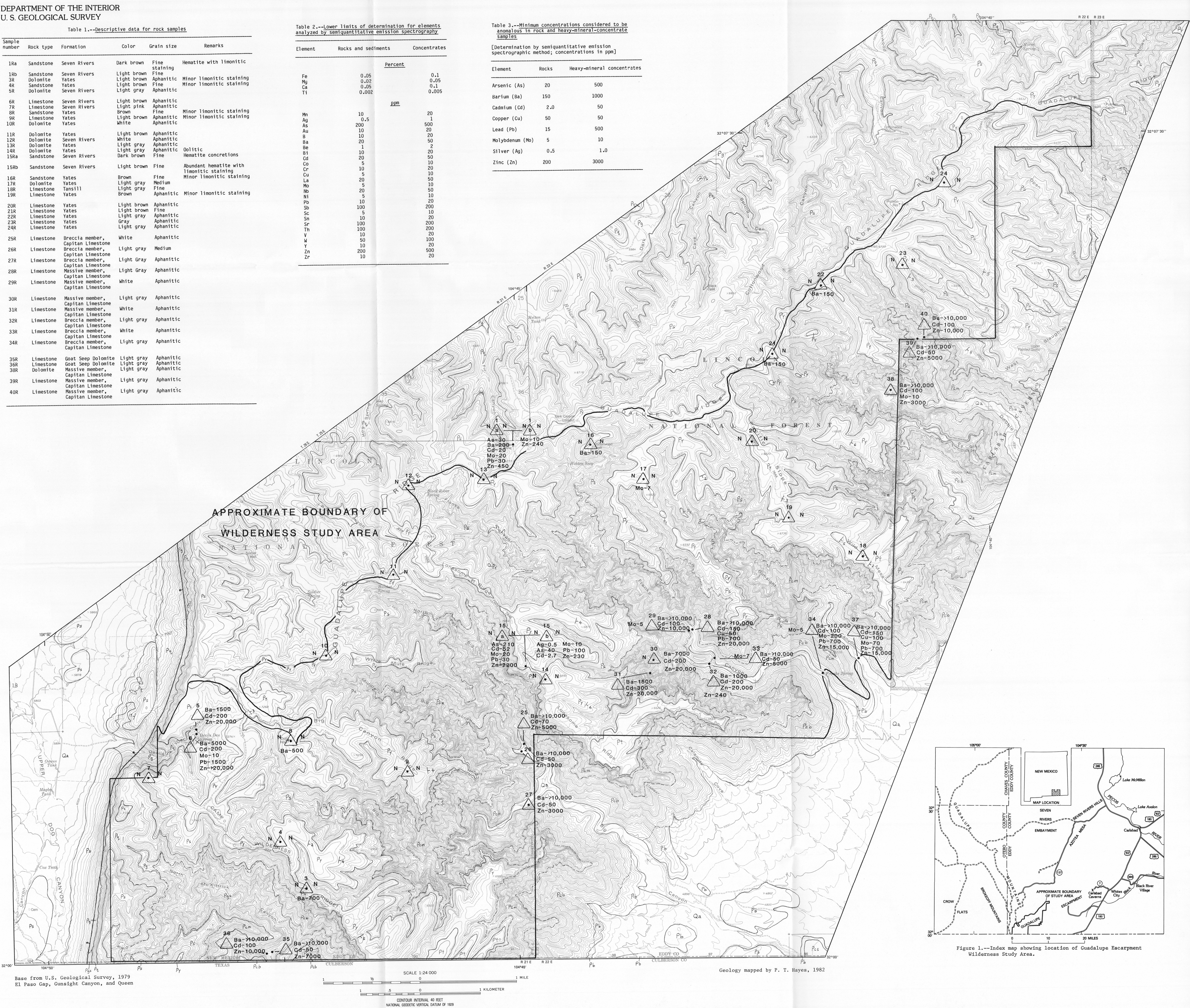


Table 1.--Descriptive data for rock samples					
Sample number	Rock type	Formation	Color	Grain size	Remarks
1Ra	Sandstone	Seven Rivers	Dark brown	Fine	Hematite with limonitic staining
1Rb	Sandstone	Seven Rivers	Light brown	Fine	
3R	Dolomite	Yates	Light brown	Aphanitic	Minor limonitic staining
4R	Sandstone	Yates	Light brown	Aphanitic	Minor limonitic staining
6R	Dolomite	Seven Rivers	Light gray	Aphanitic	
7R	Limestone	Seven Rivers	Light brown	Aphanitic	
8R	Sandstone	Yates	Brown	Fine	Minor limonitic staining
9R	Limestone	Yates	Light brown	Aphanitic	Minor limonitic staining
10R	Dolomite	Yates	White	Aphanitic	
11R	Dolomite	Yates	Light brown	Aphanitic	
12R	Dolomite	Seven Rivers	White	Aphanitic	
13R	Dolomite	Yates	Light gray	Aphanitic	
14R	Dolomite	Yates	Light gray	Aphanitic	
15Ra	Sandstone	Seven Rivers	Dark brown	Fine	Oolitic
15Rb	Sandstone	Seven Rivers	Light brown	Fine	Hematite concretions
16R	Sandstone	Yates	Brown	Fine	Abundant hematite with limonitic staining
17R	Dolomite	Yates	Light gray	Medium	Minor limonitic staining
18R	Limestone	Tansill	Light gray	Fine	Aphanitic
19R	Limestone	Yates	Brown	Aphanitic	Minor limonitic staining
20R	Limestone	Yates	Light brown	Aphanitic	
21R	Limestone	Yates	Light brown	Fine	
22R	Limestone	Yates	Light gray	Aphanitic	
23R	Limestone	Yates	Light gray	Aphanitic	
24R	Limestone	Yates	Light gray	Aphanitic	
25R	Limestone	Breccia member, Capitan Limestone	White	Aphanitic	
26R	Limestone	Breccia member, Capitan Limestone	Light gray	Medium	
27R	Limestone	Breccia member, Capitan Limestone	Light Gray	Aphanitic	
28R	Limestone	Massive member, Capitan Limestone	Light Gray	Aphanitic	
29R	Limestone	Massive member, Capitan Limestone	White	Aphanitic	
30R	Limestone	Massive member, Capitan Limestone	Light gray	Aphanitic	
31R	Limestone	Massive member, Capitan Limestone	White	Aphanitic	
32R	Limestone	Breccia member, Capitan Limestone	Light gray	Aphanitic	
33R	Limestone	Breccia member, Capitan Limestone	White	Aphanitic	
34R	Limestone	Breccia member, Capitan Limestone	Light gray	Aphanitic	
35R	Limestone	Goat Seep Dolomite	Light gray	Aphanitic	
36R	Limestone	Goat Seep Dolomite	Light gray	Aphanitic	
37R	Dolomite	Massive member, Capitan Limestone	Light gray	Aphanitic	
38R	Limestone	Massive member, Capitan Limestone	Light gray	Aphanitic	
40R	Limestone	Massive member, Capitan Limestone	Light gray	Aphanitic	

Table 2.--Lower limits of determination for elements anomalous in rock and heavy-mineral-concentrate samples			
Element	Rock and sediments	Concentrates	
		Percent	
Fe	0.05		0.1
Mg	0.02		0.05
Ca	0.05		0.1
Ti	0.02		0.05
		ppm	
Mn	10		1
Al	0.5		50
Ba	10		20
As	20		50
Be	1		10
Bi	10		20
Cd	5		10
Co	10		20
Cr	5		10
Cu	5		10
La	20		50
Mo	5		10
Nb	20		50
Pb	5		10
Sb	10		20
Sc	100		200
Se	5		10
Sn	10		20
Th	100		200
U	10		20
V	10		20
W	100		200
Zn	200		500
Zr	10		20

Table 3.--Minimum concentrations considered to be anomalous in rock and heavy-mineral-concentrate samples		
Element	Rock	Heavy-mineral concentrates
Arsenic (As)	20	500
Barium (Ba)	150	1000
Cadmium (Cd)	2.0	50
Copper (Cu)	50	50
Lead (Pb)	15	100
Molybdenum (Mo)	5	50
Silver (Ag)	0.5	1.0
Zinc (Zn)	200	3000



GEOCHEMICAL MAP OF THE GUADALUPE ESCARPMENT WILDERNESS STUDY AREA, EDDY COUNTY, NEW MEXICO

By
Thomas D. Light, James A. Domenico, and Steven M. Smith
1985

EXPLANATION FOR GEOLOGIC BASE

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

CORRELATION OF MAP UNITS

Unconformity

Qa } Holocene and Pleistocene } QUATERNARY

Pcs } Upper Permian } PERMIAN

Pcb } Lower Permian } PERMIAN

Pgs } Lower Permian } PERMIAN

DESCRIPTION OF MAP UNITS

(From Hayes and others, 1983)

Qa ALLUVIUM (QUATERNARY)--Poorly sorted, unconsolidated gravel, sand, and silt

Pcs CASTLE FORMATION (UPPER PERMIAN; OCHOANA)--Nonresistant, thinly laminated, brownish-gray weathering limestone

Pb BELL CANYON FORMATION (UPPER PERMIAN; GUADALUPIAN)--Mostly thin and irregularly bedded, dark-gray, finely bioclastic limestone and subinert, very thinly bedded quartzose siltstone. CAPITAN LIMESTONE (UPPER PERMIAN; GUADALUPIAN)

Pcm Massive member--Virtually unbedded, very light gray to yellowish-gray, fine-textured limestone that forms nearly vertical cliffs in canyon walls.

Pcb Breccia member--Brecciated limestone derived from massive member

Pt TANSILL FORMATION (UPPER PERMIAN; GUADALUPIAN)--Light-olive-gray weathering, yellowish-gray, generally bioclastic dolomite

Py YATES FORMATION (UPPER PERMIAN; GUADALUPIAN)--Coarse siltstone to very fine grained sandstone and yellowish-gray dolomite

Ps SEVEN RIVERS FORMATION (UPPER PERMIAN; GUADALUPIAN)--Yellowish-gray dolomite and a few very thin beds of siltstone

Pq QUEEN FORMATION (LOWER PERMIAN; GUADALUPIAN)--Dolomite, siltstone, and sandstone

Pg GRAYBURG FORMATION (LOWER PERMIAN; GUADALUPIAN)--Light-gray dolomite and very subordinate, very pale orange sandstone

Pgs GOAT SEEP DOLOMITE (LOWER PERMIAN; GUADALUPIAN)--Light-gray, massive, fine-textured to saccharoidal dolomite

CONTACT--Approximately located

LATERAL FACIES BOUNDARY--Approximately located

NORMAL FAULT--Ball and bar on downthrown side

EXPLANATION FOR GEOCHEMICAL DATA

SAMPLE LOCALITY SHOWING ANOMALOUS CONCENTRATIONS OF ELEMENTS--Top number is sample locality number. Remaining numbers give anomalous concentrations of elements; data to right of triangle give concentrations in heavy-mineral concentrates; data to left, in sieved sediments; data at bottom, rock samples. N. Indicates that a particular sample type was not available. No numbers on side of triangle indicates that none of the concentrations in that sample were considered to be anomalous.

WILDERNESS RELATED TO WILDERNESS

The Studies Act (Public Law 89-577, 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 values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Guadalupe Escarpment Wilderness Study Area in the Lincoln National Forest, Eddy County, N. Mex. The Guadalupe Escarpment Wilderness Study Area was established by Public Law 96-550, December 1980.

INTRODUCTION

During 1982, the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to evaluate the mineral resource potential of the Guadalupe Escarpment Wilderness Study Area. Field studies included geologic mapping, geochemical sampling, and a survey of known mines, prospects, and mineralized zones. This map presents the results of a geochemical survey of the area by the Geological Survey and complements the mineral resource assessment of the area by Hayes and others (1983).

The Guadalupe Escarpment Wilderness Study Area encompasses approximately 21,300 acres along Guadalupe Ridge in the southern end of the Guadalupe Mountains about 35 miles southwest of Carlsbad, N. Mex. (Fig. 1). The area trends northeasterly, is bounded on the south by the Texas State line and the northern boundary of Guadalupe Mountains National Park. The study area is bounded on the northeast by Carlsbad Caverns National Park. The area comprises several narrow, gently sloping mesas bounded by deeply incised canyons. Elevations range from 7,413 feet on Camp Wilderness Ridge to approximately 4,875 feet at Franks Spring. A rough jeep road along the northwest boundary of the study area can be reached by U.S. Forest Service roads from the northwest. The southeastern part of the study area can be approached via unimproved ranch roads leading off U.S. Highway 62-180.

GEOLOGIC SETTING

The Guadalupe Escarpment Wilderness Study Area lies northwest of the structurally low Delaware Basin and along the southern end of the Guadalupe Mountains uplift. Guadalupe Ridge, which defines the northwest boundary of the study area, is the crest of a gently folded, northeast-trending anticline. The area is underlain entirely by rocks of the Permian Guadalupian Series which consists of limestone and dolomite with thin lenses of interbedded siltstone and sandstone. The Capitan Limestone is divided into two members: the massive member (Hayes, 1964; reef facies of Newell and others, 1953) and the breccia member (Hayes, 1964; reef-talus facies of Newell and others, 1953). The massive member grades northward into carbonates of the Tansill facies, and Seven Rivers Formations. The older Goat Seep Dolomite is a light-gray, massive dolomite that grades northward into the Queen and Grayburg formations. Details of these facies changes are described by Hayes and others (1983).

Geological Survey Open-File Report 83-07, 18 p.

Newell, N. D., Rigby, J. K., Fischer, A. G., Whiteman, A. J., Hickox, J. E., and Bradley, J. S., 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico--a study in paleogeology. San Francisco, W. H. Freeman and Company, 236 p.

Taylor, S. R., 1964, Abundance of chemical elements in the continental crust: Geochimica et Cosmochimica Acta, v. 28, p. 1280-1281.

MISCELLANEOUS FIELD STUDIES
MAP MF-1560-B

SAMPLING AND SAMPLE PREPARATION

Geochemical rock and stream-sediment sampling was carried out during the spring of 1982. Access to the area was achieved by four-wheel drive vehicle and by foot.

Rock samples were collected at approximately 1-mi intervals along Guadalupe Ridge and along the northwest trending mesas throughout the area. Rock samples were also collected from outcrops near most of the stream-sediment sample localities. A total of 40 rock samples was collected from outcrops from 38 sites throughout the study area. No evidence of hydrothermal alteration was observed in any of the samples. A brief description of the rock samples is listed in table 1. All rock samples were crushed and pulverized to minus-150-mesh (0.10 mm) before chemical analysis.

Stream-sediment samples were collected from the active part of first- or second-order intermittent stream drainages at 18 sites. Two types of sediment samples were collected. A composite sample was collected across the active part of each drainage course at 17 of the sites, then sieved to minus-20-mesh (0.85 mm) and pulverized to minus-150-mesh (0.10 mm). The second stream-sediment sample consisted of a bulk sample to be panned for a heavy-mineral concentrate. The panned sample was further concentrated by liquid separation in bromoform (specific gravity 2.85). The magnetic fraction of the heavy-mineral concentrate was removed by magnetic separation on a Frantz Isodynamic Separator¹ set at a slope of 15°, a tilt of 10°, and a current of 0.6 ampere.

ANALYTICAL METHODS

All rock samples and both the sieved stream-sediment samples and the nonmagnetic fraction of the heavy-mineral concentrates were analyzed for 31 elements by a six-step semiquantitative emission spectrographic method (Grimes and Maranzino, 1968). The elements analyzed and their lower limits of determination are listed in table 2. Rock samples were also analyzed for zinc, cadmium, bismuth, antimony, and arsenic by atomic absorption spectrophotometry. Limestone and dolomite rock samples were split, and part of the sample was dissolved in dilute HCl. The insoluble residue was washed with distilled water, then analyzed by semiquantitative emission spectrography. All analytical data for samples from the Guadalupe Escarpment Wilderness Study Area were reported by Light and Domenico (1983).

GEOCHEMISTRY

Anomalous values from analytical data were determined from visual inspection of histogram plots and by comparison with elemental abundance in the earth's crust (Taylor, 1964). The concentration levels used to define anomalous values for elements in rock and heavy-mineral concentrate samples are listed in table 3. Sample localities and the anomalous concentrations for each sample are shown on the map.

Analytical data for rock and panned-concentrate samples revealed anomalous concentrations of metals that include arsenic, barium, cadmium, copper, lead, molybdenum, silver, and zinc (table 3). None of the analytical values for the insoluble residues of carbonate rocks were found to be anomalous, indicating that the anomalous concentrations of metals were derived from the sandstone units. Three sieved sediment samples from Franks Canyon each contained 5 or 7 parts per million (ppm) molybdenum. No other data from sieved sediment samples were considered to reflect anomalous concentrations of elements.

Anomalous concentrations of metals in rock samples were most pronounced at localities just north of the study area near the center of Guadalupe Ridge and on Lonesome Ridge near the center of the study area. Both samples were from an iron-stained sandstone from near the top of the Permian Seven Rivers Formation. The two samples from each site contained anomalous concentrations of arsenic, cadmium, molybdenum, lead, and zinc. Sample 18a also contained 200 ppm barium, and sample 15b contained 0.5 ppm silver. Anomalous concentrations of barium also occur in samples 3R, 8R, 16R, 21R, and 22R, all from the Yates Formation. Sample 17R, also from the Yates Formation on the ridge between Franks and Gunsight Canyons, contained 7 ppm molybdenum. Sample 32R, collected from an outcrop of the breccia member of the Capitan Limestone in a tributary to Franks Canyon in the southeast part of the study area, contained 240 ppm zinc.

All panned-concentrate samples contained barite and sphalerite, which produced anomalously high concentrations of barium (> 1000 ppm), cadmium (> 50 ppm), and zinc (> 3000 ppm). Barium concentrations in 13 of the 18 panned-concentrate samples were greater than 10,000 ppm, the upper limit of determination. Cadmium concentrations varied from 50 to 300 ppm. Zinc concentrations were at least 3000 ppm in all panned-concentrate samples, and 6 of the 18 samples contained > 20,000 ppm, the upper level of determination. In addition to this suite of elements having anomalous concentrations, several panned-concentrate samples also contained anomalously high concentrations of lead, molybdenum, or copper. Sample 6, from near Devils Den Spring in the western part of the area, contained 1500 ppm lead and 10 ppm molybdenum. Sample 28 contained 700 ppm lead and 50 ppm copper. Sample 34 from Franks Canyon contained 700 ppm lead and 200 ppm molybdenum. Sample 37 from Gunsight Canyon contained 700 ppm lead, 100 ppm copper, and 70 ppm molybdenum. Sample 38 from Double Canyon contained 10 ppm molybdenum.

CONCLUSIONS

The association of anomalously high concentrations of barium, zinc, cadmium, lead, molybdenum, and arsenic suggests that an enriched suite of elements is present in the Guadalupe Escarpment Wilderness Study Area. The distribution and occurrence of anomalous concentrations of elements in rock samples indicate that the iron-stained sandstone unit near the top of the Permian Seven Rivers Formation has served to concentrate metals. This sandstone represents a zone of high permeability that controlled the migration of weakly mineralized epigenetic fluids. Although the sandstone unit only covers a relatively small part of the area, the anomalous concentrations of elements in the sandstone are well defined as a result of the anomaly enhancement capabilities of heavy-mineral concentrates.

1 The use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

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