

Strategies to realize volcanic exploration on the moon

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The moon has many scientifically attractive volcanic fields and terrain created by unique igneous activities. Currently, many lunar exploration plans are being planned, but there are few exploration plans for those areas. I would like to consider why lunar volcanic exploration is not planned and how volcanic exploration can be realized.

There was once a lunar landing exploration plan called SELENE-2, and I was the chief of "SELENE-2 Landing Site Research Board". SELENE-2 was the Japanese lunar exploration project that is planned to be launched around the middle of 2010's. The SELENE-2 project was unfortunately canceled, but we had 35 scientific proposals with over 70 landing site candidates submitted from 21 groups. Based on similarity of science scenario, the proposals were combined into 10 landing-site candidates as follows: (1) Tycho, (2) Apollo14 site, (3) Copernicus, (4) Vertical Holes, (5) Mare Humorum, (6) Ina, (7) Zucchius, (8) Hansteen Alpha, (9) Marius Hills, and (10) Reiner Gamma. Among them, (4) (6) (8) (9) are volcanic terrain. However, it was difficult to remain in the finalists. The reason was that it was considered difficult to obtain sufficient results in one exploration. For a lunar exploration project, it is important that the exploration can be done in one place and that it can be done without using complicated observation equipment. This may not be very familiar to earth geologists.

I experienced a similar exploration in Cameroon. Limnic eruptions at Lake Nyos in 1986 was caused by a sudden release of magmatic CO₂ dissolved in the lake water. These disasters killed about 1800 residents around the lake (Klinget al.1987; Sigurdsson et al.1987). To investigate the pre-cursors of limnic eruptions and reduce the risks at the lake, my research group tried to develop the equipment measuring dissolved CO₂. However, complex equipment can be destroyed by animals, and it is difficult to repair broken equipment on site. Therefore, a method of measuring the CO₂ concentration of lake water using a simple sound velocity measuring device was developed (Saiki et al.,2018). Producing results with a simple device is a necessary concept in space exploration.

I gained another valuable experience in Izu Oshima. I started Izu-Oshima Unmanned Observation Robot Symposium in 2009. This symposium is intended to bring together experts developing unmanned observation robots from different study fields such as volcanology, space engineering, and disaster relief to Izu-Oshima and to provide them the opportunity of field tests and exchange of knowledge to make them accelerate the development of the robots and the establishment of the operation framework. The field tests attracted many participants each year until it ended in 2017. As a result, flying drones were frequently used for volcano observations, but robots running on the ground had little success. Because volcanologists go to dangerous places where robots cannot go. In such a situation, it may be difficult to get an idea to let the robot observe.

In order to realize a volcanic exploration on the moon, it is necessary to do the following three things. "To make an observation plan that can be done with a single, narrow-area survey", " To plan an exploration that can be realized with a simple observation equipment", and "To practice an unmanned exploration of volcanoes on the earth".

Keywords: the moon, volcano, exploration