A Submerged Volcanic cone in Deception Island (Antarctica)

Benthic communities and proximal volcanism in a rapidly changing sedimentological environment

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Introduction

Deception Island (DI) is amongst the most active volcanoes in Antarctica, with >20 explosive eruptions in the last two centuries[1] (Fig. 1). DI's caldera-forming eruption occurred 3980 ± 125c.y. before present, and it is the largest eruption documented in Antarctica during Holocene[2]. Mortality of benthic organisms occurred due to the last eruptions of 1967, 1969, and 1970[3]. A submarine volcanic lineament is observed within the caldera, where morphologically well-preserved cones raise from the seafloor up to >50 m.

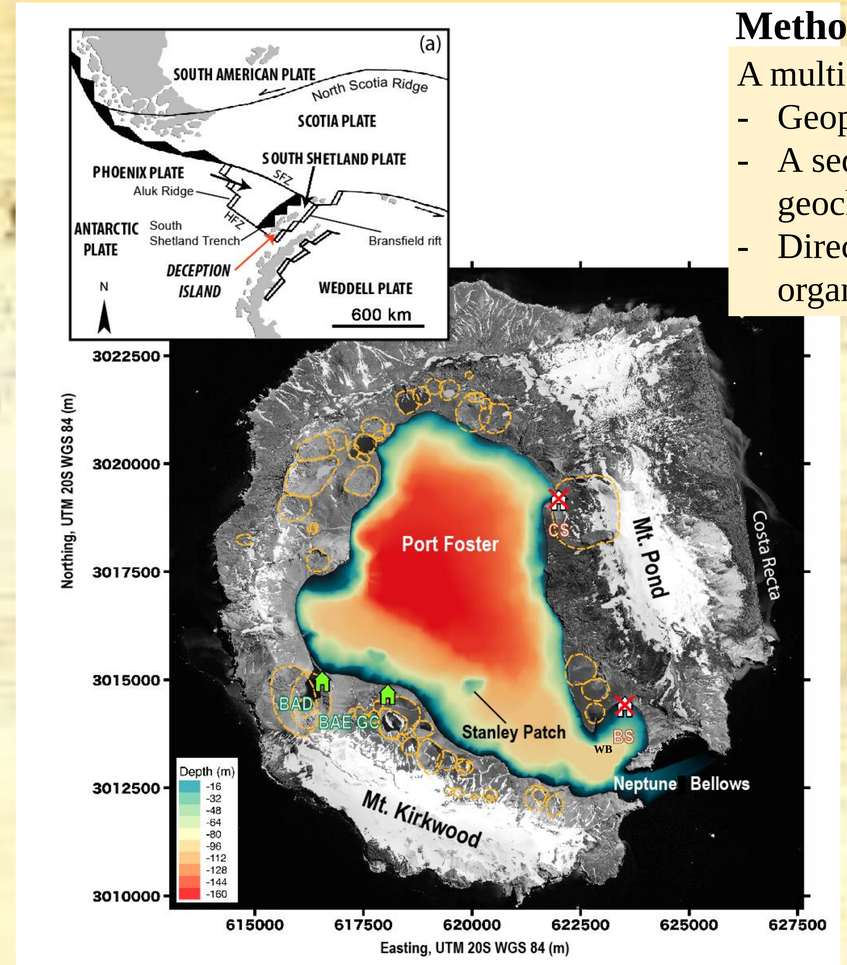

Figure 1: (a) Simplified regional tectonic map and location of the South Shetland Islands. (b) Deception Island orthophotomap (data obtained from Spatial Data Infrastructure for Deception Island SIMAC,

Methods

A multidisciplinary team sampled one of the submerged volcanoes, Stanley Patch (SP), in Port Foster (PF).

- Geophysical data to allocated the volcano and characterized its morphology and inner structure (Fig. 2).
- A sediment core from the crater (4 cm Ø, 8 cm length) was collected for sedimentological, geochemical and geochronological analysis.
- Direct sampling by SCUBA provided several rocks (Fig. 3), and photographs/video images of benthic organisms and landscape (Fig. 4).

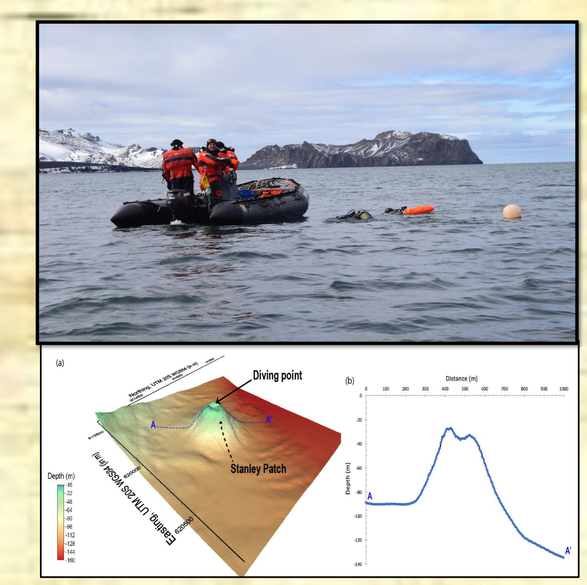

Figure 2: (a) Digital Elevation Model of a section of Port Foster Bay showing Stanley Patch volcano. (b) Terrain profile crossing Stanley Patch volcano along the line A-A'.

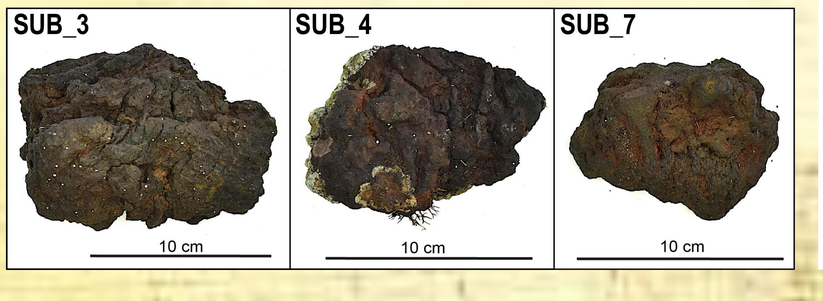

Figure 3: Examples of hand-specimens collected at Stanley Patch volcano.

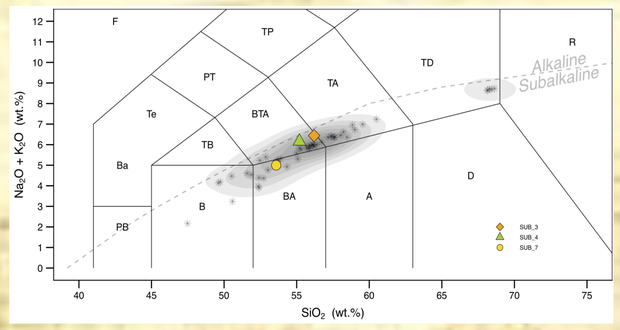

Figure 5: Total Alkali vs. Silica diagram (TAS) for the rock samples on this work. Grey dashed line discriminates between the alkaline-subalkaline fields. Grey shaded areas and asterisks correspond to the post-caldera rock samples presented by Geyer et al. (2019).

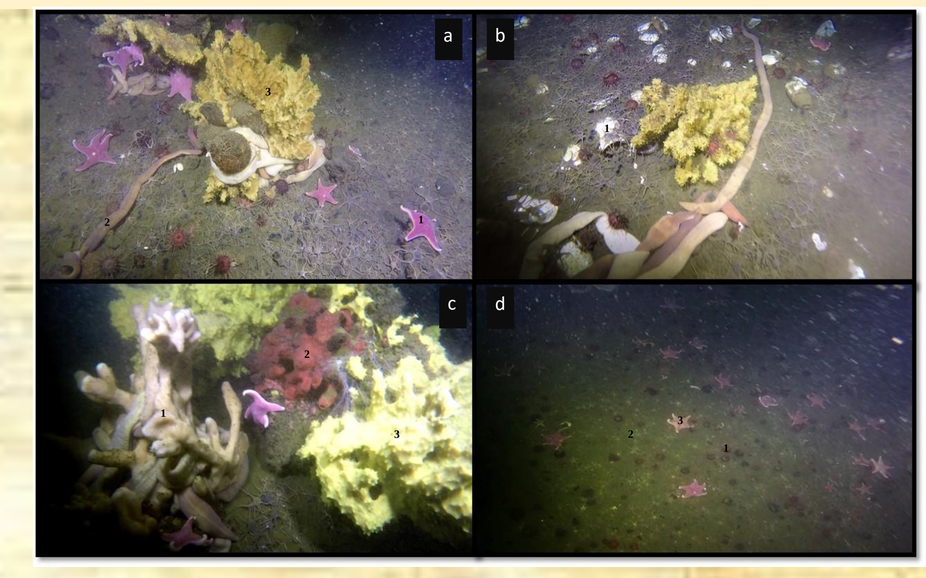

Figure 4: Photographs taken by divers on the top of the crater (a) *Odontaster validus* (1) (Echinoderm), *Parborlasia corrugatus* (2) (Nemertean), *Dendrilla antárctica* (3) (Porifera). (b) *Dendrilla antárctica*, cluster of *P. corrugatus*, shells of *Laternula elliptica* (1) (Mollusca). (c) the porifera *Hemigellius pillosus* (1), *Kirkpatrickia variolosa* (2), and *Dendrilla antárctica* (3). (d) High densities of the echinoderms *Sterechinus neumayeri* (1), *Ophionotus victoriae* (2), and *Odontaster validus* (3).

Phyllum	Class or Order	Taxa	Density	Abundance
Echinodermata	Ophiuroidea	Ophionotus victoriae Bell, 1902	high	200-500/m^2
Echinodermata	Echinoidea	Sterechinus neumayeri (Meissner, 1900)	high	100-200/m^2
Mollusca	Bivalvia	Laternula elliptica (P.P. King, 1832)	high	50-100/m^2
Echinodermata	Asteroidea	Odontaster validus Koehler, 1906	medium	10/m^2
Nemertean	Heteronemertea	Parborlasia corrugatus (McIntosh, 1876)	medium	10/ m^2
Porifera	Demospongia	Dendrilla antarctica Topsent, 1905	low	< 1/m^2
Porifera	Demospongia	Mycale (Oxymycale) acerata Kirkpatrick, 1907	low	< 1/m^2
Porifera	Demospongia	Hemigellius pilosus (Kirkpatrick, 1907)	low	< 1/m^2
Porifera	Demospongia	Kirpatrickia variolosa (Kirkpatrick, 1907)	low	< 1/m^2
Mollusca	Gastropoda	Doris kerguelenensis (Bergh, 1884)	low	< 1/m^2
Chordata	Ascidiacea	Cnemidocarpa verrucosa (Lesson, 1830)	low	< 1/m^2

Table 1 Species identified in the video transect, ordered by semi-quantitative abundances.

Concluding Remarks

- Stanley Patch submarine cone corresponds with the explosive volcanic origin of DI. Stanley Patch **formed under "dry"-subaerial conditions**, was subsequently partially eroded. This implies changes of the sea level within Port Foster Bay, by subsidence processes of the caldera floor since the caldera-forming event.
- The **low amount of organic matter in the sediments** reflects the polar climate and the present-day intense geomorphological morphodynamics, not only related to volcanism, but also to glacial, periglacial and slope processes.
- The main macrobenthic organisms present at the crater rim of the volcano were mostly **vagile organisms**. A total of 11 species have been identified, belonging to 5 different phyla (Table 1). Probably, high rates of burial disturbance do not allow a high diversity of benthic organisms, yet the competition is less intense for those species capable to cope with sediment instability.

Acknowledgements
Thanks are due to the crew of B.A.E. Gabriel de Castilla for their logistic support during the Antarctic expedition. This is a contribution to the AntEco (State of the Antarctic Ecosystem) SCAR Programme. This research was partially supported by the research projects: BLUEBIO (CTM2016-78901-ANT), POSVOLDEC (CTM2016-79617-P) (AEI/FEDER-UE), and CRONOANTAR (CTM2016-77878-P).

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