OE-7

River Pollution Caused by the Ejecta Including Arsenic of Mt. Io and the Characteristics

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1. Introduction

1.1. Eruption of Mt. Io

Mt. Io in Miyazaki Prefecture at Ebino Plateau in the Kirishima Geopark[1)] and the Kirishima - Kinkowan National[2)] Park has erupted since 19th April 2018 (Fig.1). The eruption of hydrothermal water and toxic gases are constantly. After the eruption, the eruption caution level had been raised from 2 to 3[3)], and the climbing a mountain was restricted. The restriction level 3 was off on 2nd May. However, the caution level has been 2 still. The range within 1 km from the crater is the off-limits area.

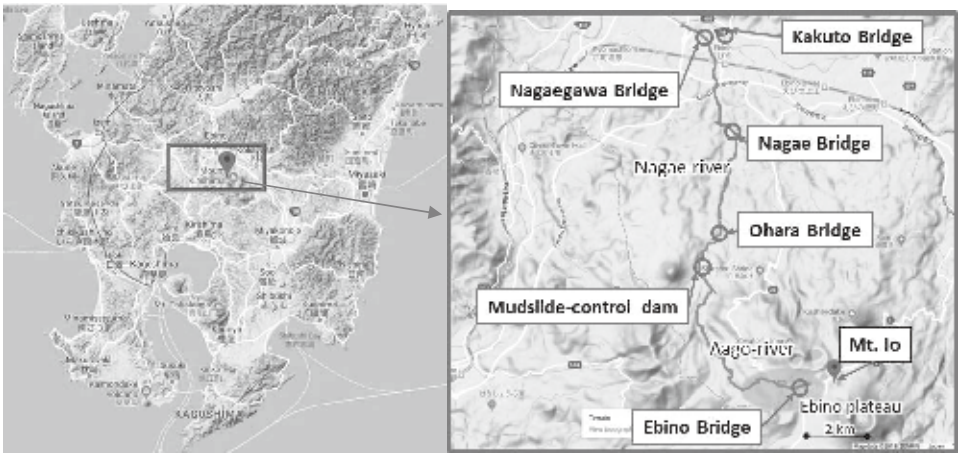

Fig.1 Location of Mt. Io and monitoring points on Nagae River and Akago River

1.2. Impact for Environment

The streams and rivers at the foot of Mt. Io was polluted by the ejecta and the hydrothermal water, and colored to white (Fig.2)[4)]. Furthermore, the death of fish was found in the Sendai River from 28th to 30th April[5)]. Now, the water quality has been monitored by Miyazaki prefectural government, Ebino city government, Kagoshima prefectural government, city offices in the basin in Kagoshima prefecture, and the Sendai River office under the Ministry of Land, Infrastructure and Transportation. According to Ebino city office, the polluted water has not almost affected to the agriculture, because the use of the river water for agriculture had been immediately restricted by the municipalities after finding the river pollution[6)]. However, the many farmers cannot sow a crop in this year, so the economic damage is serious.

Fig.2 View of downstream at Nagae Bridge

2. Pollution of Rivers

2.1. Monitoring Points

The water quality has been measured at the monitoring points on the Nagae River shown on Fig.1 by Miyazaki prefectural office, and at the monitoring points on the Sendai River shown on Fig.3 by the Sendai River office[6].

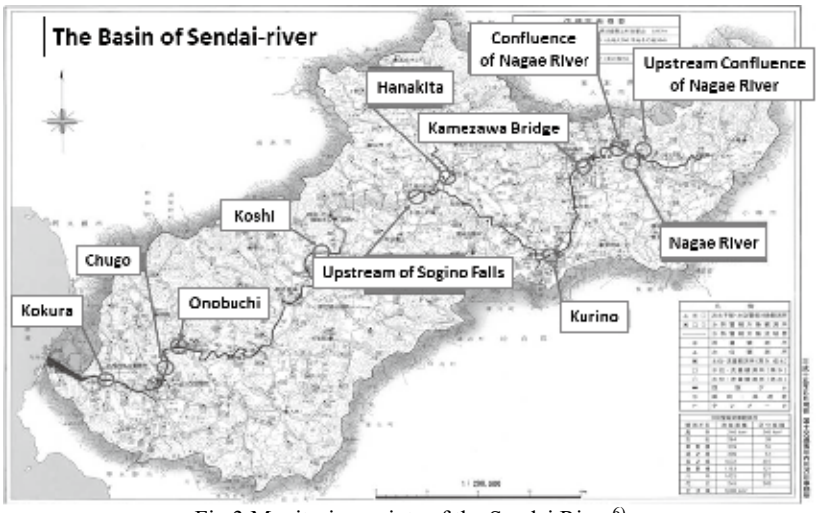

Fig.3 Monitoring points of the Sendai River[6]

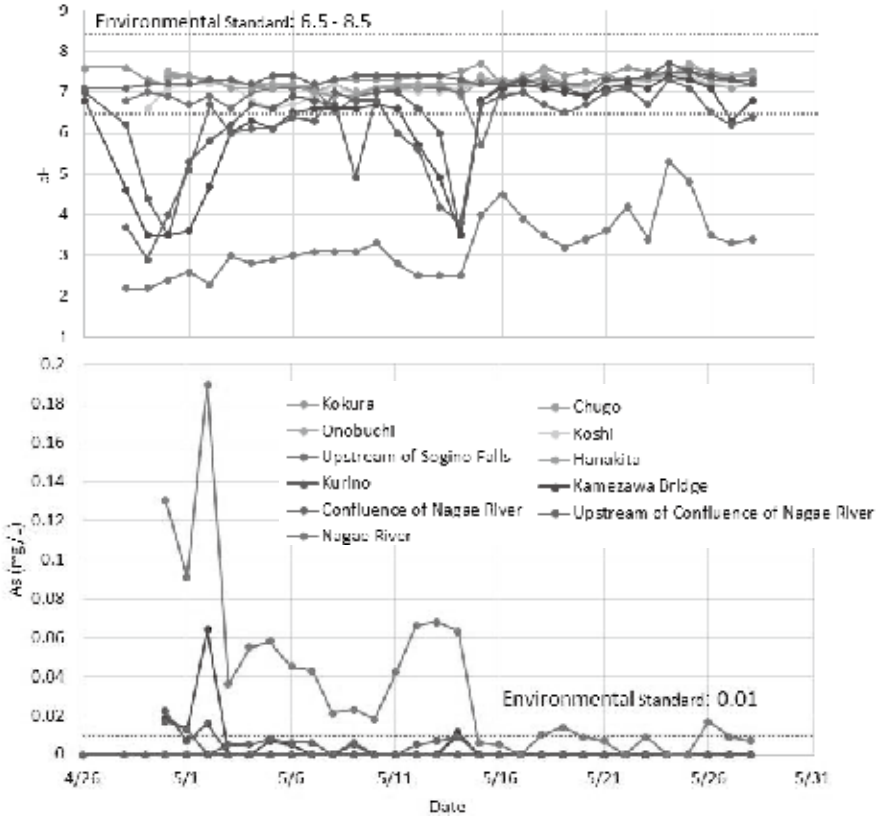

Fig.4 pH and arsenic concentration on monitoring points of the Sendai River[6]

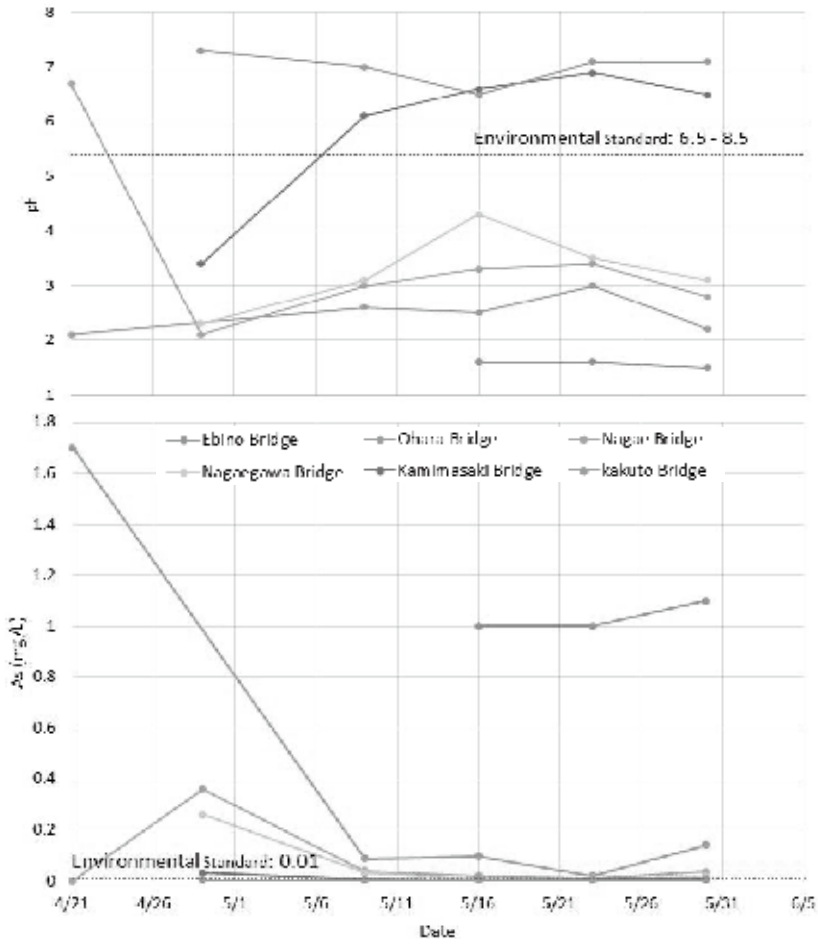

Fig.5 pH and arsenic concentration on monitoring points of the Nagae River and Akago River[8)]

2.2. Current Conditions Trends of Water Quality

The pH and concentration of heavy metals such as arsenic in the Sendai River exceeded the environmental standard of water quality after the eruption. However, the water pollution was not long term but the short period immediately after the eruption. Sendai River is recovered steadily (Fig.4)[7)]. On the other hand, pH was strongly acidic, and the heavy metals concentration was tremendously high, especially arsenic concentration was high in the Nagae River immediately after the eruption and the Akago River in the Ebino Plateau. Although the arsenic concentration decreased drastically for around two weeks after the eruption, it has still exceeded the environmental standard value and has been acidic strongly (Fig.5) [8)].

3. Characteristics of Sediment

3.1. Elution Amount and Content by leaching test

The elution amount and content of the sediment which was sampled on 16th May at the Ebino Bridge over Akago River at Ebino Plateau was evaluated by the official leaching methods for soil environment (Table 1)[8)]. Arsenic, fluorine, and boron exceeded the elution amount standard for soil environment, but the arsenic content was below the soil environmental standard. The elution amount standard is set for preventing water pollution by exudates, the content standard is set for preventing health effect by direct intake. As per these results and the meaning of these criterions, it is a suitable treatment for the sediment to immobilize the heavy metals not to leach them, and to bury in the ground not to diffuse.

3.2. Chemical Content

The characteristics of sediment which was sampled on 9th May at Akago River at Ebino Plateau was analyzed at the University of Miyazaki by X-ray diffraction analysis (XRD) and energy dispersive X-ray

analysis (EDX). Arsenic content measured by EDX was clearly higher than the content analyzed by official leaching test because the leaching test uses 1 mol/L of chloric acid solution, and the method cannot extract all content in the soil. Nevertheless, the content of each trace element was not remarkably high as compared to the general surface soil of Japan (Table 2).

3.3. Minerals

Powder X-ray diffraction analysis by fixed orientation method showed some minerals come from the volcanic activity and hydrothermal alteration (Fig.6). Cristobalite is a component of volcanic rock, and alunite, Magnesioferrite, and clay minerals such as dickite, sepiolite, and nontronite generate by hydrothermal alteration. Also, sulfur and sulfide minerals come from hydrothermal water. The result means the sediment comes from the activity of volcanic of Mt. Io.

Table 1 Elution amount and content of heavy-metals by the official methods[8)]

	Cd	Pb	Cr(VI)	As	T-Hg	Se	F	B
Elution Amount Test mg/L	<0.001	0.003	<0.02	0.024	<0.0005	<0.001	4.6	1.1
(Standards for soil environment)	0.01	0.01	0.05	0.01	<0.0005	0.01	0.8	1
Content Amount Test mg/kg	-	-	-	1.7	-	-	-	-
(Standards for soil environment)	150	150	250	150	15	150	4000	4000

Table 2 Content of trace elements measured by EDX (measured at UOM.)

Mn	Cd	Pb	Cr	As	Se	Zn	Cu	
290.7	1.18	25.65	61.67	14.11	6.96	16.3	40.84	(mg/kg)

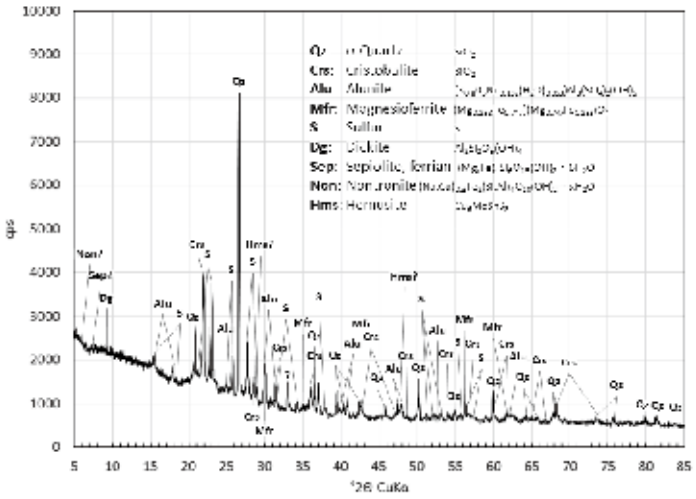

Fig 6. X-ray diffraction patterns of the sediment at Akago River at Ebino Plateau (measured at UOM.)

4. Future plan for Monitoring and Countermeasure

At first, the continuous monitoring of water quality and understanding the mechanism of sediment for the treatment following ALARA principle are important. And then, the development of the processing methods against the acidic water and the heavy metals concentration increasing should be researched.

References

1) http://www.mct.ne.jp/users/kiri-geopark/en/about/index.html (2018/06/03)
2) https://www.env.go.jp/park/kirishima/ (2018/06/03)
3) http://www.data.jma.go.jp/svd/vois/data/tokyo/STOCK/activity_info/552.html#warning (2018/06/03)
4) http://www.qsr.mlit.go.jp/sendai/press_info/H30/180525-4.pdf (2018/06/03)
5) http://www.city.ebino.lg.jp/tempimg/T201805311752160f.pdf (2018/06/03)
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