Evaluation of regions of future volcanism based on spatio-temporal patterns in volcanism combined with the related phenomena

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The basic policy for evaluating volcanism for selecting sites for HLW geological disposal is excluding regions of future volcanism to avoid direct damage to the repository due to magmatic intrusion or volcanic eruption. For this purpose, the evaluation of the possibility of generation of new volcano in the target area, in other words, the evaluation of regions of future volcanism related to the target area should be carried out. In order to accomplish this evaluation, it is important to establish plausible geological models using various data such as spatio-temporal patterns in volcanism combining with the related topographical, geological and geophysical data.

In terms of establishing geological models, recent research revealed a lot of useful information about uneven and concentrated distribution of volcanism, characterized by regions of volcanic clusters and gaps on the back-arc side of the volcanic front in NE Japan. The key phenomena for geological model are that regions of volcanic cluster, in other words, specific regions of repeated generation and ascent of magma, are closely correlated with topographical, geological and geophysical data.

Taking such information into consideration, we carried out a case study in order to clarify the feasibility of evaluation of regions of future volcanism in Tohoku using existing data. The purpose of this study is to verify a geological model which can explain the processes responsible for the repeated formation of new volcano within particular regions in the form of volcanic cluster for the last millions of years, and to verify the possibility of evaluating regions of future volcanism deterministically based on spatio-temporal patterns in volcanism combined with topographical, geological and geophysical data.

Through this case study in Tohoku, we could extract key information for the evaluation of regions of future volcanism. The results are summarized as follows.

First, spatio-temporal patterns in the past volcanism: This is characterized by region of volcanism with a branch-like pattern showing an E-W trend, indicating characteristics of volcanic clusters and gaps for the last several millions of years (since ca. 5 Ma). Based on the correlation with above spatio-temporal patterns in volcanism, the time frame of the following key phenomena was estimated to be the order of several millions of years. One is crustal movement indicating concentration of volcanism. This is characterized by region of uplift showing warping mountains with an E-W trend, possibly caused by repeated injection or underplating of magma to the crust. The other is the continuity of uneven distribution of hot regions within the core zone of the mantle wedge. This is characterized by region of low-velocity anomalies in the form of a branch with an E-W trend. Particularly this distribution pattern indicates that the continuity of hot regions within the mantle wedge is estimated to be the order of several millions of years, not merely the snapshot.