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## IDENTITY OF ASTROLITE WITH MUSCOVITE

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## ABSTRACT

Astrolite, described as  $(\text{Na}, \text{K})_2 \text{Fe} (\text{Al}, \text{Fe})_2 (\text{SiO}_3)_5 \cdot \text{H}_2\text{O}$ , is shown to be a phengitic muscovite by optical and X-ray examination of material from the type locality, Neumark, Vogtland, Germany. Microprobe analysis showed that K, Si, and Al are major elements, that Na is a trace constituent, and gave averages of 1.2% MgO, 3.5% FeO, and 31.4%  $\text{Al}_2\text{O}_3$ .

## INTRODUCTION

Astrolite was described by Reinisch (1904) from inclusions of siliceous slates, breccia, and carbonaceous limestones in basic ("diabase") tuffs at a quarry near Neumark, Vogtland, Germany. The mineral forms spheroidal aggregates, up to 6 mm in diameter, of bladed crystals. Although in optical and physical properties it resembles muscovite, chemical analysis indicated that astrolite is a ferrous-ferric silicate with the possible formula  $(\text{Na}, \text{K})_2 \text{Fe}^{+2} (\text{Al}_2\text{Fe}^{+3})_2 (\text{SiO}_3)_5 \cdot \text{H}_2\text{O}$ .

The Smithsonian Institution has several samples of astrolite from Neumark. In hand specimen they fit Reinisch's (1904) description exactly; there is no cause to doubt that they are indeed the type of material described by Reinisch. Specimens R11582 and B16252 were used in this study. These specimens are topotypes in the terminology of Embrey and Hey (1970). We were able to confirm the optical and physical properties reported by Reinisch (1904), but X-ray diffraction showed that astrolite is muscovite and microprobe study indicates that it is phengitic. We are at a loss to explain Reinisch's extraordinary chemical analysis, but astrolite is not valid mineral species, and the name should be dropped.

## OPTICAL AND PHYSICAL PROPERTIES

Table 1 presents the optical data given by Reinisch (1904) and data which we gathered. Reinisch made his optical observations on thin sections and determined birefringence with a Babinet compen-

Table 1: Optical Properties of Astrolite

Reinisch (1904)	This Study
$\alpha$ not determined	$\alpha = 1.562(4)$
$\beta$ " "	$\beta = 1.595(2)$
$\gamma$ " "	$\gamma = 1.598(2)$
$\delta = 0.020-0.022$	$\delta = 0.036$
sign -	Sign -
$2E = 48^\circ$	$2E = 19^\circ-53^\circ$ ( $2V = 12^\circ-32^\circ$ )
$r > v$ weak	$r > v$ distinct
X-c ( $\perp$ cleavage)	X=c ( $\perp$ cleavage)
Pleochroism X weakly yellow to colorless	same
Y canary yellow ("like epidote")	same, but paler?
Z canary yellow ("like epidote")	same, but paler?

sator. He observed that interference colors were around  $1^\circ$  red. The astrolite-bearing rocks contain no quartz, and Reinisch did not say how he determined the thickness of his sections. They may have been excessively thin. Our section was ground with quartz grains embedded around it as a thickness guide; we measured  $2E$ , birefringence, and pleochroism in thin section and determined indices on a crystal flake, using the spindle stage and an Na line filter.

Reinisch reported the following analysis for astrolite:  $\text{SiO}_2$  50.44 percent,  $\text{Al}_2\text{O}_3$  7.88,  $\text{Fe}_2\text{O}_3$  12.62,  $\text{FeO}$  11.62,  $\text{K}_2\text{O}$  5.03,  $\text{Na}_2\text{O}$  6.40,  $\text{H}_2\text{O}$  2.74,  $\text{CaCO}_3$  3.88, total 100.61. From this he derived the formula given above, with Na:K 2:1.

When we examined astrolite with the electron microprobe, we discovered that K, Al, and Si are major elements, that Na is present in only trace amounts, and that iron is minor. Quantitative analysis for Mg, Fe, and Al, using muscovite standards in the Smithsonian collection, gave MgO .5 to 2.8 percent, mean 1.2 percent; FeO 1.4 to 6.2 percent, mean 3.5 percent, assuming all iron is divalent;  $\text{Al}_2\text{O}_3$  26.4-38 percent, mean 31.4 percent. Iron and aluminum vary inversely with each other.

The X-ray powder pattern corresponds quite closely to that for  $2M_1$  muscovite, both in spacings and in intensities (Bradley and Grim, 1961; Levinson, 1955; Heinrich and Levinson, 1955), a weak line at  $3.62\text{\AA}$  may correspond to (105) of the  $3T$  polymorph; the weak (107) peak of  $3T$  at  $3.11\text{\AA}$  was not observed. Other possible spacings of the  $3T$  polymorph cannot be distinguished from those of the  $2M_1$  type.

## ACKNOWLEDGMENTS

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## CALCITE-ARAGONITE EQUILIBRIUM FROM 50°C TO 150°C

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## ABSTRACT

The slope of the calcite-aragonite transition curve from 50°C to 150°C is determined as 13.8 bars/degree; the 0°C intercept as 3.04 kbar. These data confirm recent work at higher temperatures and pressures and the previous determination of the 100°C equilibrium pressure of 4.35 kbar.

Recent works on the calcite-aragonite equilibria rely on the equilibrium point of 100°C and 4.35 kbar established by Crawford and Fyfe (1964). It seemed well to examine this system between 50°C and 150°C to provide a check of the location of the 100°C point, to permit an experimental determination of the slope of the equilibrium curve in this region, and to give a comparison of this curve with that obtained from higher temperature data.

A banded sample containing approximately equal widths of a banded aragonite layer on a drusy calcite layer was ground to pass a 325 mesh screen (Table 1). An X-ray powder diffractogram of this start material exhibits strong peaks of both aragonite and calcite. The powder was placed in small hot-seal vessels, brought to the desired temperature dry, and then pumped to the desired pressure. The phase produced and changes in relative quantities were determined by com-