Petrography and Magnetic Investigation of Western Part of Zafarghand Granitoidic Pluton, Ardestan, Isfahan.

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Abstract

Zafarghand granitoidic pluton is one of the granitoidic pluton of Uroumieh Dokhtar structural zone and its lithological composition range includes: gabbro, diorite, granodiorite and granite. Eocene volcanic and volcano sedimentary rocks are host rocks. This pluton investigated in the light of Anisotropy of Magnetic Susceptibility (AMS) method. Emplacement mechanism of granitoidic rocks it is possible to determine by AMS method. In this direction, we took 70 cores in the western part of Zafarghand granitoidic pluton. Based on some criteria's, magnetic parameters of these cores have been measured in the magnetic lab of Shahrood University of technology by MFK1-FA kappabridge machine. The measured mean magnetic susceptibility (Km) of the different rock groups are as follows: gabbros (24530), diorites (23536), granodiorites (20050) and granites (4534). Km values which they are more than (500 µSI) indicate that studied granitoidic rocks are ferromagnetic and correlate with I-type granitoids. Magnetic lineations and foliations which define on the base of magnetic parameters, indicate the western part of this pluton, include of two domains. North-west domain mainly composed of diorite and N-S magnetic structures. Dip of magnetic lineation is high in NW domain and it looks like that this domain is the main feeder zone of western part of Zafarghand granitoidic pluton. South-East domain mainly composed of granodiorite and they show approximate concentric pattern of magnetic foliation

Keywords: *Zafarghand granitoidic pluton; (AMS) method; Magnetic lineations and foliations.*

Introduction

Petrography, petrofabric and anisotropy of magnetic susceptibility of east part of the Zafarghand granitoidic pluton (ZGP) are the main discussed subjects in this paper. This pluton is located in the 40 km of SE Ardestan and 160 km of NE Isfahan. ZGP was intruded in Eocene volcaniclastics rocks of Uromieh Dokhtar structural zone. Our investigations show that this pluton is composed of gabbro, diorite, granodiorite and granite. Diorite and granodiorite compositions include the main part of this pluton. Gabbros and granite have very limited outcrops. Some andesitic dikes cut host rocks and granitoidic pluton.

Petrography investigations and field observations show evidences of epidoteization, choloritiztion, the presence of mafic enclaves, fragmented and buoyant mafic dikes. Petrographical studies indicate that plagioclase, alkali feldspar, green hornblende, quartz, augite and biotite are the major minerals. Zircon, apatite, esphene and magnetite are accessory minerals. Also calcite, chlorite and epidote are the secondary minerals. General textures of these rocks are granular, subhedral and the sizes of significant minerals are medium to coarse.

The consternation of magma can be revealed from Graphic texture and plagioclase zoning. In some cases, quartz has dissolution and curve margins. Diorite and granodiorite compose the main part of ZGP and they have granular texture. Granite includes a small part of this pluton and mainly has whitish cream color. They intruded into some parts of ZGP in the form of dikes or small stocks, and they are considered as crystallization product of the late stage of magmatic activities of this pluton. Gabbros have very limited outcropped (less than km^2) and they gradually evolved to diorite. Mafic microgranular enclaves are present in very extensive area and they confirm magma mixing process during formation of this pluton.

In this paper, magnetic investigations have been done by anisotropy of magnetic susceptibility (AMS) method. Meanwhile, AMS method is the first step for paleomagnetic and magnetostratigraphic studies. AMS is a new method for studying of petrofabrics. Emplacement mechanism of granitoidic pluton can be determined by AMS method (Bouchez 1997). AMS method is a new and interesting scientific field in many developed countries such as: France, Canada, England, and Brazil and ….

This method can determine the magnetic lineation and foliation according to their emplacement by ferromagnetic and paramagnetic minerals. In fact, AMS study is based on behaviors of magnetic minerals (Naba 2003, Talbot 2005). Magnetic fabric science investigates magnetite lineation and foliation of granitoidic samples. In the past, the emplacement mechanisms of plutons were determined by fabric observation in microscopic and mesoscopic scale (Cloos, 1931). Now AMS method can help us to determined granitoidic pluton. This method is introduction for magnetite studies in the geological investigations. Magnetic susceptibility is measuring with MFK1-FA kappabridge machine and it is available in geomagnetic lab of Shahrood University of technology.

For this purpose, we took dip and dip direction of the cores with compass. The location of each station recorded with GPS. Depending on the lithological features in each station, 2 or 3 cores can be obtained. Each core had 50 to 100 mm length and 25 mm in diameter. After obtaining the direction cores; we cut cores to pieces with 22 mm lengths. We get 2 to 4 samples pieces of each core. Then, the samples put in a basin with in 0.1 molar HCl for 2 hours and samples will be cleaned from any impurity. And then it is possible to measure the magnetic parameters of cores by MFK1-FA kappabridge machine (figure 2).

MFK1-FA system has 3 parts: 1-Microprocessor 2-Data processor unit and 3-Laptop or monitor. MFK1-FA's instruction entering sample in magnetic field and infuses magnetic field intensity that is called (H) and creates as magnetization that is called (M) in sample. The Ratio between H and M is equal to M/H which is defined as K parameter. If we imagine K parameter as an ellipsoid with 3 dimensions (Tarling, Heroda 1993), the largest vector is named K1 or lineation and the smallest vector is named K3 or foliation pole (figure 3). Mean vector between K1 and K3 called K2 (K1>K2>K3). The value of K1, K2, and K3 is defined Km:

$$\mathrm{Km} = \frac{K_1 + K_2 + K_3}{3}$$

We use K1 and pole of K3 for mapping lineation and foliation map. These maps eventually show the emplacement mechanism of pluton. MFK1-FA should be calibrated with a standard sample after measuring a few samples periodically. The measured mean magnetic susceptibility (Km) of the various rock groups is different. Km in μSI for gabbros (24530), diorites (23536), granodiorites (20050) and granite (4534) indicate that the ZGP is belonged to ferromagnetic granitoidic. When Km values are more than 500 μSI indicating that this pluton is ferromagnetic granitoide and correlate with I-type granitoidc. This value of Km is confirmed by the presence of the magnetite, hornblende and augite in the thin sections.

Conclusion

The magnetic parameters use for drawing diagram and magnetic map. The investigation of magnetic lineation and foliations show these parameters in diorite and gabbros have higher dip. The anisotropic amounts increase from granites to diorites. With attention to 4, 5 figures, it is possible to divided this pluton in 2 zones: southeast zone and northwest zone based on magnetic lineation dips and Km. Northwest zone is characterized by magnetic foliation with approximate north-south strikes. This part probably is the main magma feeder zone in ZGP and mainly is composed of diorite. Southeast zone is characterized by different strikes of magnetic foliation and they show approximate concentric pattern of magnetic foliation. So this part mainly composed of granodiorite and concentric magnetic structures.

References

1- Bouchez, J. L., 1997, Granite is never isotropic; an introduction to AMS studies in granitic rocks. In: J.L. Bouchez, D.H.W. Hutton and W.E. Stephens, Editors, Granite: from Segregation of Melt to Emplacement fabrics: Kluver, Dordrecht, pp. 95–112.

2- Naba, S., Lompo, M., Debat, P., Bouchez, Bouchez, J. L., Béziat, D., 2003, Structure and emplacement model for late-orogenic Paleoproterozoic granitoids; the Tenkodogo–Yamba elongate pluton (Eastern Burkina Faso): Journal of African Earth Sciences, v. 38, p. 41-57.

3- Talbot, J. Y., Chen, Y., Faure, M., 2005-A magnetic fabric study of the Aigoual-saint Guiral-Liron granite pluton (French Massif Central) and relationships with its associated dikes: Journal of Geophysical Research, v. 110, B12106

4-Cloos, E., 1931, Der Sierra Nevada Pluton: Geol, Rundshau, v. 22/6, p. 370-385.

5- Tarling, D. H., Hrouda, F., 1993, the magnetic anisotropy of rocks: published by Chapman and Hall company, 217 pages.

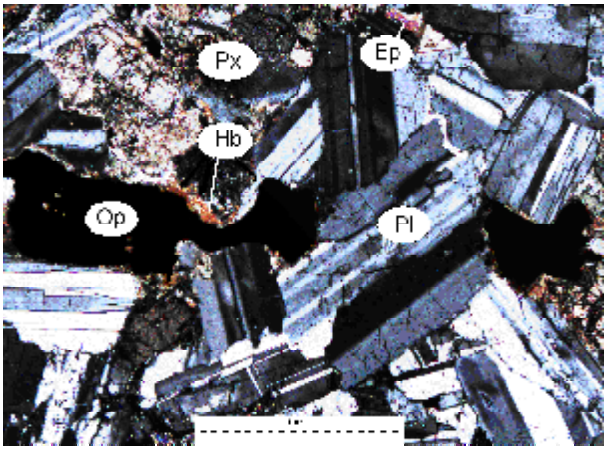

Figure1: Magmatic structures of granodiorite (XPL, 40 X).

Figure 2: Magnetic susceptometer MFK1-FA model.

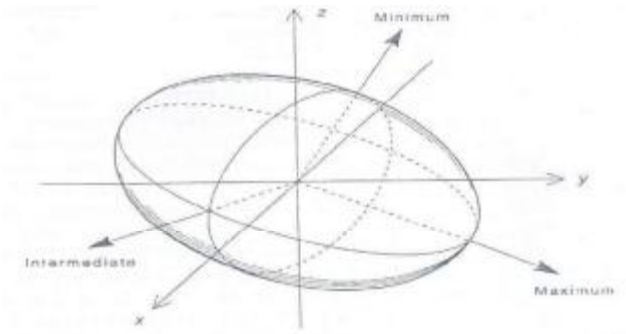

Figure3: 3 dimensions image of magnetic ellipsoid.

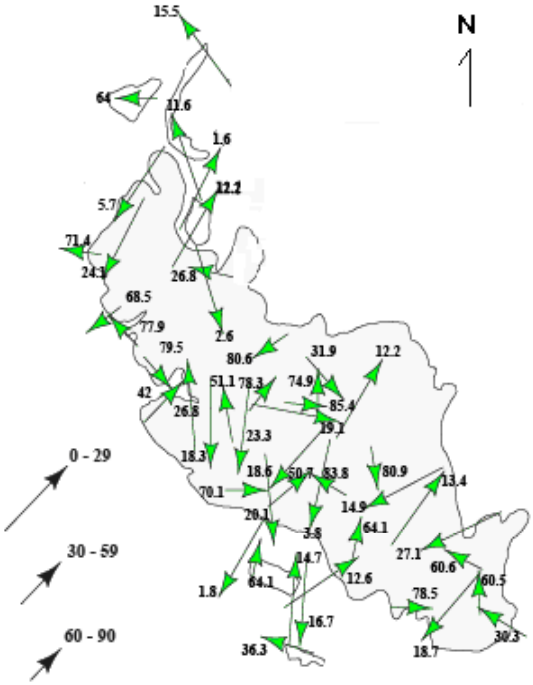

Figure 4: magnetite lineation map

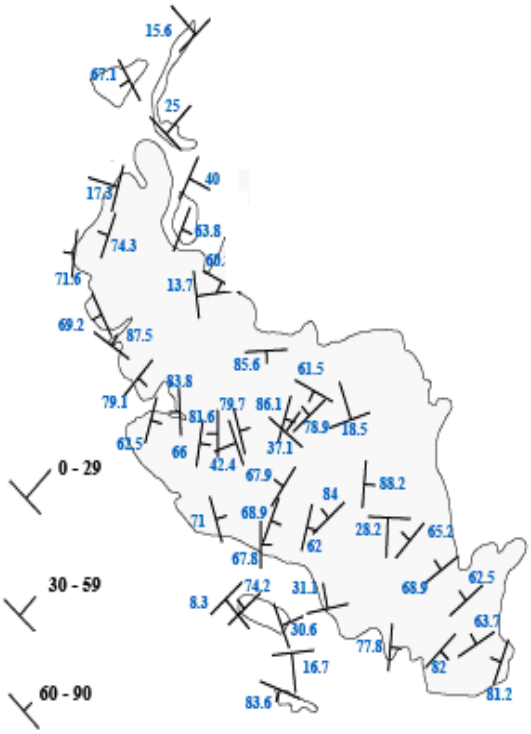

Figure 5: magnetite foliation map