It has not been possible to analyze the crystals as they are small and almost black, due to Fe_2O_3 absorbed from the surrounding glass. (Table 1 in the following note). In all probability we are dealing with nepheline. The fibrous form of nepheline is shown in Fig. 3, well known from samples of corroded glass furnace bricks.

It has not been possible to repeat the rapid growth at room temperature. I have made more than 50 attempts, but all the experiments have been unsuccessful. I have been able, however, to reproduce the initial stage in one case, and the end form in numerous cases. By heating the initial stage to ca. 700° C for 15 minutes, the fibrous form was developed. Normally the growth of the crystals in the studied glass is exeedingly slow at this temperature.

Possible sub solidus phase borders in the corundum field of the system SiO_2—Al_2O_3—Na_2O

BY

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Crystals formed in a glass taken from the surface of an industrial glass tank furnace refractory brick of the melting zone have been studied. The results indicate the presence of two, possibly three, sub solidus phase borders in the corundum field of the SiO_2-Al_2O_3-Na_2O diagram.

The top of the furnace was made of «Silicastones», containing ca. 98 % SiO_2. The alkaline vapors from the glass batch condence on the ceiling and cause the formation of a SiO_2-Na_2O glass. The viscosity of this glass decreases as the Na_2O content increases, and finally it will run down to the walls of the furnace. The wall bricks, having a composition according to Table 1a, will be corroded by the SiO_2-Na_2O glass and add Al_2O_3 to it. The studied glass, thus formed, had a composition according to Table 1b.

	a	b
SiO_2	33 %	58,3 %
Al_2O_3	67 %	27,0 %
Fe_2O_3		0,3 %
CaO		1,6 %
Na_2O		12,9 %
	100	100,1

Table 1, chemical composition, a) of the unattacked refractory stone, b) of the studied glass.

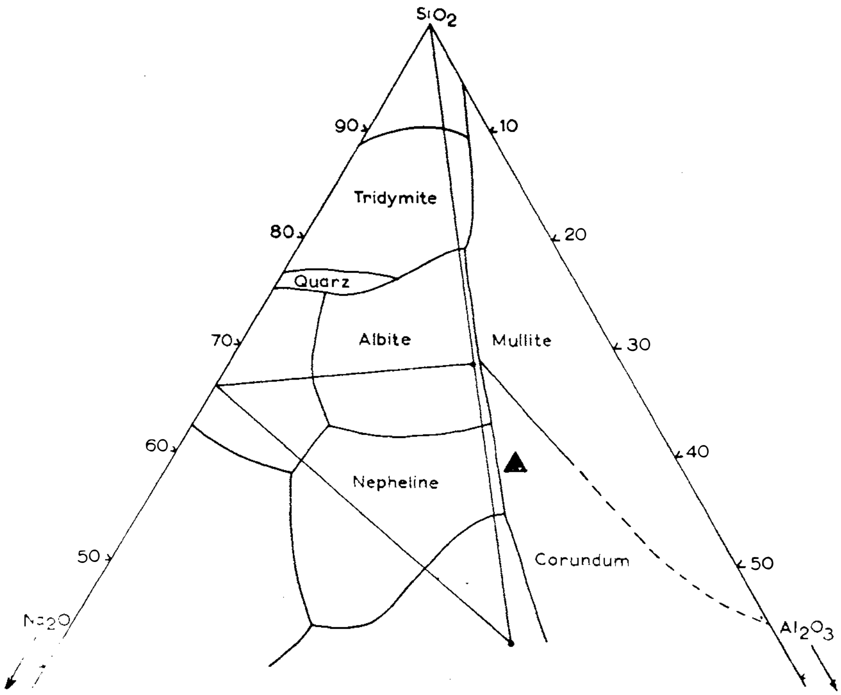

Fig. 1. Part of the phase diagram SiO_2-Al_2O_3-Na_2●. The studied glass marked by a triangle.

The chemical composition of the glass, marked by a triangle, is projected into the pure SiO_2-Al_2O_3-Na_2O phase diagram in Fig. 1.

The studied glass from the glass covered refractory brick was remelted and ground until uniform index of refraction was obtained.

The glass was heated at different temperatures in a platinum furnace. The temperature readings were made with a Pt-90Pt10Rh thermocouple calibrated against a standard thermocouple from the U. S. National Bureau of Standards.

The habit of the crystals formed during the heat treatment was studied under the microscope. The crystals were analyzed by x-ray analysis.

Microscopical Examination.

One sample was kept at 1270° C for 15 minutes. The index of refraction of the very small crystals formed during this heat treatment was much higher than the index of refraction of the glass. Because of lack of material it was not possible to analyze these crystals by means of x-ray. They are supposed to be corundum.

Fig. 2. Normal habit of albite obtained by devitrification above 1020° C.

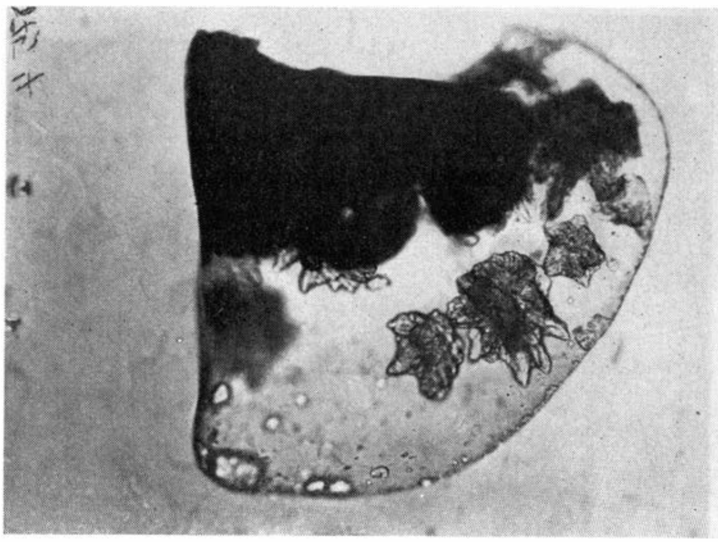

Fig. 3. Normal habit of nepheline obtained by devitrification below 1015° C.

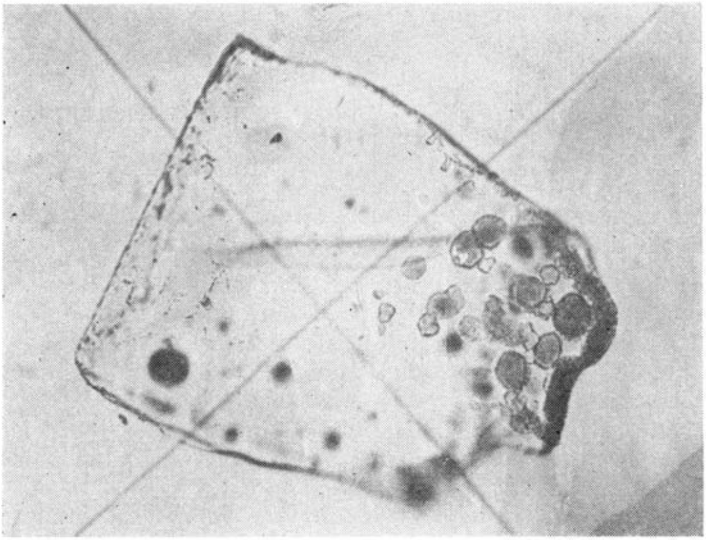

Fig. 4. Crystals formed at 860° C.

There was a change of the habit of the crystals at 1015° C—1020° C. Above 1020° C crystals as shown in Fig. 2 occured, below 1015° C crystals as shown in Fig. 3 occured. There was another distinct change of the habit of the crystals at ca. 800° C. These crystals are shown in Fig. 4. The growth of the crystals at this temperature, however, was too slow to give sufficient material for x-ray analysis even after 5 weeks.

X-ray Analysis.

The results from the powder patterns of the studied glass heated at different temperatures are shown in Table 2.

Degree Centigrade	Crystals formed according to powder pattern
1150	Albite
1047	Albite
1035	Albite
1020	Albite
1015	Nepheline
1005	Nepheline
995	Nepheline

Degree Centigrade	Crystals formed according to powder pattern
980	Nepheline
960	Nepheline
860	No Lines

Table 2, Devitrification products at different temperatures.

The lines of albite formed in the studied glass are rather indistinct, but the observed 10 strongest lines had the same spacing as the 10 strongest lines in the pattern of albite from Schmirn, Tyrol, our record number 2283. The fact that albite was found at 1150° is due to an admixture of the anorthite molecule.

The lines of nepheline formed in the studied glass are sharp and correspond to those of nepheline from Ariccia, Alabama Mountains, our record number 2260.

One sample was kept at 980° C to show if nepheline is metastable in the studied glass at this temperature. The powder pattern indicates that the nepheline was unchanged after 3 weeks. Another sample was kept at 1047° C, and the powder pattern indicates that the albite was unchanged after 1 week.

Conclusion.

This investigation indicates the presence of two, possibly three, sub solidus phase borders in the corundum field of the phase diagram SiO_2-Al_2O_3-Na_2O. The temperature of the phase border corundum-albite in the studied glass in unknown, the phase border albite-nepheline is, in this glass, situated at 1020° C—1015° C. The microscopical examination showed another change of the crystal habit at 880° C — 860° C. It is not known, whether this change is merely a change of the habit of nepheline, or if it indicates the presence of a crystal which is not nepheline.

ACKNOWLEDGEMENTS

Miss E. Christensen, Geological Survey of Norway, made the chemical analysis of the glass, the x-ray films were taken by Mr. Sellevoll, Mr. Sæbø and Mr. Sverdrup, and dr. H. Neumann kindly assisted in the interpretations of the x-ray patterns of the crystals.

Professor T. F. W. Barth placed at my disposals the laboratory facilities of Mineralogisk Geologisk Museum. To these persons I wish to express my sincere thanks.

Oslo November 1955.
Mineralogisk Geologisk Museum.

Appendix.

It is in this connection of interest to mention, that dr. J. H. Welch, in a lecture delivered at the 3rd. International Congress of The Activity of Solids in Madrid April 1956, reported the formation of corundum at sub solidus temperatures in a glass of the composition of of anortite.