Vertical intrusive magnetite-series granodiorite as a source of surface magnetic anomalies in the King George Island, Antarctica

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Throughout the Phanerozoic Era, magnetite-series and ilmenite-series granitoids are heterogeneously distributed on both sides of the Pacific Ocean. Regional distribution patterns of paired belt are also recognized along subduction zones differently, implying different subduction settings on both sides of the Pacific Ocean (Ishihara 1979). Magnetite-series granitoids are dominant in an extensional stress field along subduction zones, such as back-arc basin. On the other hand, ilimenite-series granitoids have been mainly exposed in the compressional stress field of fore-arc coast line. Ishihara (1998) proposed a genetic model for the presence of these granitoids. The model explains that the magnetite-series granitoids were formed from the ascending-oxidized mafic magmas without any crustal contamination in the extensional stress field, and the ilmenite-series ones were formed from the magmas by the assimilation of reduced carbon-bearing sediments in the compressional stress field. Fore-arc basin near Japan Islands characterizes a linear strong aeromagnetic anomaly for the presence of magnetite-series granitoids along the Tohoku coast line. This contradiction might be due to the existence of past extensional tectonic setting during the formation of Japan Island Arc. Therefore, the rock magnetism and aeromagnetic survey are key tools to provide information of ancient tectonic stress setting in the Circum-Pacific orogenic belts. Along East Antarctica, it is well known that the South Shetland Islands have been formed by back-arc spreading related to the subduction along the South Shetland trench during the late Cretaceous and middle Miocene (Birkenmajer, 1994). Moreover, geology in the South Shetland Islands consists of lava flows with subordinate pyroclastic deposits, intrusive dykes-sills, granitic plutons, displaying a typical subduction-related calc-alkaline volcanic association. However, there is little report on the presence of fore-arc granitoid. Here we report the distribution and structure of the granitic plutons around Marian Cove in the King George Island, South Shetland, East Antarctica by surface geological survey and magnetic anisotropic studies. Then we compare the distribution of granitic plutons with surface magnetic anomalies through our ship-borne and foot-borne magnetic surveys.

The granitic plutons are distributed only shallow around the Marian cove in the King George Island, and the plutons had been intruded in the Sejong formation with pyroclastic deposits and basaltic/rhyoritic lavas, suggesting the post back-arc spreading. We sampled 8 plutons, 12 basaltic lavas and 6 andestic dykes, all located within four kilometer radius from the Korean Antarctic research station (King Sejong station) in the western side of King George Island. The plutonic rocks of diorite and granodiorite show high values of bulk magnetic susceptibility of c.a. 0.01-0.4 SI, appearing to be the source of positive magnetic anomaly. On an empirical basis, Dilek et al. (1998) have shown that a fast-spreading ridge thickens oceanic lithosphere due to continuous ‘hot’ magma injection vertically to the upper crust in extensional tectonic settings. Hence, we examine the preferred petrofabric lineation directions at the sites using anisotropy of magnetic susceptibility (AMS) to reveal the flow fabrics. The AMS showed the plutonic rocks represent the vertical intrusion from the deep seated magma. Our optical microscope observation verified the maximum AMS orientation is parallel to the preferred alignment of framework-forming plagioclase, suggesting the alignment of euhedral magnetite grains along the long-axes of plagioclases. These results give support to notice that vertical magma flow was brought about by extensional tectonic setting due to opening of the marginal basin, which might be fast spreading rate. Moreover, our ship-borne and foot-borne surveys of geomagnetic filed anomaly

agree well with the distribution of the plutonic rocks, revealing the possible origin of surface magnetic anomaly. These suggest that the vertical intrusive plutons in this area may be magnetite-series granitoids, and this magnetic survey is proposed to be very powerful tool in exploration of granitoids.

References

Birkenmajer, K., Evolution of the pacific margin of the northern Antarctic Peninsula: An overview: Geologische Rundschau, 83, 309–321, 1994.

Dilek, Y., E. M. Moores, and H. Furnes, Structure of modern oceanic crust and ophiolites and implications for faulting and magmatism at oceanic spreading centers, in Faulting and Magmatism at Mid-Ocean Ridges, Geophys. Monogr. Ser., vol. 106, edited by W. R. Buck et al., 219–265, AGU, Washington, D. C., 1998.

Ishihara, S, Lateral variation of magnetic susceptibility of the Japanese granitoids: Journal of the Geological Society of Japan, 85, 509–523, 1979.

Ishihara, S, Granitoid series and mineralization in the Circum-Pacific Phanerozoic granitic belts, Resource Geology, 48, 219–24, 1998.