

Bathymetry and Geological Setting of the South Sandwich Islands Volcanic Arc

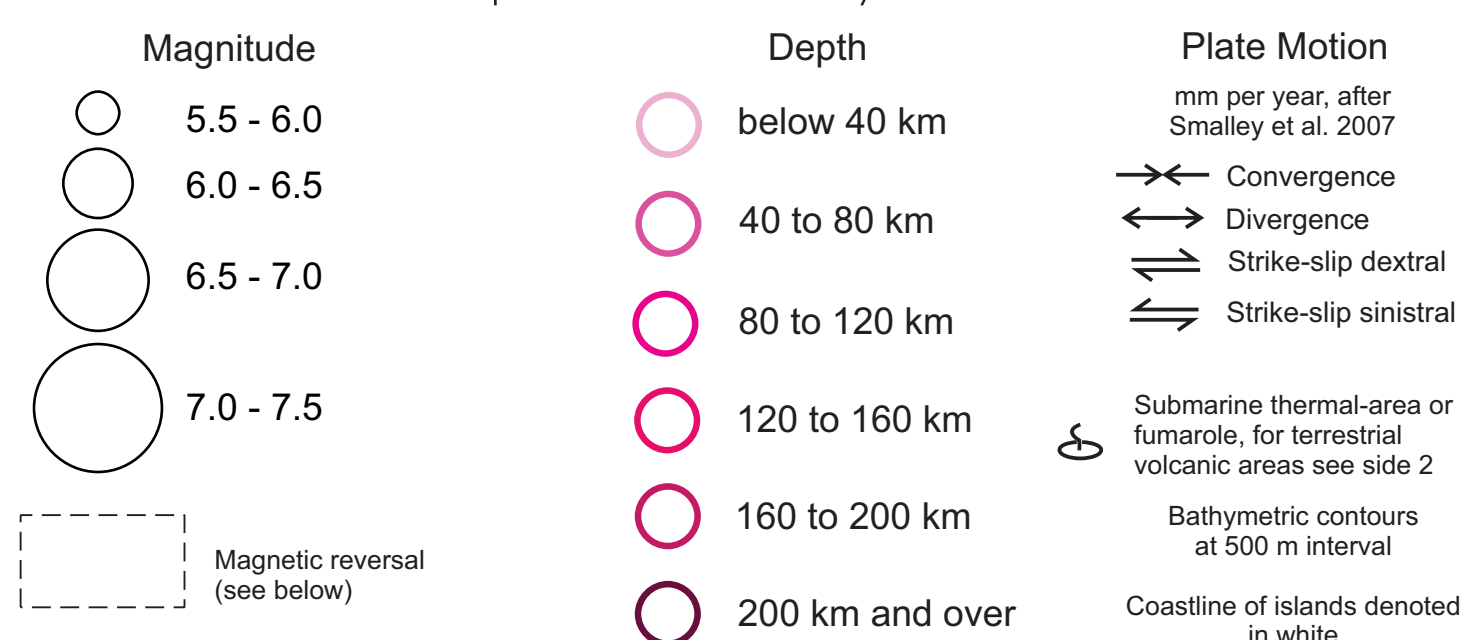
Side 1: Bathymetry and geological setting

BAS GEOMAP 2 Series, Sheet 6, Edition 1
scale: 1 : 750 000

Preferred reference for this map: Leat, P.T., Fretwell, P.T., Tate, A.J., Larter, R.D., Martin, T.J., Smellie, J.L., Jokat, W. and Bohrmann, G. (2014). *Bathymetry and Geological Setting of the South Sandwich Islands Volcanic Arc (various scales)*. BAS GEOMAP 2 series, Sheet 6, British Antarctic Survey, Cambridge, UK.
© Natural Environment Research Council, 2014

Bathymetric and geophysical interpretation: Leat, P.T., Fretwell, P.T., Tate, A.J., Larter, R.D., Martin, T.J., Smellie, J.L., Jokat, W. and Bohrmann, G. Map design and layout: Fretwell, P.T. and Leat, P.T.
Projection: WGS84 UTM Zone 26S.

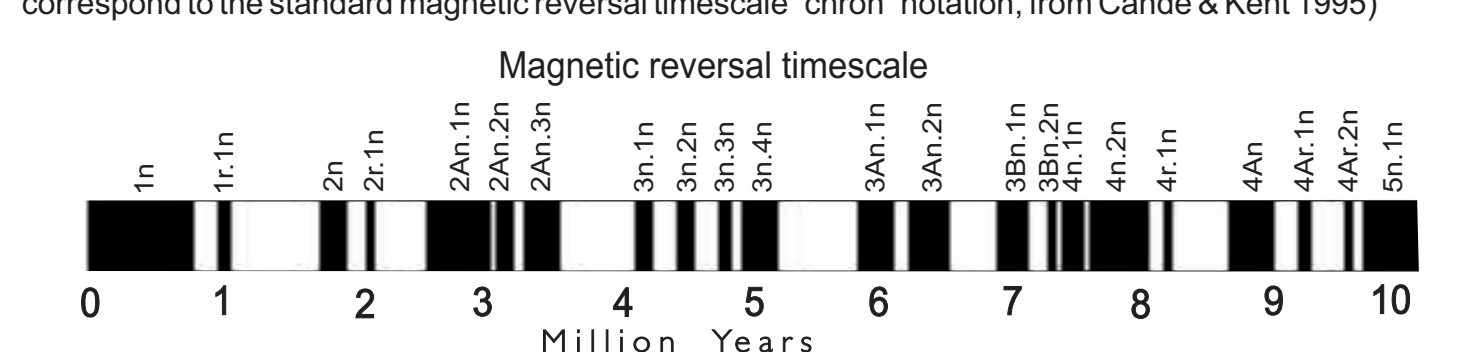
Earthquakes and other symbols



Magnetic reversal data from Centennial Catalogue (Forsyth & Valleron 2002). Filtering parameters: 1964-2008; open current (lead) < 180 degrees; solution types DEO, BEQ and PEO. Supplemented for the area west of 29W by data from the EHB Bulletin (<http://www.jsc.ac.uk/geomap/>).

Magnetics

Magnetic lineations are shown on the map as lines, with the broadest positive magnetic anomalies displayed as light grey boxes. Similarly aged pairs of lineations propagate away from the spreading ridge, with older pairs further from the ridge and younger near the centre. Each pair in the sequence is numbered, with larger numbers indicating older events (numbers correspond to the standard magnetic reversal timescale 'chron' notation, from Cande & Kent 1995)



The Sandwich plate

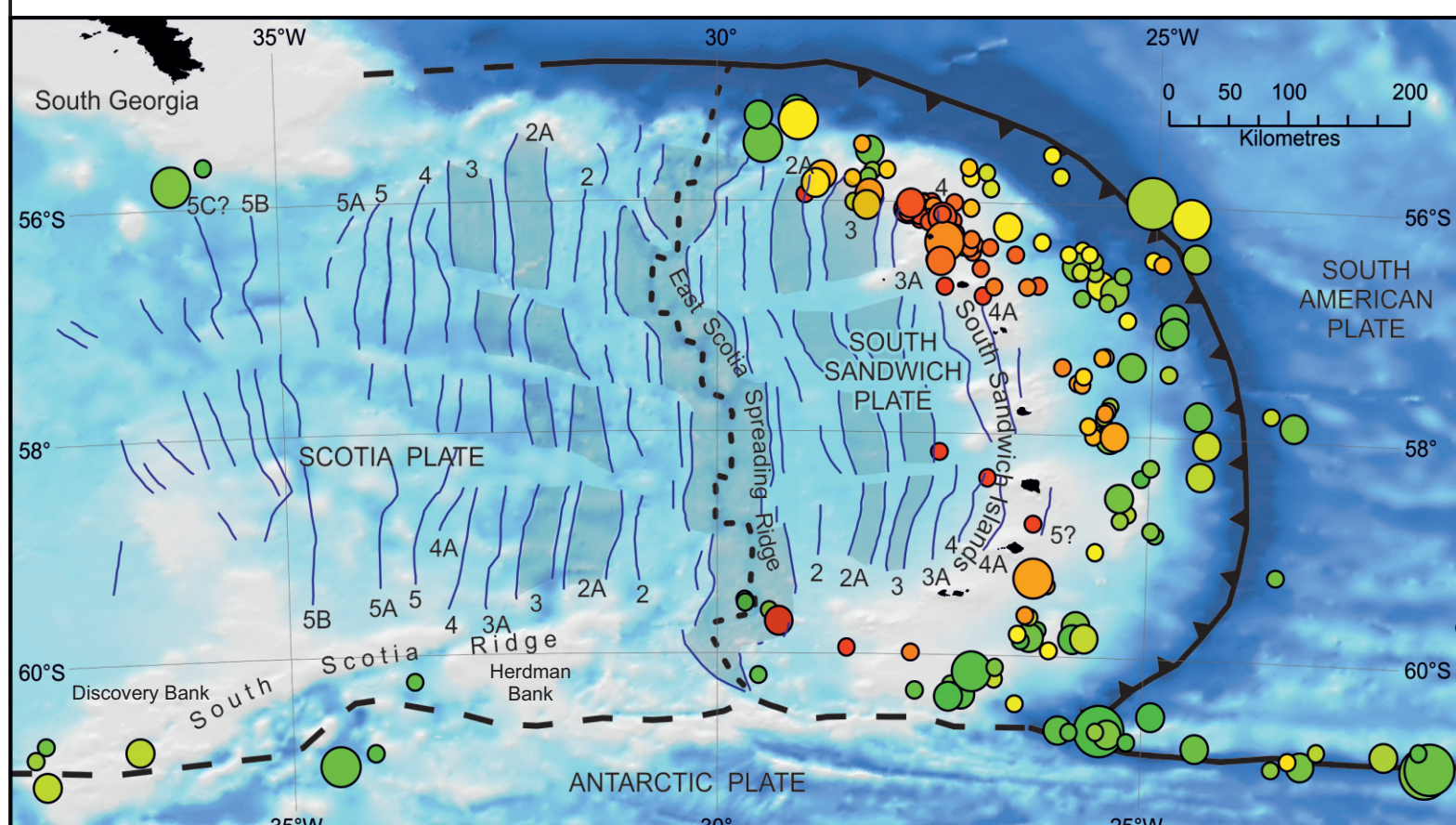
The South Sandwich volcanic arc is built on the Sandwich plate. The East Scotia Ridge spreading centre forms the western margin of the plate and the volcanic arc is built largely on oceanic crust formed at this spreading centre about 10 million years ago (Larter et al., 2003). The eastern margin of the Sandwich plate is formed by the Sandwich Trench, where South American oceanic plate is being subducted to the west at a rate of 65-78 mm per year (Thomas et al., 2003; Smalley et al., 2007). The age of the subducting oceanic crust ranges from about 27 million years old in the south to about 80 million years old in the north (Barker, 1995). All the sediment arriving at the trench is subducted, and there is a very small frontal prism (Vanneste and Larter, 2002). At the north end of the trench, the subducting plate is being torn along an east-west fracture (Forsyth, 1975), causing an earthquake cluster. The south end of the trench is aligned with the South Sandwich Fracture Zone that forms part of the South America-Antarctica plate boundary. Seismic reflection profiles reveal extensional structures in the upper and mid-fore-arc, suggesting that compressional stress associated with underthrusting of the South American plate is restricted to the lower fore-arc (Vanneste et al., 2002).

East Scotia Ridge spreading centre

The East Scotia Ridge back-arc spreading centre between the Sandwich and Scotia plates has a current full spreading rate of 59-68 mm per year (Thomas et al., 2003; Smalley et al., 2007). Magnetic anomalies west of the spreading centre record a history of continuous spreading over at least 15 Ma with stepped increases in spreading rates since 6 Ma (Larter et al., 2003). There is no evidence for large, systematic spreading asymmetry through most of this history. The spreading centre consists of nine well-defined segments, E1-E9. The bathymetry indicates that there are no stable fracture zone offsets between segments, and segment boundaries are thought to be migrating ridge offsets (Livermore et al., 1997; Larter et al., 2003). Central segments E3 to E8 are rift-like, but segments E2 and E9, near the north and south ends of the spreading centre respectively, have positive axial topography resulting from enhanced mantle melting (Livermore et al., 1997; Leat et al., 2004). Compositions in most segments are basaltic, but segment E2 has erupted basaltic andesite and rare andesite (Leat et al., 2000; Fretzloff et al., 2002). Sea-floor hydrothermal vents have been observed on the summits of segments E2 and E9 (German et al., 2000; Rogers et al., 2012).

South Sandwich volcanic arc

The South Sandwich Islands are entirely volcanic in origin. Compositionally, the volcanoes are dominated by basalts and basaltic andesites, with minor andesites, dacites and rhyolites. Magma generation was caused by subduction of the South American plate beneath the arc, producing a silica-oversaturated, tholeiitic series (Baker, 1978; 1990; Pearce et al., 1995; Leat et al., 2003, 2004; Barry et al., 2006; Tonarini et al., 2011; BAS unpublished data, 2013). The volcanoes are important sources of tephra in East Antarctic ice and marine sediments in the Atlantic sector of the Southern Ocean (Smellie, 1999; Narcisi et al., 2010). Submarine flanks of most of the emergent volcanoes have wave-like surfaces interpreted as sediment wave fields formed by down-slope transport of mass-flows (Leat et al., 2010). On the western flank of the arc, a turbidite apron up to 1 km thick overlies oceanic basement and thins towards the East Scotia Ridge. West of the spreading centre, sediment cover is generally thinner with bottom currents influencing sediment deposition. Because of the remote location, most recent information on volcanic eruptions has been obtained using satellite observations (Lachlan-Cope et al., 2001; Patrick et al., 2005; Patrick and Smellie, 2013).

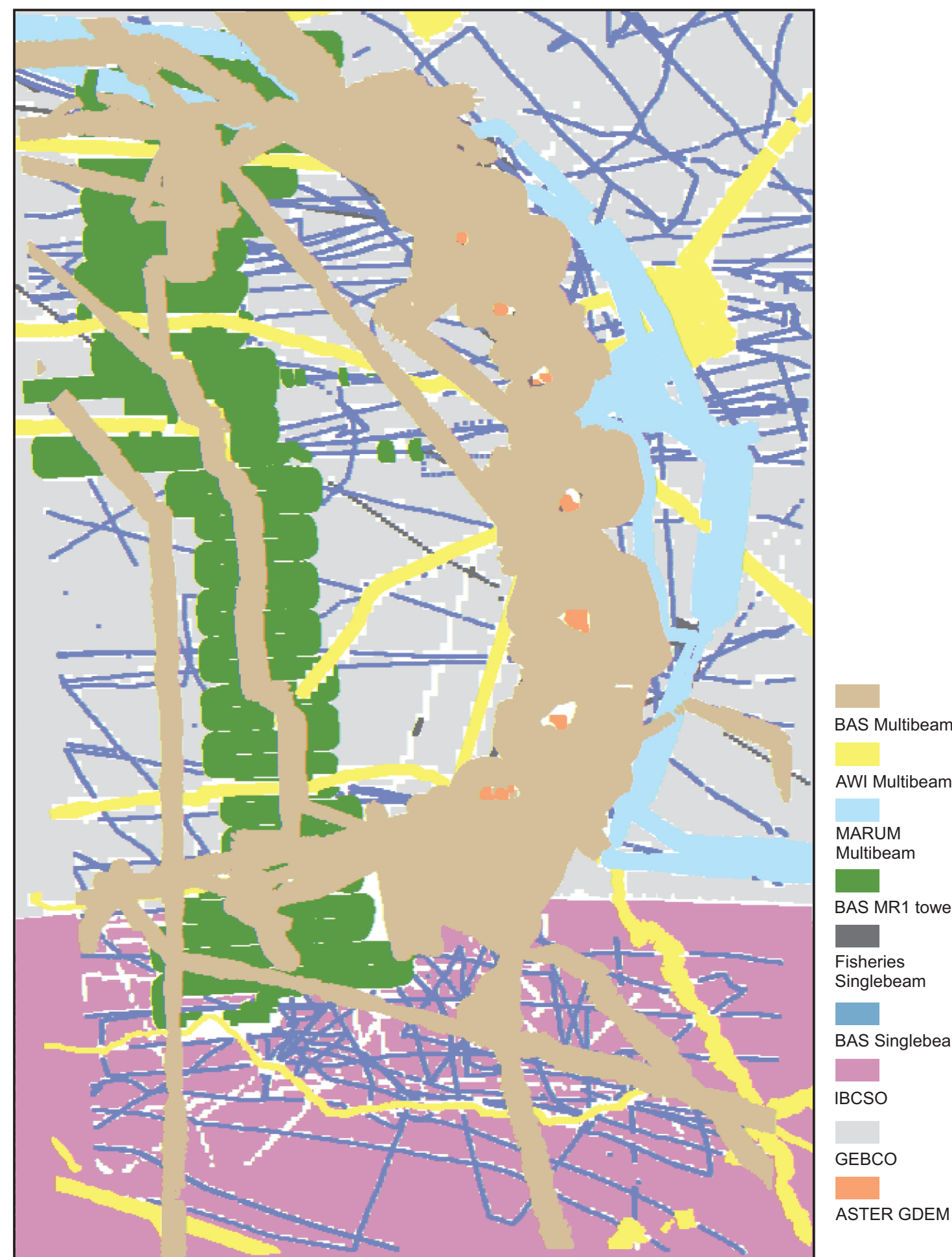


Tectonic overview map

Plate margin with known location Plate margin with inferred location Spreading ridge Subduction zone

Circles denote earthquake epicentres, size of the circle refers to the magnitude of the quake, the colour indicates the depth, with red circles denoting deep quakes and green circles denoting shallow quakes. Magnetic lineations are shown in the same way as the main map. Bathymetric depths are indicated by shading - darker blue for deeper ocean, lighter blue indicating shallower water, see main map for details of depth and magnitude.

Data Sources



This bathymetric map has been compiled from a variety of different data sources. The primary data is multibeam swath bathymetry collected from scientific cruises undertaken by British Antarctic Survey (BAS), Alfred Wegener Institute (AWI) and MARUM, University of Bremen. This is supplemented by older data from a towed sonar survey (MR1) and single-beam data collected by previous BAS ships and commercial fishing vessels. Where no data exists global compilations from the General Bathymetric Chart of the Oceans (GEBCO) and the International Chart of the Southern Ocean (IBCSO) have been used, both these data sets use satellite altimetry in areas where data is sparse. On land ASTER GDEM grids have been merged with pre-existing survey data to create new digital elevation models for each island (see side 2). Merging and gridding the dataset has been conducted using ArcGIS 10.

Bathymetry and Geological Setting of the South Sandwich Islands Volcanic Arc

Side 1: Bathymetry and geological setting

