FERRIC IRON IN PLAGIOCLASE CRYSTALS FROM ANORTHOSITE 15415,

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Three plagioclase crystals with dimensions of 0.5-1.0mm were selected from anorthosite 15415,48 and studied with electron spin resonance techniques. Anorthosite 15415 consists of 97-99 percent plagioclase (average composition An97 Ab3 Or0.3), 1-3 percent pyroxene, and traces of ilmenite, silica, and spinel. The concentration of Fe in the plagioclase is 0.08-0.10 wt percent. (1,2)

The X-band (9.5 GHz) spectra observed at room temperature can be grouped into two distinct sets of lines. The first set contains a large number of lines in the vicinity of g=2. For certain orientations of the crystals with respect to the external magnetic field, the hyperfine structure characteristic for Mn^{2+} ions is resolved within this part of the spectrum. The second set consists of a small number of isolated lines situated at magnetic fields between 600 and 2000 Gauss. We have limited our quantitative studies to this second set of lines.

The line positions as well as the intensities depend strongly on the orientation of the crystals. Two mutually perpendicular orientations have been found where the resonance fields of two intense lines have minimum values. These positions are marked with arrows in Fig. 1. They agree with

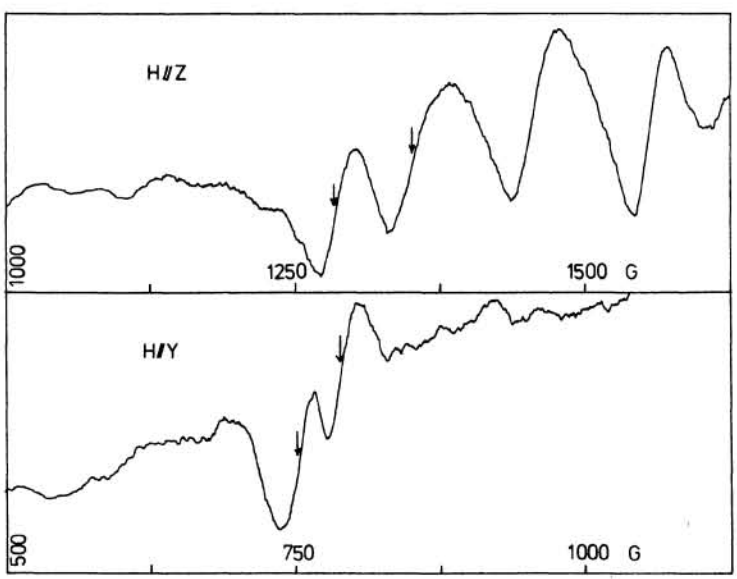

Fig.1. ESR absorption spectra (first derivative) of a plagioclase crystal from anorthosite 15415. The arrows indicate the centers of identified Fe^{3+} resonances.

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those given for Fe^{3+} ions in terrestrial anorthite by Gaite and Michoulier (3) (site 2 and 3, magnetic field parallel to the magnetic z and y axes, respectively). This is true if the simplified Hamiltonian

$$\mathcal{H} = \sum_i g\beta H_i S_i + B_2^0 O_2^0 + B_2^2 O_2^2$$

assumed by these authors and their notation for numbering the sites is used. In addition to those lines shown in Fig. 1, a weak line has been found for H//z which also agrees with the results of Gaite and Michoulier. In Table 1, our experimental field values are shown together with those calculated from the parameters reported by these authors.

Orientation	Site	Experimental Field Value (kilogauss)	Theoretical Field Value (kilogauss)	Difference (kilogauss)
H // z	2	0.689	0.682	0.007
		1.275	1.274	0.001
	3	0.689	0.685	0.004
		1.341	1.351	0.010
H // y	2	0.778	0.778	0.000
	3	0.745	0.744	0.001

Table 1. Experimental and calculated magnetic fields for a microwave frequency of 9.485 GHz.

By comparing the line intensities with those of a ruby of known chromium concentration the number of Fe^{3+} spins has been estimated. It can be concluded that more than one percent of the total amount of iron in the plagioclase is ferric iron which is substituted for Al^{3+} in at least two nonequivalent sites. This result is in agreement with a determination in powdered plagioclases (4).

Only two of the more intense lines are observed which cannot be explained. These lines are those in Fig. 1 not marked with an arrow. They behave similarly as the analysed lines. It is possible that they are due to Fe^{3+} ions in different sites or to twinning in the crystals. A quantitative analysis is complicated by the fact that near their extremum these lines overlap with the lines of sites 2 and 3.

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