Revised litho- and chronostratigraphy of the volcanic rocks in Barton peninsula, king george island, antarctica

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Despite the intense studies on the geology of Barton Peninsula, King George Island over the last two decades, there have been considerable differences on the lithologic and stratigraphic classifications between published maps. Recent compilation and synthesis made by Lee et al. (2002) and Willan and Armstrong (2002) considerably resolved these problems; however, there still remain uncertainties on the stratigraphic subdivisions of the volcanic rocks. Furthermore, the reinterpretation of the isolated massive basaltic andesite suits as the intact-preserved earliest-stage spatter/cinder cones, contrary to the previous conjectures viewing as the lastest-stage hypabyssal intrusions, proposed by Kim et al. (2005), demands a more precise age constraints for the volcanic rocks. This study attempts to refine the litho- and chronostratigraphy of the Barton volcanic rocks, based on lithofacies analysis, field mapping and Ar/Ar age datings.

LITHOSTRATIGRAPHY

Barton Peninsula consists largely of stratified volcanic succession that has been pierced by plutonic and hypabyssal intrusions (Fig. 1 Davies 1982; Tokarski 1988; Park 1989 Birkenmajer 1998; Lee et al. 2002; Willan and Armstrong 2002). The volcanic succession (300-500 m thick) characteristicallyshows a progressive lithologic change from the lower volcaniclast-rich deposits to the upper lava-flow-dominant deposits. Because of the transitional lithologic change, there have been considerable

mismatches on the boundary of the lower volcaniclastic and the upper volcanic deposits among the previously published maps. To resolve this problem, this study suggests tripartite subdivision of the volcanic succession, following Willan and Armstrong (2002): lower volcaniclastic deposits with subordinate sedimentary rocks (Sejong Formation, 100?200 m thick), the middle wedge (0-100 m thick) of tuff/lava alternations with sparse sedimentary layers and the upper volcanic sequence (200-300 m thick) dominated by basaltic andesite lavas with subordinate tuffs (Fig. 1).

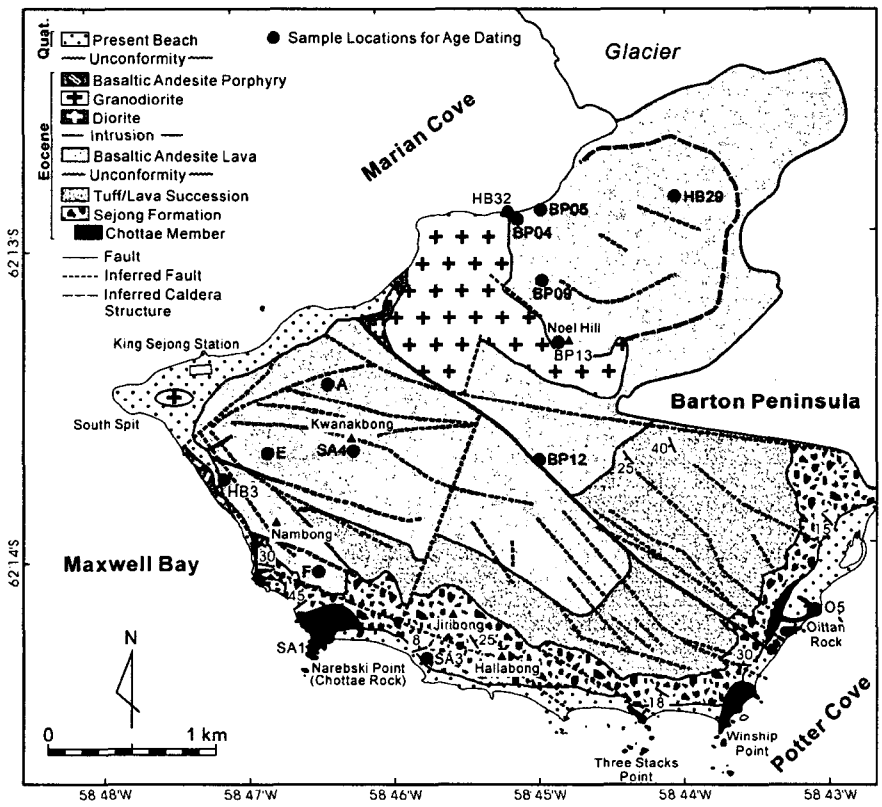

Figure 1. Geologic map of Barton Peninsula. Locations of age-dated rock samples are denoted.

The Sejong Formation is represented by very thick, tabular beds of basaltic to andesitic, welded to non-welded, tuff breccias and lapilli tuffs, emplaced by pyroclastic flows (largely block-and-ash flows), resulting

from Vulcanian explosions associated with volcanic dome extrusions and/or collapses (Kim et al., 2005). The rare intervening andesite lava flows suggest occasional effusions and the associated fluvial red sandstone/siltstone couplets and mass-flow conglomerates indicate active hydrologic remobilizations during inter-eruptive periods. At the base of the Sejong Formation, distinctive edifices of massive basaltic andesite occur as irregular to semi-circular patches in map view (Fig. 1). These rockswere formerly regarded as late-stage intrusions (dikes or plugs) (Tokarski 1988, Birkenmajer 1998, Lee et al. 2002, Willan and Armstrong 2002). The lack of distinctive discordant contacts and thermal metamorphism affecting the adjacent volcaniclastic rocks however does not support a late-stage origin. Furthermore, our new findings of the fringing basaltic agglomerates or agglutinates around the massive basaltic andesites through a transitional zone of fractured basaltic lava flows strongly indicate fire-fountaining (Hawaiian) to Strombolian eruptions through an open vent eruptions and subsequent emplacement of "ponded" lavas filling the vents at small-scale spatter/cinder cones. These cone complexes are there designated as a new stratigraphic unit (Chottae member) that occupies the base of the Sejong Formation, since they are draped, either unconformably or conformably, by the volcaniclastic rocks.

CHRONOSTRATIGRAPHY

A lot of K-Ar datings have been made for the basaltic andesites or andesites in the Upper Sequence (Park 1989; Kim et al. 2000; Hur et al. 2001), whereas only one sample was dated from the lower Sejong Formation (Table 1). We have analyzed two basaltic andesites (SA1 and O5) of Chottae member, one andesite lava (SA 3) of Sejong Formation, and one basaltic andesite (SA 4) of the Upper Sequence for the $^{40}Ar/^{39}Ar$ age determination. One basaltic andesite (SA 2) of Chottae member was also analyzed for the K-Ar age determination. The results are shown in

Fig. 2 and Table 1 and well support the revised lithostratigraphic classification of the Chottae member rocks as the lowest stratigraphic unit. Combined with the previous data, our new data suggests volcanic activities at 50-45, 45-44 and 44-42 Ma for Chottae member, Sejong Formation and the Upper Sequence, respectively, although the K-Ar ages are very disperse because of excess argon effect by the postdated hydrothermal alterations (cf. Willan and Armstrong 2002).

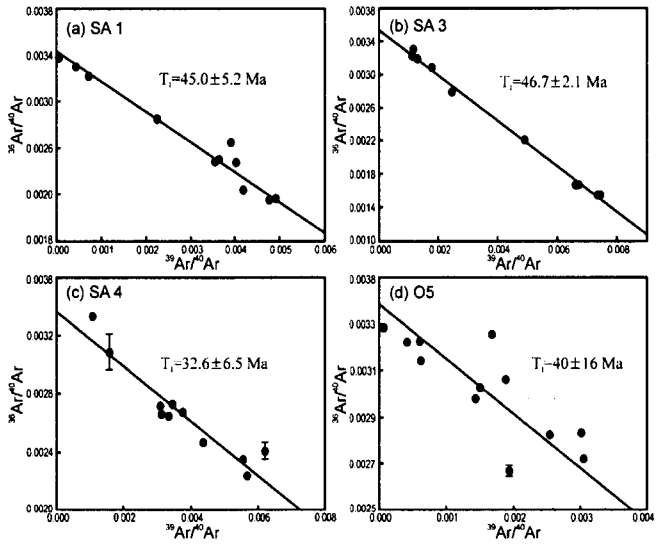

Figure 2. Ar-Ar isotope correlation diagrams of basaltic andesites (SA 1, SA 4 and O5) and andestie (SA 3) from Barton Peninsula. TI = isochron age. For sample locations, see Fig. 1.

Conclusions

Based on lithofacies analysis, field mapping, and radiometric age datings, the volcanic succession of Barton Peninsula, King George Island, can be divided into three formations: the lower pyroclastic deposits with subordinate sedimentary rocks (Sejong Formation), the middle wedge of tuff/lava alternations, and the upper sequence of basaltic andesite lavas with minor tuffs. The Sejong Formation comprises isolated, massive basaltic andesite suits with fringing basaltic agglomerates and

agglutinates (Chottae member) at the base. The Chottae member represents the precursory fire-fountaining to Strombolian eruptions at cinder/spatter cones during the 50-45 Ma, whereas the Sejong Formation indicates the volcanic climax with explosive Vulcanian eruptions at a large volcanic center (stratovolcano) at about 45-44 Ma. The middle wedge and the upper sequence suggest the lingering sporadic explosive and effusive eruptions, and the late-stage effusions and reworked deposition during the 44-42 Ma, respectively.

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