Development of an Integrated Airborne Geophysical Survey System Using Helicopter

Background

In order to mitigate natural disasters such as volcanic eruption, earthquake, landslide etc., it is important to survey underground conditions at these disaster-prone areas without actually entering them. For this purpose, there is a strong need for an airborne geophysical survey system that can acquire various geophysical parameters quickly and in detail.

Objectives

To advance airborne electromagnetic, magnetic, gamma-ray spectrometry and infrared image survey methods and develop an integrated airborne geophysical survey system that incorporates these four methods (Fig.1);

Principal Results

1. Development of survey methods to detect thermal anomaly at a deeper depth

① An airborne electromagnetic survey system was developed that uses a grounded electrical source and an airborne magnetic field receiver to increase the depth of investigation. The system was able to increase survey depth from ～200 m by conventional methods to ～1000 m (Fig.2).

② An airborne magnetic survey system employed in this study was able to produce high quality magnetic field potential maps based on precise positioning data and data handling techniques, etc (Fig.3).

③ These survey methods enable to detect thermal anomaly at a deeper depth that are characterized by low resistivity and weak magnetization.

2. Development of survey methods to detect thermal anomaly at a shallower depth

① As for airborne gamma-ray survey method, a technique was developed to convert radioactive intensity (unit: cps) that depends on censor sensitivity to absorbed dose rate (unit: nGy/h) that corresponds to geology more quantitatively.

② As for airborne infrared image survey, a high quality composite thermal image was obtained by giving each precise positioning data to thousands of thermal images and so on (Fig.4).

③ These methods can detect fractured zones at a shallower depth by high radioactive anomaly, and surface thermal anomaly, respectively.

3. Development of an integrated airborne survey system

These four airborne geophysical survey methods can be applied by three flights using one helicopter. Thereby an integrated airborne survey system was developed that can acquire various data from surface to 1 km depth safely, quickly, and cost-effectively without entering into disaster-prone areas. It would be possible to detect underground anomaly that leads to disaster as quickly as possible by applying this system to the survey area repeatedly.

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Future Developments

Data handling techniques for each method should be more advanced. It is necessary to apply this integrated airborne survey system and acquire data repeatedly at disaster-prone areas in order to mitigate natural disasters.

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Reference

H. Ito, et.al., 2007, “Development of an integrated airborne geophysical survey system using helicopter-Improvement of airborne survey methods of electromagnetic, magnetic, gamma-ray spectrometry, and infrared image-”, CRIEPI Report N06011 (in Japanese with English abstracts)

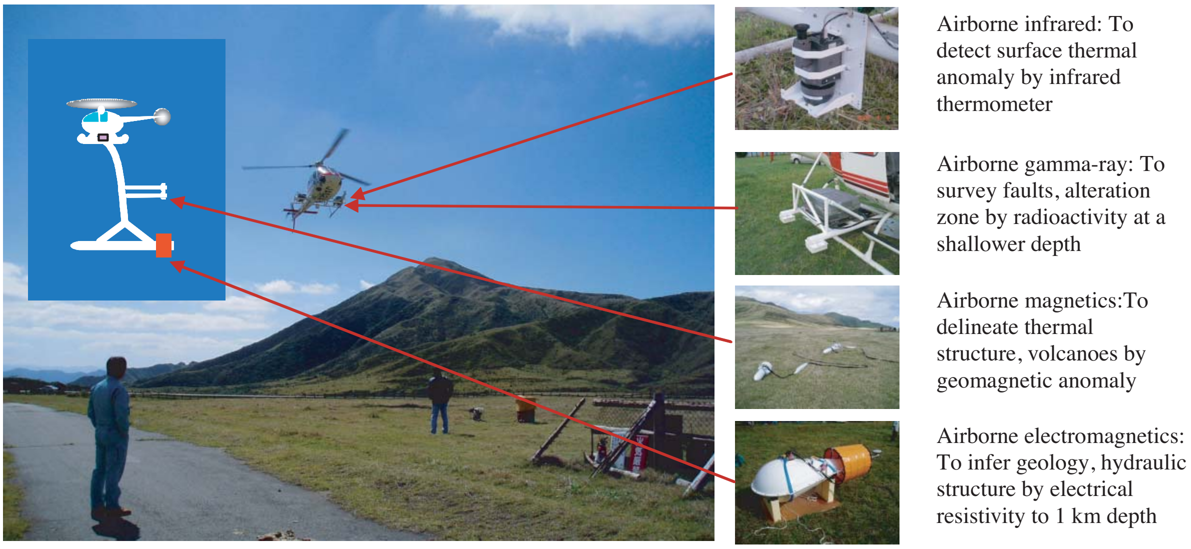

Fig.1 Integrated airborne geophysical survey system using helicopter

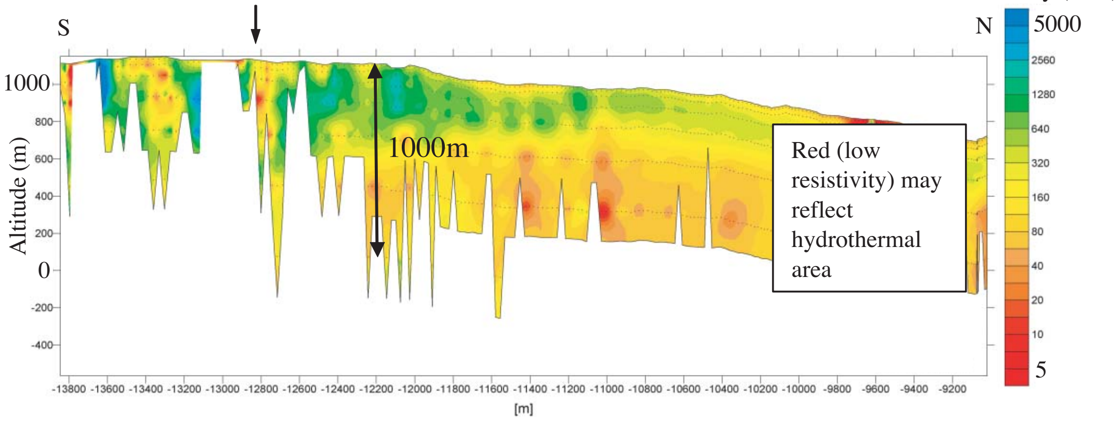

Fig.2 N-S cross-section of electrical resistivity in Aso volcano

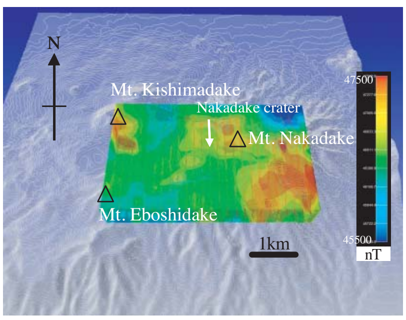

Fig.3 Magnetic field potential map
Red corresponds to strong magnetic anomaly (basaltic volcano).

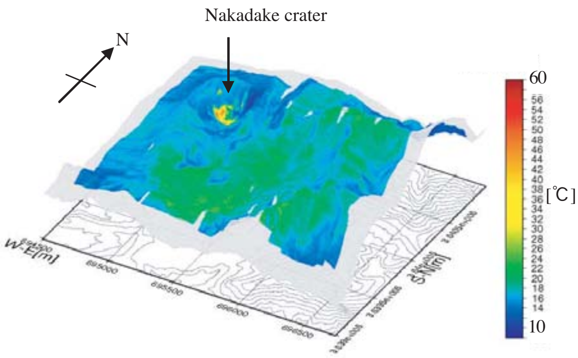

Fig.4 Surface temperature map in Aso volcano