MICROCLINIZATION OF PLAGIOCLASE BY SOLID-STATE REACTION

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THE natural conversion of albite ($NaAlSi_3O_8$) and microcline ($KAlSi_3O_8$) by the cation exchange reaction in the molten alkali halides has been reported by Wyart and Sabatier (1956) as well as by Orville (1967). The present series of experiments indicate that the reaction between albite and potassium halide takes place in the solid-state at a temperature of 550-600° C. Under the same set of conditions, conversion of disordered oligoclase to sanidine takes place. It is found that these solid-state reactions occur without any change in the order-disorder characteristics of the feldspars.

The powdered albite (c-200 to 250 mesh) is thoroughly mixed with dry potassium halide powder (chloride, bromide or iodide) in different ratios. The mixture is heated in a platinum crucible at 550° C. and maintained at this temperature for 72 hours. At the end of this interval of time, the mixture is cooled, washed with water on a sintered glass septum to dissolve all the alkali halides. The residue remaining on the septum is used for chemical analysis and infrared spectral studies. Experiments are carried out with different weight ratios of potassium halides (30, 5, 3 or 1 times the weight of albite). Reaction proceeds in all the cases at 550° C. and is complete in about 48-72 hours. Reaction is found to be quicker with potassium iodide.

The albite used in the present set of experiments is from the ore-pegmatite altered contact of the Nandydrug mine of Kolar Gold Fields. The chemical composition of this feldspar is SiO_2 68·8%, Al_2O_3 19·40% and Na_2O 10·76%. The calcium content in these samples is below detection. The sample of potassium feldspar obtained from the reaction has the composition SiO_2 64·7%, Al_2O_3 18·3% and K_2O 16·8% with minimum sodium content. It can be concluded that nearly complete replacement of sodium occurs during the reaction.

The infrared spectra of the albite, the converted material and a sample of potassium feldspar (microcline) are given in Fig. 1. The coincidence of spectra II and II are very evident. The spectrum shows that the microcline produced is highly ordered. As the degree of disordering increases, the bands in the 800-700 cm.$^{-1}$ become less sharp. It had been proved that infrared spectrum is a better tool in determining the order-disorder nature in feldspars (Hafner and Laves, 1962).

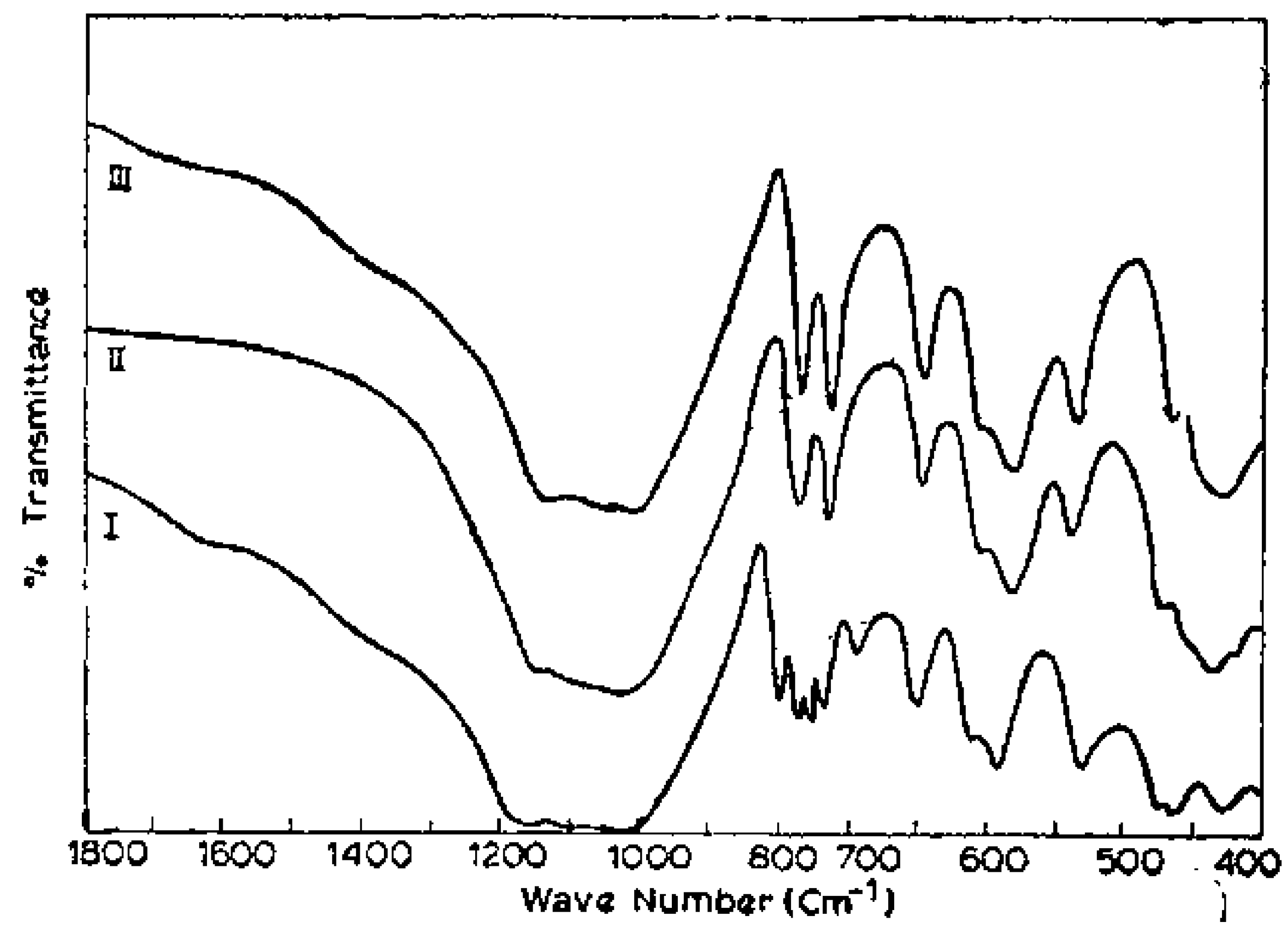

FIG. 1. Infrared spectrum. I—Albite. II—The product of reaction with KCl. III—Microcline.

The fact that the reaction occurs independent of the ratio of potassium halide to albite, indicates that the process is a solid-solid reaction. Alternatively, it can be treated as a simple exchange of cation in which the framework of linked SiO_4 and AlO_4 tetrahedra of the feldspar remain intact as in the case of zeolites. If it is a simple ion exchange of the zeolite type, the ratio of potassium halide to albite should affect the extent of reaction, the more the amount of potassium salt, the quicker and complete will be the exchange. The experimental data indicate no such characteristics and hence is a true solid-solid reaction.

The reaction is also done with oligoclase. The powdered oligoclase (from Halagur), when mixed with 30 times the weight of KCl and heated at 600° C. for 72 hours, gets converted into sanidine. The formation of sanidine is due to the fact that the oligoclase used is from the characteristic facies which is comparatively disordered (Fig. 2). The two series of reactions clearly indicate that the structural state of feldspars remains unaltered during the solid-state reaction.

These sets of reaction are of particular significance for the following reasons. The synthesis of potassium feldspar always results in the disordered monoclinic phase. The conversion of sanidine to microcline is never achieved under laboratory conditions. However, the ordered microcline is widely found in

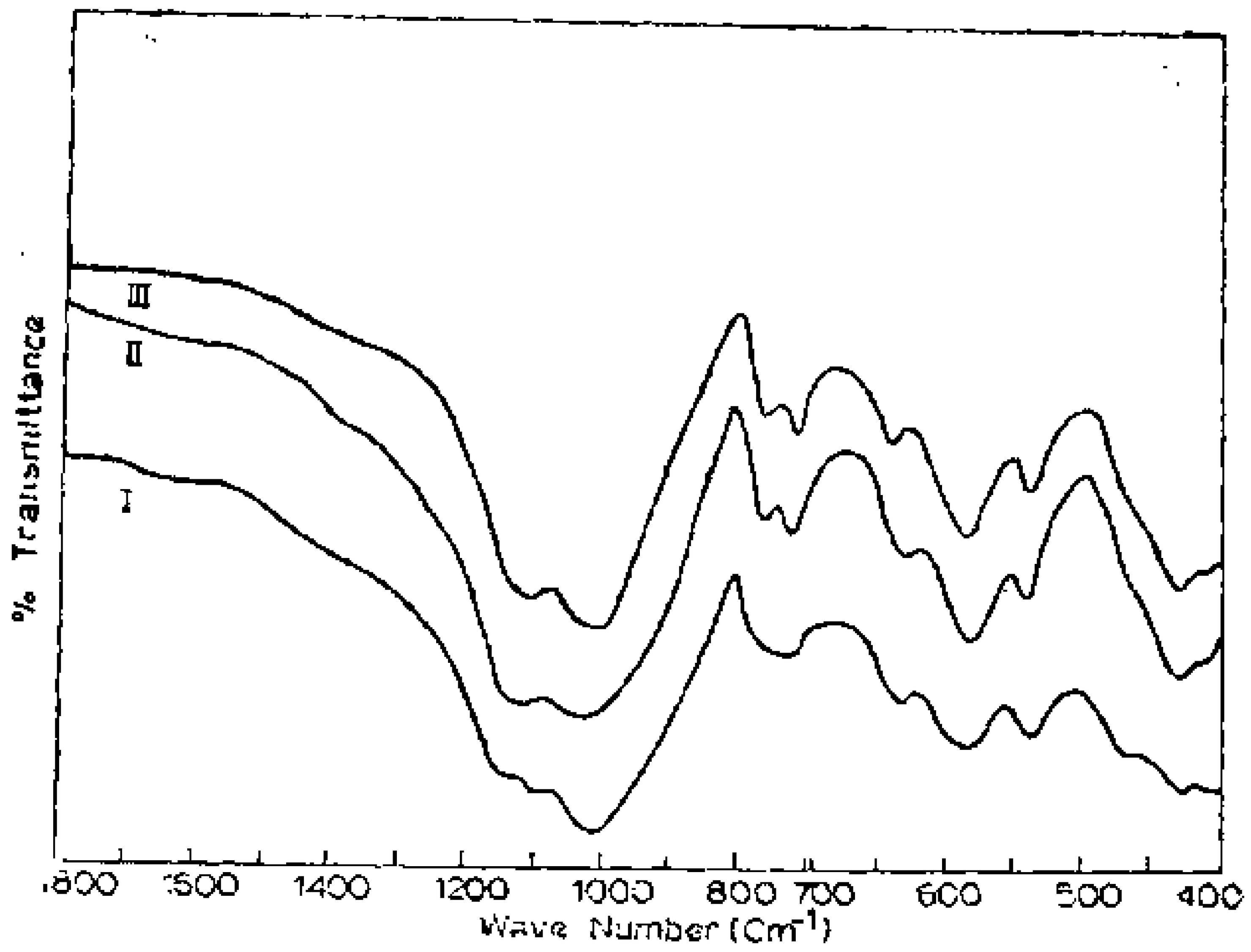

FIG. 2. Infrared spectrum of oligoclase. I—The reaction product by heating with KCl at 600° C. for 72 hrs. II and III—Sanidine.

nature in the rocks of lower amphibolite facies. The origin of microclines in such cases cah be explained as due to the solid-state conversion of plagioclase (albite rich) into microclines by potassium metasomatism. Petrographic works in the granitic rocks of South-East Precambrian of Mysore reveal that potassium feldspars were formed by the microclinization of plagioclases (Radhakrishna, 1956).

The experiments, conducted under similar conditions for the reaction of sodium chloride with microcline, do not yield any albite.

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MAGNETIZATION OF METANORITE DYKE IN HIRAPUR, DHANBAD

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METABASIC rocks of pre-Cambrian age occur intruding the Archean metamorphic rocks in and around Dhanbad (Bihar State). They include metanorite, metadolerite and epidiorite. The rocks were originally of doleritic composition but have been later subjected to metamorphism. They occur as irregular masses forming high and low hillocks and as broad dykes.

A magnetic study of a metabasic dyke in Dhaiya, Dhanbad, has been made by the authors.[1] The Hirapur and Dhaiya dykes are connected and they are about a mile apart.

The metanorite of Hirapur is composed of plagioclase (mostly labradorite) and pyroxene as essential, and olivine, biotite and magnetite as accessory minerals. The pyroxene is mainly pink hypersthene. Pyroxene is altered to fibrous green amphibole. Ophitic to subophitic texture is seen. Satyanarayana Murty and Agrawal[2] reported cloudiness of felspars in this metanorite and they attributed this to the effects of metamorphism.

The intensity and direction of natural remnant magnetization (N.R.M.) has been studied with Astatic magnetometer on oriented samples cut in the form of cylinders (discs). Volume susceptibility (k) has been determined with an A.C. bridge. The ratio J_n/J_i (Koenigsberger ratio, Q_n) is calculated. The results are shown in Table I. J_n and J_i stand for intensity of N.R.M. and induced magnetization (taking the total magnetic field at Dhanbad to be 0·45 oest.) and D and I for declination (East of north) and inclination (positive downwards) of N.R.M. respectively. The samples have been found to be magnetically stable.

The N.R.M. directions are shown in the stereographic projection (Fig. 1). All the samples have negative inclination. Based on the direction of horizontal magnetization, the samples are classified into two groups :

Group (1) : Normally magnetized in horizontal direction (samples H 10 to H 16).—The mean declination and inclination of these 7 samples are 30° and − 63°. This corresponds to normal magnetization in the southern hemisphere. The intensity of N.R.M., although quite low, is more or less consistent and varies from $0{\cdot}827 \times 10^{-3}$ to $0{\cdot}340 \times 10^{-3}$ c.g.s. units.

Group (2) : Reversely magnetized in the horizontal direction (samples H 1 to H 9, H 17 and H 18).—The mean declination and inclination of these 11 samples are 223° and − 59°. This corresponds to reversed magnetization in northern hemisphere. The intensity of N.R.M. is low and varies from $2{\cdot}515 \times 10^{-3}$ to $0{\cdot}214 \times 10^{-3}$ c.g.s. units.