Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SIT05-P13 会場:コンベンションホール 時間:5月21日 18:15-19:30

Fe-K端XANES分析によるプチスポットマグマの酸化還元状態の検討
Oxygen fugacity of basaltic magma from petit spot: a preliminary result from Fe-K edge XANES study

石橋 秀巳[1*], 鍵 裕之[2], 阿部 なつ江[3], 平野 直人[4]
Hidemi Ishibashi[1*], Hiroyuki Kagi[2], Natsue Abe[3], Naoto Hirano[4]

[1] 静岡大学理学部地球科学科, [2] 東京大学大学院理学系研究科地殻化学実験施設, [3] 海洋研究開発機構地球内部変動研究センター, [4] 東北大学東北アジア研究センター
[1]Faculty of Science, Shizuoka University, [2]Graduate School of Science, The University of Tokyo, [3]IFREE, JAMSTEC, [4]Center for Northeast Asian Studies, Tohoku University

Petit-spot is a newly-discovered site of intraplate magmatism (e.g., Hirano et al., 2006); a swarm of small knolls is formed by ascent of magmas along brittle fractures that develop where plate flexes due to subduction and/or loading by seamounts. A geochemical study suggested that alkaline basaltic lavas from petit-spot volcanoes on the northwestern Pacific Plate were generated by partial melting of asthenosphere (Machida et al., 2009). In addition, basaltic glass matrix and peridotite xenoliths found in the lava indicate that the magma rapidly ascended through lithosphere and was quenched right after eruption. Therefore, the lava can be expected to retain information about physicochemical conditions of asthenosphere beneath the old oceanic plate. Oxygen fugacity (fO_2) is an important parameter because it influences on chemical and mechanical properties of minerals and melt. MORB glasses from all over the world revealed almost constant fO_2 condition near the quartz-magnetite-fayalite (QMF) buffer, indicating that the fO_2 of MORB source mantle is near the QMF buffer condition (Cottrell et al., 2011). However, it is unobvious whether asthenospheric mantle far from the mid ocean ridge is also under similar fO_2 condition or not. Petit-spot magma may provide a chance to examine it; the present study aims to quantify fO_2 of basaltic magma from petit-spot and to examine its source mantle condition.

Valence state of Fe in silicate glass is a sensitive indicator of magmatic fO_2 condition. Recent advance in Fe-K edge micro-XANES (X-ray Absorption Near Edge Structure) study enables us to determine valence state of Fe in silicate glass with several microns order of spatial resolution. In this study, Fe-K edge XANES spectra were acquired for quenched basaltic glasses using the micro-XANES analyzing system at Beam Line 4A in Photon Factory, KEK. The obtained spectra were analyzed using the method of Cottrell et al. (2009) to determine mole ratios of ferric to total iron, Fe^{3+}/Fe_{total}. Oxygen fugacity of the basaltic melt was calculated from its Fe^{3+}/Fe_{total} ratio and major element compositions using the method of Kress and Carmichael (1991). Basaltic standard glasses synthesized at controlled fO_2 conditions were also measured; the results confirm the reliability of our analyses within ca. 0.4 log unit in fO_2.

Six basaltic samples dredged from youngest petit-spot volcanoes (site B of Hirano et al., 2006) were analyzed. They were erupted at 0.05-1Ma, include several tens vol. % of bubbles and small amount of olivine crystals within fresh basaltic glass. We measured more than three points in glass for each samples. The spectra obtained from the six glasses are very similar each other, indicating that valence states of Fe in glasses are homogeneous in the six samples. Fe^{3+}/Fe_{total} ratios calculated from the obtained spectra were ca. 0.3, which is significantly higher than the mean ratio for MORB glasses (ca. 0.17; Cottrell et al., 2011). fO_2 estimated from the Fe^{3+}/Fe_{total} ratio is ca. 2 log unit higher than the QMF buffer; the fO_2 value is comparable to that of arc magma and significantly higher than those of MORB and hot spot magmas. Our result suggests that the source mantle region of petit-spot magma beneath old oceanic plate was more oxidized than MORB mantle even allowing for the effects of olivine crystallization and volatile degassing. We will discuss why the source mantle of petit-spot magma is oxidized.

キーワード: 酸素フュガシティ, プチスポット, 玄武岩, XANES, ガラス, マントル
Keywords: oxygen fugacity, petit spot, basalt, XANES, glass, mantle