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TEXAS CLAYS AND THEIR ORIGIN.

BY W. KENNEDY, AUSTIN, TEXAS.

A SHORT time ago, while engaged in making a report on the clays of the State for the Geological Survey of Texas, I had occasion to study a large number of analyses made of clays belonging to the different Tertiary formations. During the course of the investigations it appeared to me that there was a peculiarity in the chemical composition of these clays not often seen among clays—that is, while in nearly every other clay to the analysis of which I had occasion to refer, and in which the alkalies, potash and soda were separated, the contained potash appears to exceed the percentage of soda, and in some instances this excess appears to be very great. In the Texas Tertiary clays, on the other hand, almost every one of the analyses made shows the soda to exceed the potash in ratios from 2 to 5 of soda to 1 of potash. As this excess varies in the different divisions, the difference generally increasing as we ascend in the beds, while at the same time the actual quantities of both decrease in the same ratio until the highest or coastal clays are reached, when the amounts of both are largely increased, I have been led to the opinion that this peculiarity might be due to the origin of the materials forming these deposits, or that some clue to their source might be obtained by a study of this phenomenon.

With this object in view, I have examined whatever analyses have been available of the deposits underlying or older than the Tertiary within the State, as well as the analyses belonging to the Tertiary and other beds found in the other States, so far as I have been able to obtain them, together with the analysis of the underlying deposits from which the clays may reasonably be expected to have been derived.

In the New Jersey clays, which, according to Cook, are of Cretaceous age and derived mostly from rocks lying to the southeast of the deposits, but which are now covered with water, or else completely destroyed, the percentages of potash and soda are 0.93 potash and 0.10 soda. In Ohio, according to Mr. Orton, the clays derived from the Carboniferous shales show averages of:

	Potash.	Soda.
5. Fire clays,	0.67	Traces
8. Potters' clays,	0.91	Traces
6. Pipe clays,	2.82	0.26
Or an average of	0.18	0.0137

In Kentucky, the next report examined, Dr. Peters shows the averages of the different formations to be:

	Potash.	Soda.
10. Tertiary fire clays,	0.607	0.099
17. Coal-measure fire clays,	0.537	0.407
5. Tertiary Potters' clays,	0.814	0.208
3. Coal-measure Potters' clays,	2.909	0.231
3. Black slate and Clinton clays,	4.537	0.303
1. Middle Hudson clays,	4.660	1.706

In Arkansas, according to Williams, the shales show the percentages of potash and soda to be:

	Potash.	Soda.
At Little Rock,	1.36	2.76
Round Mountain,	1.81	0.66
Fort Smith,	2.18	1.03

These shales belong to the Carboniferous, and it may be noted that the shales in the neighborhood of Little Rock are in close contiguity to the syenite area around Fourche Cove. Unfortunately no clay analyses showing the exact relations between the potash and soda in the Tertiary deposits are available from either Arkansas or Louisiana, into which many of the Texas Tertiary beds stretch with unbroken continuity.

Coming back to the fact that the Texas Tertiary clays are sodic clays, it is interesting to note that the immediately underlying deposits of Cretaceous age also carry an excess of potash over soda. The section of these beds appears to be roughly, in descending order, thus:

Greensand marls,
Marly flags,
Ponderosa (blue) marls,
Chalk marls,
Austin limestone.

The published analyses of these deposits show the percentages of potash and soda to decrease as we descend as follows:

	Potash.	Soda.
Greensand marls,	1.75	2.94
Ponderosa (blue) marls,	0.802	2.78
Chalk marl,	0.15	2.84
Austin limestone,	0.23	2.34
Average Cretaceous,	0.733	2.72

Going still further back in the deposits, the only analyses we have of the clays and shales of the Carboniferous show them to be also sodic and to carry a percentage of 3.09 soda and 1.53 potash, or closely approximating the ratio shown in the Tertiary basal clays and the lignitic beds.

The only analyses we have of the Texas kaolins show the west Texas materials to be practically free from alkalies and the Edwards County deposits to carry 0.02 of potash and 0.60 soda. An analysis of the basalt from Pilot Knob, near Austin, gave Professor Kemp 2.77 soda and 2.02 potash (*Amer. Geol.*, Nov., 1890). A kaolin from Pulaski County, Arkansas, shows 0.23 potash to 0.37 soda.

Clays naturally partake of the nature of the rocks from which they may have been derived, and the proportions of their constituents will in the same manner be in a ratio more or less in accordance with those of the parent rock, the variations being due to the solubility of the constituent and the number of changes to which it may have been subjected during the course of its transportation from the original locality to that in which we may find it. These changes are, however, sometimes extremely great, as, for instance, in the case of kaolin. Williams shows a kaolin in Arkansas, evidently derived from a syenite containing 5.48 potash and 5.96 soda, to have only 0.23 potash and 0.37 soda.

Since, then, the Texas Tertiary clays appear to be sodic,