火山におけるラドン変換を用いたミュオンＣＴ（Computed Tomography）の応用可能性

Applicability of Muon Computed Tomography with the Radon Transform Technique for Volcano

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The inner structure of volcano is important to understand volcanic dynamics, history, and eruption. “Muon radiography” is the technique to observe the inner density structure of volcano. In previous study, Tanaka et al. (2010) attempted to reconstruct the three-dimensional (3D) density structure by observing the volcano from multiple directions. However, they needed prior model of internal density structure to stabilize the result because they used inversion technique and only a few observation points could put. However, internal density information was seriously important problem because we did not know before observation.

Recently, the size of muon detector, especially emulsion, become large. In near future, we will be able to put dozens muon detector near the volcano. In this case, we can apply the analysis method of 3D density reconstruction using Radon transformation which does not require prior information. In this study, we evaluate applicability of this method by simulation.

This method has already applied to practical use in X-ray Computed Tomography (CT). However, in the case of X-ray CT, there are hundreds observation points. It is important that the number of observation points and elevation angle are limited. Especially, elevation angle is important of approximation of Feldkamp (1984). However, we can get the information of mountain shape in many cases of muon radiography, so we improved this approximation of elevation angle by using shape information.

We simulated and reconstructed density structure of Omuro-yama, located in Shizuoka pref., Japan. Omuro-yama is scoria cone and there are no objects around near it, so we considered it as an object of demonstration observation of this analysis method. We compared the two approximation methods, Feldkamp (1984) and the method by using shape information. We evaluated the relationship between the number of observation points and the systematic error. We also estimated the error range due to the accidental error of the number of observed muons.

In this publication, we will show the detail of new approximation method and the result of simulation.