Magnetites from a Sulphide Bearing Iron Ore Formation in Sweden

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Magnetite coexisting with sulphides from an iron ore formation in northern Sweden has been investigated with micro-probe and X-ray methods. The Mg/Mg+Fe ratio in magnetite can be correlated with the presence or absence of coexisting pyrite, indicating varying sulphur pressure in the rocks. Sulphurization of magnetite is assumed to be responsible for the introduction of Mg into the magnetite structure.

Magnetit aus einem Eisenerz Nordschwedens, der zusammen mit Eisensulfiden vorkommt, wurde mittels Elektronen-Mikrosonde und Röntgenbeugung untersucht. Das Mg/Mg+Fe Verhältnis des Magnetits wurde zu der Anwesenheit oder dem Fehlen von Pyrit in Beziehung gesetzt. Es zeigt sich, daß unterschiedliche Schwefel dampfdrucke in den Gesteinen geherrscht haben müssen. Die Sulfidisierung des Magnetits wird für den Einbau des Mg in die Magnetit-Struktur verantwortlich gemacht.

Introduction

Mineral chemical studies of the coexistence of oxide and sulphide ore minerals with silicates, carbonates, etc. constitute one of the major research projects at the Institute of Mineralogy and Geology in Uppsala. The present paper is a contribution to that project. A review of the present situation of the synthetic results concerning sulphide-oxide-silicate relations was given by Kullerud (1968). Solid solution relationships in magnetite have been discussed among others by Bast and Lindsley (1959) and Lindsley (1962, 1963). Sulphurization of magnetite has been studied by Kullerud et al. (1966). Most of the studies, however, were made on synthetic magnetites produced in the laboratory. Very little is known about natural magnetites and their variation in composition. The extended use of the micro-probe will probably in the future give more information on that problem. The present investigation deals with magnetite-magnesioferrite solid solution in a sulphide-bearing iron formation.

Geology and Mineralogical Features

The samples analysed, Table 1, except no. 11, are all taken from drillholes through the Stora Sahavaara deposit which is a sulphide-bearing iron formation situated in northern Sweden near the Finnish border. The area has been mapped by Eriksson (1954) and recently by Lundberg (1967). The ore is concordantly enclosed in Precambrian metamorphosed supracrustal rocks of sedimentary and volcanic origin. See map Fig. 1. The chief ore mineral is magnetite. Hematite is never found within the area. The sulphides, which account for 3.5% of the ore are pyrrhotite, pyrite and minor chalcopyrite. Pyrite may sometimes appear as an alteration product of pyrrhotite. It is not considered in this investigation. The coexisting Fe-Mg-silicates are all very poor in iron. A few analyses of phlogopite and tremolite, although not presented here show only around 3 wt-% Fe. A common mineral is a "cloudy" serpentine which is found to be an alteration product of olivine.
Quartzitic phyllite
Quartzite
Graphite schists
Dolomite
Phyllite
Volcanics
Iron ore
Skarn
Grenzschichtung

Fig. 1. Geological map of the Stora Sahavaara iron formation.
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(LUNDBERG 1967). Some of the silicates, especially micas, show alteration features such as chlorite lamellae in the phlogopite. Calcite, containing very little iron and magnesium, is present in all analysed specimens. Dolomite is also present in the area.

Sample no. 11 represents a magnetite from a hydrothermal run at 630°C when it was in equilibrium with phlogopite, sanidine and pyrite. The sample was kindly given by Mr. HAMMARBACK of the institute. Magnetite (microprobe analyses: Fe₅O₄ > 99.9 and Mg Fe₂O₄ < 0.01 wt-%) was used as starting material for the Fe-component of the syntheses. A reaction rim of pyrite around the magnetite crystals shows that a reaction has occurred. But this rim may also be a responsible for the low Mg content of the magnetite as compared to the natural magnetites coexisting with pyrite. See Table 1. A significant amount of Mg, however, has been taken up by the magnetites.

Analytical Procedure and Results
The chemical analyses of the minerals were made on polished thinsections with a Cambridge Geoscan micro-probe using a standard technique and correction factors established by