Geochemical Characteristics of Mid-oceanic Ridge Volcanic Glass from Lau Basin: Evidence from the Major Elements Variation

BAO Houyin1, LI Zhenglin1,2, *, LIU Xijun1,2, SUO Mengyin1, ZHAO Yinquang1, ZHAO Yunbiao1 and QI Junda1

1 College of Earth Sciences, Guilin University of Technology, Guilin 541004, China
2 Guangxi Key Laboratory of Hidden Metallic Ore Deposits Exploration and Guangxi Collaborative Innovation Centre of Hidden Non–ferrous Metallic Ore Deposits Exploration and Development of Materials, Guilin University of Technology, Guilin 541004, Guangxi, China

Abstract: The Lau Basin, located behind Tonga Arc in the SW Pacific, is an active back-arc basin (Tian et al., 2011; Hawkins, 1995). As is typical of back-arc basins elsewhere, the formation of oceanic crust along spreading centers in the central and southern parts of the Lau Basin is similar to the generation of mid-ocean ridge basalt (MORB) although it is also influenced by subduction processes. The volcanic glass in the mid-ocean ridge has the lowest effect on the contact and crystallization of the magma before it’s converted into magmatic rocks, so it has a more intuitive and realistic reduction effect on the magmatism in the magma chamber. This paper presents new major element in-situ analyses of volcanic glasses from Mangatolu Triple Junction (MTJ), Peggy Ridge (PR), Rochambeau Bank (RB), and Niuafo’ou Island (NF) within the northern Lau Basin (NLB) and takes the Bowen Reflective Sequence as the objective law to complete the magmatic rocks from the acid to the mafic rock.

Volcanic glasses from Lau Basin range from basaltic to rhyolitic composition, (A/CNK) range from 1.00 to 1.19; basaltic glass samples belong to calcium-alkaline series, and a small part of basaltic glass samples belong to alkaline, FeO content range from 6% to 12.3%, Mg# range from 65 to 74. Most of the glass samples of RNDB from Mangatolu Triple Junction belong to calc-alkaline basalt, and a few glass samples show K2O/Na2O is 0.2, the aluminum saturation index (A/CNK) is 0.61~1.26, basalt and basaltic andesite are the same as that of the other. The MgO content of the Peggy Ridge glass is very large (0.08~10.03%), the Mg# value is 55.8 and FeO is 0.50~17.1%. Niuafo’ou Island glass (PTTU) samples belong to the calc-alkaline basalt, Mg# =43.4~61.3, higher FeO content (4.45~15.3%). The all glass major element results show that MgO has a positive correlation with MgO and Al2O3 and CaO. On the contrary, MgO has a negative correlation with SiO2 and K2O. In addition, MgO and FeO and TiO2 show positive correlation relationship. The content of Na and K increased with the increase of SiO2 content, and the contents of Ca, Fe, Mg and Al decreased gradually from the ultrabasic rocks to the acid rock. Which is consistent with the characteristics of the elements in the melt corresponding to the Bowen reaction sequence.

Based on the Bowen reaction sequence as the main argument for the magmatic transformation, the change of the characteristic oxides in the three typical regions intersects the distribution. In the case of macro-law will be due to the characteristics of the mineral crystallization process of differentiation, the same in the volcanic glass will also be affected by the degree of melting, pressure and temperature factors. The distribution of elements in the volcanic glass samples is heterogeneous and caused by differences in the local dynamics of the mantle without homogeneity or magmatism.

Key words: Pacific ridge, Philippine basin, volcanic glass, main element, homogeneity

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References

About the first author
BAO Houyin, female, born in 1998 in Baise City, Guangxi Province; undergraduate student; Now She is studying in Guilin University of Technology. She is now interested in the study of isotope geochemistry. Email: 8176360474 @ 163.com; phone:18176360474

* Corresponding author. E-mail: lizhenglin@glut.edu.cn

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Fig. 1. Variations of MgO versus other elements for the glass from Lau Basin, showing most samples have a MgO content between 6 and 10%, while others are concentrated between 1 and 3%. MgO showed a significant positive correlation with Al2O3 and CaO. When MgO changed from 0.08 to 10.5%, the percentage of Al2O3 increased from 10% to 23%; the percentage of CaO increased from 4 to 14%, but it tends to level at 14%.

About the corresponding author
LI Zhenglin, male, born in 1989 in Wuzhou City, Guangxi Province; master; graduated from Guilin University of Technology; research assistant of college of Earth Sciences, Guilin University of Technology. He is now interested in the study of isotope geochemistry. Email: lizhenglin@glut.edu.cn; phone: 18777398685.