ANALYSIS OF MINERALS FROM ANTARCTICA

J. Sitek[1], J. Dekan[1], K. Sedlačková[1], P. Novák[1], A. Gokhman[2]

[1]Institute of Nuclear and Physical Engineering, SlovakUniversity of Technology, Ilkovicova 3, Bratislava, Slovakia, [2]South Ukraine Pedagogical University, Odessa, Ukraine
E-mail: jozef.sitek@stuba.sk

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1. Introduction

The paleomagnetic studies of rocks may provide the fundamental information about time variation of the Earth's magnetic field [1-4]. The complex paleomagnetic research of a representative collection of Andean Intrusive Suite from the Western part of Antarctic Peninsula (near Ukrainian Antarctic base Academik Vernadsky) was carried out and the results can be found in [5]. The age of igneous complex varies between 58 and 106 million years. It is necessary to reveal the chemical composition and size distribution of the sources of magnetic field in rocks to have a correct interpretation of the data [5]. Electron microscopy study presented in [5] indicates the presence of nanosize magnetic inclusions in the investigated rocks. Information about the elemental composition, size distribution function and volume fraction of the magnetic inclusions depending on the paleomagnetic direction were also obtained.

In this work, Mössbauer spectroscopy and X-ray diffraction was used for phase analysis of iron-bearing compounds with the aim to identify magnetic and non-magnetic fractions in the selected rocks of the Western part of Antarctic Peninsula from different localities. The obtained data should elucidate the directional dependence of the composition, structure, volume fraction and size of magnetic inclusions in the rocks from the Western part of Antarctic Peninsula.

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2. Experimental

The investigated samples are polycrystalline rocks composed of several phases. These specimens are: a gabbro from the Petermann Island and from the Cape Tuxen, and granodiorite from the Petermann Iceland and from the Barchans, South Island. The localities of the samples collections are signed in Fig.1.

The samples for Mössbauer experiment were studied in powder form. The Mössbauer spectra were measured at room temperature using a Wissel Mössbauer spectrometer with the Co57(Rh) source in transmission geometry. Mössbauer parameters were evaluated by CONFIT program [6]. The accuracy in their determination is about 1% for the relative area, 0,04 mm/s for the isomer shift and quadrupole splitting and about 0.5 T for the hyperfine magnetic field. X-ray diffraction analysis of all fourth samples was performed on D8 Advance diffractometer in standard $\theta/2\theta$ configuration with Co lamp and with Fe filter.

3. Results and discussion

Samples of two classes, i.e. gabbro and granodiorite, were collected from different localities of Western part of Antarctic Peninsula. Gabbro is a dark-colored rock, which contains more than 90% of pyroxene. Gabbro may also contain small amounts of olivine,

amphibole and biotite and minor amounts, typically a few percent, of iron-titanium oxides, such as magnetite and ilmenite.

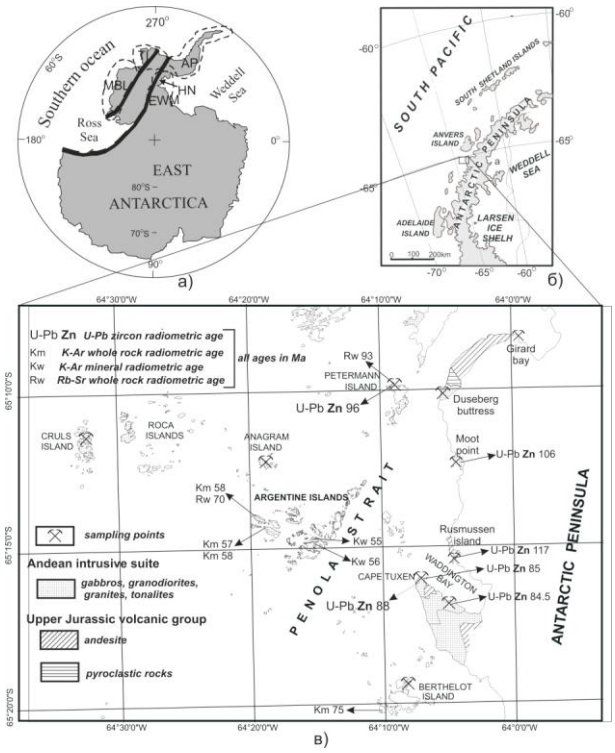

Fig.1:*Localities of the samples collections*

Granodiorite is a phaneritic texture intrusive igneous rock similar to granite. In comprison with granit, it contains more plagioclase feldspar than orthoclase feldspar. Granodiorite has a greater than 20% quartz by volume, and between 65% to 90% of the feldspar is plagioclase. It contains minor amounts of muscovite mica, biotite and amphiboles. Minor amounts of oxide minerals, such as magnetite, ilmenite, as well as some sulfide minerals may also be present.
The Mössbauer spectra of the minerals measured at room temperature are shown in Fig. 2 and in Fig. 3, respectively. Parameters of the Mössbauer spectra of the measured samples are given in Tab.1. The spectra of gabbros were evaluated by three doublets and two sextets. Results of gabbros analysis show that according to the values ofthe hyperfine magnetic field, the magnetically splitted part of the spectrum corresponds to magnetite. The non-magnetic part of the spectrum can be ascribed to pyroxene and ilmenite. Comparing the gabbro samples we found, that the samples from CapeTuxen contained magnetic component and the sample from Peterman, North WestIsland, contained only a paramagnetic components. That means, that gabbro has different composition in the area of Antarctic Peninsula. Probably it is related to the directional changes of the Earth's magnetic field from 58 to 108 million years ago.

We observed the same phenomena in the case of granodiorite. The sample from Barchans contains magnetite, pyroxene and ilmenite; and granodiorite from Peternam contains only paramagnetic components, like pyroxene and ilmenite. In all samples, the dominant phase is pyroxen. In gabbro samples, magnetite part is about 30 percents, in granodiorite approximately 20 percents. Mössbauer parameters of the internal magnetic field B are in all

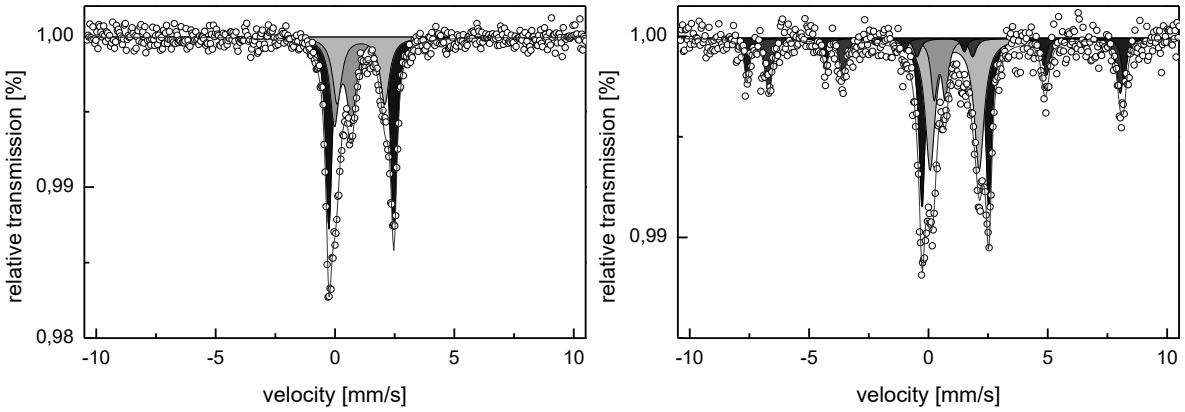

Fig.2*Mössbauer spectra of gabbro: left – Peterman, North WestIsland; right – CapeTuxen,*

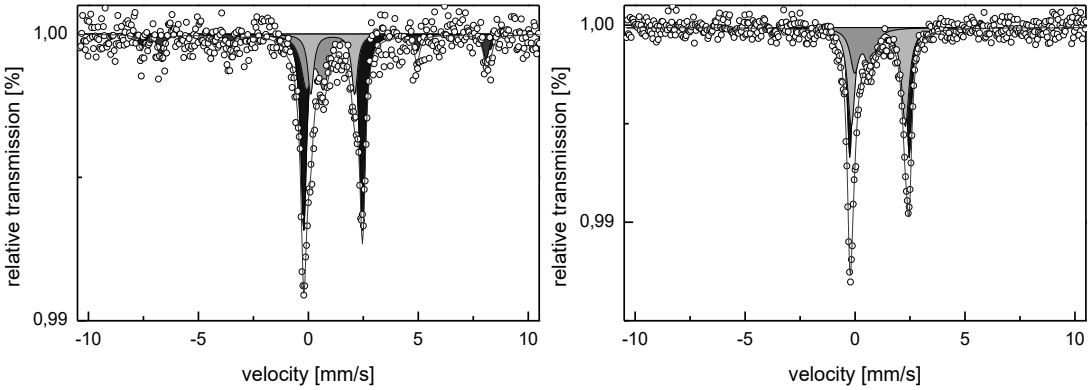

Fig.3*Mössbauer spectra of granodiorite:left- Barchans,South Island;right- PetermanIsland.*

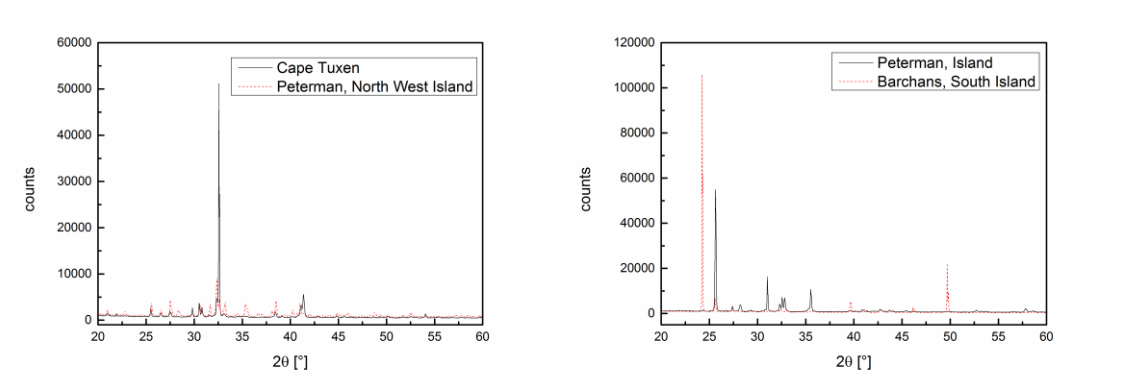

Fig. 4*X-ray diffraction patterns of gabbro (left) granodiorite (right) from different locations.*

cases stable, what indicates, that magnetite contains a very low amount of substitution elements. On the other hand, small variance parameters of pyroxene and ilmenite indicate on the impurities or changes in the crystalline structure. We can not exclude small traces of other minerals. We also must take into account that Mössbauer parameter of the same kind of minerals differ according to locality. Different phases were identified using PDF-2 database (Fig. 4). Main composition of gabbro and granodiorite were confirmed. Results confirmed the presence of magnetite phase in gabbro (CapeTuxen) and granodiorite (Barchans,South Island) sample. This results are in accordance with results from Mössbauer spectra.

TABLE 1. *Parameters of Mössbauer spectra from different localities. IS-isomer shift, QS-quadrupole splitting, B-magnetic induction of internal magnetic field, A-relative amount of the components.*

locality	IS(mm/s)	QS(mm/s)	B (T)	A (%)
PetermanNorth WestIsland (gabbro)	1.11	2.72		47
	1.09	1.99		24
	0.33	0.71		29
CapeTuxen (gabbro)	1.13	2.79		26
	1.00	2.05		33
	0.47	0.46		9
	0.27	0.04	49.08	12
	0.68	0.01	45.77	20
Barchans,South Island (granodiorite)	1.12	2.68		45
	1.11	1.99		15
	0.30	0.77		21
	0.33	0.01	49.23	7
	0.68	0.01	45.96	12
Peterman, Island (granodiorite*)*	1.11	2.71		36
	1.06	2.46		43
	0.33	0.71		21

Conclusion

Phase analysis of rocks from different localities of Western part of Antarctic Peninsula confirmed participation of magnetic component - magnetite - in gabbro as well as in granodiorite. Mössbauer study of behavior of the magnetic inclusions in rocks contribute to results from XRD. Finally, all these results will be used to explain relationship between of magnetic components in rocks and Earth magnetic field direction as is discussed in [5].

Acknowledgement

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