

XXV.—*On the Action of Sodium Hydrate and Carbonate on Felspars and Wollastonite.*

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IN the qualitative analyses of rocks which contain silicates that resist the action of hydrogen chloride, as well as other silicates which are broken up by that reagent, the silicic acid of the soluble silicates remains for the most part with the silicates which are unacted upon by the acid; and it is subsequently removed by treating the entire insoluble part with sodium carbonate in which it dissolves. By some chemists the use of sodium hydrate has been recommended in conjunction with the carbonate, and even the use of the hydrate pure and simple has been suggested in place of carbonate. As the results of many analyses, more especially those of the mixed rocks which occur in meteorites, appear to contain errors arising from the use of sodium hydrate, experiments were made with the view of determining the precise nature of the action of the hydrate in each case; and a series of specimens of felspar were exposed to the action of sodium hydrate of different strengths. Each specimen was carefully picked over to obtain as pure material as possible, and was then pounded to the same extent as nearly as it could be.

A specimen of adularia from St. Gothard was dried at 120°, and digested with about 3½ times its weight of sodium hydrate, prepared from sodium, in strong solution in a platinum vessel for 25 hours at 100°; the platinum crucible contained a little ball of platinum, which served to stir up the mixture and keep up a constant agitation. As the water slowly evaporated from the crucible it was replenished to keep it as nearly as possible at the same strength, and it was never allowed to go to dryness.

The result of the above experiment was that 35·688 per cent. of the adularia was rendered soluble; the amount of silicic acid taken up was 23·196 per cent., or of the silicate dissolved 64·996 per cent., which shows that the action of the sodium hydrate was that of a solvent only, analysis showing the adularia of St. Gothard to contain 65·69 per cent. of silica. The amount of alumina dissolved was 3·309 per cent., or one-seventh of the silicic acid, instead of between one-third and one-fourth, as it should be. The cause of this is not easily explained. That the alumina was not retained by the silicic acid was shown by evaporating it twice with ammonium fluoride, when 0·2741 gram of silicic acid was found to contain 0·0036 gram residue or 1·313 per cent.

A specimen of microclin from Siberia was next treated in the same way. Dried at 120° and carefully picked and pounded to what was believed to be the same degree, it was treated with sodium hydrate as above. There were dissolved 17·588 per cent., of which 10·946 per cent. were silica, which would make the microclin contain 62·235 per cent. of silicic acid; and 2·491 per cent. of alumina. Microclin contains from 65·5 to 65·7 per cent. of silicic acid.

A specimen of albite from the Dauphiné was dried at 120°, and treated in the same way for 22 hours, with three times its weight of solid sodium hydrate dissolved in a little water. There were dissolved 23·100 per cent., 12·553 per cent. of which was silica, and 1·466 per cent. of alumina.

These experiments were next repeated with a weaker solution of sodium hydrate. In the above experiments the amount of the solvent was three times that of the felspar; in the next set of experiments the amount of sodium hydrate was the same or, at the most, a little more than that of the powdered felspar. The conclusions arrived at in these cases were:

A quantity of adularia, another portion of the same quantity as that used above, was treated at 100° for 22 hours with a strong solution of sodium hydrate, and there were dissolved 14·693 per cent., of which 5·703 per cent. were silicic acid, and 1·752 per cent. alumina.

A quantity of the same supply of microclin, as that which was used in the above experiment, was treated for 22 hours at 100° with about its equal weight of sodium hydrate, and there dissolved 7·453 per cent., of which 4·763 per cent. were silicic acid, and 1·193 per cent. alumina.

The albite, referred to above, was in the same manner treated. A quantity was digested with about its equal weight of sodium hydrate for the usual time at 100°, and there were dissolved 9·472 per cent., of which 5·643 per cent. were silicic acid, and 2·015 per cent. of alumina.

With a view to compare the action of sodium carbonate, the

strength of the solution of which shall be such that it contains the same number of molecules as the strongest sodium hydrate previously employed on one of these feldspars, some more of the St. Gothard adularia, about 1 gram in weight, was treated with 4.56 grams of dry sodium carbonate dissolved in a very little water at  $100^{\circ}$ , for  $24\frac{1}{2}$  hours, when 1.785 per cent. of the mineral was dissolved, in which were found silicic acid 0.435 per cent., and alumina 0.145 per cent.

While, therefore, the sodium hydrate acts powerfully upon these silicates as a solvent, and takes them up in large quantities, the strongest sodium carbonate has but a slight action upon them, both when the reagent is of great strength and when its action is extended over a long time.

It should, perhaps, be pointed out that in the case of the microclin three several experiments were made with a view to ascertain the proportion of the silicate which is really taken up by the sodium hydrate in each case, and it was found that when 1 gram of microclin was acted upon in each case, it led to the following analytical results:—

1 gram microclin with 0.9893 gram of sodium hydrate in strong solution for 22 hours at  $100^{\circ}$  lost 7.453 per cent., of which 4.763 per cent. were silicic acid and 1.193 per cent. alumina.

1 gram microclin with 2.894 grams of sodium hydrate, or 2.93 units in strong solution for 22 hours at  $100^{\circ}$  lost 17.588 per cent. of its weight, of which 10.946 per cent. were silicic acid and 2.491 per cent. were alumina; and in the third case

1 gram microclin with 7.704 grams of sodium hydrate, or 7.79 units, in strong solution for 22 hours at  $100^{\circ}$  lost 32.018 per cent. of its weight, of which 20.869 per cent. were silicic acid and 3.981 per cent. were alumina.

It appears from the above results as if the monoclinic feldspar was more readily acted upon by sodium hydrate than the triclinic.

At the conclusion of these experiments it seemed desirable to determine the extent to which wollastonite would be attacked under the circumstances. A specimen from Sweden was carefully picked over to separate it from a green mineral which accompanied it, and then dried at  $120^{\circ}$ , and pounded as nearly as possible to the same degree as the feldspars were. It was then digested with about three times its weight of sodium hydrate in strong solution for 22 hours at  $100^{\circ}$ , in short, under the same circumstances as those referred to in the earlier cases. There were dissolved in the soda liquid, and one containing the slightest possible excess of acetic acid, 0.5893 or 32.059 per cent. of silicic acid and lime in the ratio of 50.79 per cent. of silicic acid to 49.21 per cent. of lime, the proportion in which they occur in wollastonite; in short, the action of the reagent was that of a solvent.