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Short Note
Sims Island: first data from a Pliocene alkaline volcanic centre in eastern Ellsworth Land

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Introduction

Although Sims Island (73°17'S/78°33'W), a bedrock peak in Carroll Inlet on the English Coast of eastern Ellsworth Land (Fig. 1), had previously been observed and photographed from the air (e.g. Rowley & Thomson 1990, fig. C.6.2), no landing had been made prior to the present study. Based on proximity and apparent lithological similarities, the island was thought likely to consist of alkaline volcanic rocks similar to those exposed on nearby Snow Nunataks (Fig. 1; e.g. Rowley & Thomson 1990). Smellie (1999) tentatively included it the Bellingshausen Sea Volcanic Group (BSVG), which consists of Miocene–Recent alkaline volcanic outcrops scattered across Alexander Island and eastern Ellsworth Land. More specifically, he provisionally assigned it to the Mount Benkert Formation (MBF), a probable subglacial volcanic succession exposed on three of the four Snow Nunataks. This note is based on observations made and samples collected during a short visit to Sims Island on 6 March 1996.

Morphology and lithology

Sims Island is *c.* 3 km in longest dimension (roughly N–S). The ice-covered raised beach at its northern tip is the only level ground of any extent (Fig. 2). On the southern side an almost sheer cliff face rises some 380 m (GPS reading on helicopter overflight) to the island's summit. Owing to limitations of time and accessibility, only the rocks exposed in the bluffs on the northern side of the island (Fig. 2c) were examined. There, pillow lavas are overlain by 30–40 m of very thickly bedded pillow breccia and gravelly volcanic sandstone, consisting largely of pillow fragments and blocky glassy clasts. This is overlain in turn by a thick pillow lava pile which appears to form most of the upper part of the island, though layering seen from the air suggests that the topmost peaks may consist of further bedded clastic deposits. The vesicular olivine–phyric pillows in the central bluffs in Fig. 2b average 60 cm across, have a glassy hyaloclastite/hyalotuff matrix, and are cut by rare, irregular dykes up to 70 cm across. Larger, crudely columnar-jointed basaltic intrusions cut the pillow lavas on the eastern and western sides of the island. The eastern intrusion, which appears to be a sill, shows poorly defined layering close to its irregular contact with overlying pillow lava. No pre-volcanic basement appears to be exposed.

Petrography, geochemistry and geochronology

Four samples (see Fig. 2c for locations) were studied in thin section and analysed for major elements (XRF at University of Keele, UK). R.6801.3 is a vesicular pillow lava in which olivine phenocrysts (to 1.5 mm) are set in a quench-textured groundmass consisting of featherlike brown pyroxene, skeletal plagioclase laths, and opaque oxides. In R.6801.1, from a dyke cutting the R.6801.3 lava, phenocrysts of plagioclase and olivine are set in a variolitic groundmass of plagioclase, titanaugite and opaque oxides. R.6801.4 and R.6801.5, from the eastern intrusion, are equigranular doleritic rocks consisting of zoned plagioclase (to 1.5 mm), pink-brown titanaugite, olivine and Fe–Ti oxides.

All samples are *ne*-normative (6.37 to 13.06 %*ne*). Apart from R.6801.5 which is classed as a tephrite, they fall in the hawaiite (S1) or nearby part of the alkali basalt (B) field on the TAS diagram of Le Bas *et al.* (1986). Based on their relatively low LOI values, R.6801.4 and R.6801.5 were selected for whole-rock $^{40}Ar/^{39}Ar$ step-heating analysis (by S.P. Kelley, Open University; see Jonkers & Kelley 1998 for analytical

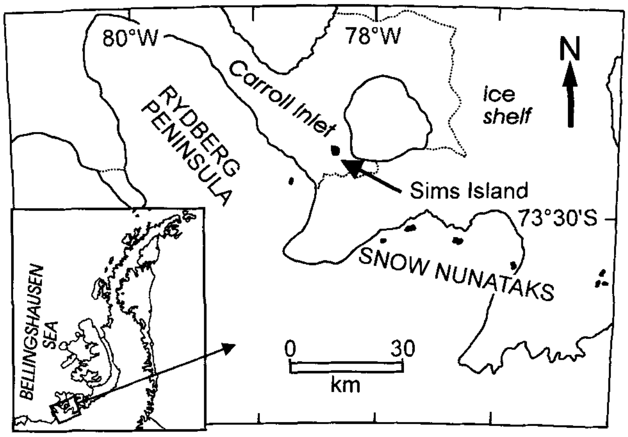

Fig. 1. Sketch map showing location of Sims Island and Snow Nunataks.

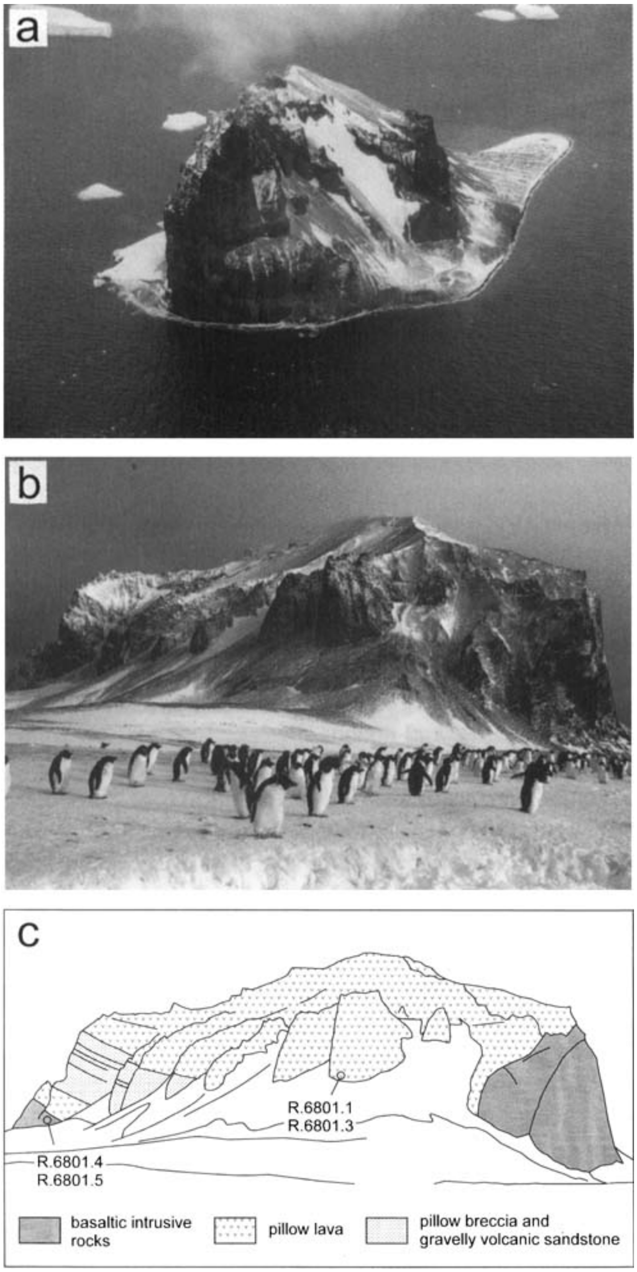

Fig. 2. a. Sims Island viewed from the south. **b.** View south from the northern tip of the island. **c.** Sketch showing lithological details of b and sample locations.

procedures). They yielded isochron ages of 3.46 ± 1.20 and 2.30 ± 0.54 Ma respectively. The latter of the two, with its lower error, is considered most reliable.

Discussion

Smellie (1999) suggested that the MBF rocks exposed on Snow Nunataks probably represent the subaqueous stages of several small subglacial volcanoes. The lithofacies and geochemistry of the Sims Island rocks support their inclusion in the MBF, and it seems likely that they represent a similar small monogenetic centre. The $^{40}Ar/^{39}Ar$ data indicate that the volcano was active during a period when ice sheets in the region are thought to have been considerably thicker than at present (Smellie 1999), and seem almost certain to have extended across Carroll Inlet. These are the first isotopic ages for Cenozoic volcanic rocks from the English Coast, indicating eruption in the late Pliocene, and falling within the youngest of the three groups of ages so far reported from the BSVG (2.7–<1 Ma; Smellie 1999).

Smellie & Hole (1997) proposed an "ideal" evolutionary sequence for the Pliocene–Recent englacial monogenetic volcanoes of the Antarctic Peninsula, in which subaqueous, non-explosive volcanism building a pillow volcano is followed by an initially subaqueous and then subaerial, explosive, tuff cone stage. In the observed succession on Sims Island, which consists mainly of pillow lava and intrusive rocks, only the pillow volcano stage seems to be represented. The clastic content of the 30–40 m-thick clastic interval is consistent with non-explosive, quench fragmentation of lava, rather than any explosive activity (cf. Smellie & Hole 1997). The bedding indicates resedimentation, and it seems likely that it consists of sediment gravity flow deposits generated by collapse of the pillow lava pile. Although deposits related to explosive volcanism were not observed, it is nevertheless possible that they are present in the unexamined upper part of the island.

Acknowledgements

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