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Rock magnetic properties of enderbites in Gaisin Block of Ukrainian Shield

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Abstract

The actual problems of detail studying of geological structures of the Ukrainian Precambrian Shield (US) were used. The aim of the work was to verify the possibility maping of xenolites of enderbytes of the abnormal magnetic field. The magnetic susceptibility Curie points of feromagnetic minerals and other properties of enderbytes were investigated. It is shown that the studies enderbites not create high positive anomalies of the magnetic field, and are actually "dumb" in the anomalous magnetic field. On the prospect of suggested further study of those areas where high positive magnetic field anomalies coincide with places spread enderbite.

Keywords: rock magnetic properties, enderbites, Ukrainian shield

1. Introduction

In expositions of *Ukrainian Precambrian Shield (US)* due to magnitometric methods during state geological testing in 1960-1980 years were practically not investigated. Now, an actual problem of geological re-carting of US our government is declared [7]. The investigation of the US with new metods besid on more detailed and complexs geology-geopthysical become actual. In this article athtors new detalin commplexs magnitometric metods [metod MMS] are used fo investigation xenolites of the enderbytes.

The basic question of article is how enderbytes are sited in Gaisin block of US (along rivers Southern Boug). It is known [31] because rocks in Gaisin block were cardinally changed during metamorphism but enderbytes is very ancient rocks that weren't changed. Therefore, studying of enderbytes magnetic properties is important for fundamental investigation of Precambrian rocks - that is result of appearance and the first formation of the Earth's crust.

The rocks in the US are mixed in a difficult correlation with each other. Is very difficult to set on map the boundaries of various rocks, because they very rarely come to the surface and are almost invisible. Almost all Precambrian basement of US is hidden and covered by layers of chalk, clay, sandstone.

The geologists-cartographs detected the Precambrian basement thorough abnormal magnetic field induction and gravitational anomalies analised. Sediments rocks hasn't many magnetite minerals, therefore their rocks do not produced anomalies of magnetic field. But the different granits of US can has a different numbers of ferromagnetic minerals and formed different intensive magnetic field anomalies. The old methods for interpretation adnormal magnetic field are used different petrografic groups it has some magnetic properties of samples for all area. Today, investigation samples with concretic exposures (different petrografic composition) in complex with observation magnetic field in this territory [complex metod] and this material are used for complex geological analis of adnormal magnetic field.

Unchanged enderbytes xenolites in Gaisin block are present conserved. Enderbyte consists practically from all granite-forming minerals. There are a quartz, hyperstene, biotite and feldspar. The difference is in content of feldspar – in enderbyte he not consist kaly K. This is formad green-gray colour enderbyte, whenever granites are gray or pink. Enderbyte has unique macrostructures [8, 34].

2. Material and Methods

Study area. In this article investigation area in the US Ros-Tykych megablock in the Uman smoll blockes in the Gaisin very smoll blockes. Gaisin blockes betwin Gayvoron and Podol block (parts of Dnistrovo-Bug megablock). Nemirov and Obodnov fractures Gaisin from Podol block is separed. Dashev fracture Gaisin from all other Uman block is separated.

Dashev fracture Gaisin from all other Uman block is separated (Figure 1).

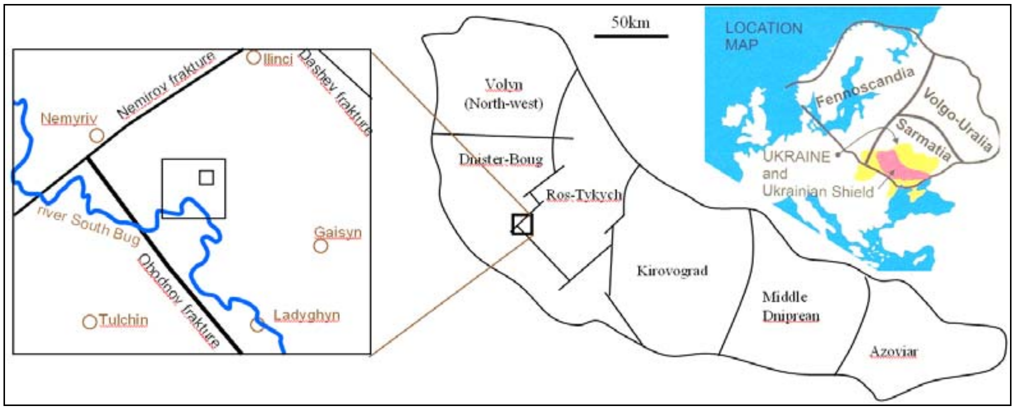

Fig 1: Geological structure position of investigation area is big square in global geological structure of Ukrainian shield

Gaisin block consists of unique composite rocks, it is the Gaisin complex [30, 31]. Gaisin complex it is wery motley becous plagio-granits and grano-diorites is alternated in one metrs and contains xenolites of gneis, kristal slate, enderbyte. Xenolites of enderbyte is unique rocks in Gaisin complex. On all territory of Gaisin block is one exposure of enderbytes. Enderbytes exposure located on board of river Gorodishe (to north of the village Sytkivci, Vinniza region of Ukraine, coordinates latitude 48 55 42.01 N, longitude 29 11 30.51 E). It exposure of enderbytes in this article is investigated. The enderbytes exposure located on Sutkivci territory geological maping. Katuk and all Sutkivcy territory were geological investigated and created geological map in scale 1:10000 [4]. We geological map with magnetic anomalies field map are combined (Figure 2).

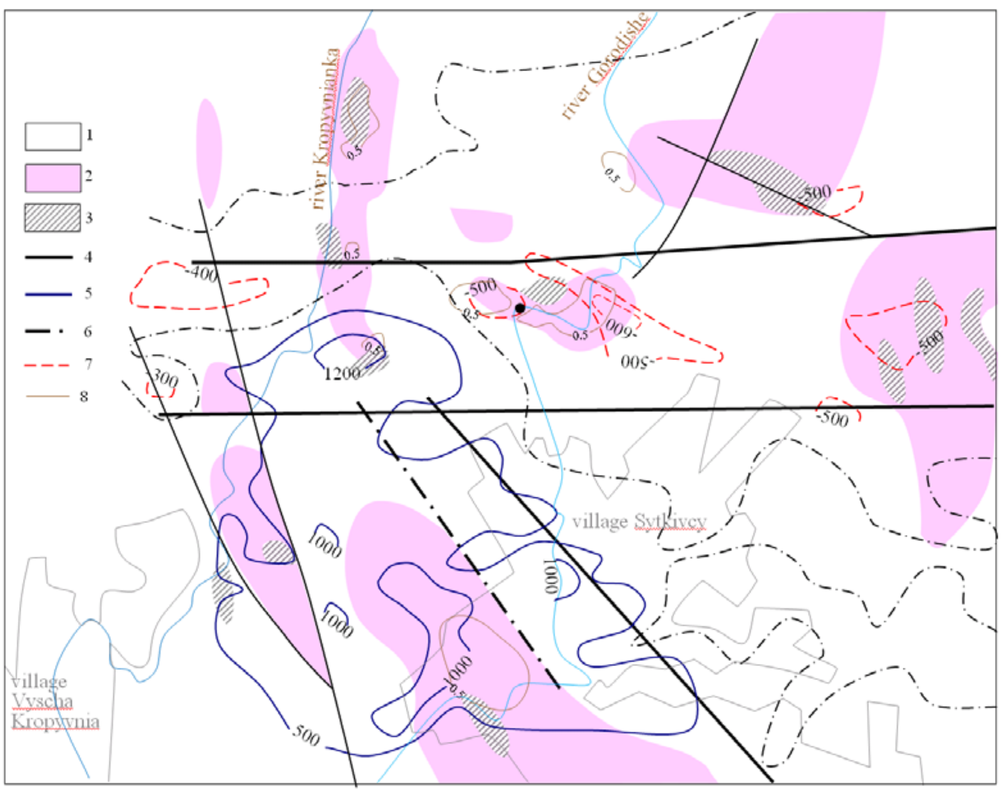

Fig 2: Fragment of geological map combinated with anomalies magnetic field T map of area among villages Vysha Kropyvnia, Rubigne and Sytkivcy (according [4]): 1 – rose granites, 2 – enderbytes, 3 – crystals shale, 4,5,6 – isolines of high and low T in nanoteslas nTl, 7 – fracture valid and from geophysical date, 8 – isolines of high gravity field mGl, black point – sites of enderbytes exposure

On figure 2 we can see then big xenolites of enderbytes are sited on differet anomalies magnetic field where there is high T (up to 1500 nTl) and low T (-500 nTl). Thus, according [4], the source of negative and positive anomalies of magnetic field are same enerbytes. Therefore is actual to study the magnetic properties of enderbytes to determined the nature of such ambiguity reflected in the abnormal magnetic field.

Methodology. In this work the autors new complexing detalisated magnitometric method is using by enderbytes investigation. It is method of magnetic scanning (MMS) which let use a new possibilities of mapping for high-differenciated sectors of precamdrian basement. Magnetic Scanning – it is a complex petro-magnetic method of detail investigation of rocks exposures as we described earlier [9-20]. In this method, laboratoric and "in field" magnetometric investigations are carried out in direct interrelation with each other.

At the first stage authors analyzed and correlations "magnetic field - geological structure" appears.

At the second stage, magnetometric investigations "in field" are carried out. The detailed measuring of magnetic susceptibility MS were executed by capameter KT-5 (Czech production). The modern counterparts of KT-5 is KT-9. The templates of rose granites and enderbytes were selected. The magnetic susceptibility of their templates were measured on astatic laboratory magnetometer LAM-24 (Czech production). The principle of the sensor is a magnetic field of pattern shifts magnets of astatic system from the equilibrium. It is need to measure in 12 direction and how much deviated astatic system. These measurements allow to calculate the value of the natural remanent magnetization of the sample, its magnetic susceptibility and orientation of remanent magnetization vector.

The magnetic minerals in rocks are definite by thermomagnetic analysis. It consists in consequent measuring of magnetic susceptibility MS of heated template. The laboratoric magnetometer KLY-2 fixes a change MS of sample which heated in an oven. The modern counterparts of KLY-2 is MFK1 Kappabridges of compani AGICO.

The density of sample was measured by method of hydrostatic gravimetry.

The dynamic of change of magnetic minerals was investigated by rock microscopy.

3. Results and discussion

Over enderbytes exposure on the board of river Gorodishe T =-351 nTl. We MS of enderbytes on exposure were observed. 80% of MS numbers is small $0\text{-}12\cdot10^{-3}$ u.SI (fig.3). It isn't big for granitoides of Gaisin complexes. (Then we were investigated other granitoid exposures near enderbytes exposure we were indentified pink grenites with small MS $<10\cdot10^{-3}$ u.SI and migmatites with big MS $> 30\cdot10^{-3}$ u.SI.) Some big MS in the range $40\text{-}50\cdot10^{-3}$ u.SI interspersed in the total weight with low values of MS $0\text{-}12\cdot10^{-3}$ u.SI. It big MS found on the exposure is not regularly (Figure 4). This can be explained by not-homogenous distribution of magnetite that have a several agglomerates in the enderbyte.

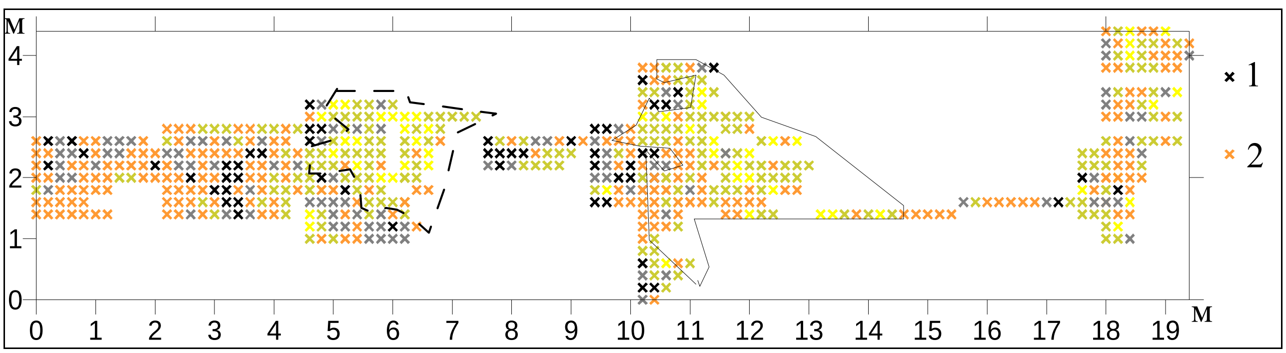

Fig 3: Diagram MS (MS range is $\cdot10^{-3}$ u.SI) distribution measured by the enderbites exposure

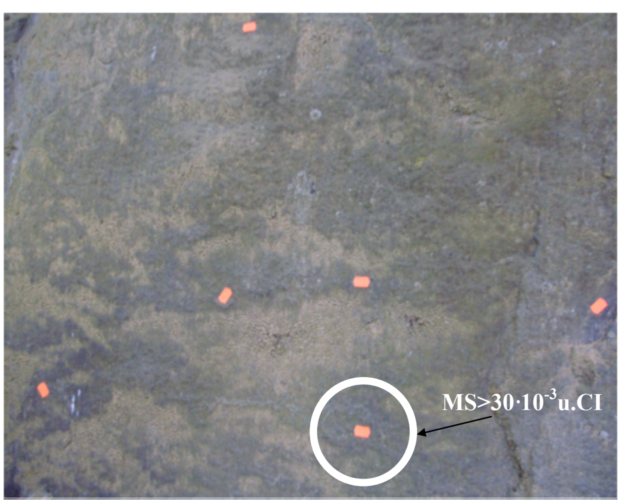

Fig 4: Limited fragment of enderbites exposition carrier with markers of sites with MS $40\text{-}50\cdot10^{-3}$ u.SI

MS very high values in the range $70\text{-}75\cdot10^{-3}$ u.SI obtained in only three measuring points (MS measured in 620 points on the network with 0.2m increments). MS sample distribution coincided with the distribution of MS measured at the enderbites exposure. The most samples (43 samples out of 54) has low MS ($0\text{-}12\cdot10^{-3}$ u.SI) indicating that a small amount of magnetite. At the same time, thermomagnetic analysis shows that their templates have magnetite and pirotine (Figure 5).

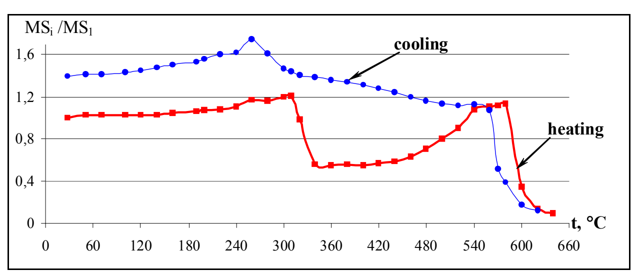

Fig 5: Thermomagnetic curves of templates

The curve MSi/MS1 falls sharply after heating to 380 ^{0}C indicating the presence pirotine. Ore microscopy revealed the presence of pirotine graines in enderbites. Enderbite samples which was identified pyrrhotite have heightened the Q factor in the range 1.5-2 units (normal 0.4-0.6 units).

These samples has back oriented vector of the remanent magnetization (Figure 6). Mostly vector of the remanent magnetization is oriented in the direction of modern magnetic field (for the coordinates our enderbites exposure declination 11 37.68 inclination 64 66.05).

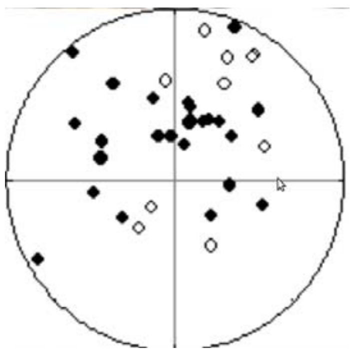

Fig 6: Stereoscopic of the remanent magnetization vector of enderbite. Black circles - straight, hollow circles - reverse orientation of the vector of the remanent magnetization

The low values of the magnetic susceptibility, and hence the induced magnetization are indicated that enderbite will not significantly affect the nature of the anomalous magnetic field. That part enderbites it is inversely oriented remanent magnetization can only weaken the magnetic field. Map of the anomalous magnetic field shows that the enderbites exposure is in the negative conjugate field anomalies. The positive part of the conjugate anomaly is located south-west enderbites exposure (see Figure 2). It is necessary to examine the method of magnetic scanning exposure in the area of positive anomalies of the magnetic field (T>1000nTl) in order to identify the source of that.

Place high positive anomalies of the magnetic field coincides with the place enderbite body position (see Figure 2). Our research has shown that enderbites can not create high positive anomalies of the magnetic field. This means that the anomaly magnetic field may cause or other rocks or there enderbites are located on the magnetic properties different from those examined enderbites.

Enderbite density ranges from 2.67 to 2.77 g/sm^3. Enderbite density ranges from 2.67 to 2.77 g/sm^3 while the pink granite have a density of 2.6 g/sm^3. Migmatites in representation of areas in figure 2 it we invistigeted have a density from 2.6 to 2.7 g/sm^3. This indicates that enderbites have high density and can produce positive anomalies in the gravitational field. Compare anomalies card Bug and geological map shows that the anomalies coincide with the contours of the body contours enderbite. This suggests that the creation of a geological map does not take into account the anomalous magnetic field map. This requires a new analysis of existing spatial information.

4. Conclusion

The magnetic susceptibility of enderbites in Gaisin Block are investigated in the first time. It is established that enderbites are weak-magnetic (MS<$12 \cdot 10^{-3}$ u.SI) rocks with magnetite+pyrotine feromagnetic minerals.

Experimental data can show that enderbites cannot produce a high induction of magnetic field. On the prospect of suggested further study of those areas where high positive magnetic field anomalies coincide with places spread enderbite.

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