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Surface topography change of 2011 eruption lava stored in the Sinmoedake crater depicted by remote sensing techniques

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Shinmoe-dake of Kirishima volcanic group is an active volcano sitting on the border of Miyazaki and Kagoshima prefectures in Southern Kyushu, japan. It erupted in the beginning of 2011; this was the first magmatic eruption for the last three centuries. The volcano was firstly formed between 25Ka and 15Ka. After thousands of years of quiescence, it became active with a sub -Plinian eruption during 1716 and 1717. Then it entered again a period of quiescence, but the signs of increased activity was suggested by a series of small phreatic eruptions in 1991, 2008,2009, and2010. Finally, a magmatic eruption began in January 2011. Before this eruption, the crater was of bowl-shape having a small lake at its bottom. After the eruption, the crater is almost completely filled by newly extruded lava whose surface is almost reached to the level of the lowest part of the crater rim. In this eruption, the extrusion of lava was completed in a short period of the first stage, then, it was followed by repeating small explosive eruptions on the surface of the lava. Those explosive activities became less-frequent in recent days.

Continuous GPS observations around Kirishima volcanic area has been conducted by the GSI and others since mid-1990s. The GPS data clearly indicated regional expansion of the western part of Kirishima during one year before eruption. A sharp contraction was observed during eruption. Immediately after the eruption a resumed expansion continued until recently. Those crustal deformations are considered to be a direct reflection of the underground magma migration activity. The horizontal and vertical displacements derived by GPS are well explained by a pre-and post- eruptive inflation and sin-eruptive deflation of the same magmatic pressure source at the depth several killometers northwest of Shinmoe-dake crater..

The GPS data also suggest that almost the same amount of magma has been already accumulated in the magma chamber. Consequently a possibility of future eruptitions are of deep concern among scientific and civil protection community..

One of the most basic information that will be useful both for the scientific and civil protection engagements is accurate data of surface topography. Since the type of eruptions is significantly controlled by the surface topography, it is highly desirable to acquire the 3-D digital topographic data before an eruption begins. Similarly it is also important to keep the data updated when the shape of the surface is changed by any volcanic activity.

Since the beginning of 2011 eruption JMA and other groups have repeated taking of photographs of the Shinmoedake crater from airplanes and helicopters. Interpretation of those pictures indicated that the shape of the lava surface is now flat and its level is close to the lowest part of the crater rim.

If a new eruption takes place in the near future, similar quasi-real-time topography measurement is necessary for both scientific and civil protection engagements. However such observation in unrest situation is not an easy task. In contrast, during quiet period, a number of techniques are available for the purpose, i.e., i) Lidar , ii) aerial photogrammetry (Visible), iii) airborne SAR , and iv) satellite remote sensing . Nevertheless , i) and ii) are difficult when the crater is erupting. Furthermore, high cost of iii) and a long recurrence time of iv) prevent frequent observations. To remedy those, we are in the process of developing of new methods applying a digital photogrammetry technique for both visible and thermal infrared imagery.

In this presentation, we compare different 3-D measurement results on surface topography made by the various institutions including one of our own, and then discuss the temporal change of the surface topography of the Shinmoe crater lava. The preliminary results suggest that no significant changes took place since the beginning of February

Keywords: Shinmoedake, remote sensing, topography, lava, disaster mitigation, forecast