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#### THE COBALTIFEROUS PYRITE SERIES

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#### INTRODUCTION

Klemm (1964) established that phases over the whole range of the series  $\text{FeS}_2$ - $\text{CoS}_2$  could be prepared synthetically, though a complete series was not attained until 700°C. A regular variation in cell size was also observed.

The author (1965) reported the natural existence of an intermediate member of the series  $\text{FeS}_2$ (pyrite)- $\text{CoS}_2$ (cattierite), and the following results are a completion of that investigation.

Sixteen mineral samples, members of the natural binary system  $\text{FeS}_2$  (pyrite)- $\text{CoS}_2$ (cattierite) were examined, both by X-ray diffraction and wet chemical analysis. The object was to establish the presence of naturally occurring phases of this composition, and to observe the effect of iron-cobalt substitution on cell dimension.

Eight of the samples were selected for examination by electron probe micro-analyser, to establish any sub-microscopic chemical variations occurring across the pyrites.

#### EXPERIMENTAL

All the samples examined were from the Copperbelt of Central Africa. The experimental methods used, except for the electron probe techniques, are essentially those reported in the author's previous mineralogical

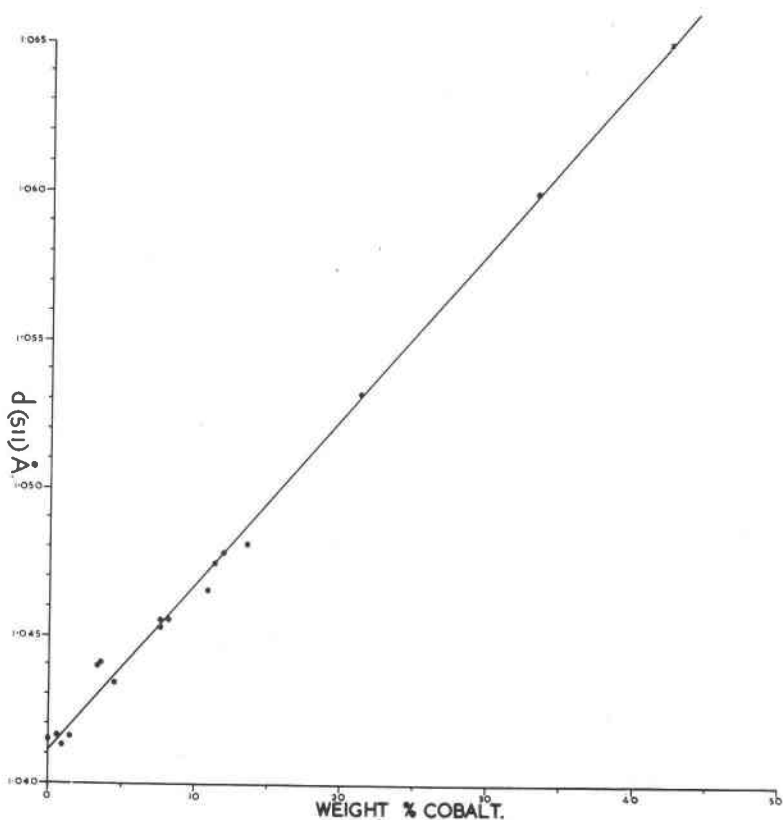


FIG. 1. Weight percentage cobalt plotted against the  $d(511)$  Å spacing, for members of the binary system  $\text{FeS}_2$ (pyrite)- $\text{CoS}_2$ (cattierite). x=Cattierite of Kerr (1945)

note, and need not be elaborated on here, except to emphasize that all samples were assayed to one hundred percent.

The electron probe examinations were carried out using a "Jeol" JXA-3 instrument with a beam diameter of 1–2 microns, generated by an accelerating voltage of 25 kV and giving a specimen current of about 0.1  $\mu\text{A}$ .

To determine the distribution of iron and cobalt, line scans on several grains of each sample were carried out at a speed of 10 microns per minute and a chart speed of 1 cm per minute. One spectrometer was set to receive iron  $K\alpha$  radiation and the other cobalt  $K\alpha$ . Scanning X-ray and electron images were obtained on cathode ray tubes.

#### RESULTS AND DISCUSSION

Figure 1 shows a plot of the  $d(511)$  Å spacing against weight percentage cobalt. Clearly phases of the composition  $(\text{Fe},\text{Co})\text{S}_2$  extending over

the whole range, occur naturally, though the scarcity of high cobalt members should be noted. The linearity of the series is also established, and the  $d(511)$  Å spacing can be used to determine compositional variations of cobaltiferous pyrites, provided elements other than cobalt and iron do not enter the lattice. For practical purposes, nickel is the only other element likely to substitute, to any great extent.

For more detailed X-ray and chemical data, the reader should consult the author.

The electron probe scans revealed only minor variations in the distribution of iron and cobalt, and these could not be interpreted as banding, or a mechanical mixture of two phases, even on the finest scale.

All samples were completely optically homogeneous, showing no exsolution features.

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#### TRANSFORMATION OF ARAGONITE TO CALCITE UNDER HYDROTHERMAL CONDITIONS

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#### INTRODUCTION

Although numerous studies contributing to the knowledge of transformation rates for aragonite $\rightleftharpoons$ calcite in dry environments have been published (e.g., Kleber, 1940; Chaudron, 1952; Jamieson, 1953; MacDonald, 1956; Clark, 1957; Wray and Daniels, 1957; Brown *et al.*, 1962; Davis and Adams, 1965), data on reaction rates for the transition accomplished under hydrothermal conditions is nearly nonexistent. Brown