

The 1993 submarine eruption near Socorro Island, Mexico

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Products of an underwater eruption near Socorro Island in the NE Pacific were observed directly on January 29, 1993, ten days after precursors were first recorded by SOFAR (Sound Fixing and Ranging) hydrophones located in Hawaii and Tahiti. Eruptive activity was noticed from boats and ships as small steam plumes rising from the sea at an area centered at 18 48 N, 111 05 W, 2.4 km NW of Punta Tosca and 4.6 km SSW of Cape Henslow on Socorro Island. The observed steam was produced by 1-3-m-large blocks of hot, dark-grey, highly vesiculated basalt rising buoyantly to the surface from two submarine shallow vents at 210 and 30 m depth. Tens of blocks accompanied by bubbles could be observed rising to the surface in irregular pulses. These scoriaceous blocks remained floating at the surface until they would crack into smaller pieces by thermal contraction, emitting hissing noises from vapourizing seawater in contact with the hot interior of the blocks. Steam jets several metres in height were produced and occasionally blocks were propelled laterally by the steam jet. Depending on vesicularity and permeability, blocks remained floating and drifting with the surface current for 1-15 minutes before sinking back. Floating rocks covered an area of about 6000 m². This intermittent activity was observed at least until April 1994. Buoyant scoria and reticulite are indicative of volatile (mostly CO₂) supersaturation and exsolution in the magma prior to rapid quenching, which inhibits loss of volatiles by bubble escape. A high-velocity ascent of low-viscosity magma in a relatively narrow conduit is also required to prevent substantial gas escape and allow formation of reticulite. The buoyant scoria is most probably ejected by intermittent lava fountaining at fixed vents as a result of changes in eruption velocities due to changes in the exsolved gas content of the lava. Between January and July 1993 floating blocks of scoria and reticulite were collected on several occasions from the surface of the sea for chemical and mineralogical analyses. Major- and minor-element analyses (including REE), as well as electron microprobe analyses of different phases revealed that the composition of the emitted lava had not changed through time. Blocks of basalt (SiO₂=45-47%) are highly vitric and vesicular with tabular anorthite phenocrysts up to 3 mm in length and minor grains of forsteritic olivine. REE and trace-element composition of these rocks suggest an anomalous mantle source for the erupted alkali basalt lava. Initially, it was feared that the eruption could change into a more dangerous explosive surtseyan style and build a mound that would reach the surface and form an island. Instead it continued in a similar effusive fashion and eventually ceased.