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Seismic activity associated with a probable submarine eruption near Tristan da Cunha, July 2004-July 2006

A. O'Mongain, L. Ottemoller, **B. Baptie**, D. Galloway, D. Booth
British Geological Survey, Edinburgh, U.K.

In July 2004, earthquake activity felt on the South Atlantic island of Tristan da Cunha caused widespread alarm, as seismic activity had preceded a destructive volcanic eruption in 1961. Analysis of data from two seismograph stations on the island shows a dramatic increase in earthquake activity beginning on 29 July 2004, with over 2000 local earthquakes detected between July and December 2004. Furthermore, we find that the initial earthquake activity shows a consistent increase in amplitude with time, culminating in four magnitude 4.7-4.8 mb earthquakes on 29/30 July, the largest detected over the monitoring period. There is no evidence of precursory activity in the period before 29 July 2004. We estimate the location of the earthquakes using the relative P-wave arrival times at the two stations, S-P arrivals times and azimuths determined from P-wave polarization analysis. Our analysis suggests that, despite the relatively large errors associated with sparse data, all the events are located between 37-53 km SSE of the island at a relatively shallow depth and may be associated with an offshore submarine volcanic eruption. The distinctive increase in both number of events and their amplitudes with time on 29 July can be interpreted as strong evidence for volcanic activity, with magma forcing its way up through the crust. In addition, the high b-value may suggest that the stresses causing the observed seismicity are a result of volcanic rather than tectonic activity. The offshore location is consistent with independent observations of pumice found floating near Tristan in August 2004 and washed up on some of its beaches. A submarine seamount, 26 km south of Tristan, is located close to the area where we have located the seismic activity. The July 2004 swarm, and its abrupt onset, is a reminder that this volcanic complex is still active, and there is clearly a potential for further large earthquakes and swarm earthquakes

associated with volcanic activity.