Nb species: columbite, niobian rutile, fersmite, eschynite and baotite. More typical carbonatites usually contain Nb principally as pyrochlore or as pyrochlore with greatly subordinate columbite.

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AN *X*-RAY SPECTROGRAPHIC METHOD FOR MEASURING BASE EXCHANGE CAPACITY

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Precise base exchange capacity measurements can be made by analyzing for exchanged strontium by *x*-ray spectrographic methods. Sample materials which had been used in A.P.I. project 49 and for which base exchange capacity values had been reported (Lewis, 1950) were used in this study. A good correlation ($r=.91$)[1] exists between the reported base exchange capacity values and the data provided by the *x*-ray fluorescent spectrograph for these samples as illustrated in Fig. 1.

The samples were prepared for this analysis according to a method previously described (Hinckley and Bates, 1960) consisting of exchanging Sr^{2+} onto the sample material by use of a $SrCl_2$ solution and by removing the excess strontium by a dialysis process. The method described by Bennett and Franklin (1954) was used in obtaining the precision values.

In the range from about 150 to 25 milliequivalents per 100 grams, the precision obtained at the .95 probability level is from ± 3.0 to ± 1.8 milliequivalents, respectively. At lower base exchange values, work on other samples, not plotted on Fig. 1, indicates that a precision in the order of $\pm 0.5\%$ of the base exchange capacity determined is obtained.

The sample underlined on Fig. 1 is a nontronite sample which did not

[1] Significant at least at 99% at $N=56$ (Arkin and Colton, 1950, p. 140).

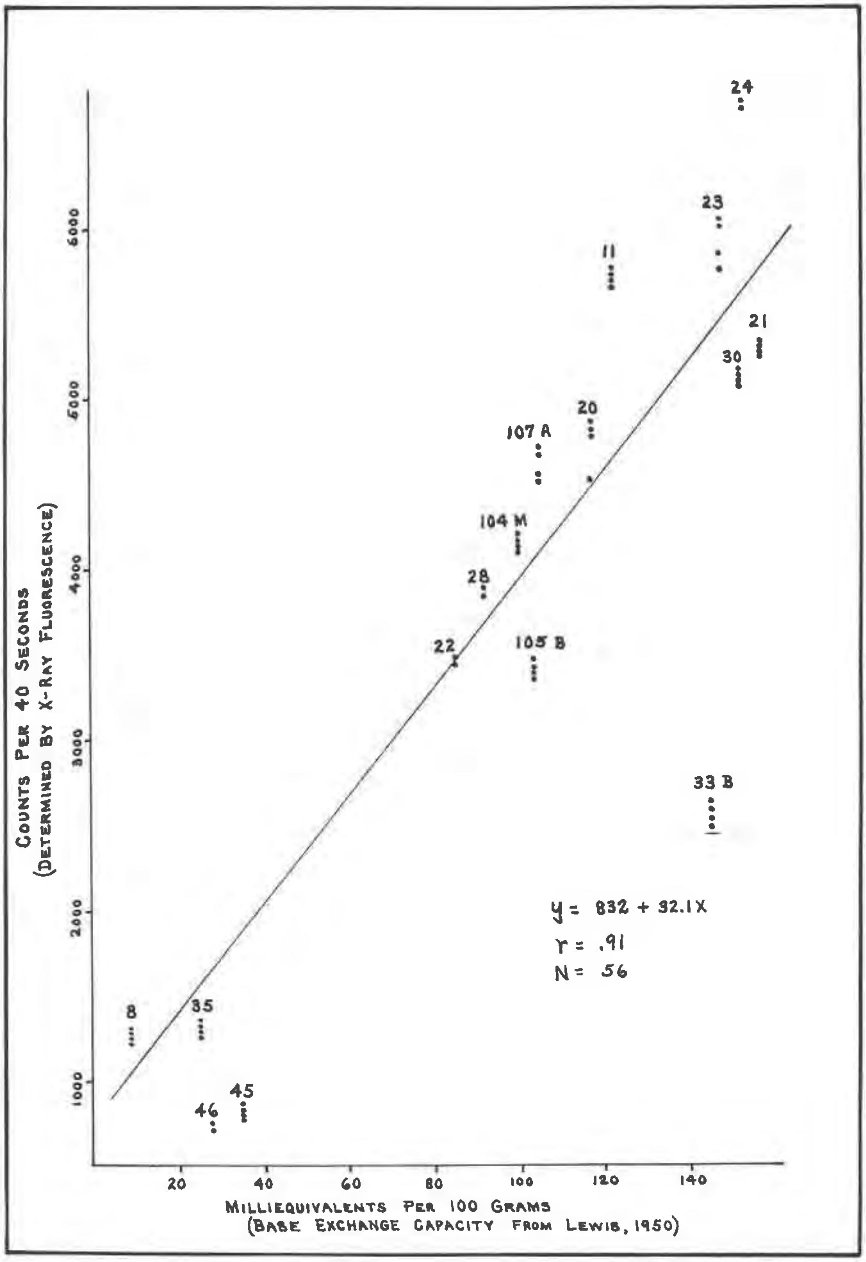

FIG. 1. Base exchange capacity versus counts per forty seconds.

TABLE 1. BASE EXCHANGE AND *X*-RAY SPECTROSCOPIC DATA

A.P.I. Sample No.	Clay Mineral, Locality	First Dialysis Group		Second Dialysis Group		Base Exchange Capacity
		Analysis 1	Analysis 2	Analysis 1	Analysis 2	
8	Attapulgus, Georgia	1246[2]	1241	1261	1262	5.5[1]
11	Santa Rita, New Mexico	5746	5655	5757	5656	122.0
20	Lorena, Mississippi	4805	4862	4789	4521	117.0
21	Jarest, Mississippi	5291	5300	5280	5258	157.0
22	Amory, Mississippi	3457	3490	—	—	85.0
23	Chambers, Arizona	6033	5850	6010	5752	147.5
24	Otay, California	6490	6461	—	—	153.0
28	Little Rock, Arkansas	3851	3896	—	—	92.0
30	Santa Rita, New Mexico	5166	5135	5087	5132	152.0
33B	Manito, Washington	2639	2587	2483	2526	145.0
35	Fithian, Illinois	1323	1298	1252	1320	25.0
45	Attapulgus, Georgia	850	845	792	790	35.0
46	Attapulgus, Georgia	714	718	—	—	28.0
104M	Nutfield, Surrey, England	4137	4194	4210	4162	100.0
105B	Nutfield, Surrey, England	3401	3396	3472	3409	103.0
107A	Somersetshire, England	4554	4536	4711	4674	105.0

[1] Milliequivalents per 100 grams (Lewis, 1950, pp. 93–97).
[2] Counts per 40 seconds.

disperse under the treatment given and whose values were not included in the data analysis. The data obtained appear on Table 1.

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OCCURRENCE OF STEVENSITE IN THE GREEN RIVER FORMATION OF WYOMING[1]

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The authigenic minerals found in the Eocene Green River Formation already make an imposing list. In the interest of keeping the record current, it seems worth while to add the occurrence of stevensite. The bed, which consists largely of stevensite, is about 4 inches thick and is extensive. The sample taken for study and analysis contains organic matter and carbonates. Because both calcite and dolomite are present in virtually all the rocks examined or analyzed in this member of the Green River Formation, we assumed they were both present in this bed. It was also assumed that calcite and dolomite were present in amounts necessary to account for the CO_2 found by analysis. By trial and error it was found that 5.2 per cent of calcite and 7.3 per cent of dolomite come close to balancing the amounts of both CO_2 and CaO available. The remaining CO_2 (0.18 per cent) is probably to be balanced by iron, either as siderite or sideritic calcite. The 7.3 per cent of dolomite requires 1.58 per cent of MgO, which is subtracted from the total MgO before recalculation of the analysis.

The stevensite bed is light chocolate brown, probably owing to the 2.78 per cent of organic matter it contains. From what has already been learned about the history of the Green River Formation it can be inferred that the clay formed in, or on the bottom of, Gosiute Lake when that lake was at a low level and was strongly saline. Studies to be reported elsewhere indicate that the brine was probably rich in carbonates, sulfates, and chlorides of Mg, Na, and K, and probably also in SiO_2.

The closely similar hectorite (= ghassoulite) has been reported as an authigenic mineral in lake beds of Africa (Jeanette, 1952). It is pertinent also to note that Eardley (1938, pp. 1344–1346) suggested the presence of a hydrated magnesium silicate in sediments now forming in Great Salt Lake, Utah. Rubey and Callaghan (1936, pp. 130–138) reported considerable quantities of a hydrated magnesium silicate (parasepiolite?) in

[1] Publication authorized by the Director, U. S. Geological Survey.