論　説

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HIReTS 法を用いた火山噴気の遠隔温度測定：薩摩硫黄島における検証

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Remote Temperature Sensing on Volcanic Fumaroles Using HIReTS: Applications to Satsuma-Iwojima Volcano, Japan

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Molecular hydrogen (H_2) in fumarolic gases shows the hydrogen isotope exchange equilibrium with coexisting H_2O at a temperature more than 400℃. Recently, we developed a new remote temperature sensing using the characteristics of hydrogen isotopes (HIReTS). In this method, the hydrogen isotopic composition (δD value) of fumarolic H_2 is obtained remotely from the observation of volcanic plume, and the outlet temperature of the fumaroles is estimated from the δD value, assuming that the hydrogen isotope exchange equilibrium is quenched within volcanic plume during the process of admixture between fumarolic gases and air. To verify this new remote temperature sensing at the field which has fumaroles with various temperatures from 100℃ to more than 800℃, we determined both concentrations and δD values of H_2 in the volcanic plume emitted from the summit crater of Satsuma-Iwojima volcano, Japan. The average H_2 concentration of the plume samples (n＝22) taken at the crater rim was 3.8 ppm (from 1.0 ppm to 14.4 ppm), while that taken apparently outside the volcanic plume was less than 0.65 ppm. The reciprocal of the H_2 concentration in the plume samples showed a good linear relationship with the δD values (r^2＝0.994). By extrapolating the linear relationship to exclude the contribution of the tropospheric H_2, we estimated that the δD value of the fumarolic H_2 to be －185.0±2.5‰ and the outlet temperature to be 813±10℃. The estimated temperature was in good agreement with the maximum outlet temperature of the fumaroles inside the crater. The remote temperature sensing using HIReTS can be applicable to obtain the maximum fumarolic temperature remotely in many volcanoes.

Key words: volcanic plume, molecular hydrogen, isotope exchange equilibrium, remote temperature sensing, HIReTS, Satsuma-Iwojima volcano

1. 序　　論

1–1　噴気温度の遠隔測定について

活動的な火山から放出されている火山ガスの噴出時の温度（以下，噴気温度と呼ぶ）は，その山体内で進行しているマグマ脱ガスの様式や，地下水系との接触の有無，火山活動度の現況や今後の推移などを推定する上で，極めて有用である（*e.g.* Giberti *et al.*, 1992; Menyailov *et al.*, 1986; Stevenson, 1993; Taran *et al.*, 1995; Ripepe *et al.*, 2002）．たとえば，噴気温度の絶対値が火山岩の融点近くに達している場合，マグマが火口直下まで迫ってきている可能性が高い．また噴気温度の時間変化から，爆発的噴火が起きる可能性が高まりつつあるのか（温度が上昇している場合），それとも噴火活動は収束に向かいつつあるのか（温度が下降している場合），といった点を判断することも出来るだろう．

しかし，観測者が噴気孔に近づいて温度を直接測定するのは危険を伴うことが多く，多くの火山において現実的では無い．そこで，物体がその温度に応じて異なる電

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