UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

LITHOLOGY AND LITHIUM CONTENT OF SEDIMENTS IN BASINS SURROUNDING CLAYTON VALLEY, ESMERALDA AND NYE COUNTIES, NEVADA

By
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Open-File Report 81-962
1981

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LITHOLOGY AND LITHIUM CONTENT OF SEDIMENTS IN BASINS SURROUNDING CLAYTON VALLEY, ESMERALDA AND NYE COUNTIES, NEVADA

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Introduction

The following pages are the lithologic and lithium logs of core drilled in the valleys adjacent to Clayton Valley, Nevada. The drilling was done to determine if rock geochemistry of these adjacent valleys could clarify the origins and geochemistry of Clayton Valley, which contains a commercial lithium brine field.

Drilling was performed in September 1979, under terms of an interagency cooperative agreement with the Division of Energy Storage Systems and the Divisions of Uranium Resources and Enrichment of the U.S. Department of Energy. Chemical analyses were performed by the U.S. Geological Survey, Denver, Colorado.

Occupying depressions in the Basin and Range physiographic province, Alkali Valley, Big Smokey Valley, Fish Lake Valley, Mud Lake, and Stonewall Flat are closed basins peripheral to Clayton Valley. Anomalous amounts of lithium are present in the clays and brines of Clayton Valley (Kunasz, 1974), and drilling was done in the adjacent valleys (fig. 1) having a similar geologic history (Vine, 1980). Present topography of Clayton Valley and the surrounding area was mostly established by late Tertiary time, but faulting has continued to the present, uplifting some parts of the original basins hundreds of feet (Turner, 1900).

These valleys may have held Pleistocene lakes (Meinzer, 1922), independent of one another, or the lakes possible may have been connected (Turner, 1900). Though the present playas maintain an individual identity as evidenced by their varied lithologies, there may be active movement of ground water from the topographically high valleys of Alkali, Big Smokey, Fish Lake, Mud Lake, and Stonewall Flat to the topographic low of Clayton Valley (Rush and others, 1971). This movement may be a cause for the increased Li concentration in the brines of Clayton Valley.

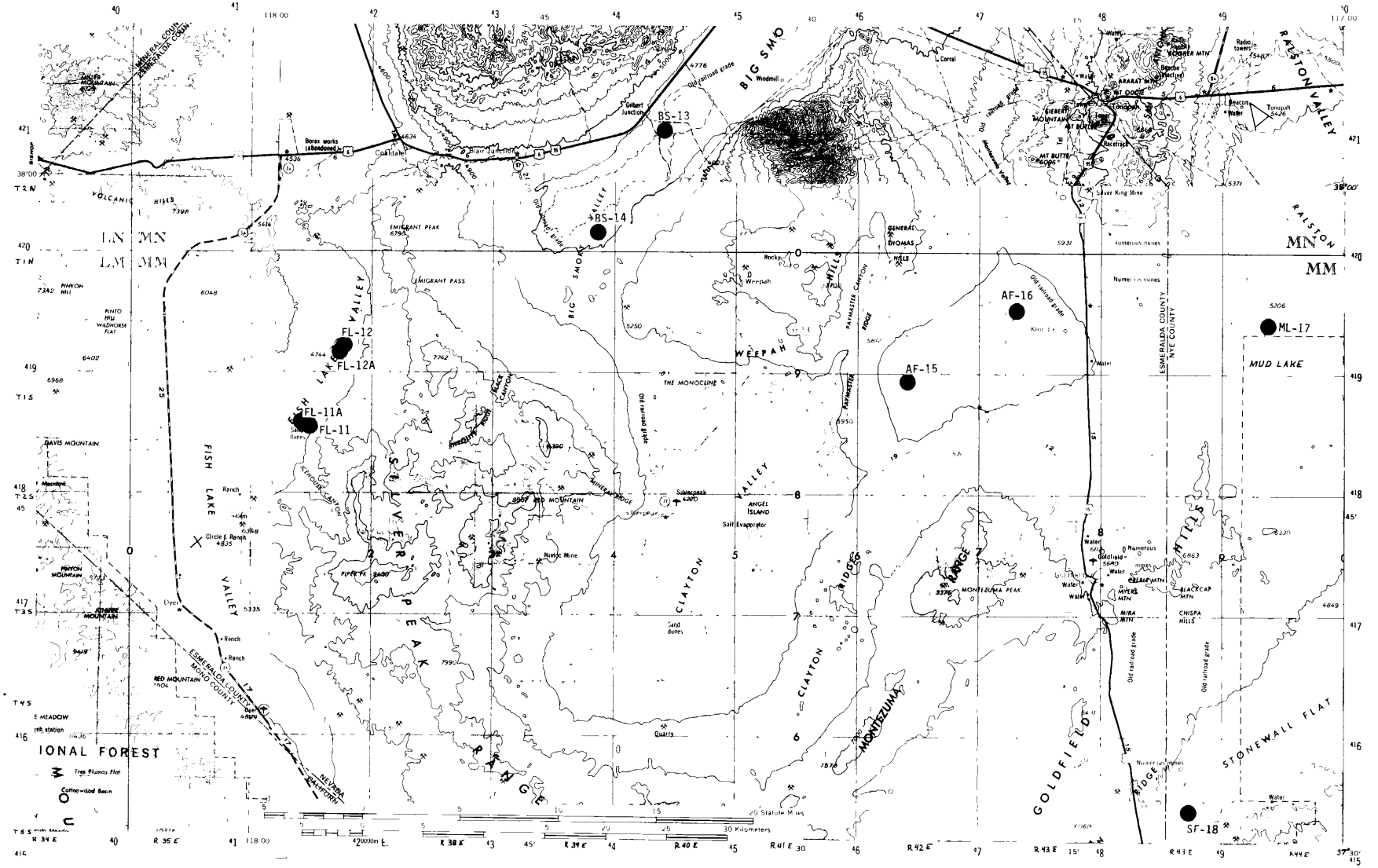

Figure 1.--Index map of a part of Esmeralda and Nye Counties, Nevada, showing locations of drill sites. Reduction from U.S. Geological Survey, Goldfield (1954), and Tonopah (1956) quadrangles, 1:250,000.

Alkali Valley

Alkali Valley is a closed basin bounded by the Weepah Hills to the west, Clayton Ridge and Montezuma Range to the south, Mud Lake and northern Goldfield Hills to the east, and the San Antonio Mountains and Montezuma Valley to the north. A playa approximately 5 miles long and 1 mile wide occupying about 5.5 miles^2 is in the lowest point of the valley. Two drill sites are in the valley; AF-15 is on the barren southern playa surface at lat. 37°51' N. and long. 117°24' W. AF-16 is in the northeast part of the valley on a pediment slope, at lat. 37°54' N. and long. 117°18' W. by a power line road.

AF-15 penetrated to a depth of 675 feet encountering mostly clay to 475 feet then tuffaceous clay, then entirely tuff by hole bottom (fig. 2).

A lithium value of 727 ppm parts per million was found at 280 feet in a calcareous clay; this is the highest lithium value found in the test holes. Lithium values in the sediments ranged from 42 ppm to 727 ppm and averaged 258.1 ppm for 139 samples analyzed. Dissolved lithium in a ground water ranged from 290 ppb parts per billion at 675 feet to 380 ppb at 435 feet (Asher-Bolinder and others, 1980).

AF-16 penetrated to a depth of 515 feet. Sediments were gravel and muddy gravel to 340 feet grading to mud at hole bottom (fig. 3).

Lithium values in sediments ranged from 24 ppm to 240 ppm, averaging of 83.6 ppm for 72 samples analyzed. Dissolved lithium in ground water ranged from 180 ppb at 100 feet to 490 ppb at 515 feet (Asher-Bolinder and others, 1980).

Big Smokey Valley

The playa in the southern end of Big Smokey Valley, is approximately 2 miles wide and 9 miles long. The playa, covering about 17 miles^2 is surrounded by Lone Mountain and the Weepah Hills to the east, Clayton Valley and the Silver Peak Range to the south, Silver Peak Range and Columbus Salt Marsh to the west, and the Monte Cristo Range and the expanse of Big Smokey Valley to the North.

Two holes were drilled in the playa depression; BS-13 near a power line road just outside the northeast part of the playa itself at lat. 38°02' N. and long. 117°37' W. BS-14 is southwest of the playa at lat. 37°57' N. and long. 117°42' W.

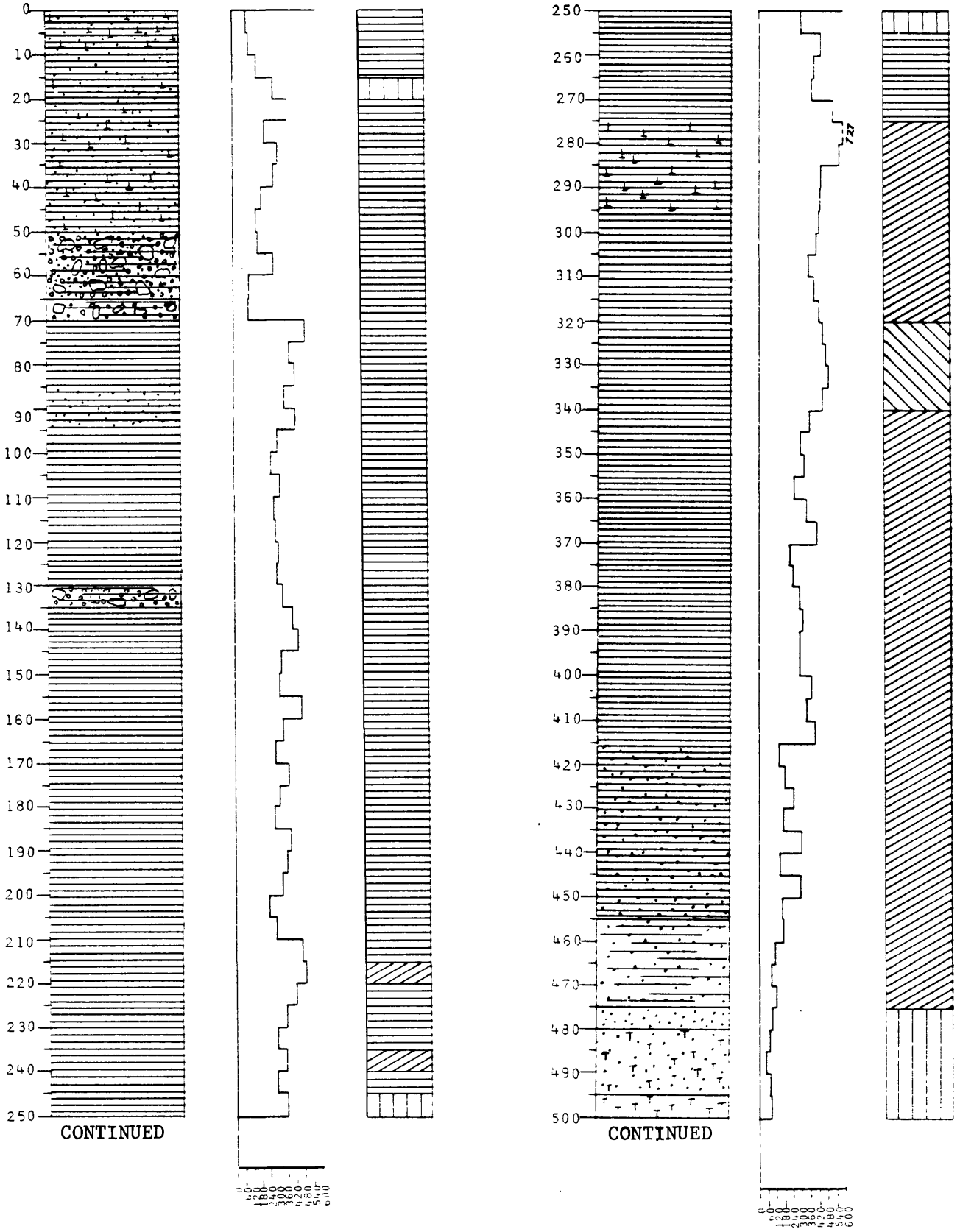

Figure 2.--Lithologic log in feet, lithium concentration log in parts per million, and color log for sediments in AF-15

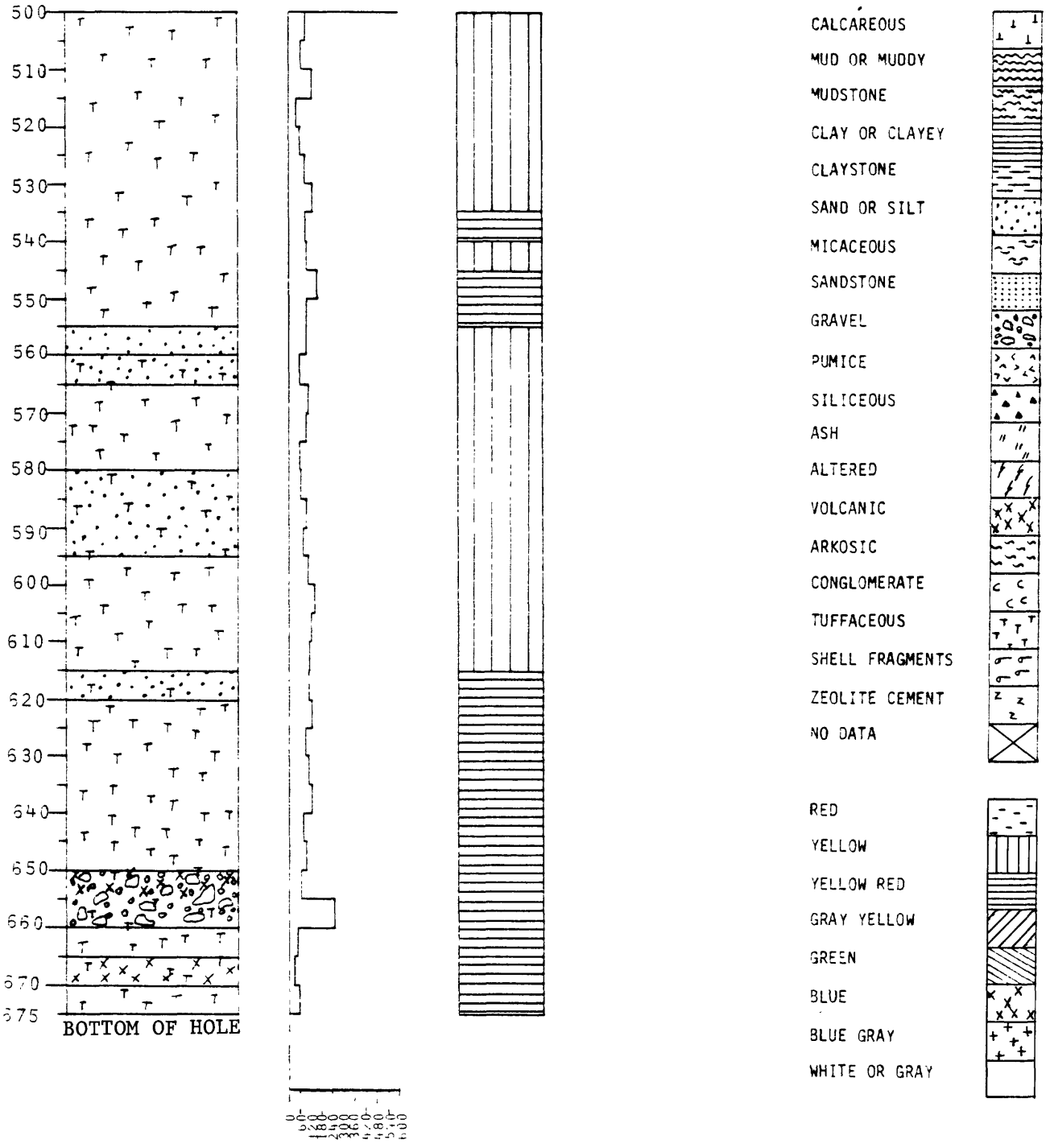

Figure 2.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments in AF-15.

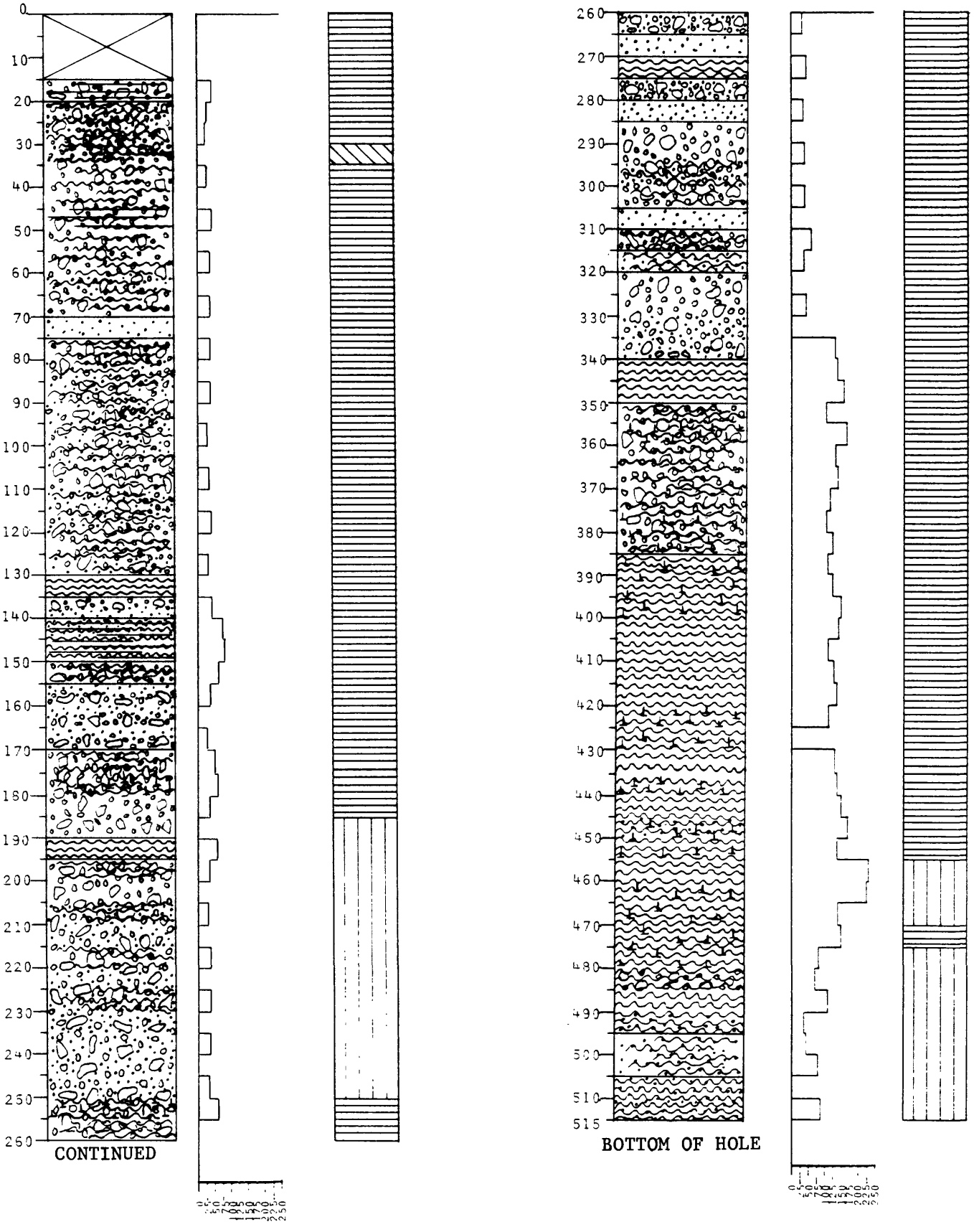

Figure 3.--Lithologic log in feet, lithium concentration log in parts per million, and color log for sediments in AF-16

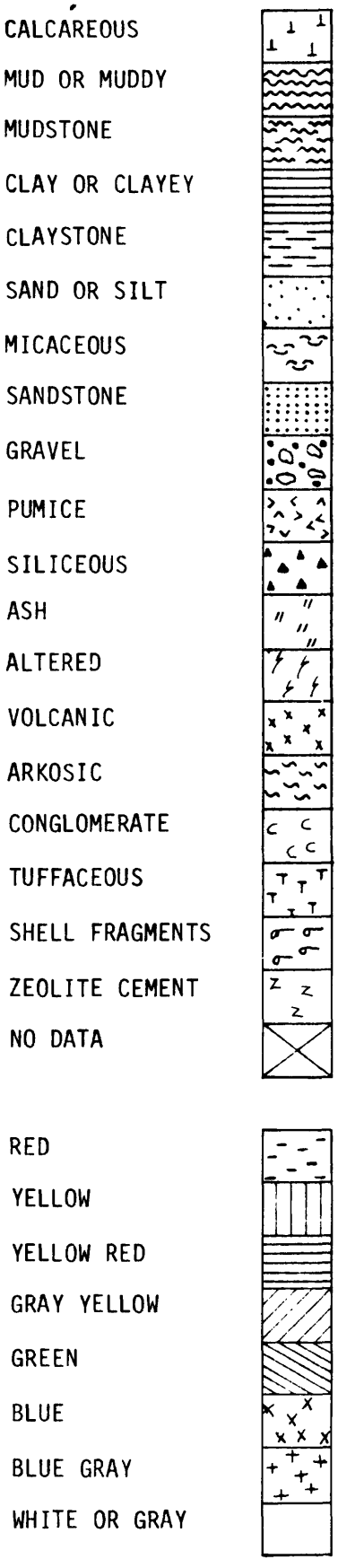

Figure 3.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments in AF-16.

BS-13 terminated at 675 feet in a calcareous mudstone. The sediments penetrated were mostly calcareous mud, and some beds of sand and clay (fig. 4). Lithium values ranged from 48 ppm to 364 ppm and averaged 160.6 ppm for 117 samples analyzed. Dissolved lithium in ground waters ranged from 100 ppb at 495 feet to 1,700 ppb at 395 feet (Asher-Bolinder and others, 1980).

BS-14 terminated at 215 feet in muddy gravel. The sediments are mostly gravel with some beds of clay or mud (fig. 5). Lithium values of the sediments ranged from 40 ppm to 287 ppm and averaged 150.6 ppm for 12 samples analyzed. Dissolved lithium in ground water went from 820 ppb at 195 feet to 1,300 ppb at 135 feet (Asher-Bolinder and others, 1980).

Fish Lake Valley

Fish Lake Valley is cresent shaped with a playa in the northern end. The playa is approximately 1.5 miles wide and 3.5 miles long and 3 $miles^2$ in area. The playa is surrounded by the Silver Peak Range to the east and south, the expanse of Fish Lake Valley, the Volcanic Hills and White Mountains to the west, and Columbus Salt Marsh to the north.

Four drill sites were chosen in the playa depression; FL-11 is about 3 miles south of the playa itself at lat. 37°49' N. and long. 117°58' W.; FL-11a is about 1,500 feet to the west of FL-11. FL-12 is on the southeastern edge of the playa at lat. 37°52' N. and long. 117°56' W.; FL-12a is located about 40 feet south of FL-12.

FL-11 was terminated at 235 feet due to drill rig problems. Sediments penetrated were mostly calcareous clays (fig. 6). Lithium values of the sediments ranged from 9 ppm to 99 ppm, and averaged 52.3 ppm for 45 samples analyzed. One ground water determination for dissolved lithium was made; and yielded a value of 30 ppb at 155 feet (Asher-Bolinder and others, 1980).

FL-11a terminated at 450 feet in a sandy clay after penetrating mostly clay and some beds of gravel or sand (fig. 7). Lithium values for the sediments ranged from 10 ppm to 115 ppm and averaged 61.7 ppm for 67 samples analyzed. Dissolved lithium in ground water went from 160 ppb at 435 feet to 21,000 ppb at 55 feet (Asher-Bolinder and others, 1980).

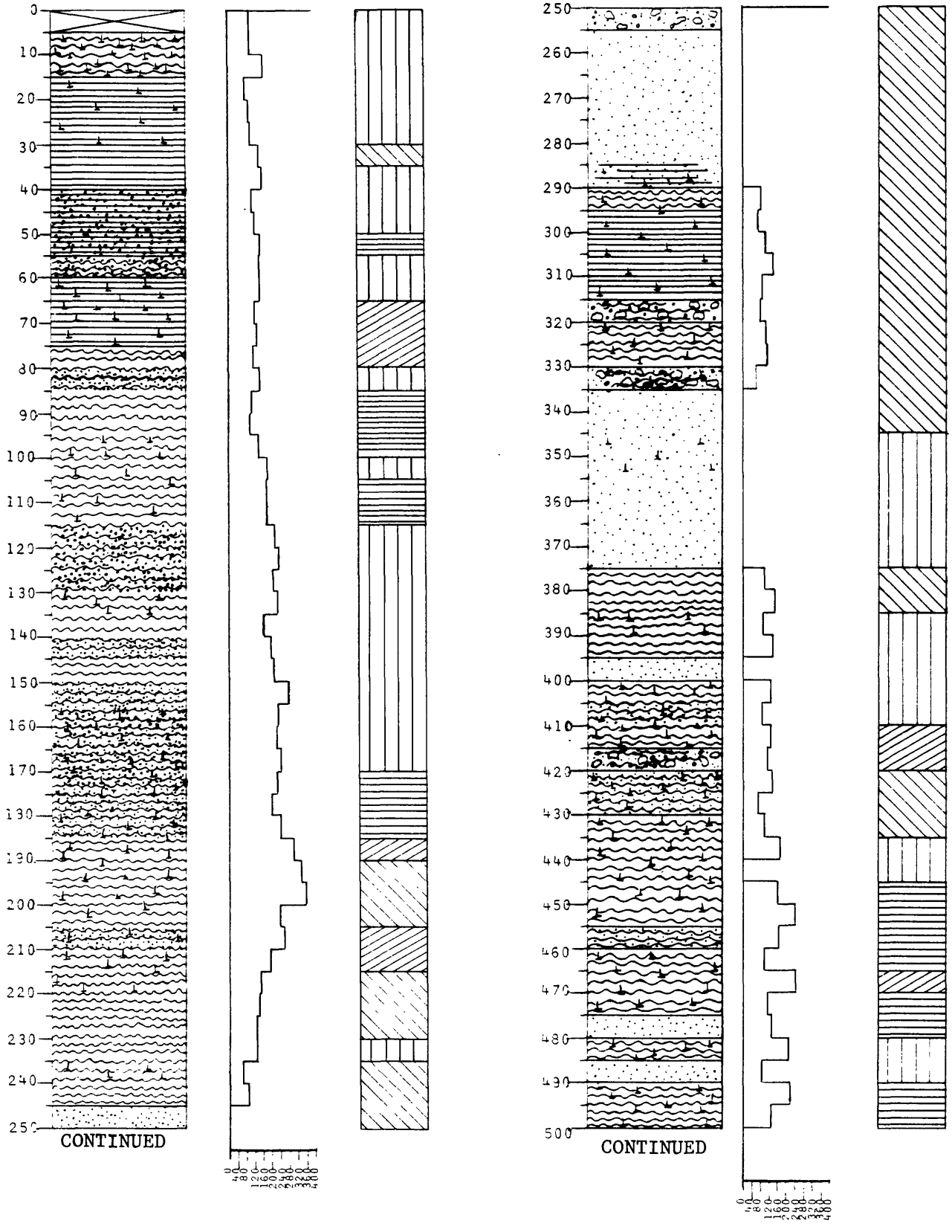

Figure 4.--Lithologic log in feet, lithium concentration log in parts per million, and color log for sediments in BS-13

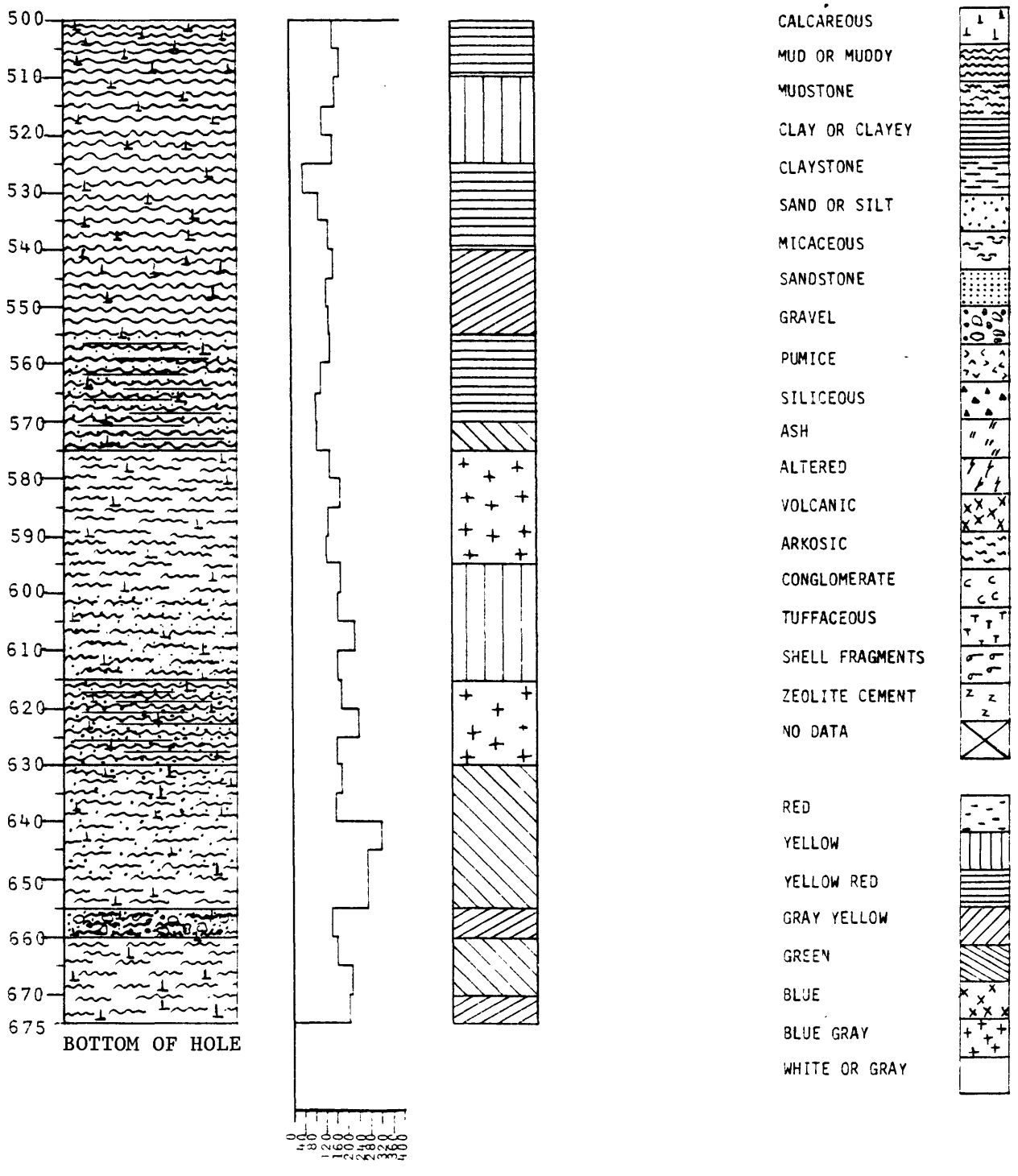

Figure 4.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments in BS-13.

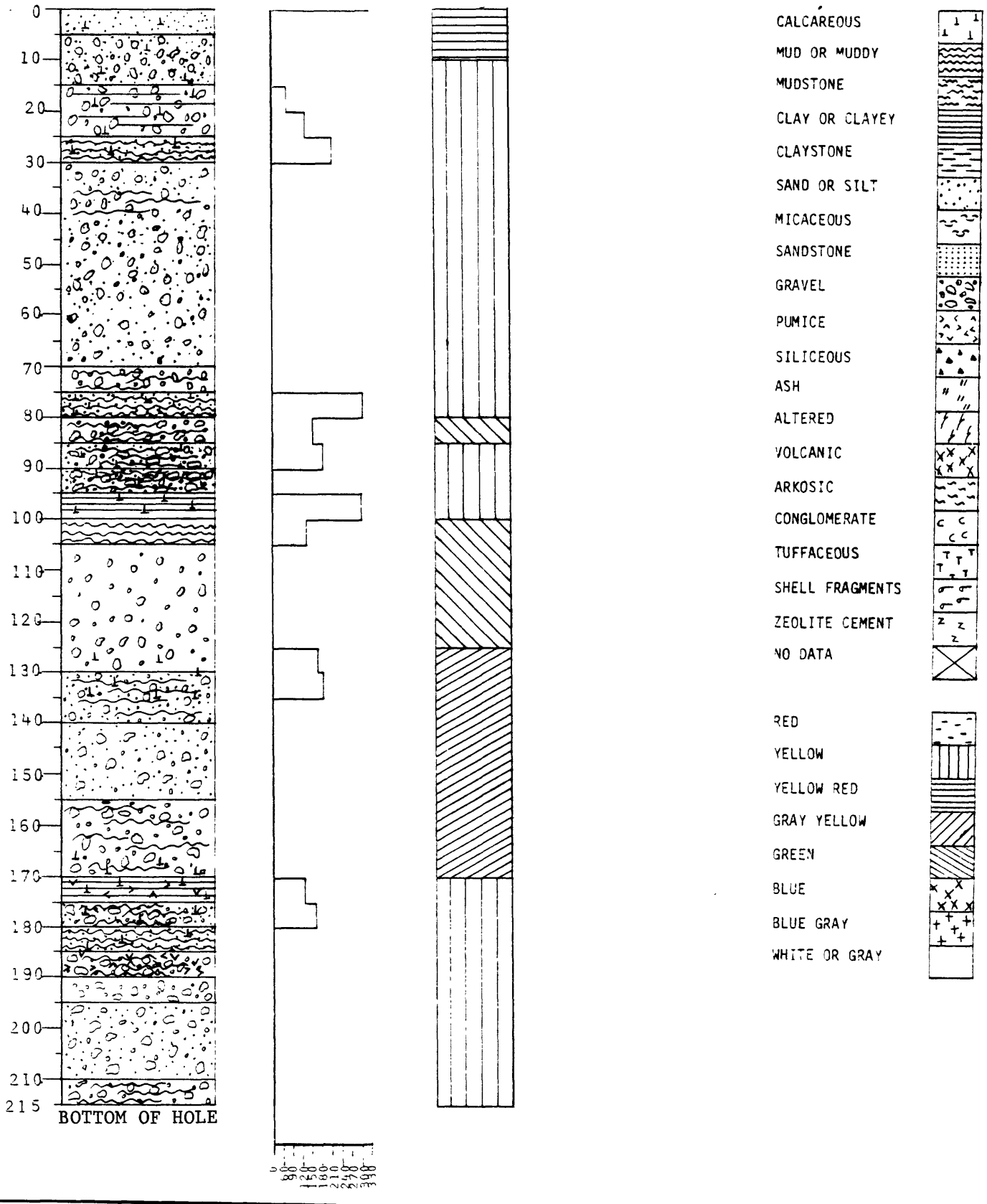

Figure 5.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments in BS-14.

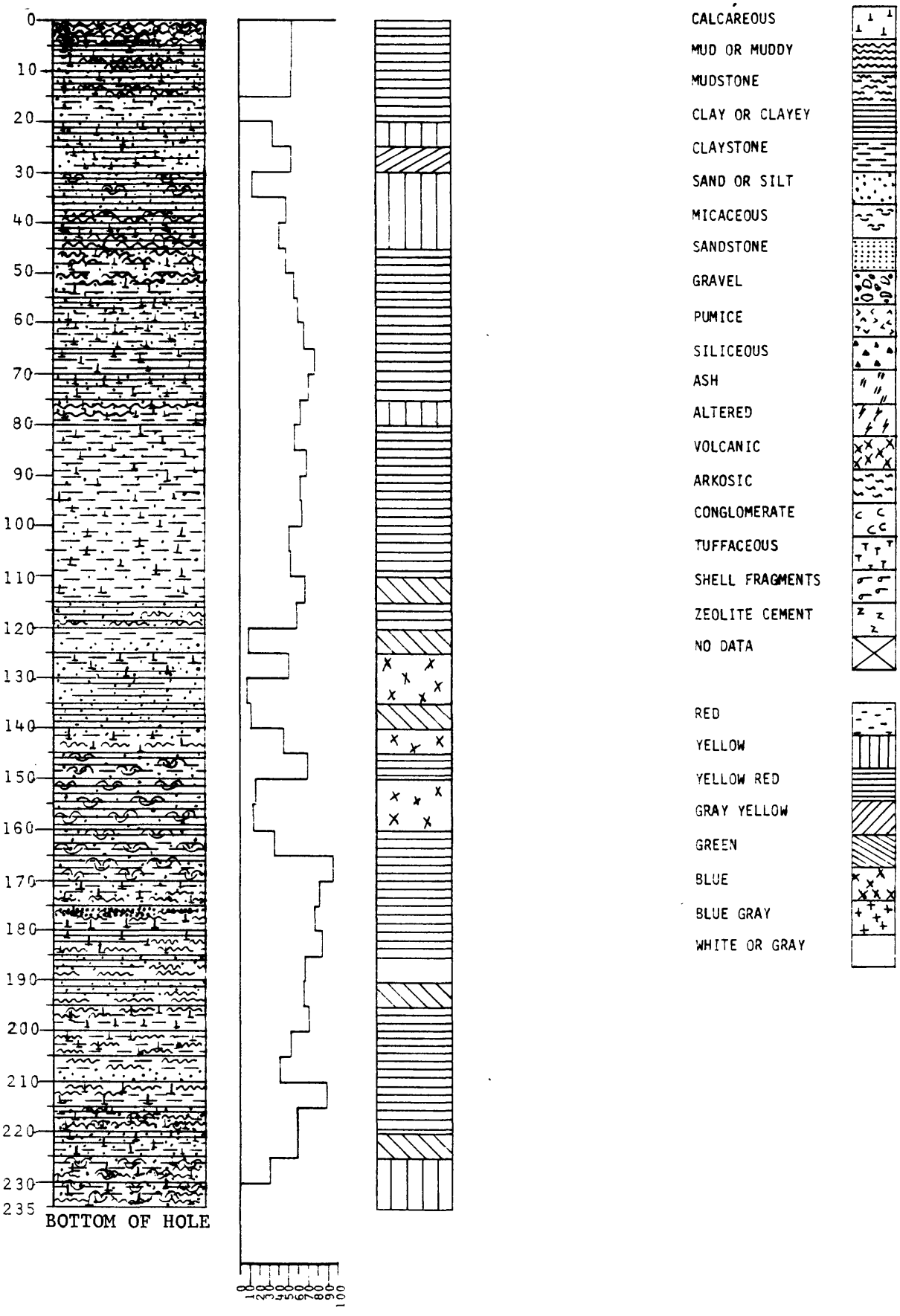

Figure 6.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments in FL-11.

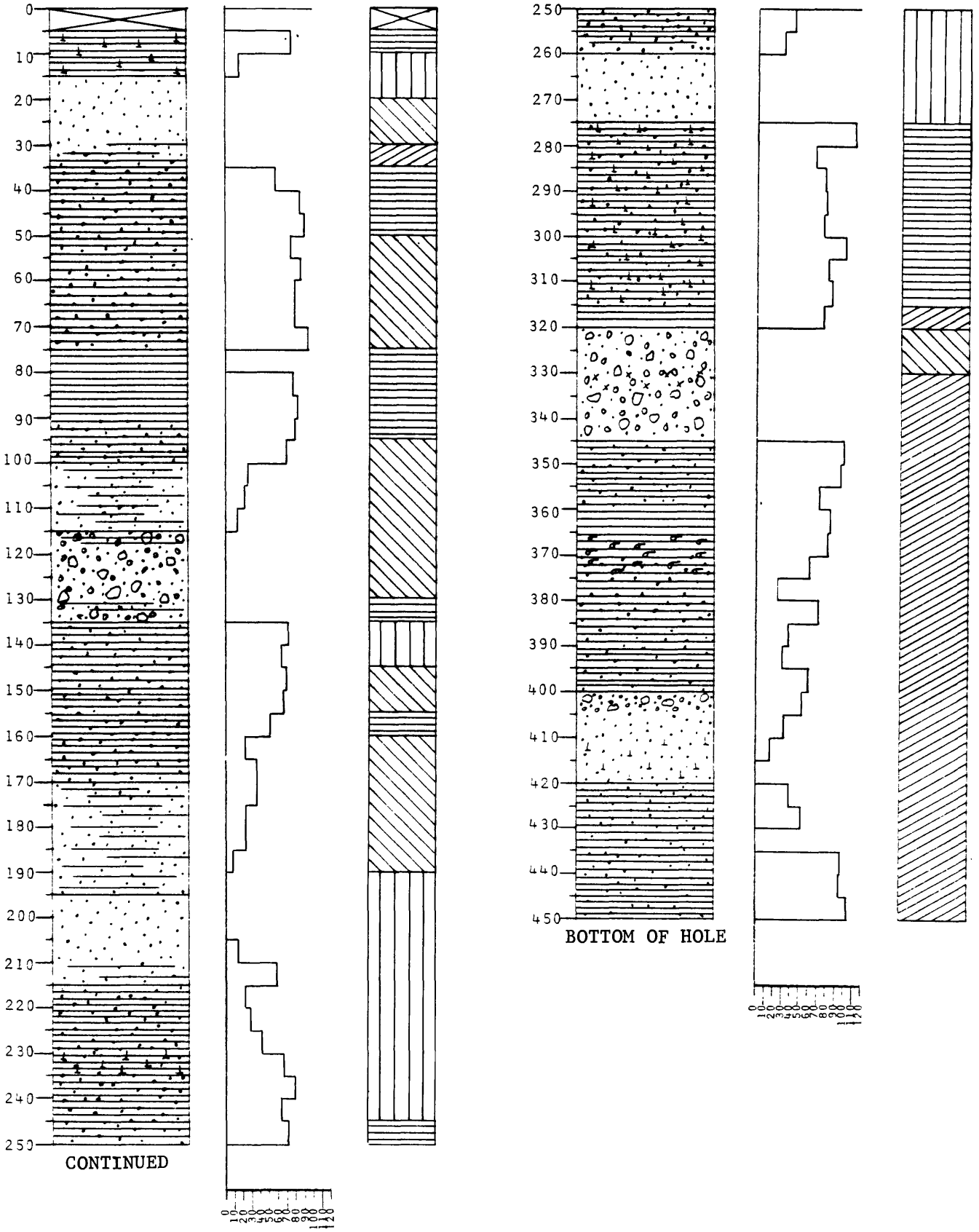

Figure 7.--lithologic log in feet, lithium concentration log in parts per million, and color log for sediments in FL-11a

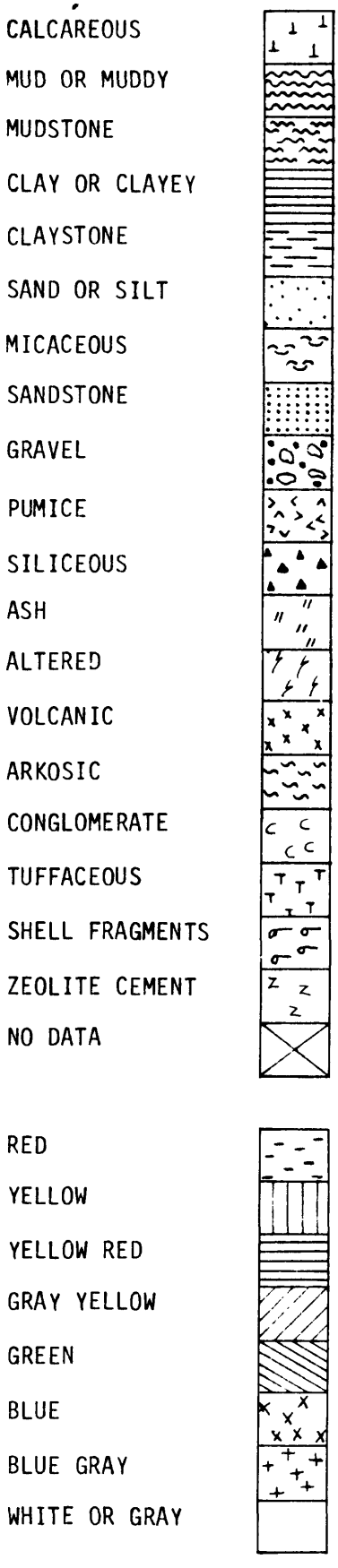

Figure 7.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments in FL-11a.

FL-12 was terminated at 155 feet in a clayey gravel due to drill rig problems. On the basis of salvaged samples, most sediments penetrated were mud or clay, and some gravel beds (fig. 8). Lithium values of the sediments ranged from 65 ppm to 240 ppm and averaged 139.6 ppm for 11 samples analyzed. One ground-water sample taken at 115 feet was analyzed and found to contain 5,700 ppb dissolved lithium (Asher-Bolinder and others, 1980).

FL-12a penetrated to a depth of 320 feet terminating in clayey gravel. Sediments penetrated were clay, gravel, or clayey gravel (fig. 9). Lithium values for the sediments ranged from 30 ppm to 409 ppm and averaged 135.9 for 27 samples analyzed. The highest lithium value for the holes drilled in Fish Lake Valley was 409 ppm at 260 feet in FL-12a. Dissolved lithium in ground water ranged from 420 ppb at 155 feet to 890 ppb at 135 feet (Asher-Bolinder and others, 1980).

Additional analyses were done on 29 samples from FL-11a to determine fluorine, thorium, and uranium, and boron concentrations (table 1). It was found that fluorine was somewhat proportional to lithium concentrations from the same sediments. Uranium was not proportional to either fluorine or lithium.

Mud Lake

Mud Lake playa occupies a depression in the southern end of Ralston Valley. The playa is approximately 5 miles wide and 5 miles long, and is about 25 miles^2 in area. The playa is bounded by the Cactus Range and Monitor Hills to the east, Goldfield Hills to the south, Alkali Valley to the west, and the expanse of Ralston Valley to the north.

Hole ML-17 is on the northern edge of the playa at lat. 37°54' N. long. 117°04' W. ML-17 penetrated mostly sand and an occasional layer of clay, terminating in sandstone at 275 feet (fig. 10). Lithium values of the sediments ranged from 24 ppm to 75 ppm and averaged 33.5 ppm for 28 samples analyzed.

Stonewall Flat

Located in the western part of the basin, the playa is approximately 0.5 miles wide and 3 miles long, and is about 1.5 miles^2 in area. The playa is bounded by the expanse of Stonewall Flat to the east, Stonewall Mountain to the south, Jackson Ridge to the west, and Goldfield Hills to the north.

The drill site, SF-18 is in the west-central part of the playa at lat. 37°32' N. long. 117°08' W. SF-18 penetrated mostly gravel and some beds of mud and sand, terminating in muddy gravel at 250 feet (fig. 11). Lithium values for the sediments ranged from 3 ppm to 121 ppm and averaged 33.9 ppm for 90 samples analyzed. One ground-water sample was taken at 455 feet and was found to contain 160 ppb dissolved lithium.

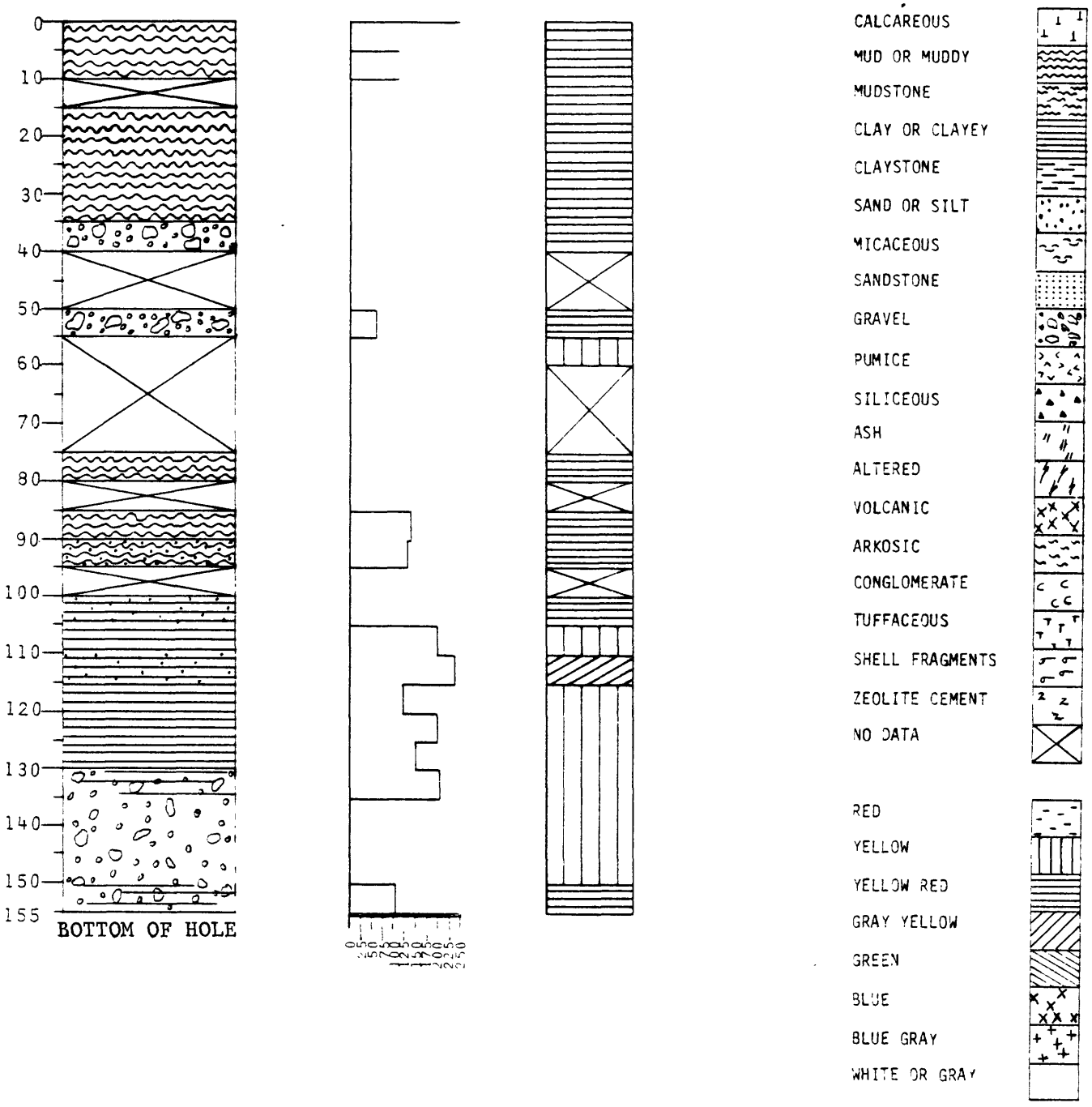

Figure 8.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments penetrated in FL-12

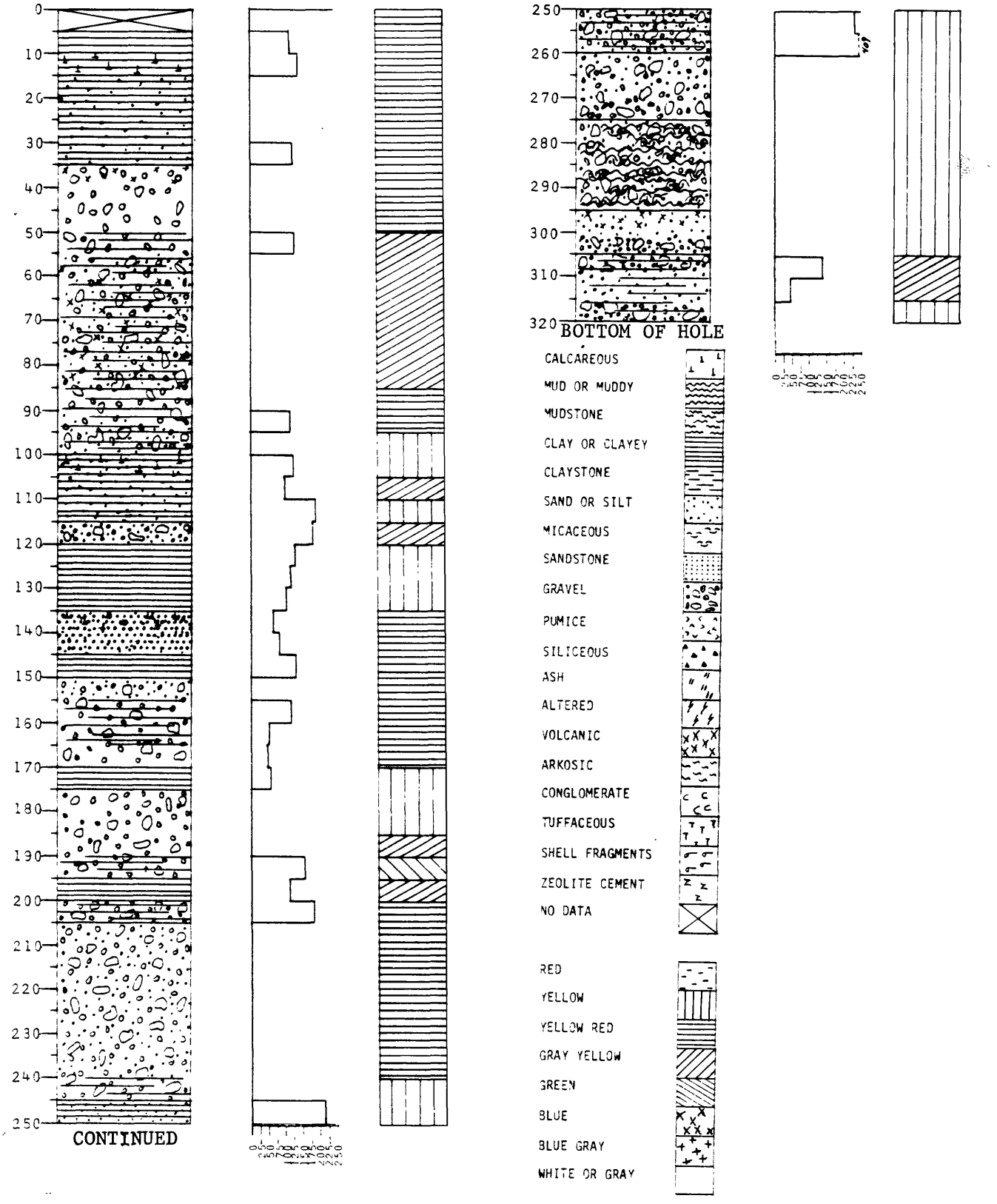

Figure 9.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments penetrated in FL-12a.

Table 1.--Analyses of selected samples from drill hole FL-11a Fish Lake Valley, Nevada

[Analysts R. Bies, M. Coughlin, B. A. Keaten, S. Laster, F. E. Lichte, F. M. Lumon, H. T. Millard, Jr., F. D. Newman, J. A. Tomas, Analytical Laboratories, U.S. Geological Survey. The last 2 digits of the field number designate depth.]

Field no.	Th,ppm	U,ppm	Th/U	F, percent	B,ppm	Sample description
FL11A-15	6.7	16.9	0.40	0.21	100	Brown to olive clay
FL11A-25	8.72	2.58	3.38	.02	16	Green-gray sand
FL11A-35	11.0	2.95	3.71	.05	19	Sand and Green-gray clay
FL11A-40	18.6	12.7	1.47	.12	96	Pale-brown clay
FL11A-45	19.0	11.5	1.65	.11	110	Pale-brown clay
FL11A-50	22.3	10.9	2.03	.11	120	Pale-brown, green-gray clay
FL11A-55	21.5	11.2	1.92	.13	120	Do.
FL11A-60	23.8	12.6	1.89	.12	130	Do.
FL11A-95	27.0	5.12	5.28	.13	84	Green-gray, yellow-brown clay
FL11A-100	29.4	5.69	5.17	.14	74	As above but sandy
FL11A-105	10.6	2.67	3.98	.03	30	Coarse sand and some clay
FL11A-110	10.3	3.67	2.81	.02	24	Do.
FL11A-115	8.28	2.57	3.22	.02	22	Do.
FL11A-120	6.65	2.68	2.48	.02	23	Sand, gravel, some green clay
FL11A-135	11.0	2.98	3.69	.04	31	Sand, pale-brown clay
FL11A-140	22.4	5.61	3.99	.12	60	Sandy olive clay
FL11A-300	20.2	6.59	3.07	.11	98	Yellow-brown clay
FL11A-310	22.4	7.23	3.09	.13	110	Do.
FL11A-320	21.5	5.42	3.97	.14	93	Green-gray clay
FL11a-325	4.3	8.80	.49	.13	10	Gray-green gravel and sand
FL11A-330	4.5	9.70	.46	.01	8	Do.
FL11A-335	4.4	9.05	.49	.02	10	As above with volcanic lithics
FL11A-350	20.2	7.46	2.70	.12	130	Gray-green sandy clay
FL11A-355	23.3	7.28	3.20	.13	140	Do.
FL11A-425	19.4	6.35	3.06	.13	130	Do.
FL11A-430	9.52	3.30	2.89	.05	47	Do.
FL11A-435	19.7	6.83	2.88	.13	120	Do.
FL11A-440	19.0	7.73	2.46	.11	120	Do.
FL11A-445	19.1	6.15	3.10	.10	110	Gray-green and light-brown clay

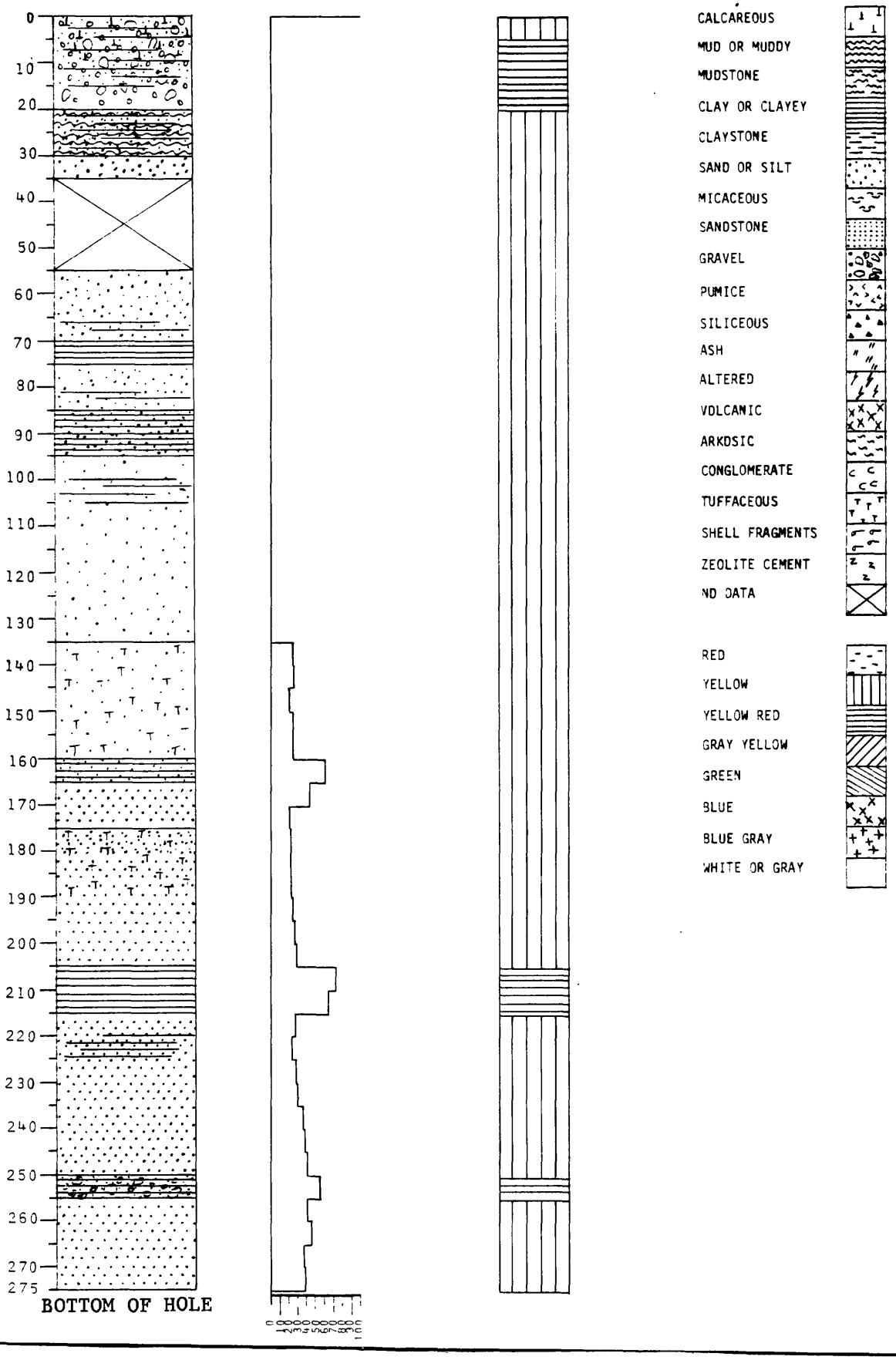

Figure 10.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments penetrated in ML-17.

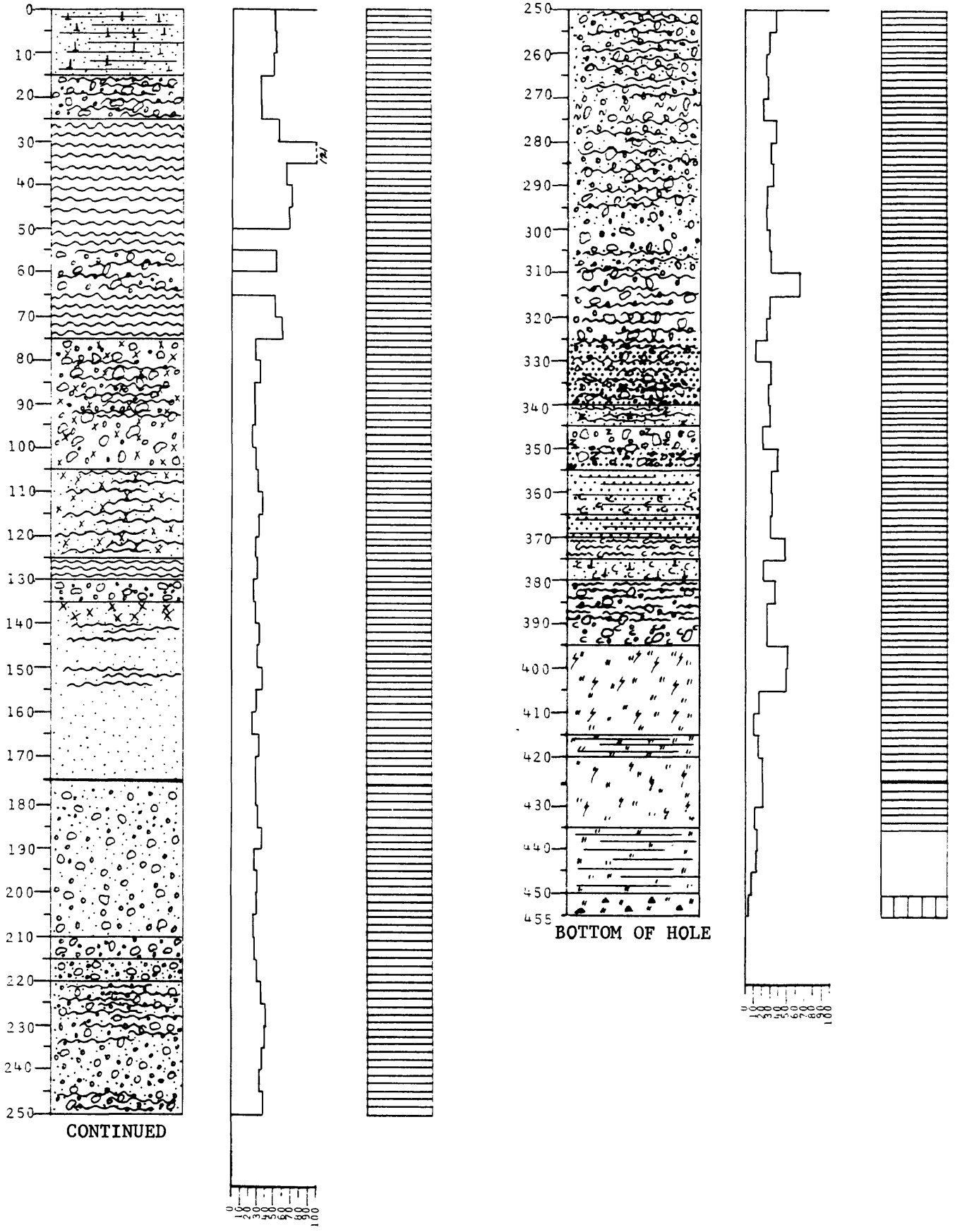

Figure 11.--Lithologic log in feet, lithium concentration log in parts per million, and color log for sediments in SF-18

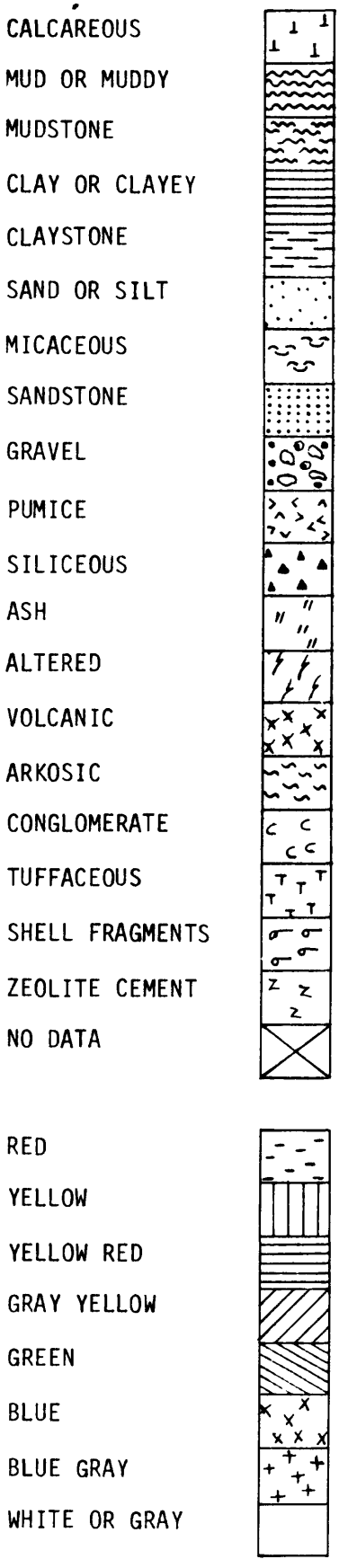

Figure 11.--Lithologic log in feet, lithium concentration log in ppm, and color log for sediments penetrated in SF-18.

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