Studland Bay Basalts, Cape Grim, Tasmania, Australia - A world class exposure of submarine basaltic lavas.

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1. INTRODUCTION

The Studland Bay Basalts (SBB) are part of a predominantly submarine volcanic succession at Cape Grim in far northwestern Tasmania, Australia (Figures 1 & 2). Volcanism at Cape Grim was part of a broader episode of Cenozoic intraplate basaltic volcanism in Tasmania. The volcanic succession is exceptionally well preserved and exposed in rock platforms and steep coastal cliffs. A detailed field mapping and sampling project has been recently completed. The purpose of the project is to determine the facies architecture of the sequence and to interpret the source, processes, environment, duration and age of volcanism at Cape Grim.

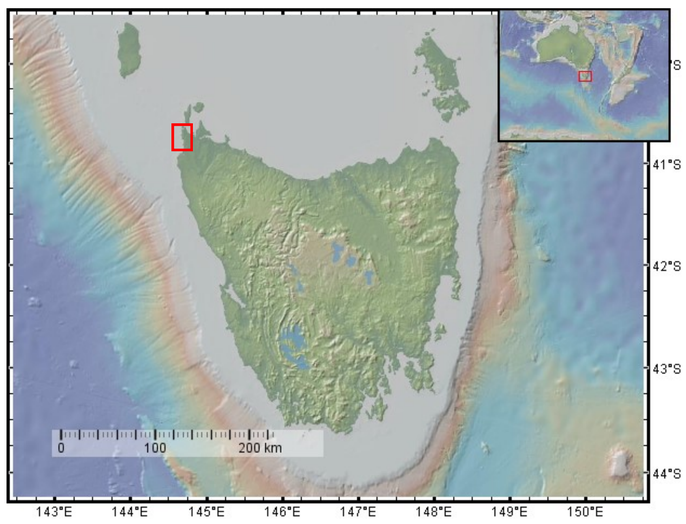

Figure 1. Location of Cape Grim.

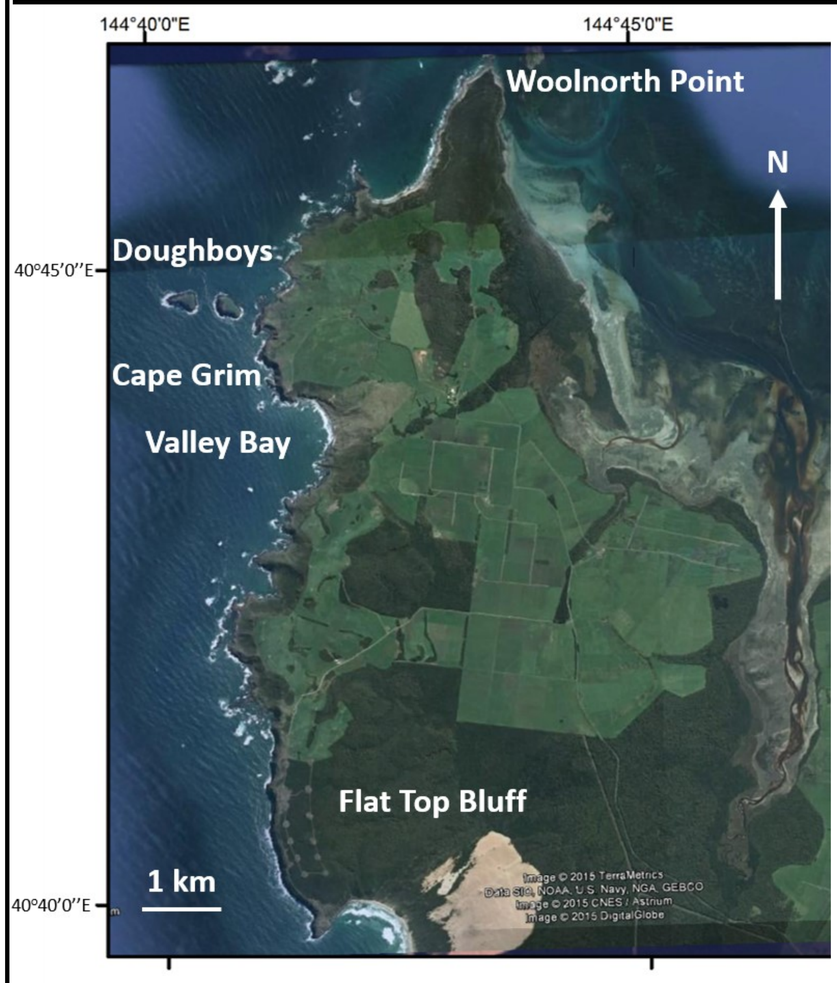

Figure 2. Cape Grim Geography.

2. GEOLOGY

The stratigraphy at Cape Grim was first described by Sutherland & Corbett (1967). The $^{39}Ar/^{40}Ar$ geochronology and field observations conducted as part of this study has revised the age relationships between the units (Table 1.)

The oldest unit in the Cape Grim succession, the Woolnorth Tuff (WT) is composed almost entirely of devitrified basaltic glass shards and olivine crystal fragments; sedimentary structures are consistent with deposition in a sub-aqueous environment. The WT is overlain by the Slaughter Bluff Volcanic Breccia (SBVB). The SBVB is dominated by a 15-25 m thick diffusely bedded pillow fragment breccia. North of Cape Grim, the Little Trefoil Basalts intrude as sills into the WT.

To the south of Cape Grim, the WT is overlain and intruded by the SBB. The SBB consists of pillow lavas, lava lobes and sills, pillow breccia and volcanic conglomerate. The sills form ellipsoidal mound shapes ~50 m long with unique joint patterns. Pillow lavas and lava lobes are exceptionally well exposed and can be viewed in 3 dimensions (Figure 3.) The basalts are typically olivine-phyric with a groundmass that includes plagioclase and pyroxene.

At Flat Top Bluff, the southern-most exposure of the SBB, lobate basalt lavas are overlain by 10-30-m-thick mounds of basaltic pillow lavas followed by 50-m-thick succession of diffusely bedded, matrix dominated pillow fragment breccia and basalt breccia. Bedding orientations generally dip to the south-southwest suggesting an inland northeastern source. This sequence represents an episode of submarine volcanic edifice construction and subaerial emergence.

References

Quilty, P.G. 1972, The biostratigraphy of the Tasmanian marine Tertiary, *Papers and Proceedings of the Royal Society of Tasmania,* 106, p25-44.

Sutherland, F.L. & Corbett, K.D. 1967, The Tertiary volcanic rocks of far north-western Tasmania, *Papers and Proceedings of the Royal Society of Tasmania*, 101, p71-90.

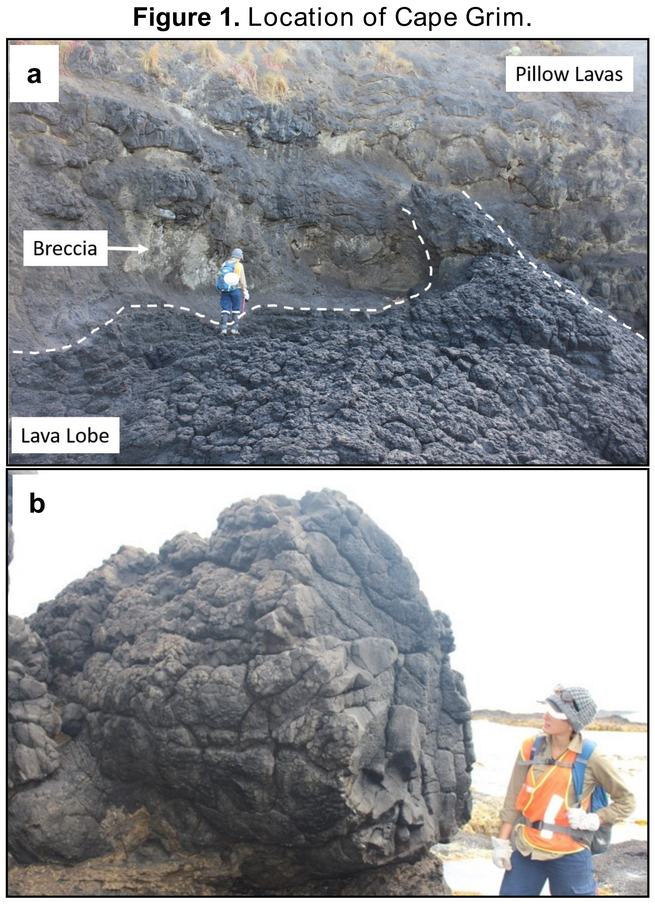

Figure 3. Studland Bay Basalts **a.** Lava lobe extending from pillow lava pile **b.** Pillow lava 2 m in diameter.

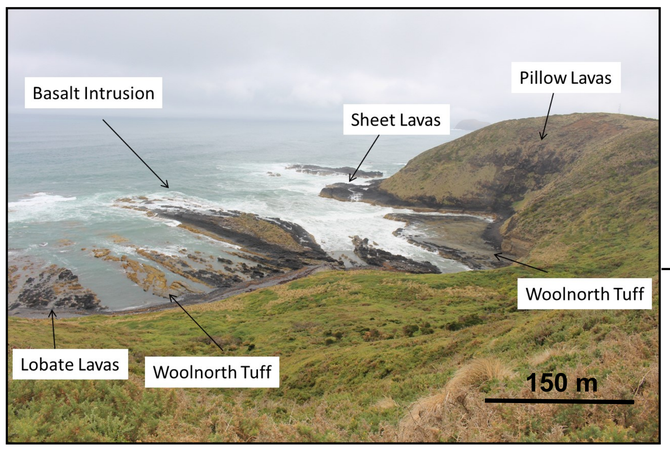

Figure 4. View of Studland Bay Basalts including an example of an ellipsoidal basaltic intrusion.

3. RESULTS AND DISCUSSION

Detailed field mapping has revealed that the environment of deposition of the Cape Grim volcanic sequence was submarine and that emplacement occurred relatively rapidly. $^{39}Ar/^{40}Ar$ dating has produced an Early Miocene age for the entire sequence (Table 1); the SBB sills have an age of 24.52 ± 0.12 Ma and the pillow lavas have an age of 23.73 ± 0.08 Ma.

The lava morphologies at Cape Grim are exceptionally well preserved and in some cases unique. The pillow lavas and lobate lavas of the SBB are variable in size, from 0.5 m to >3 m in diameter. A single lobe is 10 m long and has small (<50 cm diameter) pillows that have formed from break outs on its margins (Figure 3a). The dominant flow direction was to the west and north west indicating a source on what is now inland Tasmania.

The lavas of the SBB have a complex relationship with the WT. Not only do the lavas flow over the WT as lobate and pillow lava complexes but they also intruded the WT, forming elongate domes (Figure 4.). The domes have since been eroded, exposing complex internal joints (Figure 5.). Careful observations of contact relationships between the WT and the basaltic sills revealed apophyses of basalt within the WT that are associated with disruption of bedding within the tuff. The apophyses have quenched margins with glassy, palagonite rims (Figure 5c). The WT was a wet, unconsolidated sediment at the time of emplacement of the basaltic sills. These dome like intrusive features have not been documented previously in a basaltic submarine environment and will be subject to further study.

Table 1. Stratigraphy of the Cape Grim Volcanic Succession (Sutherland & Corbett 1967). Numerical ages are the $^{40}Ar/^{39}Ar$ age results from this study with an error margin of 2σ. *No plateau achieved. **No age available.

Unit	Age	Rock Types
Cape Grim Beds	Early Miocene (Quilty 1972)	Fossiliferous calcarenites, tuffaceous breccia and conglomerate
Valley Bay Conglomerate	- **	Pebble and boulder conglomerate
Slaughter Bluff Volcanic Breccia	23.12 ± 0.19 Ma	Basaltic pillow breccia with basal layer of pillow lava
Studland Bay Basalts	23.73 ± 0.08 Ma	Lobate, pillow and sheet lava. Basaltic sills. Pillow breccia
Little Trefoil Basalts	~ 24 Ma*	Basalt sills within the Woolnorth Tuff
Woolnorth Tuff	-	Composed of devitrified basaltic glass shards and olivine crystals. Bedding forms include cross bedding and climbing ripples.

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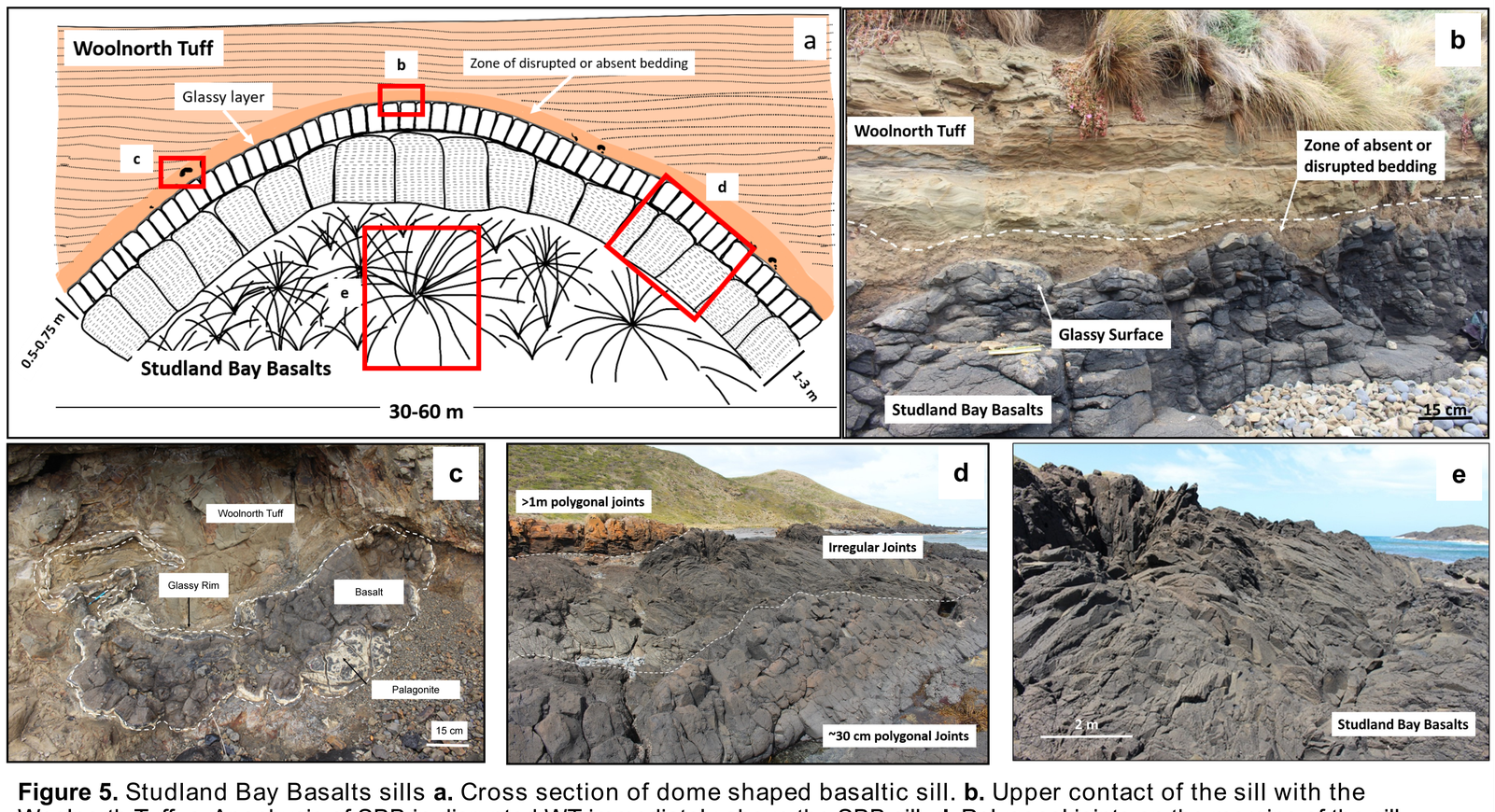

Figure 5. Studland Bay Basalts sills **a.** Cross section of dome shaped basaltic sill. **b.** Upper contact of the sill with the Woolnorth Tuff. **c.** Apophysis of SBB in disrupted WT immediately above the SBB sill. **d.** Polygonal joints on the margins of the sill **e.** Irregular, complex joints within the centre of the basaltic sill.

4. CONCLUSION

1. The lavas of the Studland Bay Basalts were erupted over and into the Woolnorth Tuff in a submarine environment between 24.52 ± 0.12 Ma and 23.73 ± 0.08 Ma. 2. The basaltic sills described as part of this research project warrant further study to determine the emplacement and cooling processes that have produced the complex internal joints.