NOTE ON THE FLUORESCENCE TEST OF BENTONITE

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Brown (1) recently reported that swelling bentonites fluoresce under ultra violet light when moistened with a water solution of zinc uranyl acetate, but that non-swelling bentonites fluoresce only slightly, or not at all. He explained the cause of fluorescence as due probably to the dehydrating powers of clay involving free energy levels of the order chemisorption. He also stated that the sodium ion might play a considerable, but undetermined part in the effect. The writers have found that the sodium ion (exchangeable base) is the dominant cause.

Duplicate determinations of the fluorescence reaction were carried out by the writers on Wyoming sodium bentonite, Arizona bentonite, Mississippi bentonite, Illinois illite, and kaolinite. Fluorescence occurs only with sodium bentonite and gives negative results with calcium bentonite, calcium illite and kaolinite. However, all of the clay minerals including the kaolinite and illite groups show fluorescence when a small amount of sodium chloride is added. This fluorescence reaction appears to be due to the precipitate of the triple salt, sodium uranyl zinc acetate, having the composition $Na(UO_2)_3Zn\ (CH_3COO)_9 \cdot 6H_2O$. Feigl (2) reported that sodium zinc uranyl acetate gives a bright green-yellow fluorescence in ultra violet light, whereas zinc uranyl acetate gives no fluorescence.

To confirm the importance of sodium in causing fluorescence, a fluorescing Wyoming bentonite was leached with a calcium chloride solution to remove the exchangeable sodium and replace it with calcium. The resulting Ca-bentonite did not fluoresce with the acetate reagent. Furthermore, after the Arizona calcium bentonite (non-fluorescing) was leached with sodium chloride and washed free of NaCl, it then fluoresced. Sodium illite and sodium kaolinite which were prepared by leaching with NaCl solution fluoresced, weakly and not at all, respectively.

The quantitative effect on fluorescence of the degree of saturation by sodium of the exchangeable bases of montmorillonite and kaolinite was determined by adding known quantities of sodium (NaOH) to the respective hydrogen clays and testing the treated clays. The results are shown in table 1.

Obviously fluorescence of clay varies with the content of sodium. There is no fluorescence in montmorillonite when the saturation is less than 0.2 per cent sodium. Feigl (2) reported 2.5 gamma as the limit of identification of sodium by the fluorescence test. It is very interesting to note

TABLE 1. FLUORESCENCE REACTION OF MONTMORILLONITE AND KAOLINITE

No.	Degree of Na saturation	Gms. H-clay used	m.e. NaOH used	ml. 0.001 N NaOH used	Fluorescence* reaction
Montmorillonite, Base exchange capacity 100 m.e. per 100 grams					
1	0.1	0.08	0.00008	0.08	−
2	0.2	0.08	0.00016	0.16	−
3	0.5	0.08	0.0004	0.40	+
4	1.0	0.08	0.0008	0.80	+
5	5.0	0.08	0.004	4.00	++
6	10.0	0.08	0.008	8.00	+++
Kaolinite, base exchange capacity 2.75 m.e. per 100 grams					
7	50.0	0.1	0.00138	1.38	−
8	80.0	0.1	0.00220	2.20	−
9	100.0	0.1	0.00275	2.75	−

* − negative, + weak, ++ medium, +++ strong.

that the kaolinite when completely saturated with sodium does not fluoresce.

In addition to the above clay minerals, some sodium salts were also tested for fluorescence. Most mineral sodium salts fluoresce but some organic salts do not. Phosphates and large amounts of organic acids, such as oxalic and tartaric acids, have an interfering effect (3).

The writers wish to express sincere thanks to Dr. W. D. Keller, Dept. of Geology, Univ. of Mo., for his advice and encouragement in this test and also for furnishing samples of clay minerals.

REFERENCES

(1) BROWN, B. W., A fluorescence study of Wyoming bentonite: *Am. Mineral.*, **34**, 98 (1949).

(2) FEIGL, F., Beiträge zur anorganischen Tüpfelanalyse: *Rec. Trav. Chim.*, **58**, 473 (1939).

(3) BARBER, H. H., AND KOLTHOFF, I. M., A specific reagent for the rapid gravimetric determination of sodium: *Jour. Am. Chem. Soc.*, **50**, 1625–1631 (1928).

The American Petroleum Institute has published Preliminary Reports No. 2 and No. 3 in connection with Project 49, Clay Mineral Standards. No. 2, entitled, "Reference Clay Localities—United States," has been prepared by Paul F. Kerr and J. L. Kulp. The same authors, together with P. K. Hamilton, also have completed No. 3, "Differential Thermal Analyses of Reference Clay Mineral Specimens."

In No. 2 are descriptions of 33 clay mineral localities, kaolin group—10, montmorillonite group—15, potash bentonite—4, hydromica—2, and attapulgite and pyrophyllite—1 each. All localities save one (San Juanito, Mexico, for dickite) are in the United States. Included are 38 sketch geologic and location maps.

Preliminary Report No. 3 is divided into two parts. In the first the authors describe the method of differential thermal analysis and the equipment required for the technique. Part two presents the experimental results on the reference samples described in Report No. 2.

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Hugh S. Spence, Fellow of the Society, retired on September 15 from the Mineral Resources Division, Canadian Bureau of Mines, after thirty-nine years service. A graduate (1908) of the Royal Saxon School of Mines (Kgl. Sächsische Bergakademie), he specialized in mineralogy and geology under professors Kolbeck and Beck.

His work in the Bureau of Mines was mainly in the industrial and rare-element minerals field, and he is the author of numerous technical reports on these subjects. He made the first official report on the pitchblende discoveries at Great Bear Lake, and also is the author of the Prospector's Guide to Uranium and Thorium Minerals published by the Bureau in 1948. This useful little handbook has found the largest circulation of any of the Bureau's publications, and is now in its third printing.

With pegmatites as his particular interest, Mr. Spence has contributed several papers on Canadian pegmatite minerals to the *American Mineralogist.* He will engage in private practice as consulting mineral technologist, with address at 222 Argyle Avenue, Ottawa, Ontario.

Dr. A. E. Alexander, authority on gem stones and pearls, has resigned the directorship of the Gem Trade Laboratory, Inc., and has become associated with Tiffany & Co., where he will serve in an executive capacity.

Professor E. L. Bruce, Miller professor of research geology and head of the department of geology at Queen's University, died at Kingston, Ontario, on Oct. 5 from a heart ailment.

Correction

Line 7, page 696, the symbol "[100]" should be "[001]."
Line 22, page 698, "reworked" should read "reworking."