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TOPOTACTIC THERMAL CHANGE OF ARTINITE  
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## ABSTRACT

The thermal change of artinite from Hokkaido, Japan into magnesium oxide was studied using the high temperature Weissenberg technique. On heating up to 575°C, artinite transformed into magnesium oxide with highly topotaxial relationship of [010] artinite||[110]MgO, [001]artinite $\wedge$ [001]MgO=22° and [100]artinite $\wedge$ [1 $\bar{1}$ 0]MgO=13° through an amorphous state with liberation of H<sub>2</sub>O and CO<sub>2</sub>.

Artinite is one of the hydrate magnesium carbonate minerals and its chemical composition is represented as Mg<sub>2</sub>(OH)<sub>2</sub>CO<sub>3</sub>·3H<sub>2</sub>O. P. M. de Wolff (1952) reported that the crystal structure was monoclinic with  $a=16.56$  Å,  $b=3.15$  Å,  $c=6.22$  Å, and  $\beta=99^{\circ}9'$ . The unit cell contains two molecules and the space group probably being C2. In the present investigation the thermal transformation of artinite into magnesium oxide was studied using the high temperature Weissenberg technique, developed by the present authors (S. Iwai *et al.*, 1969).

The specimens used were transparent needle-shape crystals of approximately 0.5×0.02×0.02 mm<sup>3</sup> in size from the Utonai river basin, Hokkaido, Japan. Figure 1 shows the DTA and TGA curves of the arti-

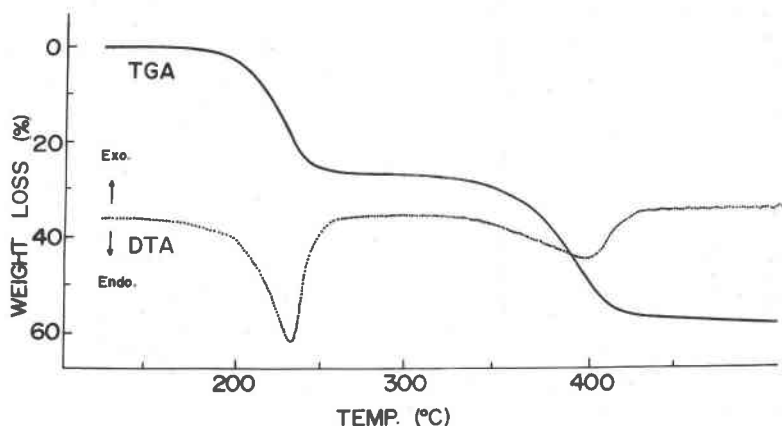


FIG. 1. Differential thermal analysis (D.T.A.) curve and thermogravimetric analysis (T.G.A.) curve of artinite.

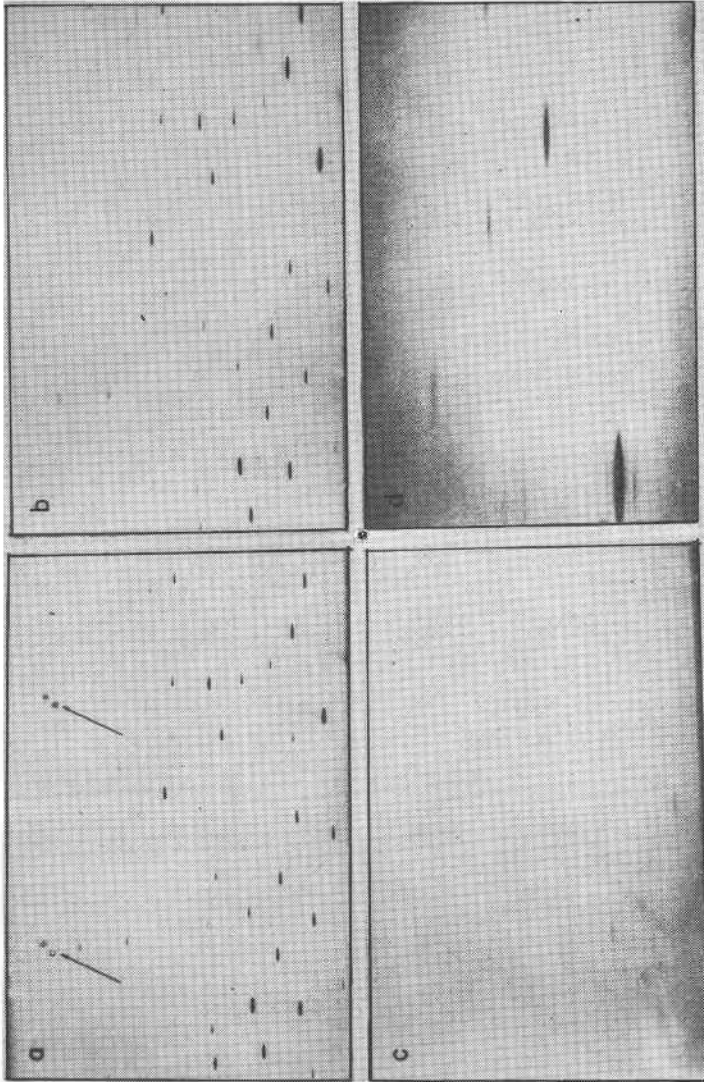


FIG. 2. Zero layer *b*-axis Weissenberg photographs of artinite taken at elevated temperature. ( $\text{CuK}\alpha$ , one hour at 50kV and 80mA) a: the original artinite at 20°C; b: the same at 200°C which is almost identical with a; c: at 300°C showing nearly amorphous; d: at 540°C showing magnesium oxide produced with high degree of preferred orientation.

nite heated in air from room temperature to 650°C with heating rate of 2.5°C/min. The detailed analysis of Figure 1 indicates that three moles of crystal water of artinite were liberated between 150°C and 300°C, and one mole water between 320°C and 450°C together with one mole carbon dioxide.

Figures 2 a,b,c, and d show the zero layer *b*-axis Weissenberg photographs which were taken respectively at 20°C, 200°C, 300°C, and 540°C, the exposure time being one hour. Figures 2a and b are almost identical to each other with respect to positions and intensities of diffraction spots. Thus, it can be concluded that the original structure remained nearly unchanged on heating at 200°C. At 300°C (Fig. 2c) the artinite became nearly amorphous, so far as revealed from the X-ray pattern, with liberation of three moles of crystal water. At 540°C (Fig. 3d) the remaining mole of water was liberated together with one mole carbon dioxide, and the specimen was converted into magnesium oxide with degree of preferred orientation. Figure 3 is a double exposure equatorial Weissenberg photograph of the original artinite and that at 575°C, which shows a topotaxial relation between the original artinite and the magnesium oxide produced.

From the above results, it was concluded that the artinite transformed topotaxially into the magnesium oxide through an amorphous state with liberation of H<sub>2</sub>O and CO<sub>2</sub>. The orientation relationships were [010]

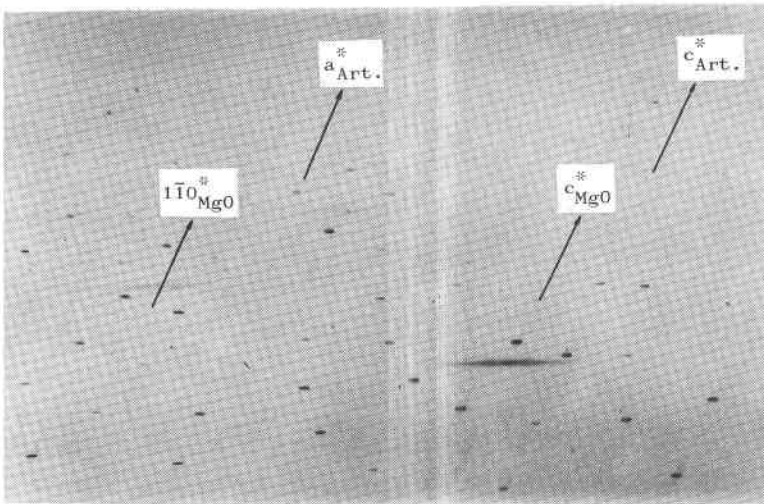


FIG. 3. Double exposed zero layer *b*-axis Weissenberg photograph of the original artinite and that at 575°C, showing topotaxial relation between the original artinite and the magnesium oxide produced.

artinite  $\parallel$  [110]MgO, [001]artinite  $\wedge$  [001]MgO = 22° and [110]artinite  $\wedge$  [1 $\bar{1}$ 0]MgO = 13°.

## REFERENCE

- DE WOLFF, P. M. (1952) The crystal structure of artinite,  $Mg_2(OH)_2CO_3 \cdot 3H_2O$ . *Acta Crystallogr.* 5, 286-287.

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SCANDIUM-RICH MINERALS FROM RHYOLITE IN THE  
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## ABSTRACT

Scandium is present in the range 0.1 to 0.7 weight percent  $Sc_2O_3$  in late-stage minerals, including pseudobrookite, bixbyite, spessartite, hematite and beryl, in the lithophysae of the rhyolite flows of the Thomas Mountains, Utah. The  $Sc^{3+}$  ion substitutes for  $Fe^{3+}$  and Al in these minerals. Scandium also is enriched in bixbyite from volcanic rocks in Argentina, but is present only in a few ppm in bixbyite from metamorphosed sedimentary manganese deposits.

The literature on the topaz, pseudobrookite, bixbyite, beryl, garnet and other minerals present in the lithophysae of the rhyolite flows of the Thomas Range, Utah, has been summarized by Staatz and Carr (1964). Analyses by neutron activation techniques reveal that some of these minerals contain exceptionally large amounts of scandium, extending to over 0.5 percent  $Sc_2O_3$  (Table 1).

Sc is a dispersed element usually present in amounts up to a few hundred ppm in solid solution in its various host minerals. Only a very few of the over 1500 analyses of minerals containing Sc as a vicarious constituent, tabulated in large part by Vlasov (1966), Borisenko (1963) and Phan (1963, 1967), report over 0.5 percent  $Sc_2O_3$ . Among them are a beryl with about 1.5 percent  $Sc_2O_3$  (Oftedal, 1943), chevkinite with 4.14 percent  $Sc_2O_3$  (Semenov, et al., 1966), and columbite and ilmenorutile with 6.1 and 0.78 percent  $Sc_2O_3$  respectively (Phan, 1967).

The presence of Sc in substitution for  $Fe^{3+}$  and Al in the various host minerals in the Thomas Range rhyolite is well substantiated on crystallochemical grounds. In the case of pseudobrookite, a complete solid solution has been shown by Ito (personal communication) to extend

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