Unzen Volcano : the 1900-1992 eruption

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8. Surface Temperature Measurements of Lava Domes and Pyroclastic Flows by Infrared Thermal Video System

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Introduction

Surface temperature of lava domes and pyroclastic flows at Unzen Volcano have been repeatedly measured by an infrared thermal video system since 7 June 1991. Measurements were mainly made from the air.

Infrared thermal video system

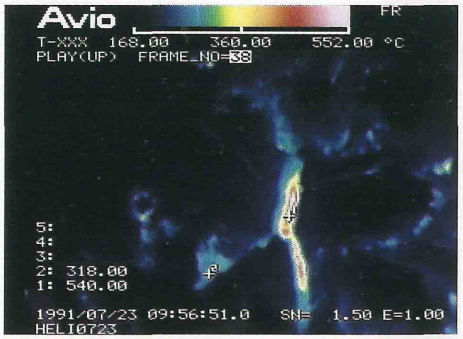
The system is composed of an infrared camera head and an image processor. Temperature distribution of an object is measured remotely and its thermal imagery is displayed at once on the color monitor attached to the image processor. Obtained data are stored on a floppy disk or a real time recorder. A handy video camera is simultaneously used in order to merge the thermal imagery into video when analyzing. As a result, we can easily identify the temperature distribution of the object. A photograph of the system is shown in Fig. 8-1.

Surface temperatures in this study were obtained by assuming that emissivity is 1.0, so that they are not true temperatures of the objects. We can, however, roughly estimate the surface temperature of the object and track its change by the repeated measurements at the same point.

Fig. 8-1. Photograph of the infrared thermal video system. Infrared camera (bottom left), image processor (middle right), real time recorder (top right), handy video camera (top left) and video copy processor (bottom right).

Thermal imagery

Repeated surface temperature measurements revealed that temperatures were constantly or often high in the following areas, as shown in Figs. 8-2 to 8-8.



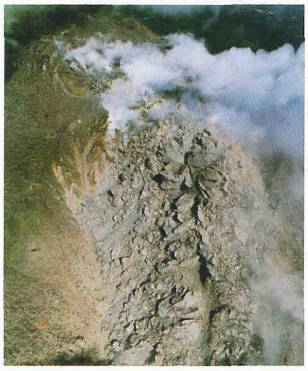


Fig. 8-2 (a). Thermal imagery at the vent area of Dome 2, viewed from the east on 23 July 1991.
Fig. 8-2 (b). Photographs of Dome 2, viewed from the east on 23 July 1991 (K. Ohta).

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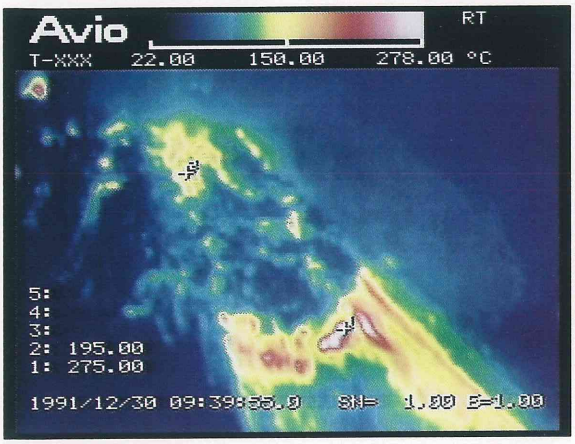

Fig. 8-3 (a). Thermal imagery of Dome 6, viewed from the southeast on 30 December 1991.

Fig. 8-3 (b). Photograph of Domes 6 (left) and 4 (right), viewed from the southeast on 20 December 1991 (K. Umakoshi).

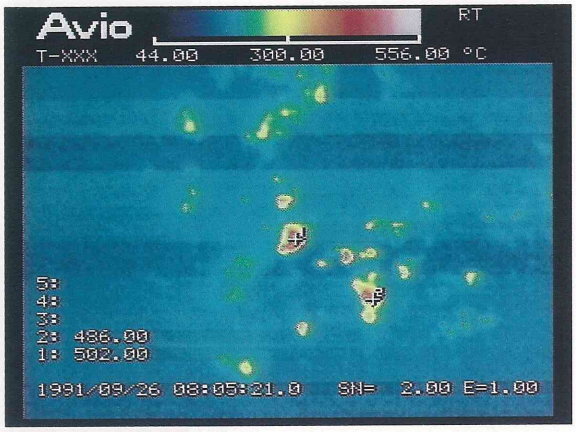

Fig. 8-4 (a). Thermal imagery of the vent area at the western edge of Dome 1, viewed from the west on 26 September 1991. High temperature spots correspond to vents of steam.

Fig. 8-4 (b). Photographs of the vent area at the western edge of Dome 1 on 25 October 1991. (K. Umakoshi).

(1) Vent areas

High temperatures have been observed at the vent areas. A spot at 540°C was found at the vent of Dome 2 on 23 July 1991 (Fig. 8-2).

(2) Front of growing lava dome

Rockfalls, generating pyroclastic flows, have been frequently occurred in the vicinity of the front of the growing lava dome. Relatively high temperatures were constantly recorded in this portion. Thermal imagery of the growing lava dome showed typical temperature distribution as in Fig. 8-3.

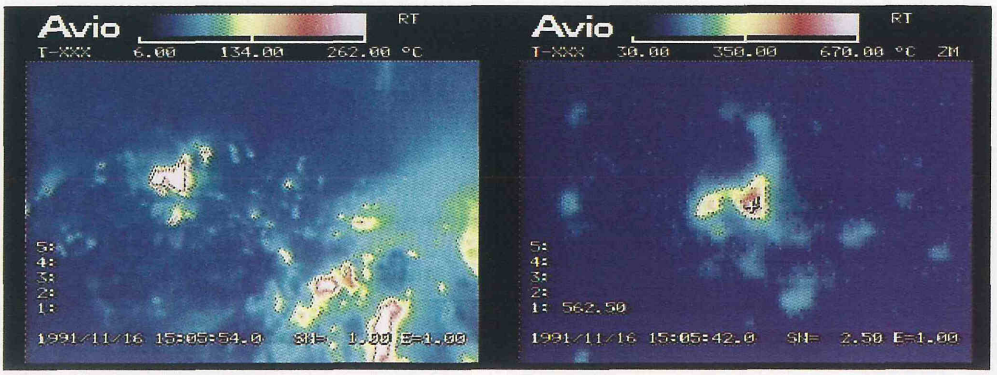

Fig. 8-5 (a). Thermal imagery of the vent at the top of Dome 3, viewed from the south on 16 November 1991. Left, a complete view of Dome 3 from the southeast; right, the vent area gushing bluish gas at the top of Dome 3.

Fig. 8-5 (b). Photograph of Dome 3 (left), viewed from southeast on 7 November 1991 (K. Umakoshi).

Fig. 8-6 (a). Thermal imagery of the pyroclastic flow deposits of 15 September 1991, viewed from the north on 21 September 1991.

Fig. 8-6 (b). Photograph of the Oshigadani Valley, viewed from the west on 25 October 1991 (K.Umakoshi). The pyroclastic flow of 15 September 1991 ran down in this valley.

Fig. 8-7 (b). Photograph of the Tansansuidani Valley. A new course of pyroclastic flows in November 1991. (photo. on 25 October 1991 by K. Umakoshi).

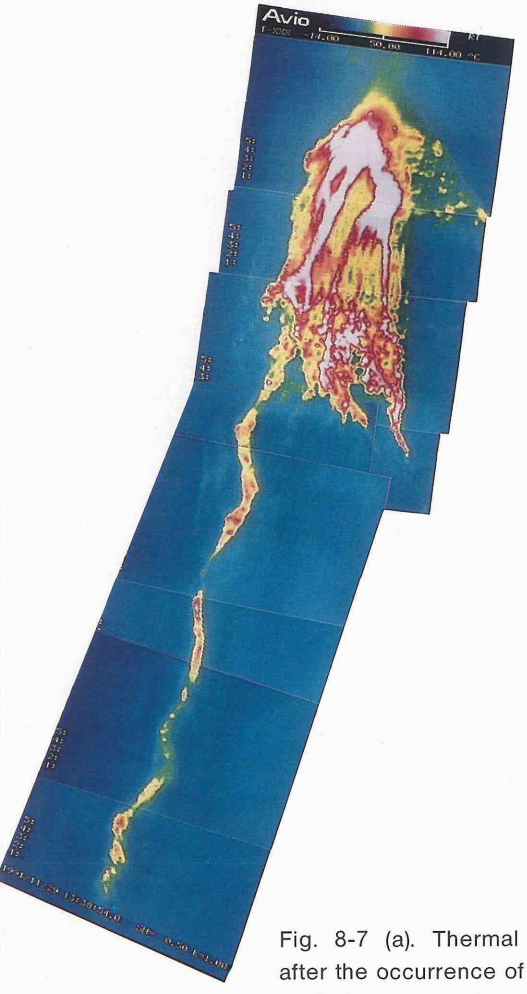

Fig. 8-7 (a). Thermal imagery after the occurrence of a pyroclastic flow in the Tansansuidani Valley, viewed from east on 29 November 1991.

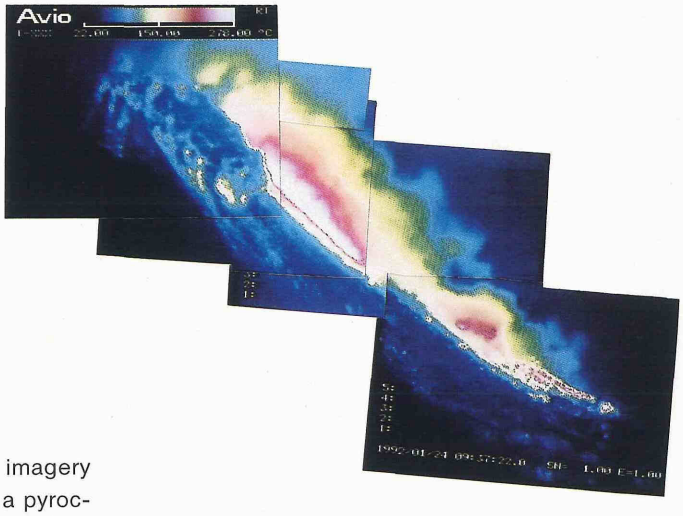

Fig. 8-8 (a). Thermal imagery of a rockfall, viewed from south on 24 January 1992. The front is Dome 6.

Fig. 8-8 (b). Photographs of a rockfall, viewed from southwest on 28 January 1992 (K. Umakoshi). The pyroclastic flow ran down between Domes 4 and 6, the same course as the rockfall in Fig. 8-8(a). The front is Dome 6.

(3) Vent area at the western edge of Dome 1

Emission of steam is continuing from several vents at the western edge of Dome 1. In the vicinity of them, temperatures above 500°C were recorded many times. The maximum temperature of 658°C was recorded on 24 October 1991. Figure 8-4 shows an example of the thermal imagery at the western edge of Dome 1.

(4) Vent area at the top of Dome 3

Bluish gas is gushing constantly from the top of Dome 3. Temperatures at the vent area have often been raised to levels above 500°C. The maximum temperature of 626°C was recorded on 25 October 1991. Figure 8-5 shows an example of the thermal imagery at the top of Dome 3.

(5) Pyroclastic flow deposits

The largest pyroclastic flow occurred on 15 September 1991. The flow ran ENE in the Oshigadani Valley and changed its direction to SE because of the topography. The flow front of the flow ran 5.5 km from the dome. Figure 8-6 shows the thermal imagery, viewed from the north on 21 September, of the pyroclastic flow deposits.

Dome 5 appeared near the head of Dome 4 on 24 November 1991. Pyroclastic flows from Dome 5 came to run along a new course in an ESE direction: Tansansuidani Valley (a branch of the Akamatsudani Valley). Figure 8-7 shows the thermal imagery along this course right after the occurrence of a pyroclastic flow.

(6) Pyroclastic flow

We have often observed the generation of pyroclastic flows by thermal video system. Figure 8-8 shows a thermal imagery of a rockfall at the top of Dome 6 and the resultant pyroclastic flow between Domes 4 and 6.