Volatile leakage from the crater bottom of Teishi Knoll of Izu-Tobu Volcanoes, Japan, 23 years after the 1989 submarine eruption

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A submarine eruption occurred off the Izu Peninsula, Japan, at about 18h 33m of 13 July 1989, forming Teishi Knoll (diameter about 450m, height 10m) on the seafloor at a depth of 90-100 m. Since the diameter and depth of Teishi crater are about 200m and 10m respectively, the shallowest point of the crater rim is 81m deep and the deepest point of the crater bottom is 122m deep. Teishi Knoll is the youngest volcano belonging to Izu-Tobu Volcanoes consisting of more than 100 monogenetic volcanoes both on land and seafloor. The eruption was associated with intense gas emission. The released bubbles were collected from the crater bottom using an unmanned probe boat, Dolphin 3K, on 27 Sep. 1989, and their chemical composition (volume per cent) was measured to be CO2 (23.8), H2 (14.0), N2 (49.0), O2 (10.6) and CH4 (1.8) (Ossaka et al, Fall Meeting of Vol. Soc. Japan, Abstract No.50, 1992). Soon after the eruption, the bubbling activity has decreased and disappeared until the end of 1991. To monitor the volcanic activity of Teishi Knoll, seismic and geodesic observations and observation of colour of surface seawater have been continued, but no survey has been carried out to examine volatile release from the crater bottom until now.

In this work, we tried to detect volatile components of magmatic origin in seawater inside the Teishi crater bottom. A plastic tube with an inner diameter of 12mm (TOYOX TG12) attached with stainless wire was thrown down from the deck of a small fishing boat (9-ton) to the depth at which seawater samples were collected. A CTD sensor and metallic drag were connected to the lower end of the stainless wire. The seawater was continuously pumped out using a tubing pump, introducing into several sample bottles. Inside the crater of Teishi Knoll, seawater samples were collected at 3 different points just above the crater bottom (A:116-117m, B:114-115m, C:107-108m deep). Shallower seawater samples were also collected above the crater (D:100m, E: 80m, F: 50m deep) for comparison. For each seawater sample, dissolved CH4 content with its 13C/12C ratio, dissolved TIC (total inorganic carbon) content with 14C content and 13C/12C ratio, dissolved organic carbon content, dissolved inorganic gases contents, and dissolved rare gases contents with 3He/4He ratio, were measured. The CH4 contents of crater bottom samples (A-C) are 10-30 per cent higher than shallower samples (D-F), and 13C/12C ratios of CH4 in A-C samples seem to be higher than D-F ones, suggesting the addition of CH4 originated from magmatic fluid through the crater bottom. The 14C content and 3He/4He ratio of the bottom samples also show the magmatic fluid contribution through the crater bottom. Considering that leaked contents of CH4 or CO2 through the crater bottom are very few, volatile emission from the Teishi magma has become extremely weak, 23 years after the eruption.