	N	L	70	20	50	N	L	10	L	L	N	G5,000	50	100	G1,000
165P	2	.1	2	1	500	50	G5,000	N	L	50	20	50	N	L	10	L	L	N	G5,000	70	100	G1,000
166P	2	.1	2	G1	500	200	G5,000	N	L	100	20	50	N	L	10	L	L	N	G5,000	70	200	G1,000
167P	1.5	.15	2	G1	500	50	G5,000	N	L	100	20	50	N	L	10	L	L	N	G5,000	70	70	G1,000
169P	1.5	.05	.2	.5	300	50	G5,000	N	L	100	10	50	N	L	L	L	L	N	G5,000	50	50	G1,000
170P	2	.2	5	G1	200	50	G5,000	N	L	50	20	150	N	L	10	50	20	N	G5,000	50	500	G1,000
171P	5	.3	2	G1	500	150	G5,000	N	L	500	20	100	N	L	10	50	50	N	G5,000	100	500	G1,000
172P	5	.1	2	G1	200	150	G5,000	N	L	150	20	100	N	L	10	30	10	N	G5,000	100	200	G1,000
177P*	1.5	.15	2	.7	200	50	G5,000	N	L	70	10	50	N	L	10	L	10	N	G5,000	50	100	G1,000
178P	2	.15	1.5	G1	300	200	G5,000	N	L	200	20	50	20	L	10	20	10	N	G5,000	70	200	G1,000
179P	2	.1	2	.7	500	150	G5,000	N	L	150	10	50	N	L	10	20	10	N	G5,000	50	300	G1,000
180P*	3	.15	.5	1	300	150	G5,000	N	L	100	10	50	N	L	10	30	20	N	G5,000	70	500	G1,000
181P*	2	.2	1.5	G1	200	150	G5,000	N	L	150	10	50	N	L	10	20	20	N	G5,000	70	300	G1,000
182P*	3	.2	2	G1	500	500	G5,000	N	L	700	10	50	N	L	10	20	20	N	G5,000	100	100	G1,000
183P	3	.15	2	G1	300	150	G5,000	N	L	150	20	50	N	L	10	20	20	N	G5,000	70	500	G1,000
184P*	1.5	.1	2	1	200	200	G5,000	N	L	50	10	70	N	L	10	L	20	N	G5,000	50	500	G1,000
185P	2	.1	1.5	G1	300	200	G5,000	N	L	100	20	50	N	N	10	50	10	N	G5,000	70	200	G1,000
186P	1.5	.1	2	G1	200	300	G5,000	N	L	70	20	100	N	N	10	20	10	N	G5,000	70	200	G1,000
187P	1	.1	1.5	1	200	70	G5,000	N	L	50	20	50	N	N	10	L	10	N	G5,000	50	200	G1,000
188P	1.5	.1	1.5	G1	150	70	G5,000	N	L	70	15	50	N	N	10	20	20	N	G5,000	50	300	G1,000
189P	5	.1	1	G1	300	100	G5,000	N	L	20	20	150	N	L	10	30	L	N	G5,000	70	500	G1,000
190P	5	.1	1	G1	300	70	G5,000	N	L	20	20	100	N	L	10	30	L	150	G5,000	70	500	G1,000
191P	5	.15	1.5	G1	700	200	G5,000	L	L	200	30	100	N	L	10	30	10	N	G5,000	100	70	G1,000
192P	2	.1	1.5	.7	500	100	G5,000	N	L	200	20	50	N	L	10	50	10	N	G5,000	50	150	G1,000
193P	1	.1	2	.5	500	150	G5,000	N	L	70	10	50	N	L	10	20	L	N	G5,000	50	100	G1,000
194P	2	.1	1	.5	200	100	G5,000	N	L	700	20	50	N	L	10	70	L	N	G5,000	50	100	G1,000
195P	.7	.15	1	.3	300	100	G5,000	N	L	50	15	50	N	L	10	20	L	N	G5,000	50	50	G1,000
196P	3	.15	1.5	1	300	300	G5,000	N	L	150	20	50	N	L	10	20	20	N	G5,000	70	300	G1,000
197P	1	.1	1	.5	500	50	G5,000	N	L	150	20	50	N	L	10	100	10	N	G5,000	70	100	G1,000
198P	1	.1	1	.5	200	50	G5,000	N	L	50	10	50	N	L	10	L	L	N	G5,000	30	70	G1,000
199P	2	.15	1.5	G1	700	200	G5,000	N	L	500	10	50	N	L	10	20	10	N	G5,000	100	200	G1,000
200P	5	.15	2	G1	1,000	500	G5,000	N	L	500	20	100	N	L	10	50	20	N	G5,000	100	300	G1,000
201P	2	.1	1.5	1	200	50	G5,000	N	L	150	15	50	N	L	10	20	10	50	G5,000	50	100	G1,000
202P	2	.1	1	.5	300	150	G5,000	N	L	100	20	50	N	N	10	20	10	N	G5,000	50	100	G1,000
203P	2	.1	1.5	1	300	150	G5,000	N	L	200	10	50	N	N	10	100	10	N	G5,000	50	200	G1,000
204P	2	.15	2	1	500	200	G5,000	N	L	200	10	50	N	N	10	20	10	N	G5,000	70	200	G1,000
205P	1.5	.15	2	.5	500	150	G5,000	N	L	70	20	50	N	N	10	50	L	N	G5,000	50	100	G1,000
206P	2	.2	2	1	500	100	G5,000	N	L	500	30	50	N	N	10	20	10	N	G5,000	50	100	G1,000
207P	3	.2	2	.7	700	150	G5,000	N	L	200	30	50	N	N	10	20	L	N	G5,000	70	100	G1,000
208P	2	.1	1	1	300	200	G5,000	N	L	150	20	50	N	N	10	20	10	N	G5,000	50	150	G1,000
209P	7	.15	2	1	1,000	300	G5,000	N	L	200	30	50	N	N	10	30	10	N	G5,000	70	200	G1,000
210P	1.5	.1	1.5	1	200	100	G5,000	N	L	50	15	50	N	N	10	20	20	N	G5,000	70	300	G1,000
212P	1.5	.15	5	G1	200	200	G5,000	N	L	50	50	100	N	N	10	200	20	N	5,000	100	300	G1,000
214P	2	.1	2	G1	200	300	G5,000	N	L	200	10	100	N	N	10	20	30	N	G5,000	100	300	G1,000
215P	5	.1	1	G1	300	150	G5,000	N	L	50	20	100	N	50	10	30	30	N	G5,000	70	300	G1,000
216P	5	.15	1	G1	300	100	G5,000	N	L	30	20	50	N	50	10	30	20	N	G5,000	70	200	G1,000
218P	5	.15	1	G1	300	100	G5,000	N	L	50	20	150	N	L	10	30	20	N	G5,000	70	300	G1,000
221P	5	.15	1	G1	300	300	G5,000	N	L	200	30	150	N	50	10	30	20	N	G5,000	70	300	G1,000
223P	1.5	.1	1.5	1	150	50	G5,000	N	L	50	70	100	N	N	10	20	10	N	5,000	50	70	G1,000
226P	1.5	.15	1	.7	150	50	G5,000	N	L	50	10	50	N	N	10	20	30	N	5,000	50	300	G1,000
227P	2	.05	1	.7	150	200	G5,000	N	L	100	10	L	N	L	10	20	30	N	G5,000	50	500	G1,000
228P	3	.1	2	1.5	300	200	G5,000	N	L	100	10	70	N	L	10	20	10	N	G5,000	100	150	G1,000
229P	2	.1	1.5	1	300	300	G5,000	N	L	150	10	50	N	L	10	20	30	50	G5,000	100	500	G1,000
230P	2	.1	1.5	.7	150	70	G5,000	N	L	150	10	50	N	L	10	L	10	N	G5,000	50	200	G1,000
231P	1.5	.1	1.5	.5	150	100	G5,000	N	L	30	10	50	N	L	10	20	10	N	G5,000	50	200	G1,000
232P	2	.1	1.5	.7	200	100	G5,000	N	L	70	10	70	N	L	10	20	30	N	G5,000	50	300	G1,000

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and Congress. This report presents the results of a geochemical survey of the Chama River Canyon Wilderness and Roadless Area in the Santa Fe and Carson National Forests, Rio Arriba County, New Mexico. The Chama River Canyon Wilderness was established by Public Law 95-237, Feb. 24, 1978. The Chama River Canyon Roadless Area (03098) was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January, 1979.

INTRODUCTION

The Chama River Canyon Wilderness, in Rio Arriba County, north-central New Mexico, covers 50,300 acres (20,364 hectares) within the Coyote and Cuba Ranger Districts of the Santa Fe National Forest and the Canjilon Ranger District of the Carson National Forest. In 1979 the U.S. Forest Service, under the Forest Service Roadless Area Review and Evaluation (RARE II) program, designated three additional areas, contiguous to the wilderness, for further planning to assess wilderness characteristics. These areas, totaling 4,800 acres (1,945 hectares), were collectively designated Roadless Area 03098; they have since been dropped from consideration.

The Chama River Canyon Wilderness and adjacent Roadless Area are approximately 70 mi (120 km) northwest of Santa Fe and nearly 130 mi (220 km) north of Albuquerque. The areas are accessible by several Forest Service roads that join major highways in the vicinity.

The wilderness and adjacent roadless area consist of the steep canyons and adjacent slopes cut by the Rio Chama, Rio Gallina, and their tributaries. The elevation ranges from 6,300 ft (1,920 m) above sea level along the valley of the Rio Chama to 8,900 ft (2,715 m) at Mesa Alta, in the southern part of the wilderness.

SAMPLE COLLECTION, PREPARATION, AND ANALYSIS

A geochemical survey of the Chama River Canyon Wilderness and contiguous Roadless Area was conducted by the U.S. Geological Survey during 1980 and 1981 to identify areas that might contain mineral resources. The survey was made by collecting and analyzing rock, stream-sediment, and panned-concentrate samples.

A total of 130 rock samples were collected from 5 widely spaced localities (see map). The localities were chosen to provide broad sample coverage. Samples of different lithologies were collected from each formation or members of a formation. The localities sampled were generally the most accessible outcrops, and grab samples of the seemingly least weathered rock were collected. Additional samples of outcrops at known mineralized prospects were collected by the U.S. Bureau of Mines. The results of their geochemical survey were reported by Light (1983).

Stream-sediment and panned-concentrate samples were collected from most first- and second-order streams in the study area. Sample sites were located a short distance upstream from the confluence of the sampled stream with an adjoining stream. Most streams sampled are ephemeral and were dry when the samples were collected. A few streams are perennial; samples from these were collected wet and air dried.

A total of 102 stream-sediment samples were collected. The samples consisted of about 1 cup (1/4 L) of very fine sand, silt, and clay. Each sample was sieved at the sample site to remove material larger than 4 mm and was later resieved at the laboratory, where the minus-80-mesh (0.177-mm) fraction was saved.

Panned-concentrate samples were collected from 86 sites. Each panned-concentrate sample consisted of a composite of the coarser sediment fraction (coarser than the very fine sand, silt, and clay collected for the stream-sediment samples) taken from several places across the stream. At a few localities no coarse sediment fraction was present, so no sample was collected. Each panned-concentrate sample, consisting of 5 to 10 lbs of sediment, was seived through a minus-8-mesh (4-mm) aluminum screen at the sample site. The sample was resieved at the laboratory to reduce the volume of material to be processed; the minus-20-mesh (0.84-mm) fraction was retained. This fraction was processed further with a diagonal-deck concentrating table (similar to a Wilfley table[1]) to concentrate the heavy minerals. The heavy fraction was sieved, and the minus-35-mesh (0.5-mm) fraction was saved. This fraction was processed in bromoform to remove extraneous light minerals. The resultant heavy fraction was further split into magnetic and nonmagnetic components with a Franz separator[1]. Only the 1 ampere nonmagnetic component was analyzed.

Of the 86 panned-concentrate samples processed, 12 had sufficient material for both chemical analysis and mineral identification (table 1). After processing on the diagonal-deck concentrating table, the material for these 12 samples was split into two groups. The material in the group that was to be chemically analyzed was treated the same way as the other 74 samples. The remaining material was processed separately in bromoform. The resultant heavy fraction was split into magnetic and nonmagnetic fractions by a hand magnet. In this procedure, the resulting nonmagnetic fraction actually contains a minor amount of magnetic minerals. Individual grain mounts, consisting of a subsample of the nonmagnetic fraction, were prepared for each of the 12 samples. The grain mounts were examined and the minerals identified using a petrographic microscope. Similar mineral suites are present in each sample. The common minerals identified were tourmaline, zircon, garnet, rutile, apatite, hematite, barite, ilmenite, and sphene.

All samples were analyzed for 31 elements by semiquantitative emission spectroscopy (table 1). Values are reported in six steps per order of magnitude (0.1, 0.15, 0.2, 0.3, 0.5, 0.7, or factors of 10 of these numbers). Motooka and Grimes (1976) showed the precision of these values to be within one adjacent interval on each side of the reported value 83 percent of the time and within two adjacent intervals 96 percent of the time. All rock and stream-sediment samples were also analyzed for uranium using a fluorimetric extraction procedure (table 1).

[1]The use of trade names in this report does not imply endorsement by the U.S. Geological Survey.

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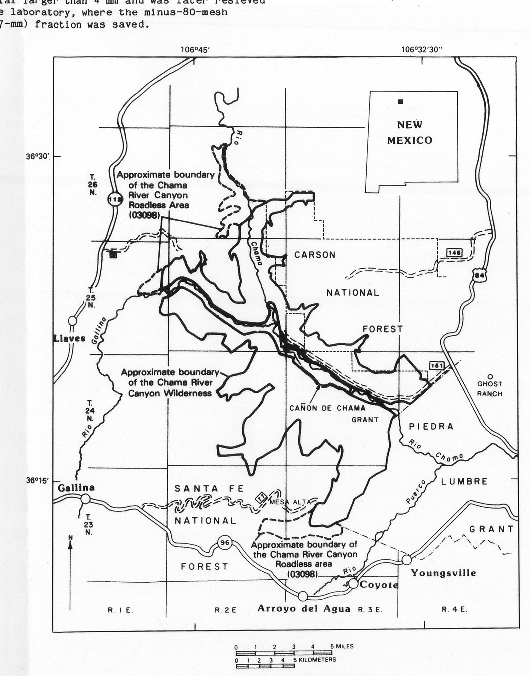

INDEX MAP SHOWING THE LOCATION OF THE CHAMA RIVER CANYON WILDERNESS AND ROADLESS AREA (03098), NORTHERN NEW MEXICO

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