Resistivity structure of Unzen Volcano and its implication to magma supply & emission system

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Electromagnetic research is a powerful method to clarify a rising process of magma and magmatic gas beneath volcanoes, because the resistivity of the ground strongly depends on existence of water and magmatic gas, which decrease the resistivity. Kagiyama et al. (2000) indicated that a water saturated layer is widely distributed around Fugen-Dake, and that magma-water interaction caused precursory phenomena and the change of eruption type during the 1990-95 Eruption. We have conducted MT and TDEM surveys around Unzen Volcano to reveal more precise resistivity structure and to clarify a supply & emission process of magma in Unzen Volcano.

After these surveys, a general feature of the resistivity structure was confirmed again that a low resistive 2nd layer (1-30 ohm-m) appeared in most observation sites under a resistive (10k-300 ohm-m) surface layer and resistive 3rd layer was found bellow this low resistive layer. This low resistive layer is considered to be a complex of water-saturated and altered layers. More precise examination of the structure leads some different regional features in Shimabara Peninsula. Around the northeastern part of Shimabara Peninsula, which is near from the coast, low resistive 2nd layer appears almost the same as the sea level. On the other hand, this layer appears at deeper depth along the western part of the Chijiwa Fault, and at shallower depth along some other normal faults within the western part of the Unzen Graben. Very low resistive zones are found at the shallow depth around the Heisei Dome and Unzen hot spring. Distribution of the conductance indicates that a high conductance zone is clearly seen along the fault trending W-E, starting from Tachibana Bay to the area of the summit dome. It is also indicated that another high conductance zone is distributed around Mayu-Yama. After a precise MT survey near USDP4, north of the Dome, the resistivity of this 2nd layer found to decrease toward the dome, and the value of the resistivity was consistent with the logging result of USDP4. These evidences suggest that magmatic gas was supplied to the water saturated layer beneath Mayu-Yama and the elongated zone from Tachibana Bay to the summit dome.

3-D modeling analysis suggests the existence of highly conductive body in the deeper part of Shimabara Peninsula. It is a W-E trending magma slab traversing Unzen. The slab is located about 4.5 km deep with 3.4 km N-S width and the thickness of about 7.5 km. This evidence indicates that magma has been supplied not only in the western part of the Shimabara Peninsula but also in the eastern part.