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THE OCCURRENCE OF NATROALUNITE AT ANAK KRAKATAU, INDONESIA

By

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Abstract

Natroalunite occurs as masses of platy crystals on the surface of an andesite in Anak Krakatau, Indoensia. The composition of the natroalunite was determined by x-ray diffraction method. The natroalunite is very close to the sodium end member of alunite-natroalunite series.

Introduction

Alunites are characteristic minerals produced by the acid-sulfate alteration of silicate rocks. Alunite often occurs in areas where volcanic rocks of rhyolitic to andesitic composition have undergone surficial solfataric or acid hot spring alteration. The mud post and acid hot springs in Yellowstone (FENNER, 1936) and Lassen (ANDERSON, 1935) National Parks, and some areas of Wairakei, New Zealand (STEINER, 1963) are good examples of alunite formation in present-day hydrothermally active areas. Numerous occurrences of alunite in the Tertiary period and more recent geologic periods have been described, but occurrence of natroalunite remains very rare. An alunite from Anak Krakatau gave a distinctive x-ray diffraction pattern which was similar to that of natroalunite. Because thin-bedded deposits of the mineral on the andesite surface were obtained by scratching the surface with a knife, only small amounts of the sample were obtained. X-ray diffraction was used to estimate the composition of the alunite in the alunite-natroalunite series for fear that the collected sample contained amorphous silica, volcanic glass and some impurities. Because naturally occurring alunite of the alunite-natroalunite series often contain some impurities, synthetic alunites of pure K and Na end members were prepared by the present writers, so a comparison can be made with the natroalunite gathered from Anak Krakatau.

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Locality and Occurrence

Anak Krakatau is a volcano found among the Krakatau Group consisting three other islands, namely Sertung, Rakata and Small Rakata, and is located in the Sunda Strait between Jawa and Sumatra (Fig. 1). Anak Krakatau is composed of andesitic lavas and pyroclastic materials. The natroalaunite occurs as masses of platy crystals on the surface of the slope of the central cone, which is composed of an andesite. The white natroalunite occurs at places where solfataric alteration has occurred.

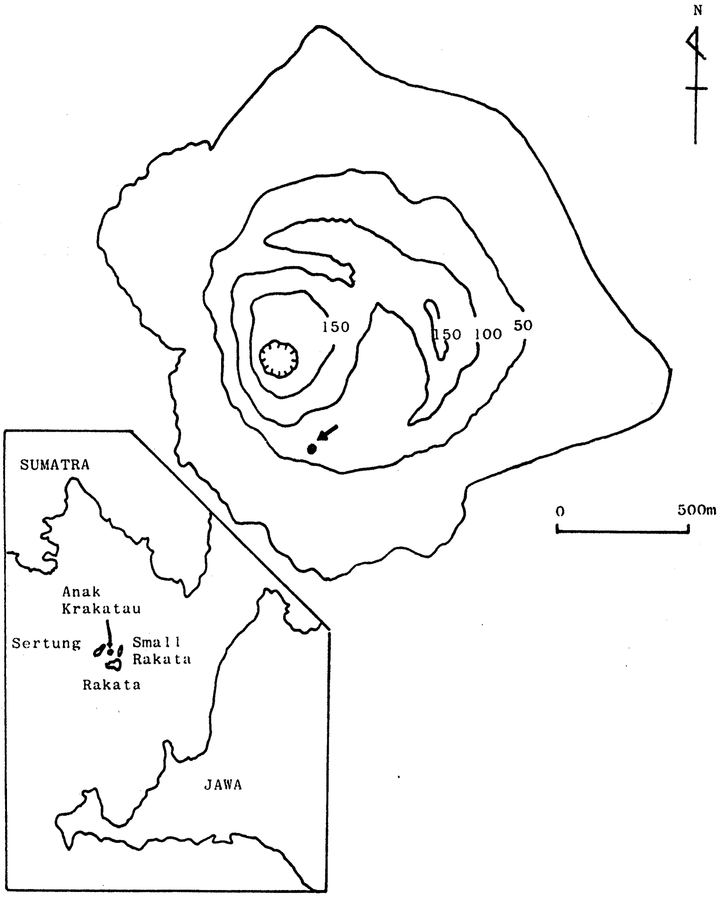

Fig. 1. Map showing the sample locality.

X-ray Study

Because the natroalunite obtained by scratching the andesite surface contains small amounts of mixtures of andesite fragments and amorphous silica, the sodium component of the alunite-natroalunite series could be determined by x-ray diffraction method. The plot of a and c of alunites against their relative atomic percentages of potassium and sodium indicates the nature of the isomorphous series. The a dimension is nearly constant for natural alunites. The c dimensins shows a marked linear shrinkage of the unit cell with increasing sodium content. Such relationships satisfy Vegard's law, which requires that unit cell dimensions vary linearly with change in composition, expressed in atomic percent (PARKER, 1962). The variation diagram of the a and c dimensions with changes in the relative atomic percentages of potassium and sodium in natural alunites made by PARKER (1962) is available to estimate the sodium percent of the natroalunite, but plots of a and c dimensions vs. composition of natural alunite samples show reverse S-shaped curve for the alunite-natraolaunite isomorphous series which deviates slightly from a straight-line curve. It is mainly due to the fact that Parker used some natural alunites containing impurities. PARKER (1962) found that synthetic alunites heated to 300°C for 1 hour have a and c dimensions nearly the same as natural alunites. The present authors synthesized sodium and potassium end members of alunites by using chemical reagents (K_2SO_4 and $Al_2(SO_4)_3 \cdot 18H_2O$ for alunite, and Na_2SO_4 and $Al_2(SO_4)_3 \cdot 18H_2O$ for natroalunite), and heated the synthetic samples to 300°C for 1 hour, and used them for the estimation of sodium percentage of the alunite-natroalunite series. The natural and synthetic samples were examined with a x-ray diffractometer set to traverse at the rate of one-fourth degree (2θ) per minute, using a chart speed of 1 cm per minute. The instrument was standardized using silicon powder. Copper radiation was used exclusively. Computations are

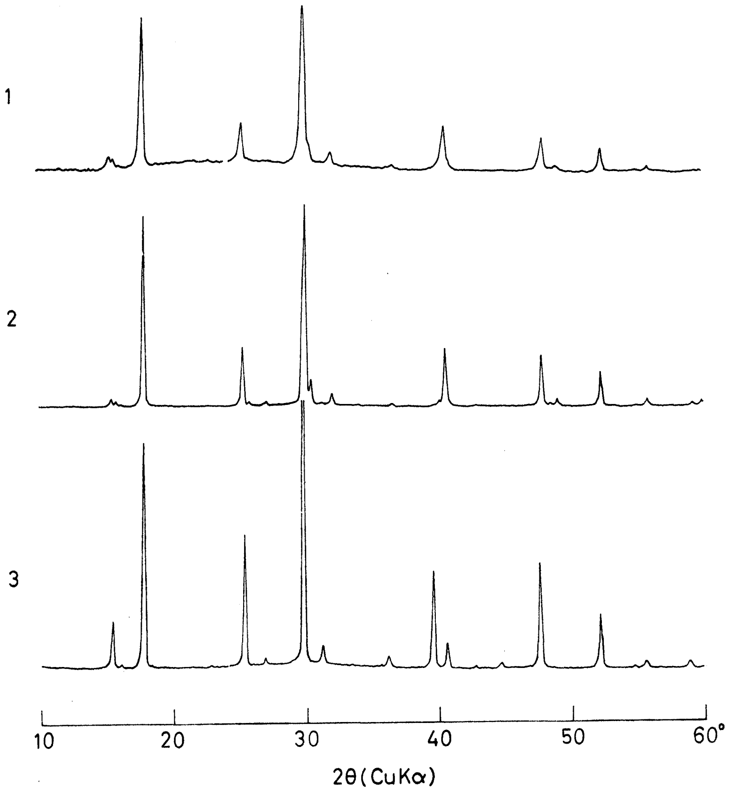

Fig. 2. X-ray powder diffraction patterns for the natroalunite from Anak Krakatau, and the synthetic natroalunite and alunite.
1: the natrolaunite from Anak Krakatau; 2: synthetic natroalunite; 3: synthetic alunite.

based on CuKα radiation for reflections with 2θ less than 36°C and CuKα_1 radiation for reflections with 2θ greater than 36°.

X-ray powder patterns of the natroalunite from Anaka Krakatau, synthetic alunite and synthetic natroalunite are shown in Fig. 2. The x-ray powder pattern of the natroalunite from Anak Krakatau is very similar to that of the synthetic natroalunite. From the powder data a=6.97 Å and c=16.73 Å were obtained for the natroalunite from Anak Krakatau. X-ray powder data for the natroalunite from Anak Krakatau, the synthetic alunites and some natural alunites are listed in Table 1. The plots of a and c of the heated synthetic alunites are shown in Fig. 3. The a and c dimensions of the natraolunite from Anak Krakatau are plotted as A and B respectively in the Fig. 3. The relative atomic percentage of sodium in the natroalunite from Anak Krakatau is very close to 100%. The natroalunite from Anak Krakatau and the synthetic alunite and natroalunite were heated to 1000°C for 1 hour. X-ray powder diffraction

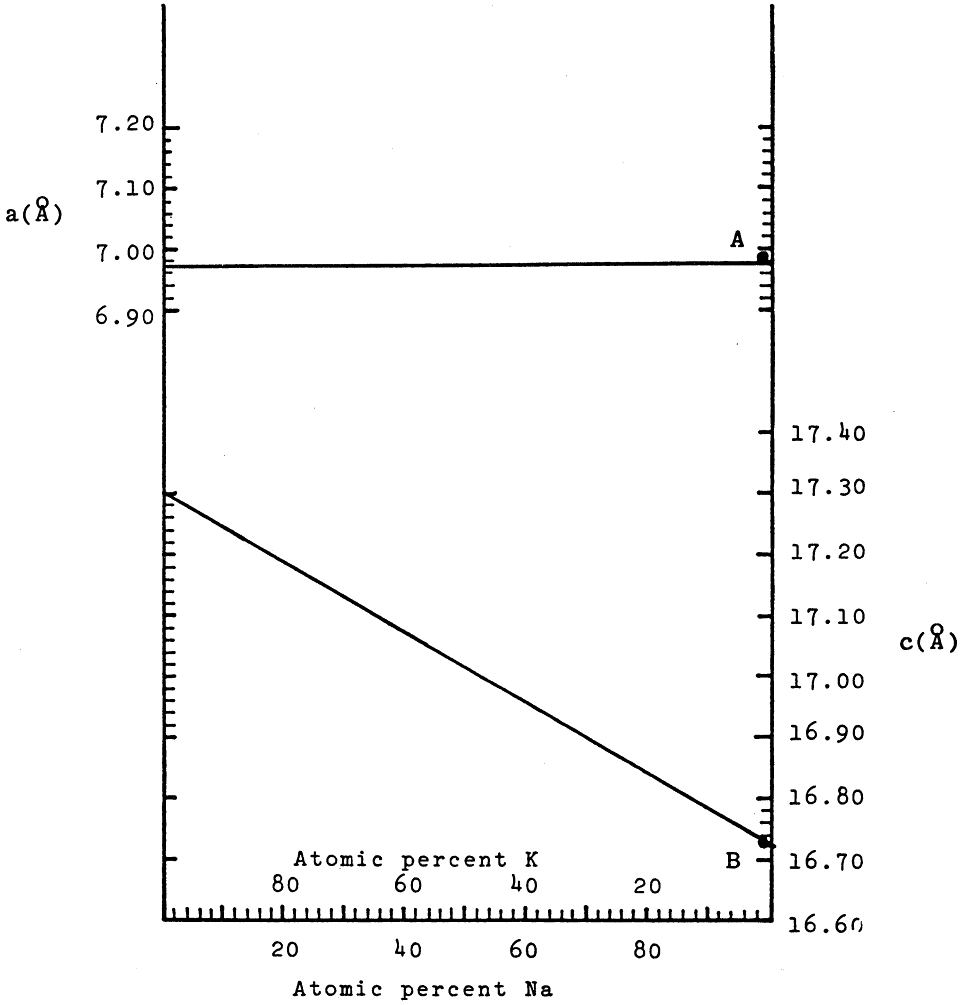

Fig. 3. Variation of the unit cell dimensions, a and c, with changes in the relative atomic percentages of potassium and sodium in synthetic alunites, and plot of the natraolunite from Anak Krakatau.