Introduction

Shallow submarine volcanism producing floating scoria bombs is one of the most peculiar and rarely observed eruption styles on Earth. Conditions of the eruptions producing these "lava balloons" are not clearly understood due to their rare occurrence and difficulty to observe them. Worldwide, there have only been four other cases where floating scoria bombs have been observed: El Hierro, Canary Islands, Spain (2011-2012), Socorro Island, Mexico (1994), west of the island of Hawai‘i’s (1977), and northwest of Tercera Island, Azores (1998-2001). Here we report on the first study of the vent system and products of this eruption style based on ROV observations at the site of the 1891 Foerstner eruption in the Straits of Sicily.

Geologic Setting

The Straits of Sicily is located in the northern part of the African continental plate called the Pelagian block (Burollet et al., 1998). It is very shallow (averaging 350 m) except for three NW-trending depressions formed by Late Miocene-Early Pliocene continental rifting (Pantelleria, Malta, and Linosa grabens) (Civile et al., 2008). The rifted setting is associated with the formation of two subaerial volcanic islands (Pantelleria and Linosa) and a series of small islands located on the Adventure Plateau and Graham and Nameless Banks (Peccei, 2005; Rotoli et al., 2006). High resolution mapping of the Pantelleria subaerial Shank has revealed several small volcanic cones concentrated to the NW of the island and identification of the likely vent area for the most recent 1891 submarine eruption of Foerstner volcano (Bosman et al., 2007).

1891 Eruption of Foerstner Volcano

The most recent submarine volcanic eruption in the Straits of Sicily occurred in 1891 off the coast of Pantelleria (Butler, 1892). Premorty signals on the island began in the summer of 1890, including increased fumarolic and earthquake activity, uplift of the north coast, and columns of "smoke" protruding from the sea surface 4 km offshore (Butler, 1892). The eruption began on October 17, 1891 when black, subspherical, scoriaceous bombs up to 1 m in diameter were seen rising to the surface. Some of the bombs were still degassing at the surface and as a result were propelled laterally by horizontal jet streams or ejected upright into the air. After the degassing episodes had ceased, the fragments sank as a result of seawater saturation. The eruption ended on October 25, 1891.

Procedures

A geologic map of Foerstner volcano was created using the Remotely Operated Vehicle (ROV), Hercules, on board the RV Nautilus. Hercules is equipped with video cameras capable of recording many hours of high definition footage. Additionally, Hercules is equipped with a high-resolution multibeam imaging sonar, which was used to create a bathymetric map of the vent site. A total of 40 hours of video footage were recorded during 3 separate dives on Foerstner. This video footage was reviewed entirely and geologic observations were recorded every minute based on a variety of facies descriptors. These observations were then overlain on the ROV dive tracks based on their corresponding time stamps.