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Geochemistry Characteristics of the Diaoyutai Complexes in Liaoning, eastern North China Craton

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1 Introduction

There are complex rocks exposed in the Diaoyutai area which is in western Liaoning, eastern North China Craton. The Neo-Archean "Suizhong migmatitic granites" are the important parts of the Diaoyutai complexes. It is generally accepted that there was a significant tectonic magmatic thermal events occurred in NCC (North China Craton) at 2.5Ga. The study of granitoids of Neo-Archean plays a key role in comprehending the mechanism of tectonic magmatic thermal events in NCC and the process of continental crust's formation and evolution (Geng Yuansheng et al., 2010). The research of Diaoyutai complexes was concentrated on granitic rocks and its petrology and chronology materials, but the systematically geochemical data were few. At the same time, the exposed mafic rocks in the study area don't have any chronology proof.

2 Geochemistry Characteristics of the Diaoyutai Complex

The Diaoyutai area, which is in western Liaoning Province, is located in the eastern North China Craton (NCC). There are not only "Suizhong migmatitic granites", but also mafic dykes in Diaoyutai area. Field investigation and major elements TAS diagram revealed that "Suizhong migmatitic granites" consist of biotite monzonitic granite, porphyraceous granodiorite and quartz diorite. Former researchers had already performed zircon U-Pb dating experiment on these three types of rocks (which makes up the "Suizhong migmatitic granites"). It showed that all of them are crystallized at 2.5Ga in Neo-Archean (Zhang Yuanyuan et al., 2016).

The Sample 11D03 data of rocks drops into the granite area in the TAS diagram; integrated with petrological characteristics from field observation, it should be named as biotite monzonitic granite. The Sample 11D02 falls into the boundary of granodiorite area, according to its petrological features, it should be called as porphyraceous granodiorite. The Sample 11D04 drops into the margin of diorite area, coupled with petrological characteristics from field survey, the rock should be quartz diorite. Sample 11D01 and 11L01 fall into the scope of gabbro, their rock constituents are equivalent to gabbro phase, but it ought to be diabase according to their textures and structures. On basis of A/NCK-A/NK diagram, biotite monzonitic granite, porphyraceous granodiorite and quartz diorite are all quasi-aluminous rocks and don't illustrate the typical characteristics which S-type granites show. The three types of rocks, which SiO_2 contents varying from 52% to 66% of Neo-Archean, are intermediate acidic igneous rocks. Total alkaline contents range from 6% to 9% and K_2O contents are about 2% to 4%, which belong to high potassium calc-alkali lavas. We can see clearly evolutionary trend from the Harker diagram that the content of TiO_2, Fe_2O_3, MgO, MnO and CaO show a good negative correlation with the content of SiO_2. Al_2O_3 hits the highest value in mafic rocks. The content of Na_2O and K_2O are positively correlated with that of SiO_2. The high potassium calc-alkali granite presents us $Na_2O/K_2O<1$. On account of the same age that the granites of study area share and the diagrams' information, these rocks were inferred that are probably affected by the tectonic magmatic thermal events in Neo-Archean. These regular relationships are usually connected with magma crystallization differentiation or large-scale magma mixing. Some scholars point out that the increase of magma acid degree and viscosity brings out limited crystallization differentiation (Zhang Qi,

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2012). Consequently, the good linear relation may have something to do with magma mixing or the intrant crustal materials.

REE distribution patterns and trace element Spider-gram characteristics of "Suizhong migmatitic granites" in Diaoyutai area are analogical. Granitic pluton has the traits of high total REE content (∑REE=181.79~337.95ppm) and obvious light and heavy rare earth elements differentiation which presents LREE enrichment. Sample 11D02 and 11D04 show weak Eu negative anomaly, and this may be influenced by the low differentiation maturity of source rocks or plagioclase crystallization in source area. Sample 11D03 shows representative Eu negative anomaly, which indicates its high differentiation degree. The Nb/Ta value of granite body is 15.49 on average, much higher than the average lower-crust (Nb/Ta=8.3) (Rudnick and Gao，2003). The Nb/Ta ratio of the rocks varies from 8.66 to 20.62. These Nb/Ta values suggests that materials of the granitic pluton were impacted by foreign substances, and that materials maybe were from magma mixing or crustal rokcs during the pluton formation process. Meanwhile, large ion lithophile elements, such as K, Rb, Th and U, appear slightly positive anomaly, and they also demonstrate that source materials were partly from the crust during pluton formation.

The diabase dykes were exposed in Diaoyutai area, and these dykes crossed monzonitic granites of Neo-Archean. In addition, there are diabase dyke outcrops in Longhuitou area in the vicinity of Diaoyutai area. Suizhong granites were in unconformable contact with the mid-Jurassic conglomerate of Haifanggou formation. Haifanggou formation rocks were crossed by multiple diabase dykes. Zircons from Jurassic diabase rocks are characterized by one group of U–Pb ages (158 Ma). Diabase (11D01) is rich in LREE, which manifests that its source area was affected by enriched mantle. If the emergence of potassic granites, such as "Suizhong migmatitic granites" and "Qinhuangdao granites" (Chen Danling et al., 2007), symbolizes that NCC finished the final potassic cratonization in Neo-Archean, the occurrence of diabase in late-Jurassic signifies that NCC Mesozoic system transition had activated in late-Jurassic.

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