Study on Method to Extract Hazardous Slopes for Deep-seated Landslides, Focusing on Temporal Changes of EC

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INTRODUCTION

It is important to extract slopes liable to deep-seated landslides in advance. As a method to extract hazardous sites for deep-seated landslides, there are several studies which suggest that the electric conductivity (EC) of gully water or spring water near such a hazardous site is higher than that of other areas in the same drainage basin. Meanwhile, the value of EC may drop due to rainfall and there have not been many studies exploring the right timing to accurately observe the EC without being affected by rainfall, etc. This study focuses on the ratio between EC of spring water at a hazardous site for deep-seated landslides and EC of river water into which the said spring water flows with a view to examining a viable method to determine the optimal date for the measurement of EC.

OUTLINE OF THE STUDY SITE

1. OVERVIEW OF THE STUDY AREA

Within the geological and topographic ranges associated with a high risk of frequent occurrence of deep-seated landslides in Wakayama Prefecture, slopes with mass rock creep were identified by means of interpreting LP data and other topographical data. Of these sites, one site where the field survey confirmed the existence of spring water was selected as the study site. The drainage basin of Migi-Aizu River, selected as the study site(**Fig.1**), suffered extensive damage in 1889 due to a blocked river channel caused by a deep-seated landslide and subsequent breach. Spring water with a relatively higher EC than nearby river water gushes out from the slope(**Fig.2**).

2. STUDY METHOD

The EC of spring water and the main stream were studied in the following manner. ① Continuous observation by installing a water quality meter equipped with a logger to study the seasonal changes and effects of rainfall. ② To examine the relationship between EC and rainfall, using data of the rainfall stations in the vicinity of springwater site. A similar study was conducted in the past in winter

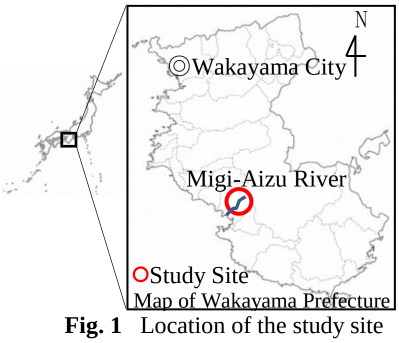

Fig. 1 Location of the study site

Fig.2 Left:Mass rock creep,Right:Spring water gushing out from the base of the slope with mass rock creep

with a low level of rainfall because of the likelihood of a difference of the EC value between the main stream and the spring water. In this study, however, special focus was placed on the flood season because of the need to study the post-rainfall effects.

OBSERVATION RESULTS FOR EC VALUES OF SPRING WATER AND RIVER WATER

1. CONTINUOUS OBSERVATION RESULTS FOR EC VALUES

Fig. 3 shows changes of the EC values of spring water and river water continuously observed for a period of longer than one year. The EC value of spring water is high at approximately double that of the EC value of river water and is almost constant throughout the year except for a decline caused by rainwater. While the EC value of river water shows a similar tendency to spring water, it increases at certain periods (April to May and August, etc.) of the year.

2. CHANGE OF EC VALUE DUE TO RAINFALL

The rate of change of the EC value (ratio to the EC value of the previous day) was analysed for comparison using the daily mean EC values of spring water and river water. After daily rainfall of some 100 mm, the EC value of spring water drops to some 80% of the pre-rainfall level. In contrast, the EC value of river water drops to some 5－60% of the pre-rainfall level. As the rate of change of the EC value of spring water is always smaller than that of river water under different rainfall conditions, it is safe to conclude that spring water is less influenced by rainfall than river water.

3. CHANGE OF EC RATIO BETWEEN SPRING WATER AND RIVER WATER

The EC values of spring water and river water drop due to rainfall and their ratio r (EC value of spring water to EC value of river water) changes due to rainfall. The value of r is constant during a period of no rainfall or a period of little rainfall . As the EC value of river water is more likely to be influenced than spring water at the time of rainfall, the value of r increases. It returns to the pre-rainfall level after a certain period of time. The value of r at the study site is around 1.5－2 and it was found that a changed r value with much rainfall will return to the original value after 2－5 days.

CONCLUSIONS

The observation results indicate that it is inappropriate to use the EC value of spring water for after rainfall accurately. The EC value declines due to rainfall from the normal level even though it is relatively higher than that observed in the neighbouring area after rainfall. Nevertheless, it is confirmed that there is a possibility of accurately measuring changes of the EC ratio between spring water and river water to extract hazardous slopes without being affected by rainfall.

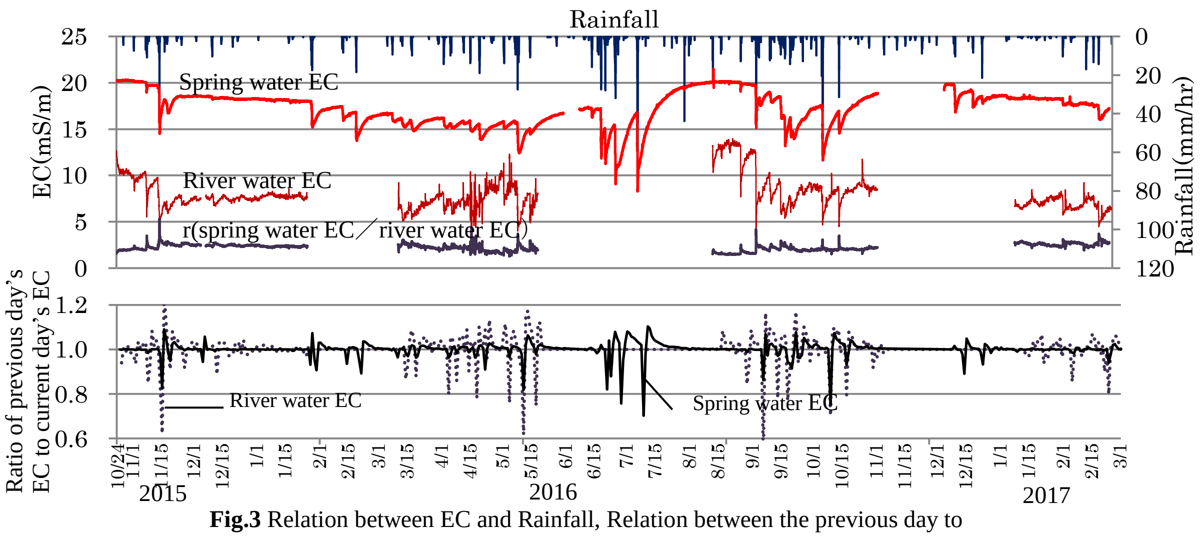

Fig.3 Relation between EC and Rainfall, Relation between the previous day to the current day ratio of daily mean EC value of spring water and that river water

Keyword: Deep-Seated Landslides, electric conductivity, Spring water