Possible Case of Deep-seated Catastrophic Landslide in Himekawa River Basin

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INTRODUCTION

Sediment disasters caused by deep-seated landslides may result in extensive damage. However, as the location and scale of deep-seated catastrophic landslides cannot be identified at this time, effective and efficient counter measures have not been taken against them and sediment disasters caused by them.

We carried it out for the purpose of the collection of basic data to assume the location and scale of deep-seated catastrophic landslides produced in the future.

In response to this, possible deep-seated catastrophic landslide in the Himekawa River basin are estimated experimentally by considering deep-seated catastrophic landslide cases in the past and local situations. Also, possible cases are introduced as reference material for future counter measures in this report.

METHOD

Possible deep-seated catastrophic landslide in the Himekawa River basin were estimated by referring to “How to estimate sediment disaster damage caused by deep-seated landslide (preliminary draft).”

We classified the “divided areas for examining deep-seated catastrophic landslides” in the basin as units for analyzing the characteristics of deep-seated catastrophic landslides of the past. We then organized and analyzed deep-seated catastrophic landslides of the past according to the documents, thereby estimating possible deep-seated catastrophic landslide in the Himekawa River basin.

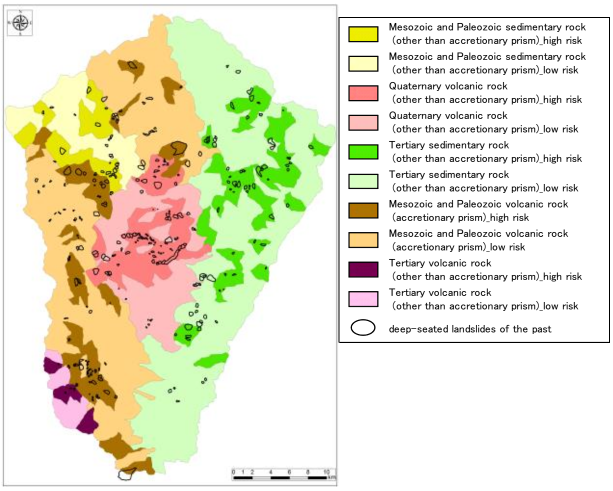

Fig. 1 Divide areas for examining deep-seated landslides

RESULTS

The locations of deep-seated catastrophic landslides of the past were extracted according to microtopography interpretation results using documents, LiDAR. As a result, 324 slopes were extracted within the Himekawa River basin. The divided areas were determined on the assumption that deep-seated catastrophic landslides were affected by the geology. The risk of deep-seated landslide was classified as “high risk” and “low risk”(**Fig.1**).

We organized collapse sediment volume as the scale of extracted deep-seated catastrophic landslide. The collapsed sediment volumes were calculated by using Guzzett’s empiric formula based on the collapse area.

The flow system and form of debris caused by deep-seated catastrophic landslides of the past were debris flow type occurred more frequently in the Himekawa River basin.

The topographical characteristics showed that the landslide sites distributed in high-risk areas were found in higher altitude areas than the landslide sites distributed in low-risk areas.

In geologic characteristics, there were no clear differences between the areas of higher risk and the areas of lower risk. The distribution of faults, geologic boundaries and structures (dip slope and stratum of opposite dip) shows that deep-seated catastrophic landslides occurred in areas of lower risk if located near the geologic boundary.

The frequency of deep-seated catastrophic landslides was calculated by estimating the occurrence time. This was done by confirming the collapse status according to the occurrence time found in the documents and aerial photographs taken in two or more periods.

Based on the results of organizing the deep-seated catastrophic landslides that occurred in the past, we assumed deep-seated catastrophic landslides that can be expected in the future.

We assumed the phenomenon of the same magnitude as the disaster occurred within about 100 years as "① the phenomenon that is more likely to occur", the largest phenomenon as "② the phenomenon that possibility to occur is thought about"(**Table.1**).

Table. 1 A classification result by the characteristic of deep-seated catastrophic landslide in the Himekawa River basin

Divide areas for examining deep-seated landslides	Mesozoic and Paleozoic sedimentary rock (other than accretionary prism)		Quaternary volcanic rock (other than accretionary prism)			Tertiary sedimentary rock (other than accretionary prism)				Mesozoic and Paleozoic volcanic rock (accretionary prism)				Tertiary volcanic rock (other than accretionary prism)	
	high risk	low risk	high risk		low risk	high risk		low risk		high risk		low risk		high risk	low risk
Phenomena	①	①	①	②	①	①	②	①	②	①	②	①	②	①	①
Area (km^2)	24.8	35.7	45.4	59.4		57.8		216.4		54.9		176.3		6.7	9.9
1. Scalse of deep-seated landslides (sediment volume(m^3))															
Standard scale (average)	229,296	230,186	237,614	150,000,000	19,967	219,454	80,000,000	281,176	9,000,000	714,298	50,000,000	139,440	3,200,000	no example	no example
The largest scale	297,992	249,057	1,628,985	150,000,000	31,387	682,759	80,000,000	558,101	9,000,000	4,422,249	50,000,000	437,959	3,200,000	no example	no example
2. Flow system and form of debris caused by deep-seated landslide															
Probability of occurrense of landslide dam	25%	there is no clear example in flow system and form of debris	6%	100%	there is no clear example in flow system and form of debris	–	100%	50%	100%	29%	100%	29%	100%	no example	no example
Probability of occurrense of debris flood	25%		18%	100%		20%	—	–	—	86%	—	29%	100%		
3. Topographic and geologic characteristics of deep-seated landslides occurrence location															
Topographic characteristics	near the knick point about elevation level 1,080m	near the knick point about elevation level 915m	near the knick point about elevation level 1,150m	near the knick point about elevation level 1,350m	near the knick point about elevation level 985m	near the knick point about elevation level 990m	near the knick point about elevation level 665m	near the knick point about elevation level 860m	near the knick point about elevation level 780m	near the knick point about elevation level 1,110m	near the knick point about elevation level 1,110m	near the knick point about elevation level 1,110m	near the knick point about elevation level 1,680m	near the knick point about elevation level 2,120m	no example
Geologic characteristics	Jurassic sedimentary rock	Jurassic sedimentary rock	Quaternary mafic volcanic rock	Quaternary mafic volcanic rock	Quaternary mafic volcanic rock	Neogene period sedimentary rock	Neogene period sedimentary rock	Neogene period sedimentary rock	Neogene period sedimentary rock	Ultramafic rock	Permian accretionary prism	Ultramafic rock	Carboniferous Sangun-Omi-Renge belt	Paleo granite	no example
4. Frequency of deep-seated landslides of the past(year km^2/time)															
Frequency of occurrence based on the past documents	no document	no document	687		1,188	14,885		21,861		7,074		5,553		no document	no document
Frequency of occurrence based on the topography interpretation	434	405	198		1,227	570		3,896		568		1,168		no example	no example
5. Past disaster outline															
Occurrence factor			snowmelt	rainfall	rainfall・snowmelt	rainfall	earthquake	rainfall・snowmelt	earthquake	snowmelt	earthquake	snowmelt	rainfall		
Occurrence situation			single occurrence	simultaneous frequent occurrence	single occurrence	single occurrence	simultaneous frequent occurrence	single occurrence	simultaneous frequent occurrence	simultaneous frequent occurrence	simultaneous frequent occurrence	simultaneous frequent occurrence	simultaneous frequent occurrence		
Phenomena that occurred			debris flood and landslide dam	debris flood and landslide dam	debris flood	debris flood	landslide dam	landslide dam	landslide dam	debris flood and landslide dam	landslide dam	debris flood and landslide dam	debris flood and landslide dam		

CONCLUSIONS

According to the estimated results, the scales of possible deep-seated catastrophic landslides in the Himekawa River basin were estimated up to a point. It is possible to examine the scale and status of sediment disasters caused by deep-seated catastrophic landslides by using the scale of landslides that we estimated. However, to consideration counter measures, the locations of possible deep-seated catastrophic landslides must be estimated accurately and thus it is necessary to consider how to estimate the occurrence locations.

Keywords: Deep-seated catastrophic landslide, Himekawa River basin