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Results of the First Western Task Force Round Robin Soil and Overburden Analysis Program

By

R. C. Severson and Scott E. Fisher, Jr.

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INTRODUCTION

Regulatory guidelines for surface mining require the assessment of various physical and chemical properties of soil and overburden-spoil materials before mining, and minesoil and regraded spoil after mining. The list of properties, or parameters, that are required to evaluate suitability of materials is not consistent among regulatory agencies from all western states, or the federal Office of Surface Mining. In addition, the analytical requirements within each state may differ for soil before mining, redistributed soil after mining, and overburden material. The parameters requested in this First Western Task Force Round Robin Soil and Overburden Analysis Program may, or may not, be required by each state for each type of material. Many of the requested parameters are, however, required by each state for all types of materials listed above.

Seventeen laboratories participated in this round robin analysis program.* The participating laboratories and laboratories expressing an interest in participating in future programs are listed in the appendix (table A1). The parameters that were requested along with the suggested procedures are also listed in the appendix (table A2).

Each laboratory was asked to respond to a questionnaire (reproduced in the appendix as table A3). A summary of the workload information is presented as figure A1 in the appendix. Responses indicate that the mining industry supplies most of the annual workload to a majority of the responding laboratories. For only two laboratories 80-100% of the workload is research oriented, while for the majority of the laboratories it represents less than 20% of their activity. Plant and water samples represent a small fraction of the effort of a majority of laboratories, while soil and overburden samples show no distinct workload trend.

The results of the topics-of-interest survey are reported in table A4 of the appendix. If importance can be associated with the number of laboratories reporting topics being "of interest," then methods, correlation among methods, and analytical problems are of most importance to a majority of the reporting laboratories. Of least importance are geobotanical data, drilling methods, and drilling mud composition. Results of these surveys will be presented at the American Society for Surface Mining and Reclamation Meeting in Denver, Colorado, in October of 1985.

The remainder of this report is a presentation of the data obtained from the first round robin. No statistical tests have been applied to the data because of the small number of samples (n of 17 or less), and because of the differences in methods used for each parameter by the participating laboratories.

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*A round robin analysis program is an informal, intralaboratory comparison of analytical precision based on analysis of uncertified sample splits.

DESCRIPTION OF SAMPLES

Samples were provided by Roger Pasch of Intermountain Laboratories in Sheridan, Wyoming. The two overburden samples consisted of materials composited from a variety of overburden samples from the western United States and represented excess sample provided to Intermountain for laboratory analysis. The soil sample was obtained from Sweetwater County, Wyoming, in the southwestern portion of the state. Rick Barth, from the Colorado School of Mines Research Institute, prepared the samples by first grinding them to pass a 2-mm sieve. The ground samples were then split with a mechanical splitter into the individual samples supplied to each laboratory. Thirty-five of the three-sample sets were shipped to laboratories in the western and central states.

REPORTED DATA

The values reported by each laboratory for each parameter are listed in tables 1-3 for the topsoil and the two overburden samples. A value reported by a laboratory in different units than the suggested units for that parameter (table A2), was converted to the appropriate units. Converted values are identified on tables 1-3. The laboratories performing the analyses are coded to conceal the identity of the individual laboratories. Judgements on laboratory quality, based on comparisons of reported values, are inappropriate because many of the analyses were made utilizing different analytical techniques and no correct value can be assigned to an individucal parameter.

Summaries of the reported values are given in tables 4-6. Only pH and sodium absorption ratio (SAR) ranged by a factor of two or less for all three sample types. At the other extreme, the range in values reported for exchangeable sodium and acid potential differed by 100 times or more, and exchangeable sodium percentage (ESP), boron, and selenium ranged by a factor of 10 times or more for all three sample types. The remainder of the parameters ranged between 2 times and 100 times, depending on the parameter and the sample type. Because at least two parameters differed by a factor of two or less, the samples, as received by the participating laboratory, must be assumed to possess acceptable homogeneity.The intermediate and large differences for many parameters suggest that inconsistencies in sample preparation, analytical methods, or instrumental analysis can produce results with deviations large enough to make some data unreliable for estimating a simple average value. The sources of the deviations could not be identified from the information provided by the participating laboratories.

Histograms showing the frequency distribution for the values reported by all laboratories for each parameter in each of the three samples are presented in figures 1-17. While the sample size was small (n of 17 or less), most histograms show a distribution of reported values with one or two values being extremely large or small. The distributions, even after excluding the large or small values, suggest that the mean or median value for each parameter in

each of the three samples would be questionable as a true representation of the sample composition. Histograms for soluble sodium (fig. 5) and boron (fig. 14) in all three samples, cation exchange capacity (CEC) (fig. 11), and exchangeable sodium (fig. 12) in the topsoil sample could probably be used to represent an acceptable average composition; however, a comparison of the methods used to generate the values would need to be made first.

LABORATORY METHODS

The techniques reported by each participating laboratory to determine each parameter are summarized in tables 7-21. Several laboratories reported only information such as sample aliquot or sample preparation; therefore, it is questionable whether to assume the recommended method was used, or accept that a different procedure was used but not reported. From the information provided, however, it becomes obvious that the techniques used for any single parameter are not consistent among laboratories. For example, in table 13, the sample aliquot used for CEC ranged from 2-5gm. The sample preparation ranged from using the sample as received to resieving or further grinding to as fine as a 60-mesh size. The amount and kind of extracting solution, and the sample-to-solution ratio was inconsistent among laboratories. Finally, the reaction time ranged from 5 minutes to 4.5 hours.

It would be informative to graphically evaluate the effects of sample aliquot, sample preparation, sample-to-solution ratio, extraction procedure, and reaction time on the reported parameter values. These evaluations are not reported here because the number of laboratories providing detailed information on their methods was inadequate.

RECOMMENDATIONS

1. Several laboratories suggested, in response to the questionnaire, that the report sheets could be better designed. Additional items which might be included on the sheet are:
    a. columns for reporting units of measurement,
    b. individual rows for reporting analytical results for each requested parameter,
    c. a check (yes, no) column to verify use of the recommended procedure, and if not, a request to detail the procedure used,
    d. check columns for sample preparation (ground, sieved, or used as received, or mesh size of analyzed fraction).

2. Laboratories should carefully check the results they are reporting. Some values reported in this round robin appear to be in error because of a mistake in the placement of the decimal point. Other common errors are in calculation, transcription, and conversion of data from one unit to another.

3. Sample aliquot, sample preparation, soil-to-solution ratio, reaction time, and other special techniques used by the laboratory should be reported so that changes in these variables could be related to the reported values to determine whether or not they affect the reported values in a predictable way.

4. One laboratory suggested that the sample be supplied in a large enough quantity to be used as a future reference standard. This is not the purpose of a round-robin program. Preparation and validation of a reference standard is a time consuming and costly operation.

5. Several laboratories suggested that the time between the arrival of the sample and the requested return date for the results was too short to measure all the requested parameters. The time between sample arrival and return of results should be reasonable, but not so long as to permit procrastination.

6. The range in reported values for most parameters was wide. This may be due to the different techniques used by the laboratories for a single parameter, and to the potential errors listed in item 2 above. Lack of homogeneity of the sample split sent to each laboratory was thought to be an insignificant contribution to error. We recommend that these data not be used as a best estimate of a single "correct value" for each parameter in each of the three samples because of the different techniques used by the participating laboratories.

7. The round-robin results point out that when determining an exchangeable, soluble, or available fraction of the total, the same method must be used by all participating laboratories in order to obtain comparable results. If different methods are used by participating laboratories, then the techniques used must be given in sufficient detail so that the effects of the variation in technique on reported values can be assessed.

8. If the purpose of an analysis is to comply with regulatory guidelines for soil and overburden, then the method used for analysis should be the one recommended by the regulatory agency unless there is a demonstrated correlation between the recommended method and the alternative method. It should be the responsibility of the regulatory agency to recommend methods that will provide data that are useful, accurate, and reliable in predicting the suitability or unsuitability of soil or overburden. It should be the responsibility of the laboratory using an alternative method to demonstrate the relationship between the recommended and alternative methods.

Table 1. Reported data for 'TOPSOIL-1' sample from the First Western Task Force Round Robin Soil and Overburden Analysis Program.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Units are given in table 4; description of acronyms are given in appendix table A2.]

Laboratory Code	pH	Conduc-tivity	Soluble Ca	Soluble Mg	Soluble Na	SAR	Saturation Percentage	Sand	Silt	Clay	Carbon-Ash	Carbon-Organic
A	7.41	3.0b	23.14	20.78	6.28	1.34	38.67	44.65	37.56	17.78	4.64	-- a
B	7.70	3.00	26.40	14.60	7.80	1.70	35.00	50.00	30.00	16.00	4.63	--
C	7.48	4.38	34.09	19.70	10.79	2.14	27.20	58.00	24.80	17.20	--	1.88
D	7.20	3.72	27.10	13.80	7.10	1.57	32.50	61.50	26.70	11.80	--	--
E	7.90	3.40	18.90	14.70	8.30	2.00	33.60	52.00	32.00	16.00	--	1.00
F	7.40	3.70	28.00	15.00	7.00	1.50	38.00	59.00	30.00	11.00	4.90	--
G	7.30	1.70	20.20	13.30	4.96	1.20	54.50	51.00	31.00	18.00	3.70	--
H	7.70	--	20.29	13.47	5.83	1.42	34.37	--	--	--	4.71	--
I	7.80	3.70	34.60	16.30	8.50	1.70	38.20	57.00	30.00	13.00	5.00	--
J	7.50	3.70	25.70b	14.30b	5.70 b	1.50	35.00	51.00	32.00	17.00	--	.80
K	7.50	4.49	31.12	18.09	8.09	1.60	31.00	55.60	31.10	13.40	--	--
L	7.64	3.77	18.61	16.40	9.22	2.20	37.00	50.50	32.50	17.00	.85	.50
M	8.07	4.05	23.10	15.10	6.96	1.60	27.00	56.00	28.00	16.00	--	--
N	7.50	3.76	28.20	18.60	8.30	1.72	31.00	53.00	31.00	16.00	2.90	--
O	7.86	1.94	--	--	--	--	--	58.00	28.00	14.00	--	--
P	5.72	3.52	33.90	17.30	8.50	1.70	35.00	52.00	27.30	20.70	5.50	.70
Q	7.70	4.20	33.80	19.00	9.00	1.80	31.70	62.00	26.00	12.00	4.80	--

Laboratory Code	CEC	Exch. Na	ESP	B	Avail. N	Cu	Mo	Se	Acid Potential	Neut. Potential	Acid-Base Potential
A	3.08	.70	22.73	.49	--	--	--	--	3.750b	3.800	34.25
B	16.42	.06	6.30	.50	11.8	1.30	1.10	<.010	.050	3.180	30.20
C	9.08	.19	2.09	.38	13.2	.76	.01	.010	--	2.900	--
D	11.10	.75	4.68	.50	16.3	.46	.04	<.005	--	--	--
E	11.40	6.60	57.90	1.00	11.0	.80	--	--	.050	3.480	33.20
F	7.60	.32	.70	.80	12.0	.60	.12	<.025	.060	3.800	36.00
G	6.95	.33	4.75	.49	14.3	.90	--	--	.030b	3.500	34.10
H	--	--	--	.46	--	--	--	--	.020	3.360	32.98
I	7.20	.09	1.20	.80	5.0	1.70	<.06	<.010	1.250	3.040	29.13
J	6.30	.37	5.90	.08	13.0	.60	--	--	--	2.100	--
K	--	--	--	--	--	--	--	--	--	--	--
L	6.30	.41	1.11	1.28	18.2	3.08	.02	.038	.002	3.200	31.90
M	22.60	.29	1.30	5.50	11.8	.94	.10	<.020	--	--	--
N	8.83	.36	4.08	.70	63.0	1.76	.09	<.005	.040	2.900	28.00
O	12.57	--	--	--	--	--	--	--	.050b	3.315	--
P	2.30	.27b	1.10	.64	3.7	7.50	--	--	--	1.600	--
Q	14.70	.41	2.80	.81	12.0	.60	<.02	.240	.100	3.000	--

a, Not determined.
b, Reported values were converted to common units.

Table 2. Reported data for 'OVERBURDEN-1' sample from the First Western Task Force Round Robin Soil and Overburden Analysis Program.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Units are given in table 4; description of acronyms are given in appendix table A2.]

Laboratory Code	pH	Conductivity	Soluble Ca	Soluble Mg	Soluble Na	SAR	Saturation Percentage	Sand	Silt	Clay	Carbon-Ash	Carbon-Organic
A	6.62	2.88	21.31	18.91	5.73	1.28	50.91	22.28	49.06	28.65	8.66	-- a
B	6.60	2.60	23.00	12.20	6.20	1.50	63.30	28.00	38.00	34.00	7.15	--
C	6.63	3.77	30.28	16.06	9.66	2.00	47.30	35.20	31.60	33.20	--	.72
D	6.50	3.21	23.20	11.00	6.51	1.58	47.90	61.60	14.00	24.50	4.90	--
E	7.30	2.50	13.90	10.40	7.40	2.10	57.50	40.00	30.00	30.00	--	1.30
F	6.60	3.30	25.00	13.00	5.80	1.30	62.00	35.00	38.00	27.00	8.90	--
G	6.40	1.50	21.80	13.60	6.61	1.60	51.50	27.00	35.00	38.00	5.80	--
H	6.70	2.00	15.67	10.32	4.53	1.25	60.88	--	--	--	8.89	--
I	6.80	3.00	25.20	12.80	7.90	1.80	55.20	31.00	42.00	27.00	8.70	--
J	7.20	2.30	12.80 b	7.70 b	5.10 b	1.50	78.00	32.00	40.00	28.00	--	1.00
K	6.90	3.60	25.11	13.77	6.60	1.50	59.00	30.40	41.50	28.20	--	--
L	6.70	3.55	18.24	12.90	6.84	1.73	58.00	32.00	36.00	32.00	1.55	.91
M	8.13	3.36	19.80	12.90	6.18	1.50	45.70	36.00	34.00	30.00	--	--
N	6.50	3.38	25.70	13.70	7.30	1.64	55.00	34.00	38.00	28.00	4.50	--
O	7.90	2.30	--	--	--	--	--	38.00	28.00	34.00	--	--
P	6.63	3.02	46.70	13.90	7.36	1.30	60.00	30.00	34.30	35.70	5.30	1.10
Q	6.90	3.80	30.30	16.50	8.20	1.70	50.20	35.00	39.00	26.00	8.60	--

Laboratory Code	CEC	Exch Na	ESP	B	Avail. N	Cu	Mo	Se	Acid Potential	Neut. Potential	Acid-Base Potential
A	8.48	1.18	13.92	1.38	--	--	--	--	7.810	5.575 b	47.94
B	31.10	.31	2.50	.70	8.5	3.40	<8.000	.100	.170	4.410	38.80
C	21.77	.32	1.47	.62	10.3	2.85	.190	.030	--	3.400	--
D	19.60	1.05	3.77	.63	12.7	1.62	.090	.087	4.840	4.300 b	38.16
E	16.40	9.70	59.10	1.60	12.0	2.90	--	--	.120	4.430	41.20
F	20.00	.50	.60	1.00	14.0	2.70	.120	.085	.180	4.500	39.00
G	19.90	.57	2.86	.66	10.4	3.60	--	--	.090	4.340 b	40.60
H	--	--	--	.59	--	--	--	--	.140	4.670	42.33
I	21.80	.39	1.80	1.10	25.0	4.30	<.060	.060	2.500	4.190	39.36
J	16.30	.53	3.20	.15	7.8	3.00	--	--	--	3.600	--
K	--	--	--	--	--	--	--	--	--	--	--
L	16.04	.54	.87	1.35	14.9	1.51	.085	<.013	.018	3.000	29.40
M	40.60	.37	.90	5.00	9.2	3.20	.390	<.020	--	--	--
N	21.00	.58	2.76	1.00	59.0	4.28	.570	.010	.130	3.800	34.00
O	14.52	--	--	--	--	--	--	--	.110	4.743 b	--
P	14.20	.40 b	2.10	.45	3.1	5.70	--	.0	--	2.460	--
Q	32.90	.67	2.00	1.14	9.0	2.60	.110	.020	.300	2.800	--

a, Not determined.

b, Reported values were converted to common units.

Table 3. Reported data for 'OVERBURDEN-2' sample from the First Western Task Force Round Robin Soil and Overburden Analysis Program.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.] Units are given in table 4; description of acronyms are given in appendix table A2.]

Laboratory Code	pH	Conduc-tivity	Soluble Ca	Soluble Mg	Soluble Na	SAR	Saturation Percentage	Sand	Silt	Clay	Carbon-Ash	Carbon-Organic
A	5.77	5.72	19.72	41.60	16.19	2.92	46.16	19.55	46.2	34.25	10.78	-- a
B	5.80	5.30	23.50	67.40	15.70	2.30	53.80	28.00	32.0	40.00	8.58	--
C	5.87	8.09	28.31	90.17	22.45	2.92	42.80	27.60	29.2	43.20	--	1.00
D	5.70	4.83	24.60	57.90	14.60	2.27	42.90	36.90	41.3	21.80	7.30	--
E	5.60	.95	16.10	60.80	18.30	2.90	53.20	36.00	30.0	34.00	--	2.60
F	5.70	65.00	23.00	69.00	15.00	2.20	55.00	29.00	40.0	31.00	12.00	--
G	5.50	2.70	18.80	69.60	15.50	2.33	53.20	22.00	28.0	50.00	8.00	--
H	5.60	3.19	15.59	48.93	10.37	1.77	52.88	--	--	--	11.53	--
I	5.50	7.20	26.80	81.70	19.10	2.60	51.50	20.00	31.0	49.00	12.60	--
J	6.80	5.90	13.50 b	50.50 b	11.70 b	2.10	111.00	13.00	45.0	42.00	--	1.70
K	6.00	7.70	24.86	75.42	16.45	2.30	56.00	19.10	43.9	37.10	--	--
L	5.95	6.80	12.23	64.70	13.99	2.26	53.00	27.00	31.5	41.50	2.81	1.65
M	7.83	7.13	19.50	70.90	13.49	2.00	44.10	26.00	40.0	34.00	--	--
N	5.60	7.10	24.20	82.20	19.80	2.71	49.00	21.00	36.0	43.00	7.20	--
O	7.31	4.83	--	--	--	--	--	22.00	34.0	44.00	--	--
P	7.61	6.55	28.70	75.70	18.80	2.60	50.00	26.00	27.3	46.70	8.20	2.10
Q	6.00	8.20	28.30	93.00	22.10	2.80	44.00	15.00	45.0	40.00	10.90	--

Laboratory Code	CEC	Exch. Na	ESP	B	Avail. N	Cu	Mo	Se	Acid Potential	Neut. Potential	Acid-Base Potential
A	11.23	1.90	16.92	1.13	--	--	--	--	10.930	3.175 b	20.82
B	37.73	.42	2.43	.70	30.2	5.50	.900	<.100	.340	2.100	10.40
C	26.27	.60	2.28	.48	32.2	5.36	.130	.130	--	.0	--
D	24.10	1.72	4.53	.53	35.0	2.47	.070	.010	9.520	2.290 b	13.38
E	32.20	21.90	68.00	.90	30.0	6.50	--	--	.020	2.330	22.70
F	25.00	1.00	2.00	.90	29.0	5.20	.190	.140	.340	2.400	13.00
G	21.40	.10	.47	.48	35.5	6.90	--	--	.250	1.920 b	11.40
H	--	--	--	.40	--	--	--	--	.290	2.720	18.14
I	24.70	.68	2.80	.70	27.0	.70	<.060	.060	9.370	2.250	13.13
J	21.70	.39	1.80	.16	29.9	4.30	--	--	--	.0	--
K	--	--	--	--	--	--	--	--	--	--	--
L	20.74	1.59	4.10	1.48	40.1	.38	.079	.013	.007	1.700	16.80
M	43.00	.98	2.30	3.50	30.8	5.82	.220	<.020	--	--	--
N	29.80	.68	2.29	.70	74.0	6.64	.290	<.005	.250	1.800	10.00
O	12.43	--	--	--	--	--	--	--	.250	2.507 b	--
P	21.70	.87 b	2.50	.49	8.3	2.10	--	--	--	1.500	--
Q	40.70	1.62	4.00	.69	31.0	4.80	.130	.250	.100	<.100	--

a, Not determined.
b, Reported values were converted to common units.

Table 4. Summary statistics for 'TOPSOIL-1' sample from the First Western Task Force Round Robin Soil and Overburden Analysis Program

Parameter	Units	Range[1]		Median	Mean	Standard Deviation	N[2]
pH	Standard	5.72	8.07	7.5	7.5	0.51	17
Conductivity	mmhos/cm	1.7	4.49	3.7	4.5	0.78	16
Soluble-Ca	meq/L	18.61	34.6	26.4	26.7	5.65	16
-Mg	meq/L	13.3	20.78	15.1	16.3	2.37	16
-Na	meq/L	4.96	10.79	7 8	7.7	1.51	16
Sodium Absorption Ratio	None	1.2	2.2	1.6	1.7	0.27	16
Saturation Percentage	Percent	27.0	54.5	34.4	35.0	6.29	16
Particle Size-Sand	Percent	44.65	62	53.0	54.5	4.71	16
-Silt	Percent	24.8	37.56	30.0	29.9	3.09	16
-Clay	Percent	11	20.7	16.0	15.4	2.66	16
Carbon-Ash	Percent	0.85	5.5	4.6	4.2	1.37	10
-Organic	Percent	0.5	1.88	0.75	0.97	0.54	5
Cation Exchange Capacity	meq/100g	2.3	22.6	8.2	9.8	5.28	15
Exchangeable Sodium	meq/100g	0.06	6.6	0.36	0.84	1.67	14
Exchangeable Sodium Percentage	Percent	0.7	57.9	2.8	8.3	15.3	14
Boron	mg/kg (ppm)	0.08	5.5	0.57	0.96	1.29	15
Available Nitrogen	mg/kg	3.7	63	12.0	15.8	14.7	13
Copper	mg/kg	0.46	7.5	0.85	1.6	1.91	13
Molybdenum	mg/kg	0.01	1.1	0.05	0.21	0.39	9
Selenium	mg/kg	0.01	0.24	0.05	0.096	0.13	9
Acid Potential	% Total S	0.002	3.75	0.05	0.49	1.14	11
Neutralization Potential	% $CaCO_3$	1.6	3.8	3.2	3.1	0.60	14
Acid Base Potential	Tons $CaCO_3$/1000 Tons	28	36	32.4	32.2	2.62	9

[1] Significant figures are those reported by the participating laboratory.

[2] Number of laboratories reporting values for this parameter.

Table 5. Summary statistics for 'OVERBURDEN-1' sample from the First Western Task Force Round Robin Soil and Overburden Analysis Program

Parameter	Units	---Range[1]--		Median	Mean	Standard Deviation	N[2]
pH	Standard	6.4	8.13	6.7	6.9	0.49	17
Conductivity	mmhos/cm	1.5	3.8	3.0	2.9	0.66	17
Soluble-Ca	meq/L	12.8	46.7	23.0	23.6	8.00	16
-Mg	meq/L	7.7	18.91	12.9	13.1	2.65	16
-Na	meq/L	4.5	9.66	6.6	6.7	1.25	16
Sodium Absorption Ratio	None	1.25	2.1	1.5	1.6	0.25	16
Saturation Percentage	Percent	45.7	78	55.2	56.4	7.98	16
Particle Size-Sand	Percent	22.28	61.6	32.0	34.2	8.52	16
-Silt	Percent	14.0	49.06	36.0	35.5	7.66	16
-Clay	Percent	24.5	38	28.7	30.3	3.82	16
Carbon-Ash	Percent	1.55	8.9	6.5	6.6	2.42	11
-Organic	Percent	0.72	1.3	0.96	1.0	0.22	5
Cation Exchange Capacity	meq/100g	8.48	40.6	19.8	21.0	8.22	15
Exchangeable Sodium	meq/100g	0.31	9.7	0.53	1.2	2.45	14
Exchangeable Sodium Percentage	Percent	0.6	59.1	2.1	7.0	15.3	14
Boron	mg/kg (ppm)	0.15	5.0	0.85	1.2	1.13	15
Available Nitrogen	mg/kg	3.1	59	10.4	15.1	14.1	13
Copper	mg/kg	1.51	5.7	3.0	3.2	1.12	13
Molybdenum	mg/kg	0.085	0.57	0.12	0.22	0.19	9
Selenium	mg/kg	0	0.10	0.020	0.049	0.039	10
Acid Potential	% Total S	0.018	7.81	0.14	1.4	2.49	12
Neutralization Potential	% $CaCO_3$	2.46	5.575	4.2	4.0	0.83	15
Acid Base Potential	Tons $CaCO_3$/1000 Tons	29.4	47.94	39.0	39.1	4.90	10

[1] Significant figures are those reported by the participating laboratory.

[2] Number of laboratories reporting values for this parameter.

Table 6. Summary statistics for 'OVERBURDEN-2' sample from the First Western Task Force Round Robin Soil and Overburden Analysis Program

Parameter	Units	---Range[1]--		Median	Mean	Standard Deviation	N[2]
pH	Standard	5.5	7.83	5.8	6.1	0.76	17
Conductivity	mmhos/cm	0.95	65	6.2	9.2	14.5	17
Soluble-Ca	meq/L	12.23	28.7	23.0	21.7	5.38	16
-Mg	meq/L	41.60	93.0	69.0	68.7	14.5	16
-Na	meq/L	10.37	22.45	15.7	16.5	3.43	16
Sodium Absorption Ratio	None	1.77	2.92	2.3	2.4	0.35	16
Saturation Percentage	Percent	42.8	111	51.5	53.7	15.9	16
Particle Size-Sand	Percent	13	36.9	22.0	24.3	6.63	16
-Silt	Percent	27.3	46.2	34.0	36.3	6.71	16
-Clay	Percent	21.8	50	40.0	39.5	7.25	16
Carbon-Ash	Percent	2.81	12.6	8.4	9.1	2.85	11
-Organic	Percent	1.0	2.6	1.7	1.8	0.59	5
Cation Exchange Capacity	meq/100g	11.23	43.0	24.4	26.2	9.22	15
Exchangeable Sodium	meq/100g	0.10	21.9	0.87	2.5	5.62	14
Exchangeable Sodium Percentage	Percent	0.47	68.0	2.4	8.3	17.6	14
Boron	mg/kg (ppm)	0.16	3.5	0.70	0.88	0.70	15
Available Nitrogen	mg/kg	8.3	74	30.5	33.3	14.3	13
Copper	mg/kg	0.38	6.9	5.0	4.4	2.23	13
Molybdenum	mg/kg	0.07	0.9	0.13	0.25	0.27	9
Selenium	mg/kg	0.010	0.25	0.04	0.1	0.092	9
Acid Potential	% Total S	0.007	10.93	0.25	2.6	4.42	12
Neutralization Potential	% $CaCO_3$	0	3.175	2.0	1.9	0.91	15
Acid Base Potential	Tons $CaCO_3$/1000 Tons	10	22.7	13.1	15.0	4.42	10

[1]Significant figures are those reported by the participating laboratory.

[2]Number of laboratories reporting values for this parameter.

Table 7. Summary of the techniques used by participating laboratories to determine pH

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
A	400gm	---[2]	---	Set 16 hrs.
B	---	As received	---	---
C	200gm	---	Deionized water	24 hrs.
D	200gm	-10 mesh	---	18 hrs
F	---	As received	Paste with water	24 hrs.
H	300gm	2mm	124ml water	2 hrs.
I	30gm	2mm	---	Set 1 hr.
J	---	---	Water	---
K	200gm	---	---	Overnight in refrigeration
L	---	2mm	Saturation with water	4 hrs.
M	200gm±	As received	Saturation with water	Set 20 hrs.
N	---	As received	Saturated paste	24 hrs.
O	---	---	1:1 extract	
P	100gm±	2mm	Saturation with deionized water	6 hrs.
Q	100gm	2mm	Paste with water	Overnight

[1]Laboratories not reporting details are excluded.

[2]No details reported.

Table 8. Summary of the techniques used by participating laboratories to determine conductivity

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	As received	---	---
C	200gm	---	Deionized water	24 hrs.
D	---	-10 mesh	---	2 hrs.
F	---	As received	Paste with water	24 hrs.
H	300gm	2mm	124ml water	---
I	30gm	2mm	Water	Set 4 hr.
J	---	---	Water	---
L	---	---	Saturation	4 hrs.
M	200gm±	As received	Saturation with water	Set 20 hrs.
N	---	As received	Saturated paste	24 hrs.
P	100gm±	2mm	Saturation with deionized water	6 hrs.
Q	100gm	2mm	Water	Overnight

[1]Laboratories not reporting details are excluded.

[2]No details reported.

Table 9. Summary of the techniques used by participating laboratories to determine soluble calcium, magnesium, and sodium

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	As received	---	---
C	200gm	---	Deionized water	24 hrs.
D	200gm	-10 mesh	---	2 hrs.
F	---	As received	Paste with water	24 hrs.
H	300gm	2mm	124ml water	---
I	30gm	2mm	Water	Set 4 hrs.
J	---	---	Water	---
L	---	---	Saturation with water	4 hrs.
M	200gm±	As received	Saturation with water	Set 24 hrs.
N	---	As received	Saturated paste	24 hrs.
P	100gm±	2mm	Saturation with deionized water	6 hrs.
Q	100gm	2mm	Water	Overnight

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 10. Summary of the techniques used by participating laboratories to determine saturation percentage

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	As received	---	---
C	10-20gm	---	Deionized water	Dry 24 hrs. at 105°C
D	200gm	-10 mesh	---	18 hrs.
F	---	As received	Paste with water	24 hrs.
H	300gm	---	---	---
I	25gm	2mm	---	---
J	---	---	Water	---
L	---	---	Saturation with water	1 hr.
M	200gm±	As received	Saturation with water	Set 20 hrs.
N	---	As received	Saturated paste	24 hrs.
P	100gm±	2mm	Saturation with deionized water	Oven dry 6 hrs.
Q	100gm	2mm	Water	Overnight

[1]Laboratories not reporting details are excluded

[2]No details given.

Table 11. Summary of the techniques used by participating laboratories to determine particle size (texture)

Laboratory code[1]	Sample aliquot	Sample preparation	-----Dispersant procedure------	-------Sedimentation-----
B	---[2]	As received	---	---
C	50gm	---	Sonify 3 min.	40 sec./2 hrs.; hydrometer
D	55gm	-10 mesh	---	30 sec./8 hrs.; hydrometer
F	40gm	As received	1 L calgon plus deionized water, set 12 hrs.	Hydrometer
I	---	2mm	Shake 16 hrs.	---
K	10gm	---	Set overnight	Pipette
L	50gm	---	62.5ml of 4% hexametaphosphate per L	Hydrometer
M	50gm	As received	10ml of 1N $Na_6(PO_4)_6$	40 sec./8 hrs.; hydrometer
N	---	As received	---	Hydrometer
P	50gm	2mm	---	40 sec./8 hrs.; hydrometer
Q	15gm	2mm	Salts removed by leaching	Pipette

[1] Laboratories not reporting details are excluded.

[2] No details given.

Table 12. Summary of the techniques used by participating laboratories to determine organic carbon

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
A	---[2]	---	Muffle furnace	---
B	---	60 mesh	Dry basis	
C	1.0gm		10ml of 0.5N K-dichromate	30 min. then cool
D	0.15gm	-10 mesh	Furnace	7 hrs. at 550°C
F	1gm	As received	Muffle furnace	12 hrs. at 750°C
H	10gm	0.25mm	Muffle furnace	ASTM .05 .05 D3174
I	---	2mm	Muffle furnace	---
J	---	---	$K_2Cr_2O_7$	---
L	0.25gm	---	Dichromate	20 hrs.
N	10gm	As received	Muffle furnace	---
P	0.5gm	0.25mm	Muffle furnace	1/3 hr./1 hr.
P	1.0	2mm	$H_2SO_4/K_2Cr_2O_7$	4 hrs.
Q	20gm	2mm	---	Loss on ignition

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 13. Summary of the techniques used by participating laboratories to determine cation exchange capacity

Laboratory code[1]	Sample aliqout	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	0.5M $MgNO_3$	---
B	---	60 mesh	NaOAc and NH_4OAc replacement	---
C	5gm	---	30ml pH 7 NaOAc/ 30ml NH_4OAc	5 min. per wash
D	5gm	-10 mesh	100ml by ASA Monog. 9	---
F	---	As received	---	4.5 hrs shaking time
I	---	2mm	---	---
J	---	---	NH_4OAc	---
L	2gm	---	25ml 1M NaOAc/ 25ml 1M NH_4OAc	USDA Handbook 60
M	5gm	---	NAOAc/NaCl/$MgNO_3$	---
N	2gm	As received	50ml 1M NaOAc/ 50ml 1M NH_4OAc	30 min.
P	2gm	---	99ml	
Q	4gm	2mm	NaOAc/NH_4OAc	---

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 14. Summary of the techniques used by participating laboratories to determine exchangeable sodium

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	1.0M NH_4OAc	---
C	10gm	---	30ml 1N NH_4OAc	Shake 30 min./set 24 hrs.
D	5gm	-10 mesh	50ml 1.0N NH_4OAc	30 min.
F	---	As received	---	Shake 1.5 hrs.
I	---	2mm	---	---
J	---	---	NH_4OAc	---
L	2gm	---	10ml 1M NH_4OAc	15 min.
M	5gm	As received	50ml 0.5N $MgNO_3$	---
N	2gm	As received	50ml 1M NH_4OAc	30 min.
P	10gm	2mm	---	---
Q	10gm	2mm	100ml 1M NH_4OAc	30 min.

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 15. Summary of the techniques used by participating laboratories to determine boron

Laboratory Code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	Water	---
C	20gm	---	40ml 0.01M $CaCl_2$	Boil 5 min.; ICAP detection
D	25gm	-10 mesh	50ml 1% $CaCl_2$	30 min.;Carmine-autoanalyzer
F	10gm	As received	20ml water	30 min.;Spectrometer
H	---	0.25mm	---	---
I	5gm	2mm	20ml hot water	Curcumin-visible spectrometer
J	---	---	Water	---
L	10gm	---	50ml hot water	Boil 1 min.;Spectrometer
M	20gm	As received	Hot water	Curcumin
N	10gm	As received	50ml water	30 min.; Azo H, autoanalyzer
P	92gm	2mm	53ml	30 min.; spectrometer
Q	10gm	2mm	Water	Boil 5 min.;ICP detection

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 16. Summary of the techniques used by participating laboratories to determine available nitrogen

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	Water	Shake 10 min.
C	5gm	---	50ml 2M KCl	1 hr.; Autoanalyzer
D	5gm	-10 mesh	50ml 1% $CaCl_2$	30 min.; Cadinum red-autoanalyzer
F	10gm	As received	50ml NaCl	1 hr.; Technicon
I	5gm	2mm	---	---
J	---	---	$Ca(OH)_2$	---
L	5gm	---	25ml water	Specific ion electrode
M	10gm	As received	100ml 2M KCl	Shake 1 hr.; Spectrometer
N	10gm	As received	50ml water	30 min.; Cd reduction-autoanalyzer
P	10gm	2mm	13ml	20 min; Spectrometer
Q	10gm	2mm	20ml AB-DTPA	15 min.; Cd reduction-flow injection

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 17. Summary of the techniques used by participating laboratories to determine copper

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	DTPA	Shake 2 hrs.
C	5gm	---	30ml DTPA	2 hrs.
D	25gm	-10 mesh	50ml DTPA	2 hrs.
F	20gm	As received	40ml DTPA	2 hrs.
I	10gm	2mm	AB-DTPA	---
J	---	---	DTPA	---
L	5gm	---	20ml 0.005M DTPA	---
M	10gm	As received	20ml DTPA	Shake 2 hrs. at 120cpm
N	40gm	As received	80ml AB-DTPA	15 min.
P	10gm	2mm	20ml AB-DTPA	15 min. at 180cpm
Q	10gm	2mm	20ml DTPA	2 hrs.

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 18. Summary of the techniques used by participating laboratories to determine molybdenum

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	Tamm's reagent	Shake overnight
C	5gm	---	50ml Tamm's reagent	Shake overnight
D	5gm	-10 mesh	10ml ammonium carbonate	8 hrs.
F	15gm	As received	30ml $(NH_4)_2C_2O_4$	---
I	5gm	2mm	Tamm's reagent	---
L	10gm	---	20ml 1M $(NH_4)_2CO_3$	---
M	10gm	As received	100ml $(NH_4)_2C_2O_4$	Shake overnight at 120cpm
N	5gm	As received	50ml acid $(NH_4)_2C_2O_4$	8 hrs.
Q	10gm	2mm	20ml AB-DTPA	15 min.

[1]Laboratories not reporting details are excluded.

[2]No details given.

Table 19. Summary of the techniques used by participating laboratories to determine selenium

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	Water	Heat several hours
C	10gm	---	50ml deionized water	3 hrs. on steam bath
D	25gm	-10 mesh	Water	30 min.
F	10gm	As received	50ml water	30 min.
I	10gm	2mm	50ml hot water	---
L	10gm	---	50ml water, 125ml H_2O_2	Boil 1 min.
M	5gm	As received	50ml water	4 hrs. on hotplate at 100°C
N	10gm	As received	50ml water	30 min.
Q	10gm	2mm	50ml water	Boil 30 min.

[1]Laboratories not reporting details are excluded.

[2]No details reported.

Table 20. Summary of the techniques used by participating laboratories to determine acid potential

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
A	---[2]	---	Fischer S analyzer	---
B	---	60 mesh	---	---
D	0.198gm	-60 mesh	Automated S analyzer	---
H	---	0.25mm	LECO S analyzer	---
I	0.1gm	2mm	LECO S analyzer	---
L	---	---	HNO_3 after HCl leach	---
N	2gm	As received	Eschka method	---
Q	1gm	2mm	HCL/HNO_3	---

[1]Laboratories not reporting details are excluded.

[2]No details reported.

Table 21. Summary of the techniques used by participating laboratories to determine neutralization potential

Laboratory code[1]	Sample aliquot	Sample preparation	-----Extraction procedure------	-------Reaction time-----
B	---[2]	60 mesh	0.1M HCl	---
C	5gm	---	0.5M HCl, 0.5M NaOH	---
D	2gm	60 mesh	20ml 0.1023M HCl	---
F	5gm	---	20ml HCl	30 min.
H	---	0.25mm	---	---
I	2gm	2mm	25ml 0.1N HCl, 0.1N NaOH	---
L	---	---	HCl plus water	---
N	4gm	As received	0.2M HCl	---
P	---	---	---	2 hrs.
Q	5gm	2mm	Acid neutralization method	---

[1]Laboratories not reporting details are excluded.

[2]No details given.

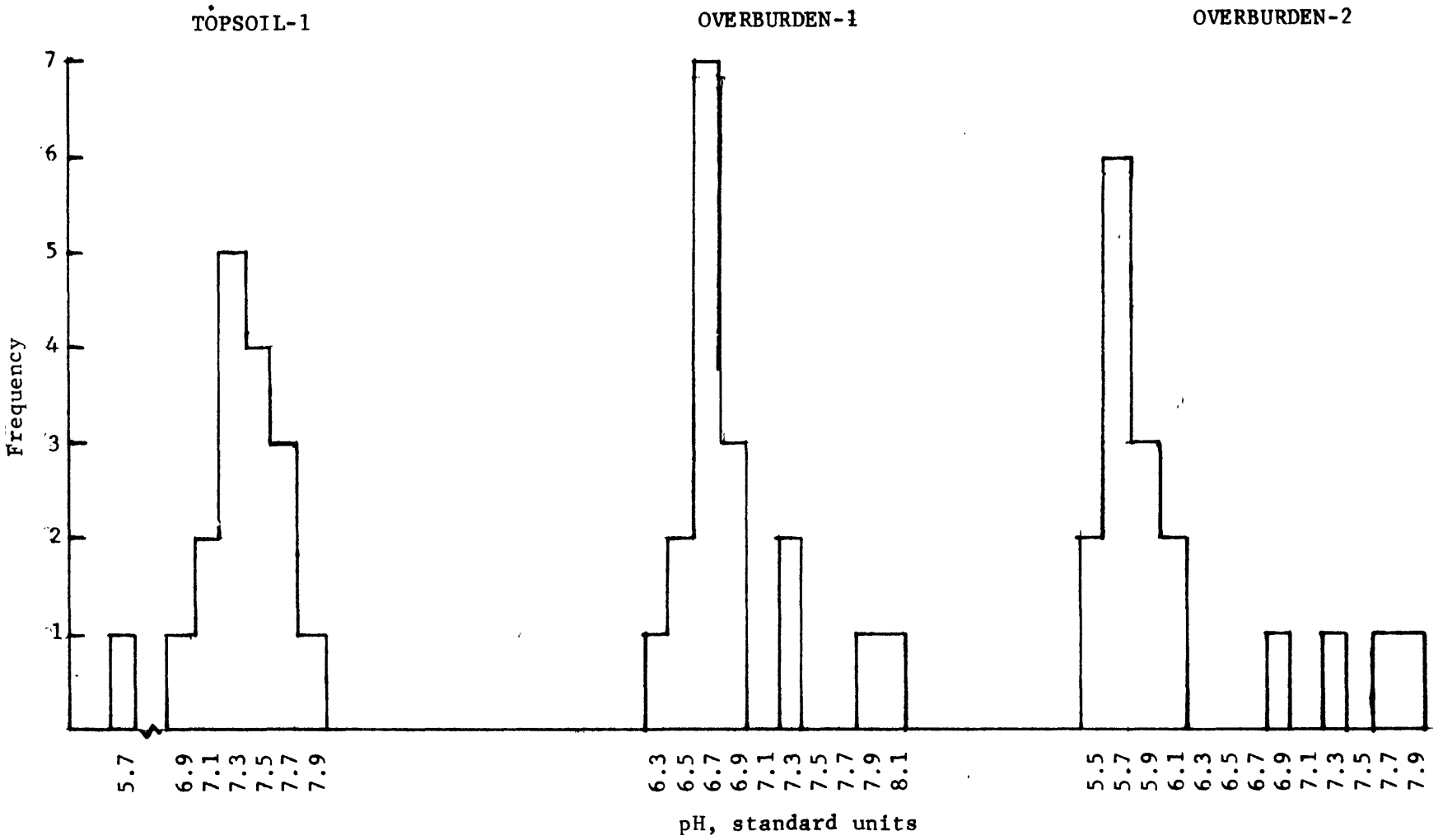

Figure 1. Histograms showing frequency distribution of analytical values for pH.

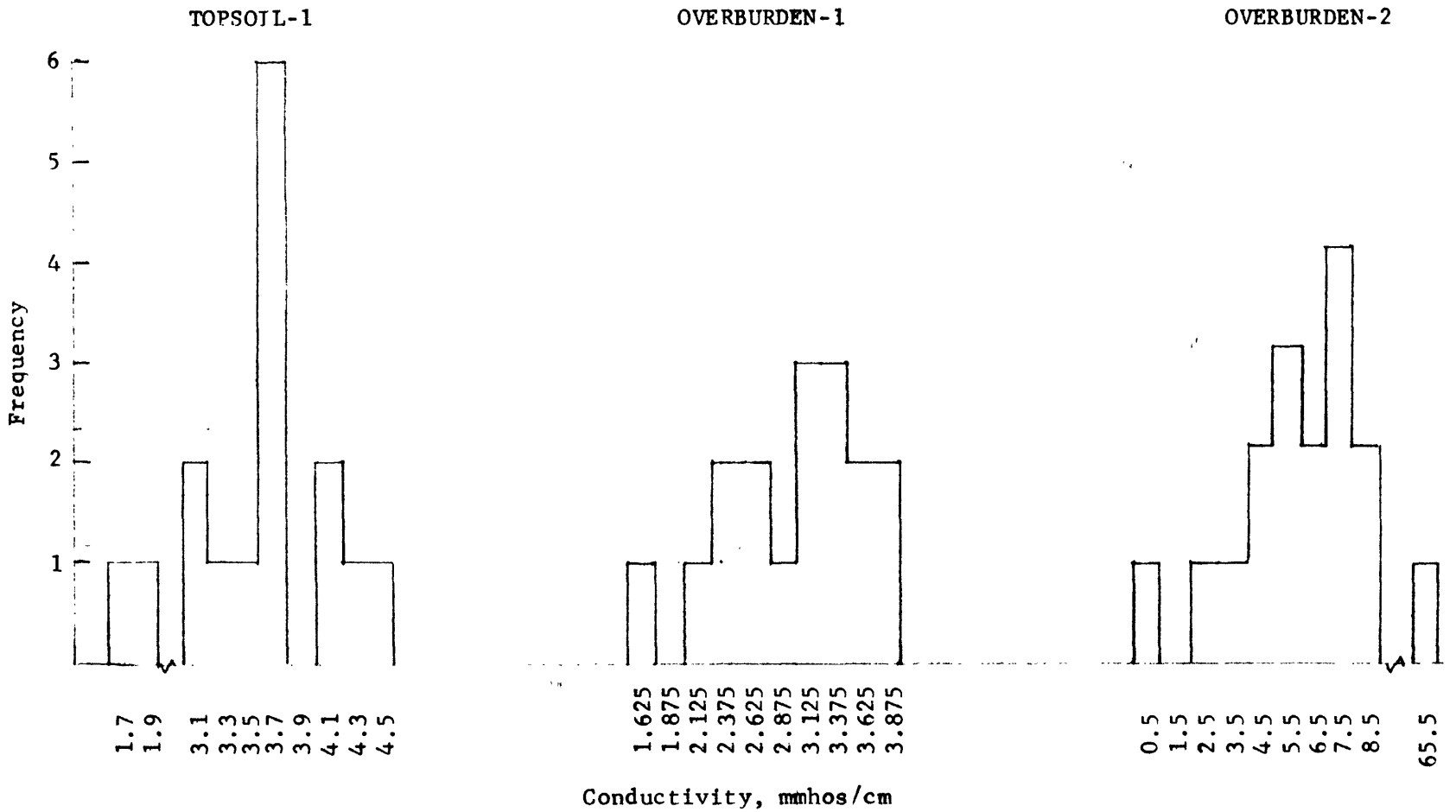

Figure 2. Histograms showing frequency distirbution of analytical values for conductivity.

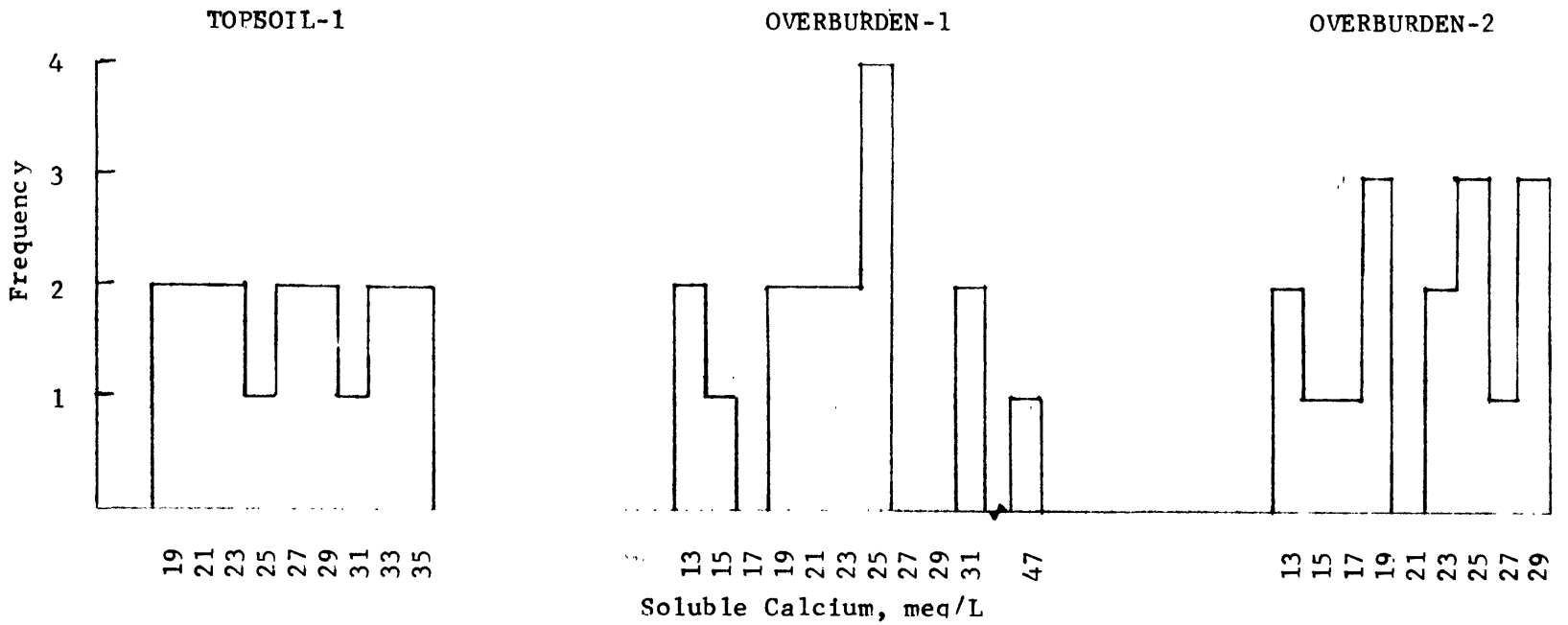

Figure 3. Histograms showing frequency distribution of analytical values for soluble calcium.

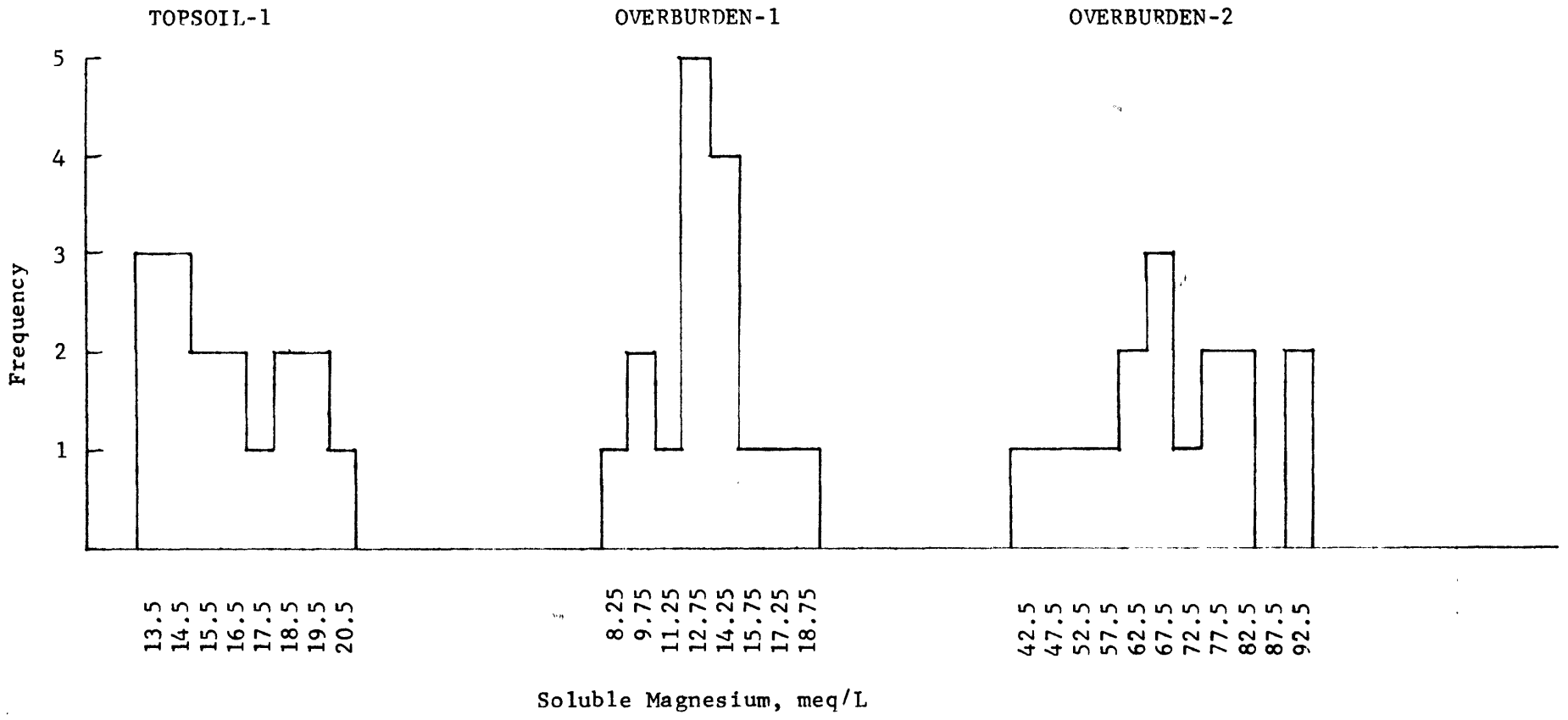

Figure 4. Histograms showing frequency distribution of analytical values for soluble magnesium.

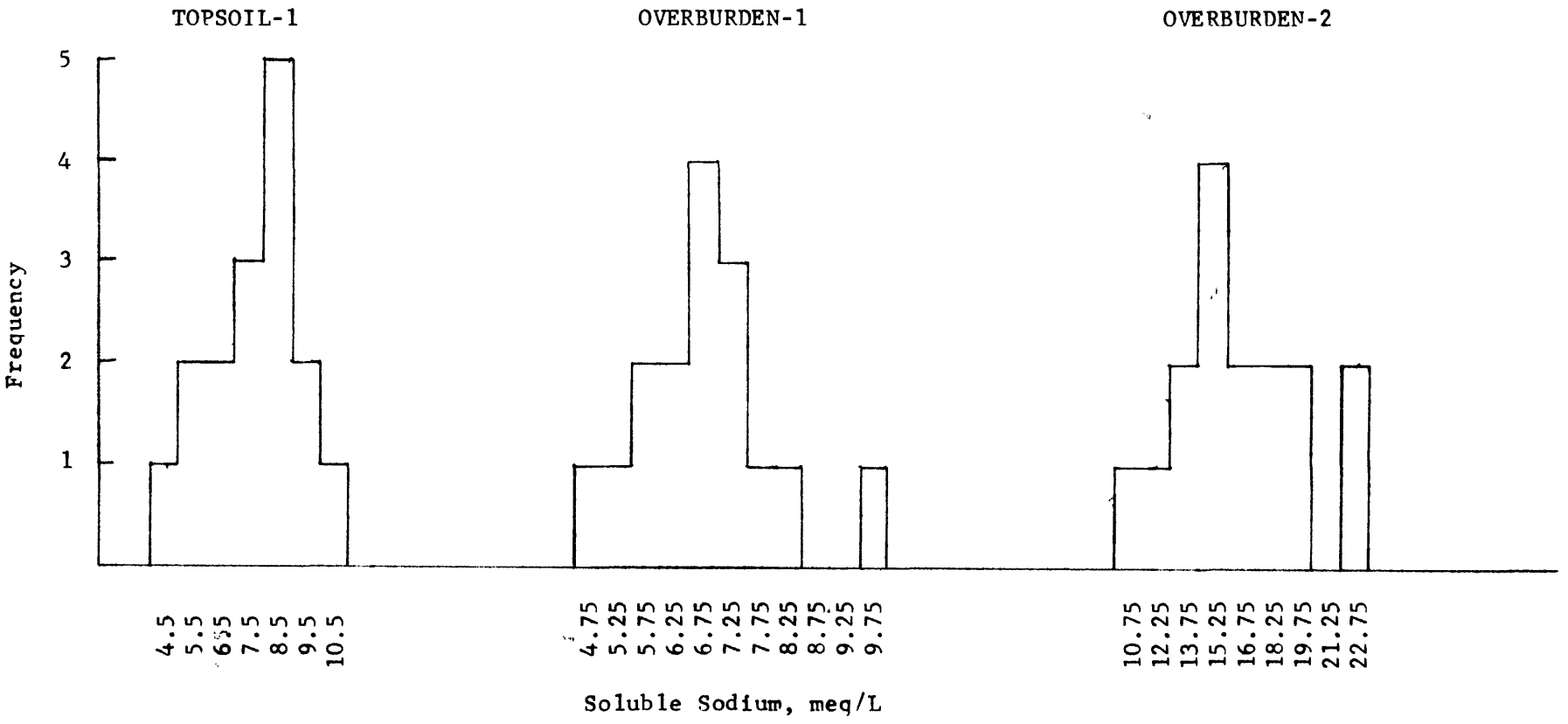

Figure 5. Histograms showing frequency distribution of analytical values for soluble sodium.

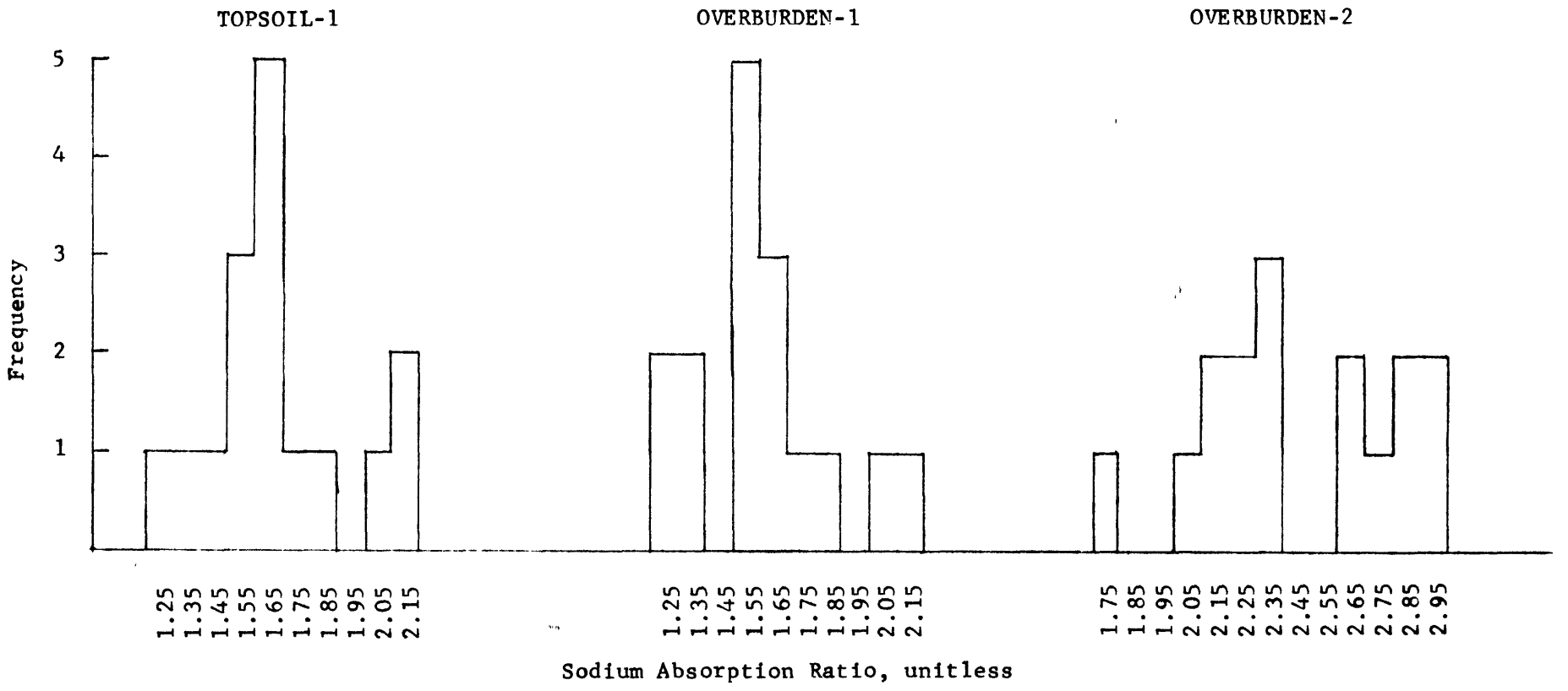

Figure 6. Histograms showing frequency distribution of analytical values for sodium absorption ratio.

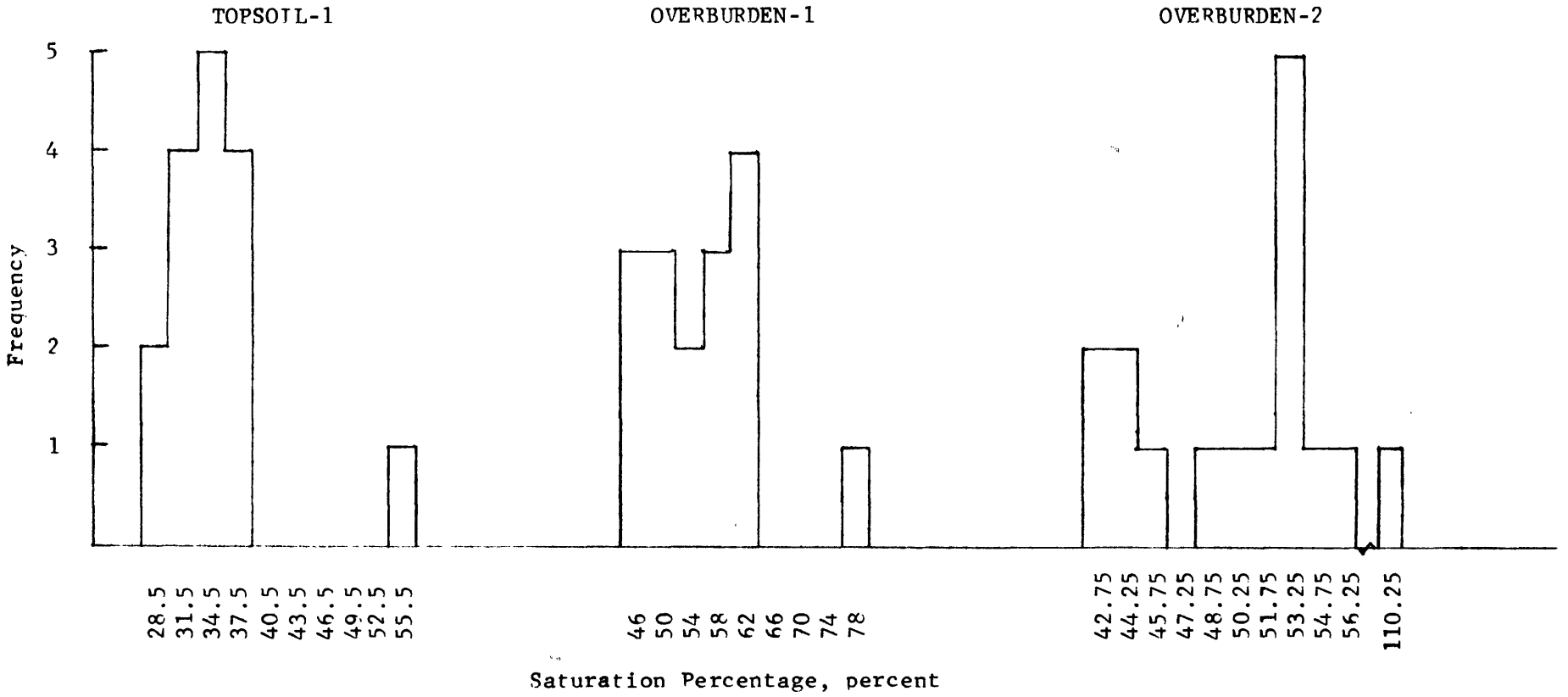

Figure 7. Histograms showing frequency distribution of analytical values for saturation percentage.

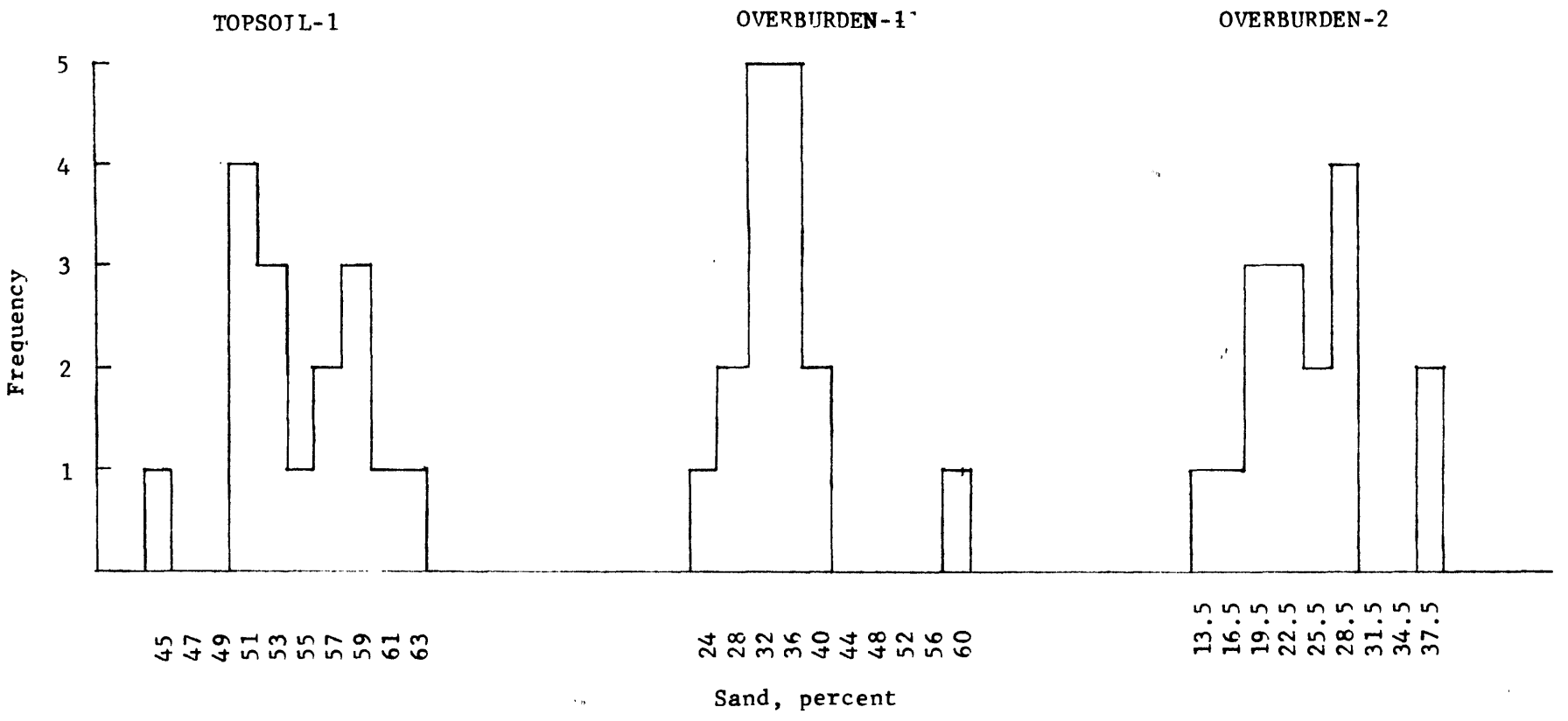

Figure 8. Histograms showing frequency distribution of analytical values for sand.

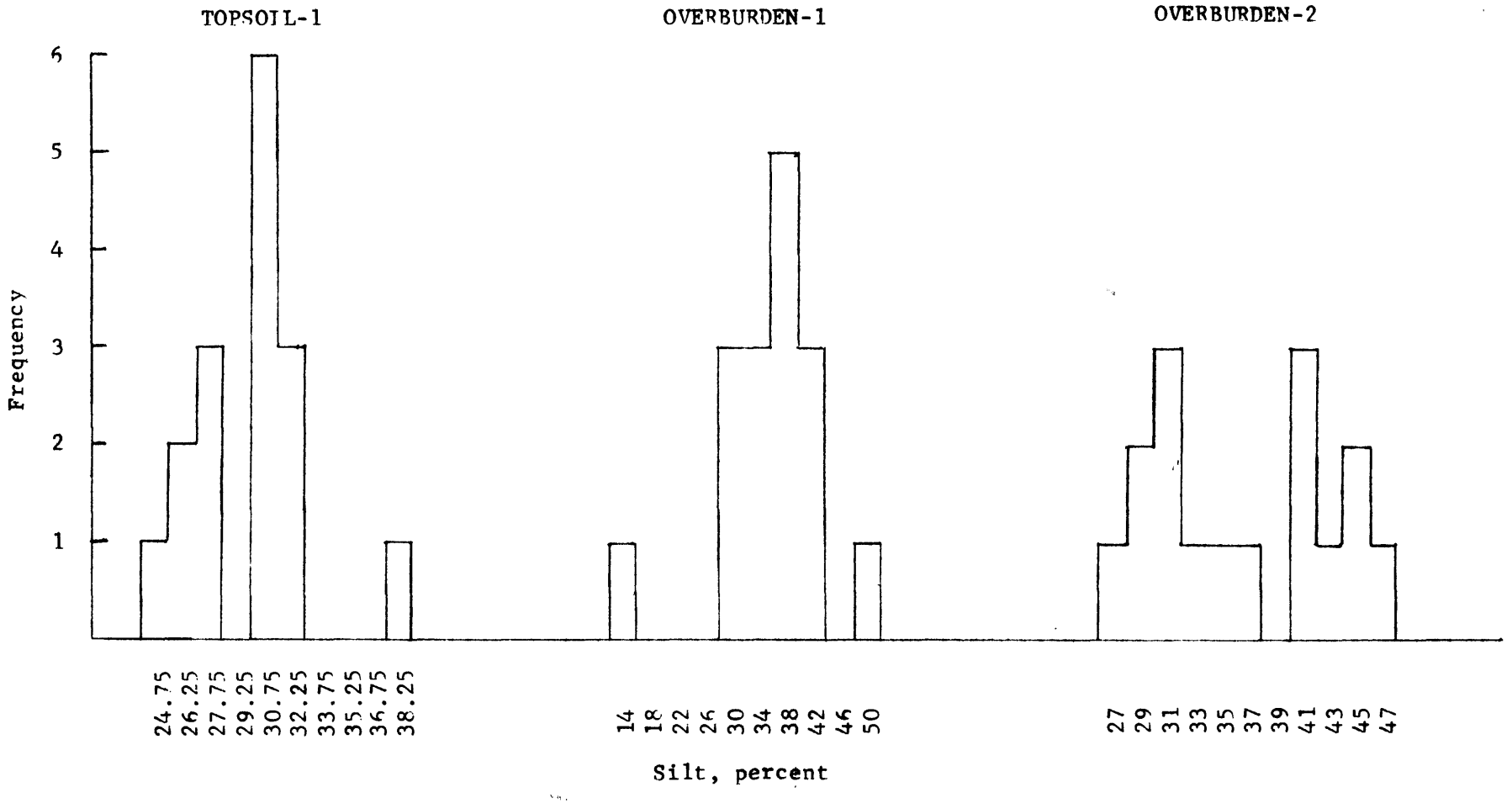

Figure 9. Histograms showing frequency distribution of analytical values for silt.

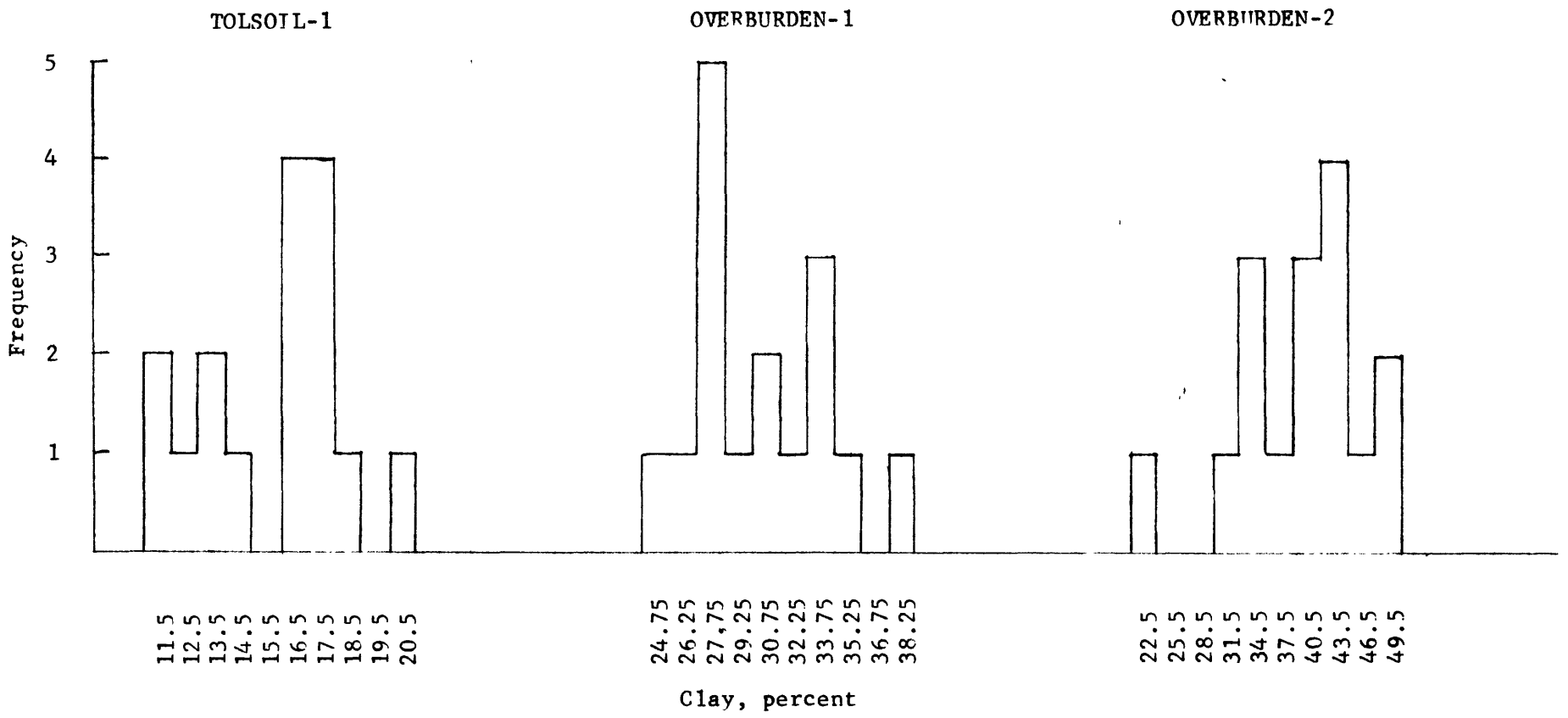

Figure 10. Histograms showing frequency distribution of analytical values for clay.

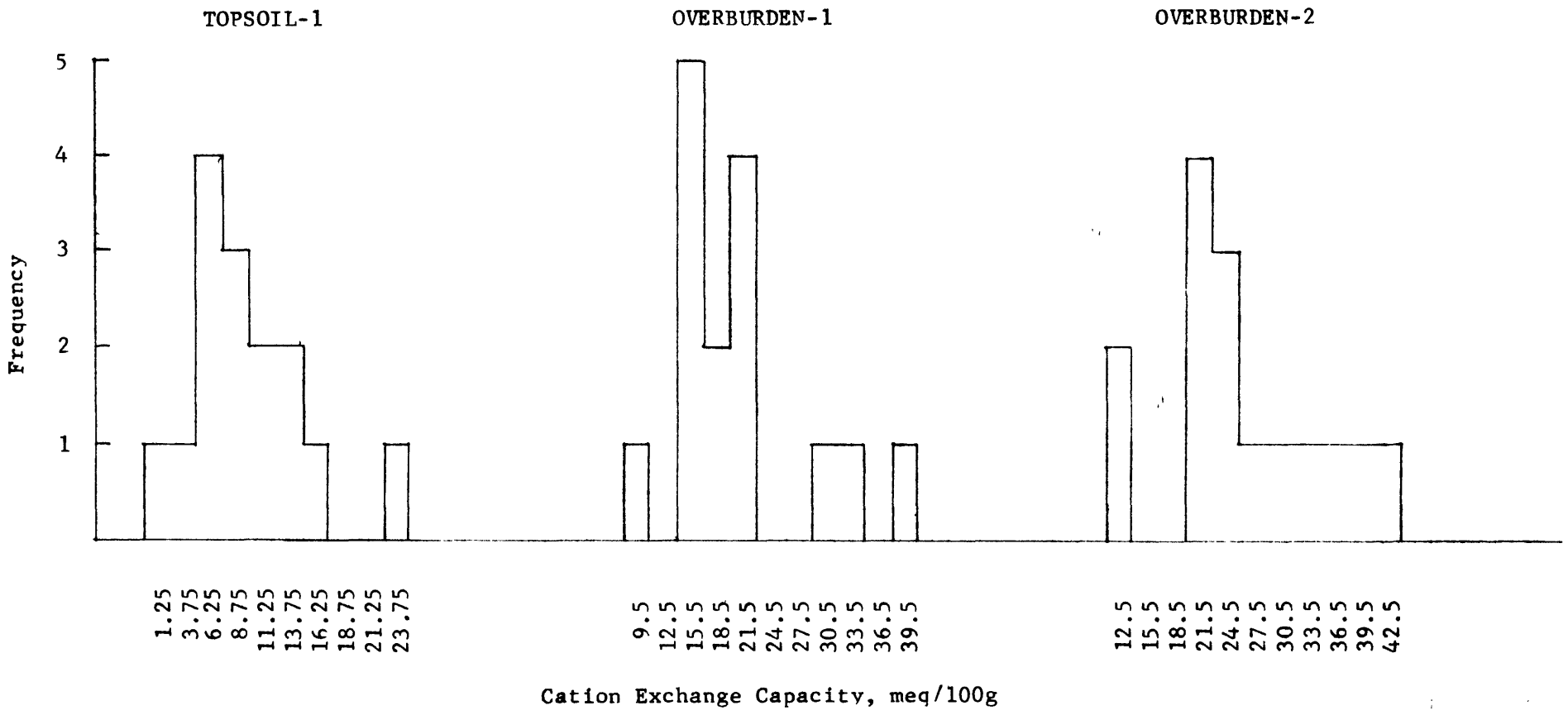

Figure 11. Histograms showing frequency distribution of analytical values for cation exchange capacity.

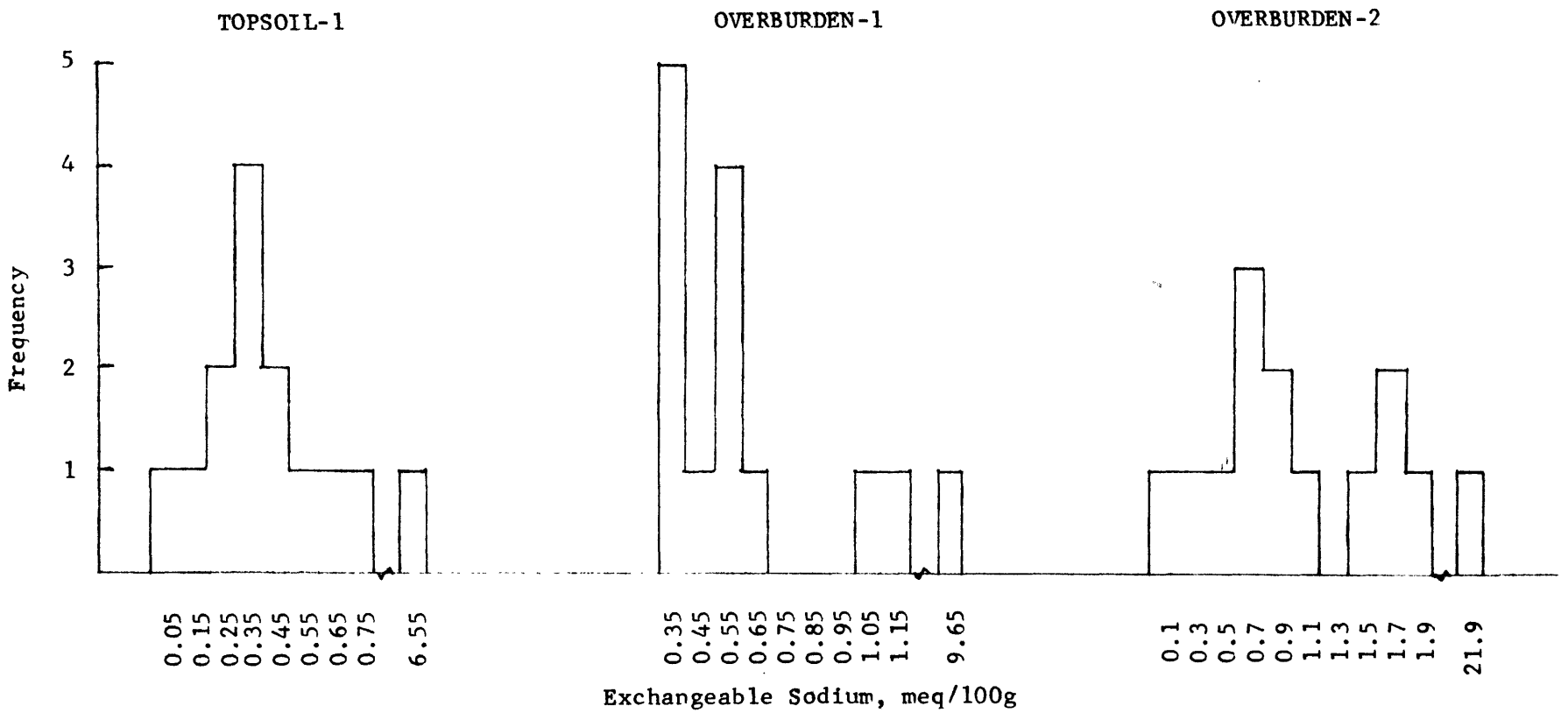

Figure 12. Histograms showing frequency distribution of analytical values for exchangeable sodium.

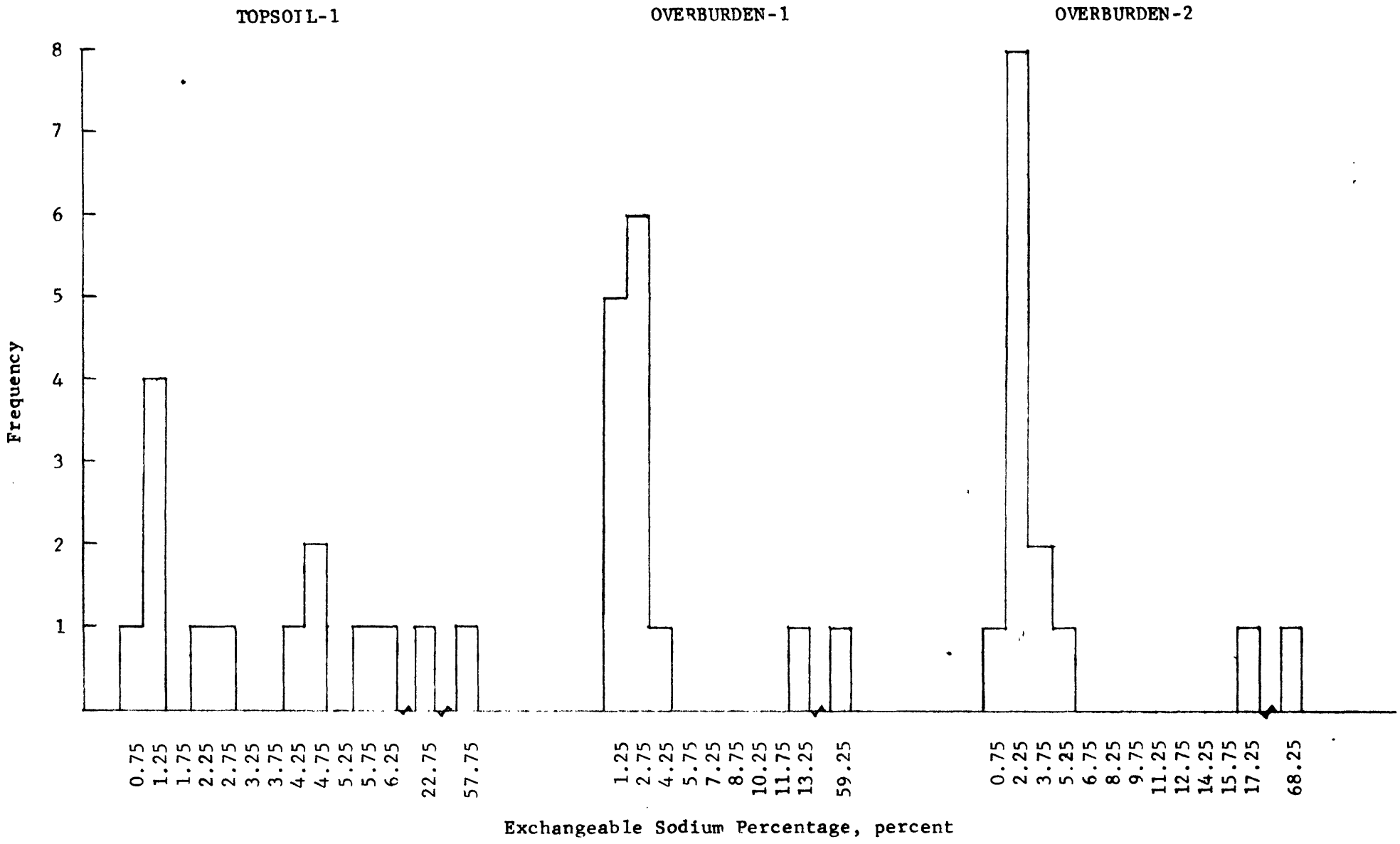

Figure 13. Histograms showing frequency distribution of analytical values for exchangeable sodium percentage.

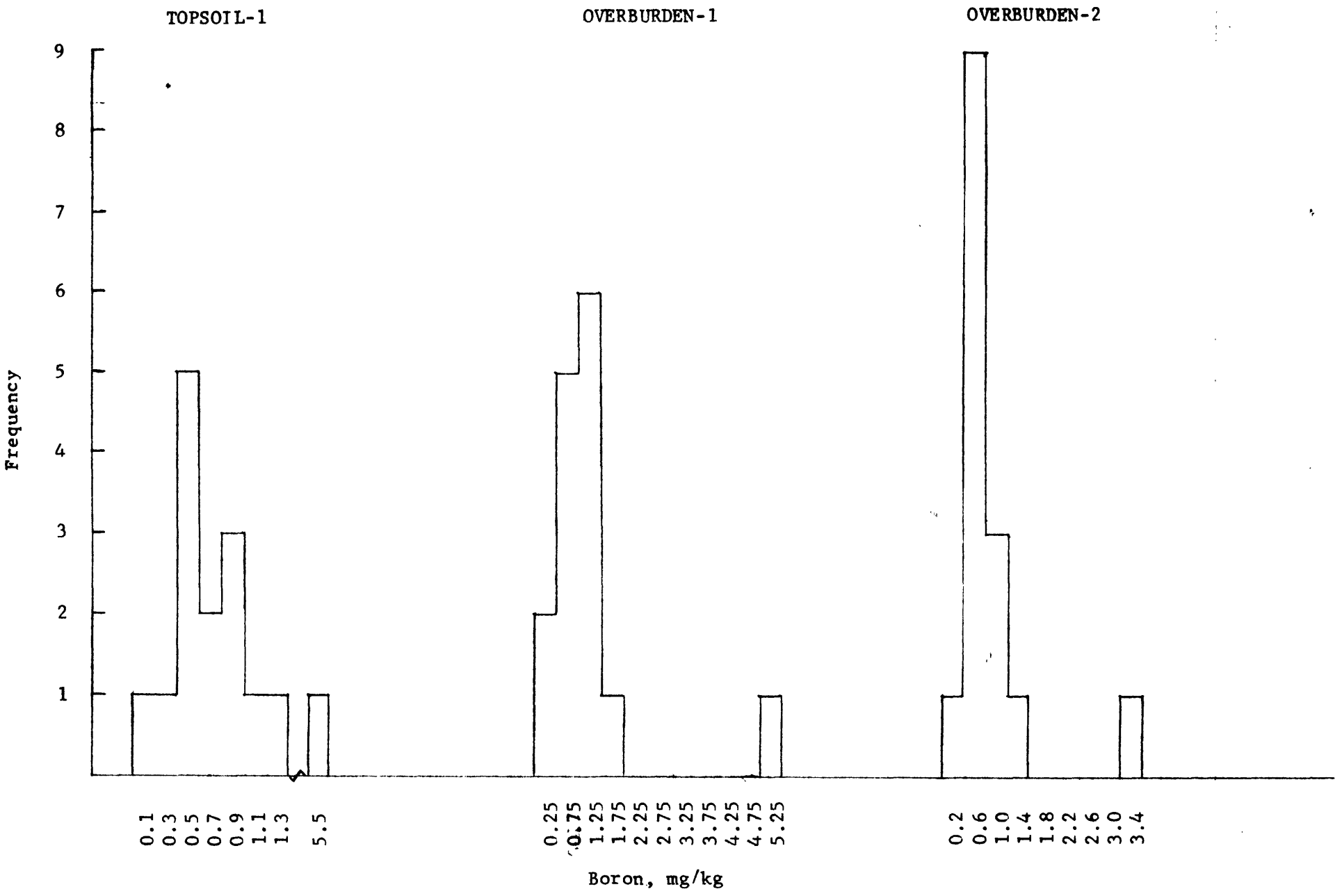

Figure 14. Histograms showing frequency distribution of analytical values for boron.

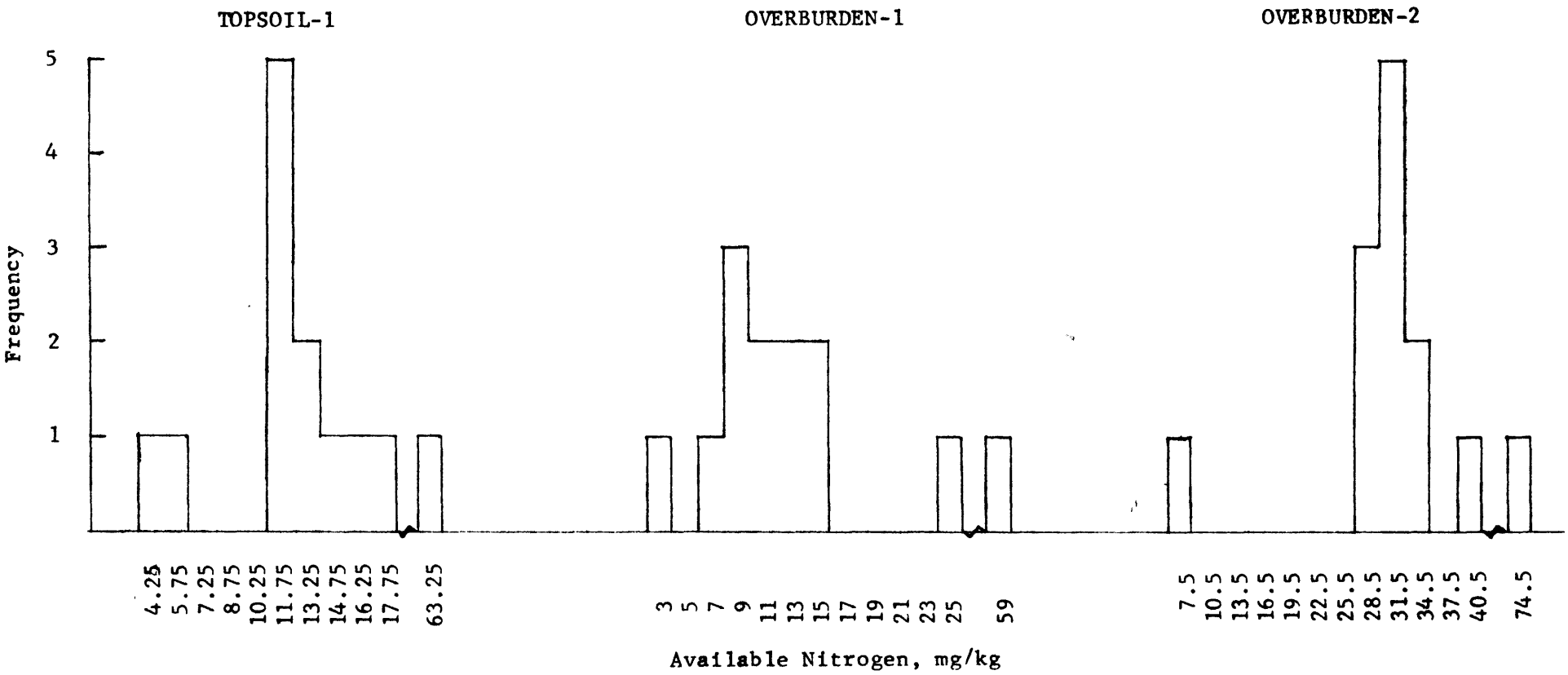

Figure 15. Histograms showing frequency distribution of analytical values for available nitrogen.

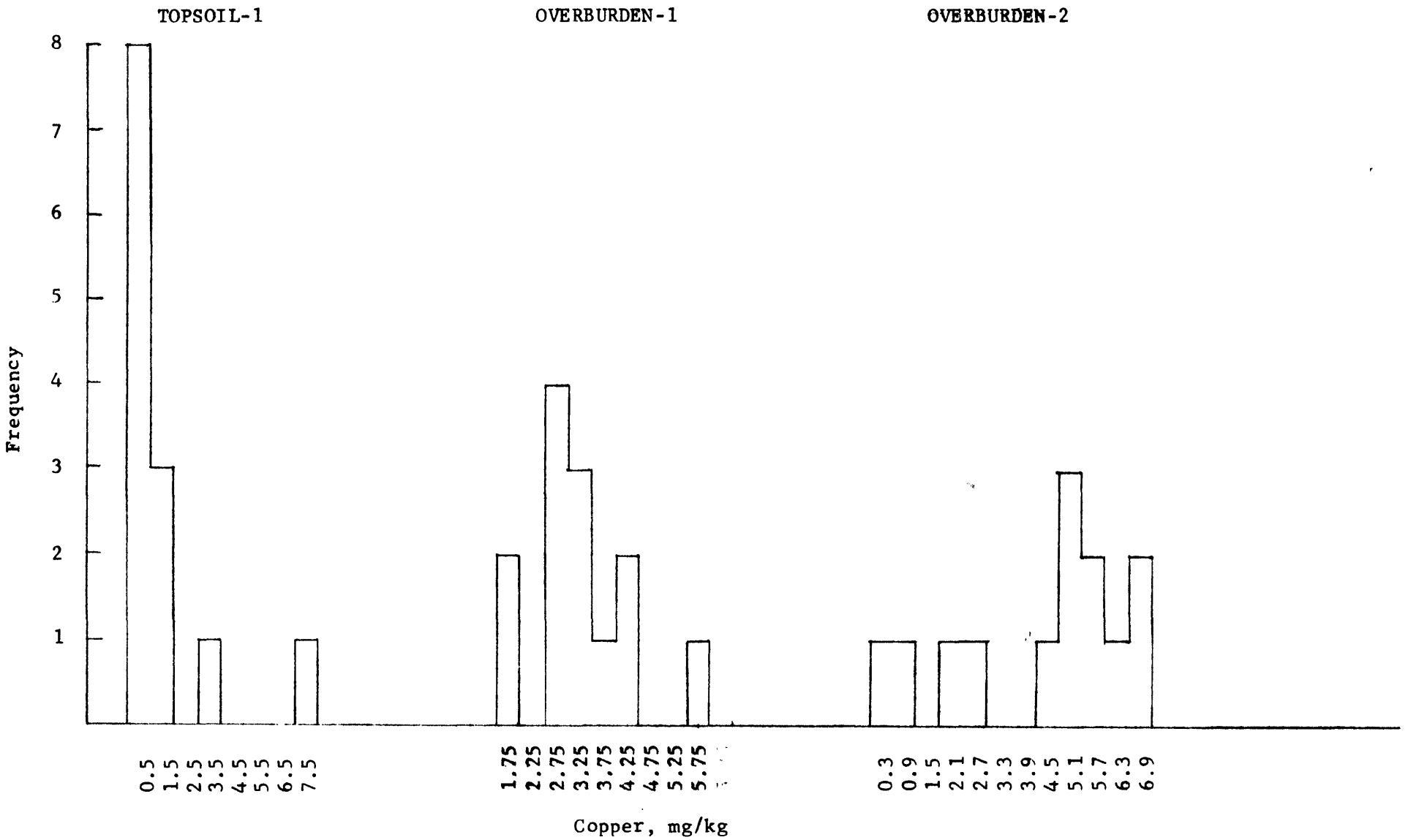

Figure 16. Histograms showing frequency distribution of analytical values for copper.

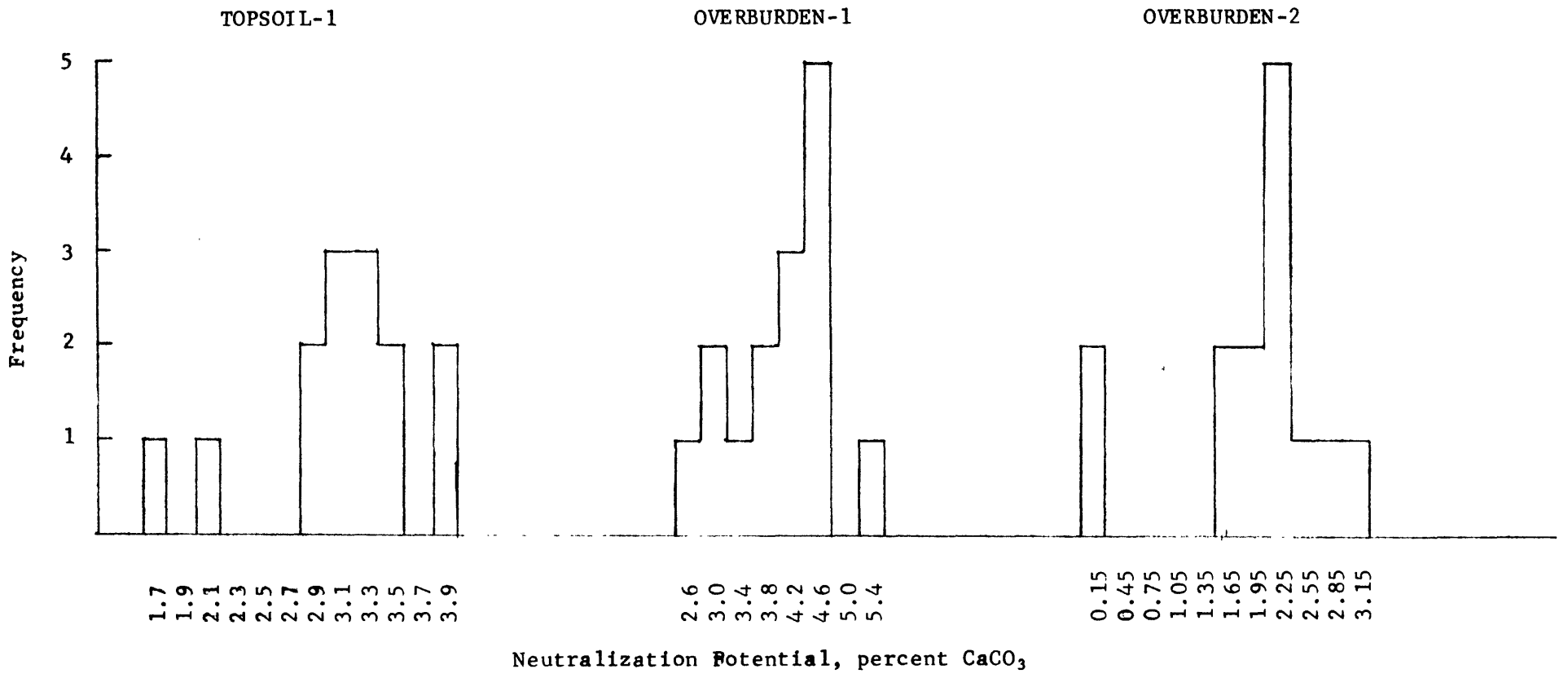

Figure 17. Histograms showing frequency distribution of analytical values for neutralization potential.

Table A1. Laboratories participating in the first round robin analysis program and laboratories expressing an interest in participating in future programs

ACCU Labs Research, Inc.
Attn: Jane Haefeli-Rund
11485 West 48th Avenue
Wheatridge, CO 80033
(303) 423-2766

A-L Mid West Agricultural Laboratories
Attn: John Menghini
13611 "B" Street
Omaha, Nebraska 68144

Analab Corporation
Attn: Dr. Charles Whiteside
2600 Dudley Road
Kilgore, TX 77662

Assaigai Analytical Laboratories
Attn: Dr. Jennifer Smith
7300 Jefferson, NE
Albuquerque, NM 87109
(303) 345-8964

Bookcliffs Commercial Laboratory
Attn: Dr. Ralph Poulsen
737 Lincoln Avenue
P. O. Box 774018
Steamboat Springs, CO 80477

Bowser-Morner Laboratory
Attn: Jim Fletcher
P. O. Box 51
Dayton, OH 45401

Casa Del Sol, Inc.
Attn: Dr. Joe Bowden
P. O. Bos 2605
Durango, CO 83301

Colorado School of Mines Research Inst.
Attn: Dr. Rick Barth
5920 McIntyre Street

Table A1.--continued

Golden, CO 80403

Colorado State Univ./Soil Testing Lab
Attn: Dr. Steve Workman
Room 6, Voc. Educ. Building
Fort Collins, CO 80523

Colorado Test Center, Inc.
155 South Navajo Street
Denver, CO 80223
(303) 698-1050

Commercial Testing and Engineering
Black Butte Coal Co.
P. O. Box 98
Point of Rocks, WY 82942

Commercial Testing and Engineering Co.
Attn: Robert Taylor & Leroy Jacobs
Instrumental Analysis Division
490 Orchard Street
Golden, CO 80401

CORE Laboratories
Attn: Mike Alexander
2116 Anthony Drive
Tyler, TX 75701

CORE Laboratories
Attn: Jeff Erion
P. O. Box 2794
Casper, WY 82602

CORE Laboratories, Inc.
Attn: Bill Lemons
1300 S. Potomac, #130
Aurora, CO 80012

Duel and Zahray Laboratories
P. O. Box 3006
College Station, TX 77841

Table A1.--continued

Energy Laboratories
Attn: John Standish
P. O. Box 30916
Billings, MT 59107

Engineering Surveys and Services
Attn: Larry Hendren
1113 Fay Street
Columbia, MO 65201

Environmental Analysis Laboratory
Brigham Young University
Provo, Utah 84602

Ford Chemical Laboratory, Inc.
Attn: Lyle Ford
40 West Louise Avenue
Salt Lake City, UT 84101

Grand Junction Laboratory
435 North Avenue
Grand Junction, CO 81501

High Plains Grasslands Research Center
Attn: Ernie Taylor & Jerry Schuman
8408 Hildreth Road
Cheyenne, WY 82009

Intermountain Analytical Service
3314 Pole Line Road
Pocatello, ID 83201

Intermountain Laboratories, Inc.
Attn: Roger Pasch
1633 Terra Avenue
Sheridan, WY 82801

Kiewit Mining and Engineering Co.

Table A1.--continued

Attn: Tom Bury
P. O. Box 3049
Sheridan, WY 82801

Lincoln-Devore Testing Laboratory
100 W. Fillmore
Colorado Springs, CO 880907

Lyndes Environmental Laboratory, Inc.
Attn: Jay Lyndes
P. O. Box 31733
Billings, MT 59107

Minnesota Valley Testing Laboratory
Attn: Jeff Reiser
1411 South 12th
Bismarck, ND 58501

Montana State University
Soil Testing Laboratory
Agricultural Experiment Station
Bozeman, MT 59717

Native Plants, Inc.
Applied Ecology - Soils Lab.
Attn: Marlene Pratt
417 Wakara Way
Salt Lake City, UT 84108

Natural Resource Laboratories
Attn: Ron Keil
100 Simms Street
Golden, CO 80401

New Mexico State University
Soil, Water & Plant Testing Laboratory
Attn: Andy Bristol
Agricultural Experiment Station
Las Cruces, NM 88003

Table A1.--continued

North Dakota State University
Soil Testing Laboratory
Fargo, ND 58105

North Dakota State Univ.
Land Reclamation Research Center
P. O. Box 459
Mandan, ND 58554

Northern Testing Laboratory, Inc.
Attn: Merle Listoe
P. O. Box 30615
Billings, MT 59107

Peabody Coal Company
Central Laboratory
P. O. Box 39
Freeburg, IL 62243

Railroad Commission of Texas
Attn: Dr. Paul Askenasy
Div. Surface Mining and Reclamation
P. O. Drawer 12967
Austin, TX 78711

Reclamation Research Unit
Attn: Dennis Neuman
Montana State University
Bozeman, MT 59717

Reclamation Services
Attn: Linda Sanz
12 Hartland Avenue
Madisonville, KY 42431

Standard Laboratories
Attn: Ray Sim
P. O. Box 1140
Huntington, UT 84528

Table A1.--continued

Standard Laboratory, Inc.
3322 Penn Avenue
Charlestown, WV 25302

Tradet Inc.
Attn: Dr. William Kalb
Wheeling - Ohio County Airport
Wheeling, WV 26003

Jim Travis
1854 Lombardy Drive
Rapid City, SD 57701

TSL Laboratory, Limited
Attn: Marvin Coleman
Spokane, WA 99214

Twin City Testing and Engineering Lab
3306 East Second
Gillette, WY 82716

Twin City Testing and Engineering Lab
3100 East Broadway
Bismarck, ND 58501

USDA-FS Northestern Forest Station
Attn: Dr. Willie Curtis
Route 2 - KY Highway 21 East
Berea, KY 40403

USGS Analytical Laboratory
P. O. Box 25046 (MS-928)
Denver Federal Center
Denver, CO 80225

University of Wyoming
Soil Testing Laboratory
Agriclutural Experiment Station
Laramie, WY 82001

Table A1.--continued

Utah State University
Soil Testing Laboratory
  Attn: Dr. Revel Lamborn
Agricultural Experiment Station
Logan, UT 84322

UTE Research Laboratories
  Attn: Dr. Richards
P. O. Box 266
Fort Duchesne, Ut 84057

Western States Reclamation
  Attn: Carl Mackey
7650 West 120th Avenue
Broomfield, CO 80020
(303) 469-1986

Wyoming Analytical Laboratory, Inc.
  Attn: Jane Thomas
605 South Adams
Laramie, WY 82070

Yakima Testing
  Attn: Mr. Duncan
1011 South 3rd Street
Yakima, WA 98901

Table A2. Recommended procedures for the First Western Task Force Round Robin Soil and Overburden Analysis Program

	Parameter	Reported As	Procedure
1.	pH	standard units	USDA Handbook 60, Method (21a), pg. 102.
2.	Conductivity	mmhos/cm @ 25°C	USDA Handbook 60, Method (3a), pg. 84 and Method (4b), pg. 89.
3.	Soluble calcium (Ca), magnesium (Mg), sodium (Na)	meq/L	USDA Handbook 60, Method (3a), pg. 84. Analysis by AA or ICP.
4.	Sodium absorption ration (SAR)		Calculated from: USDA Handbook 60, pg. 26
5.	Saturation %	%	USDA Handbook 60, Method (27a) or (27b), pg. 107
6.	Particle size analysis	% sand, silt, clay	ASA Mono. No. 9, Pt 1, Method (43-5), pg. 562-566.
7.	Texture	USDA textural class	
8.	Organic Carbon	%	ASTM, Method (D3174-82), pg. 396-397.
9.	Cation Exchange Capacity (CEC)	meq/100g	ASA Mono. No. 9, Pt 2 (2nd Ed), Method (8-3), pg. 152-154.
10.	Exchangeable sodium (ES)	meq/100g	ASA Mono. No. 9, Pt 2, (2nd Ed), Method (13-4.3), pg. 238-240.
11.	Exchangeable sodium percentage (ESP)	%	Calculated: $\frac{ES}{CEC} \times 100$
12.	Boron (B)	ppm	ASA Mono. No. 9, Pt 2, (2nd Ed), Method (25-9.1), pg. 443 and Method (25-5), pg. 435-436.
13.	Available nitrogen (N)	ppm	ASA Mono. No. 9, Pt 2 (2nd Ed), Method (33-3.2), pg. 649 and Method (33-8.2), pg. 679-682.
14.	Copper (Cu)	ppm	ASA Mono. No. 9, Pt 2 (2nd Ed), Method (19-3.3), pg. 331-333. Analysis by AA or ICP.

Table A2.--continued

Parameter	Reported As	Procedure
15. Molybdenum (Mo)	ppm	ASA Mono. No. 9, Pt 2 (1st Ed), Method (74-2), pg. 1062-1063. Analysis by Furnace AA or ICP.
16. Selenium (Se)	ppm	ASA Mono. No. 9, Pt 2 (1st Ed), Method (80-3.2), pg. 1122 and hydride generation for AA or ICP by ASA Mono. No. 9, Pt 2 (2nd Ed), Method (3-5.5.3), pg. 60
17. Acid Potential (AP)	% Total Sulfur	LECO Sulfur Analyzer
18. Neutralization Potential (NP)	% $CaCO_3$	USDA Handbook 60, Method (23c), pg. 105.
19. Acid Base Potential (ABP)	Tons Ca CO_3/1000 tons material	Calculated:[1] ABP = NP-AP

[1]The following calculations are necessary for conversion of % total sulfur and % $CaCO_3$ to common units of tons $CaCO_3$/1000 tons material:

% S x (31.24) = tons $CaCO_3$ required/1000 tons material

% $CaCO_3$ x (10) = tons $CaCO_3$ present/1000 tons material.

References

ASA Monograph No. 9, Part 1, (First Edition), C. A. Black (Ed), Methods of Soil Analysis - Physical and Mineralogical Properties, Including Statistics of Measurement and Sampling; American Society of Agronomy, Inc., Madison, Wisconsin, 1965.

ASA Monograph No. 9, Part 2 (First Edition), C. A. Black (Ed), Methods of Soil Analysis - Chemical and Microbiological Properties. American Society of Agronomy, Inc., Madison, Wisconsin, 1965.

ASA Monograph No. 9, Part 2 (Second Edition), A. L. Page (Ed), Methods of Soil Analysis, Chemical and Microbiological Properties. American Society of Agronomy, Inc., Madison, Wisconsin, 1982.

American Society of Testing and Materials, Part 26, Gaseous Fuels, Coal and Coke - Atmospheric Analysis. 1982. Philadelphia, PA.

USDA Handbook 60, U.S. Salinity Laboratory Staff. 1954. Diagnosis and Improvement of Saline and Alkali Soils; Washington, D. C.

Table A3. First Western Task Force Round Robin Soil and Overburden Analysis Program questionnaire

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Laboratory Name and Address:

Laboratory Director:

Percentage of Annual Workload:

Mining Agriculture Research

Percentage of Annual Workload:

Water Soil/Overburden Plants

Date samples received:

Briefly describe additional sample preparation prior to analysis:

Briefly identify any criticism you have regarding the current round-robin analysis program:

Briefly outline any improvements necessary prior to the second round-robin analysis program (fall, 1984):

In preparation of the Fall 1985 Conference, the Task Force would like to identify primary topics of interest. Please check the appropriate topic.

Methodologies	pH
Correlations among methods	Conductivitiy
Analytical problem areas	Soluble cations
Quality control	Soluble anions
Topsoil characterization	SAR
Overburden characterization	Particle size
Regraded spoil characterization	Organic carbon
Sampling methods	Available Na
Spoil chemistry	CEC
Soil analysis	ESP
Water analysis	Boron
Plant analysis	Available N, P, K
Geobotanical data	Acid potential
Drilling methods	Copper
Drilling mud composition	Molybdenum
Fly-ash disposal	Selenium
Other_____	Neutralization potential

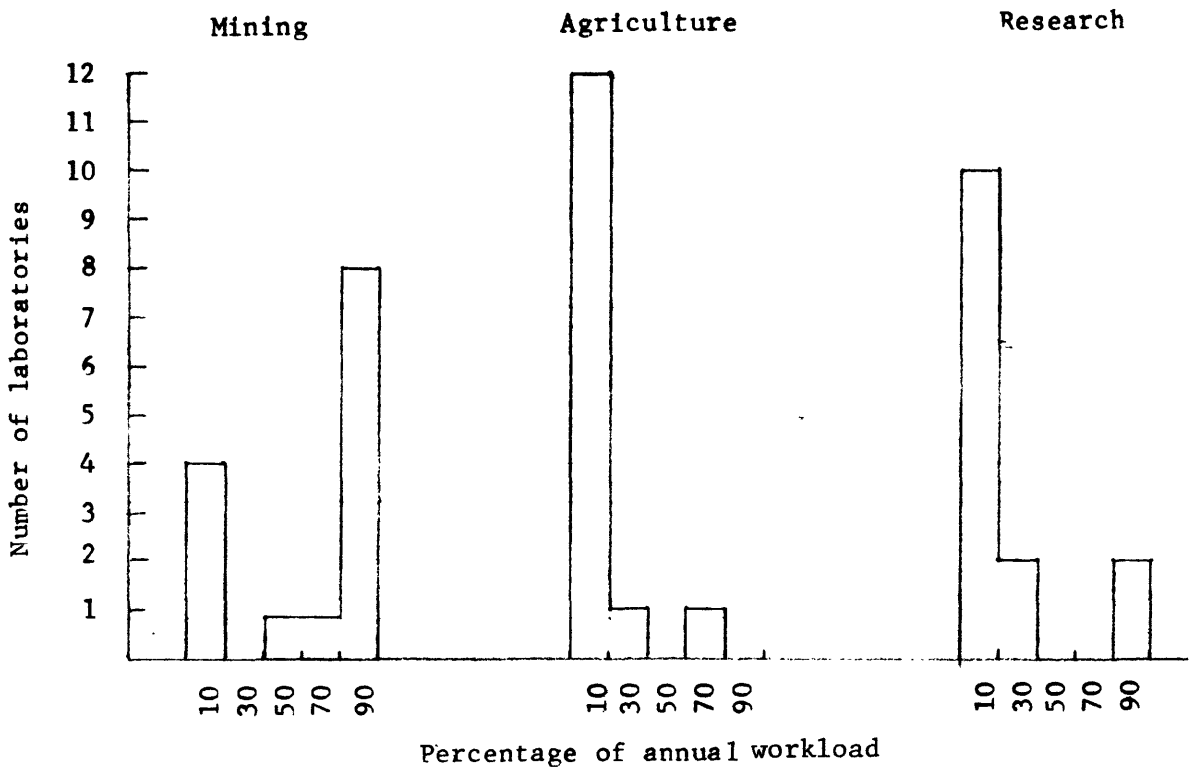
The possibility exists to include several invited speakers to the conference. Please list speakers and topics you would like them to address.

Table A4. Results of the round-robin survey on identifying topics of interest of participating laboratories

Number of Laboratories Expressing Interest					
11-10	9-8	7-6	5-4	3-2	1-0
Methodologies	Quality control	Soil analysis	Spoil chemistry	Overburden characterization	Geobotanical data
Correlations among methods	Acid potential	Selenium	Soluble cations	Regraded spoil characterization	Drilling methods
Analytical problem areas	Neutralization potential	Water analysis	Boron	Sampling methods	Drilling mud composition
		Organic carbon	Available N, P, K	pH	
		Cation exchange capacity		Conductivity	
				Sodium absorption ratio (SAR)	
				Particle size	
				Exchangeable sodium percentage (ESP)	
				Copper	
				Plant analysis	
				Fly ash disposal	
				Soluble anions	
				Available sodium	
				Molybdenum	
				Topsoil characterization	

Topics of interest other than those listed

- Acid-base potential methods
- Sulfate
- Fly ash analysis
- Problems in extraction methods
- Mercury
- Spoil mixing
- Instrumentation



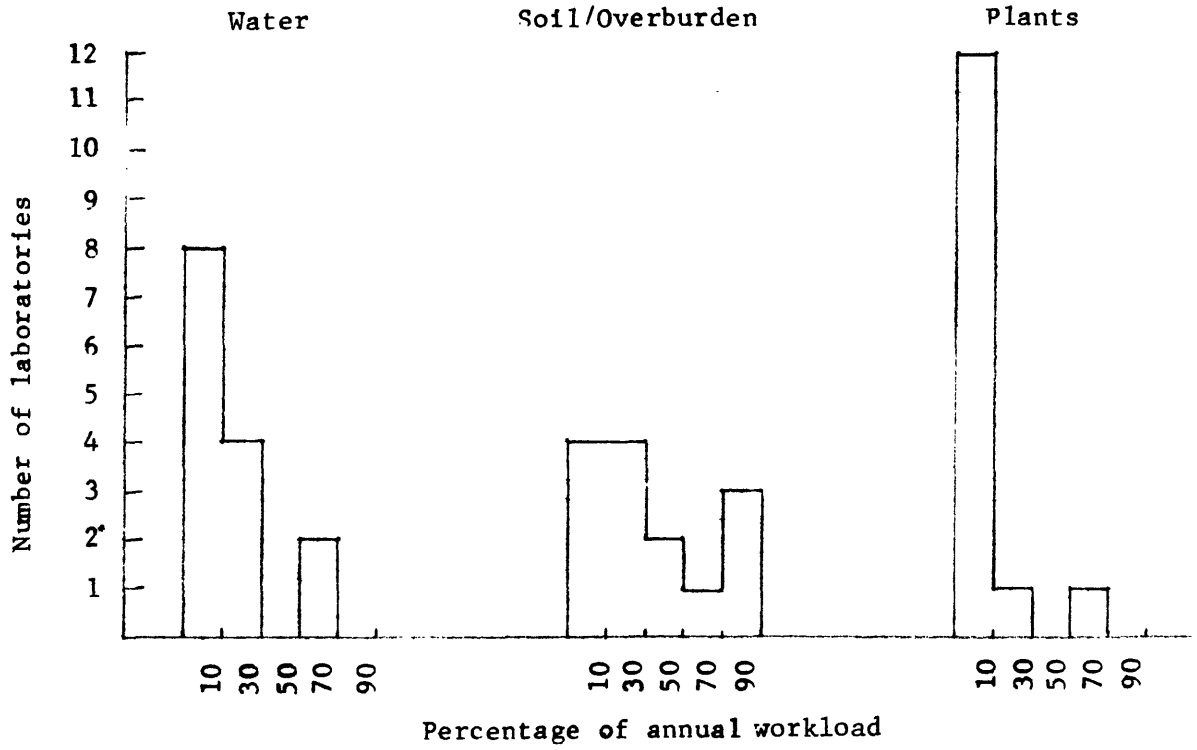


Figure A1. Results of the workload survey from the first round robin analysis program.