The role of bedrock geology, rock uplift rate and topography on large catastrophic landslide occurrence

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Background

- Recently, several large catastrophic landslides occurred in Japan and gave serious damages.
- It can be though that large catastrophic landslides will increase due to global climate change.
- So, hazard mapping for large catastrophic landslides becomes very important.

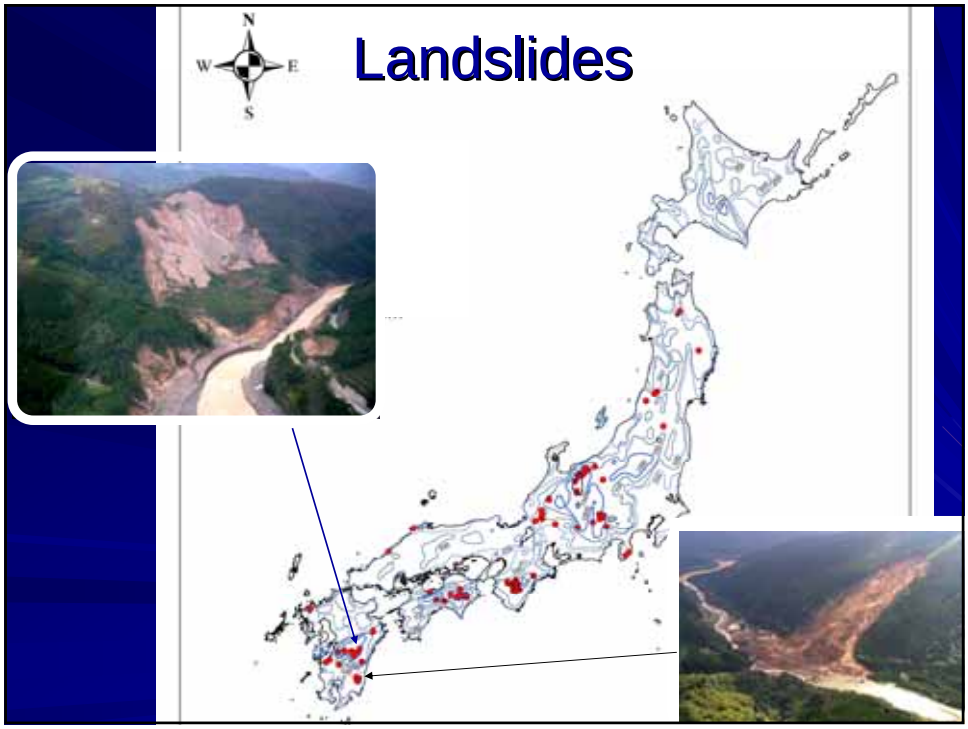
Objectives

- However, since still examples of these landslides are not so many, controlling factors of large catastrophic landslides have not been fully understand.

- To develop a hazard mapping method for large catastrophic landslide, we examined following questions:
  - What is the relationship between **rock uplift rate** and landslide probability?
  - What is the role of **geology** on landslide occurrence?

Landslide inventory

- We compiled an inventory of large ($V > 10^5$ m^3) catastrophic landslide which occurred since 1870 in Japan.
- Our dataset includes only landslides which have been clarified location and occurrence date.
- We included only rainfall induced landslide, we excluded seismic large landslide.
- We excluded slow failure of a more chronic nature (e.g., deep-seated landslide)
- Our dataset includes about 120 landslides



Maps

- Rock uplift rate

  We used “Quaternary Tectonic Map of Japan” (by Quaternary Research Group (1968).

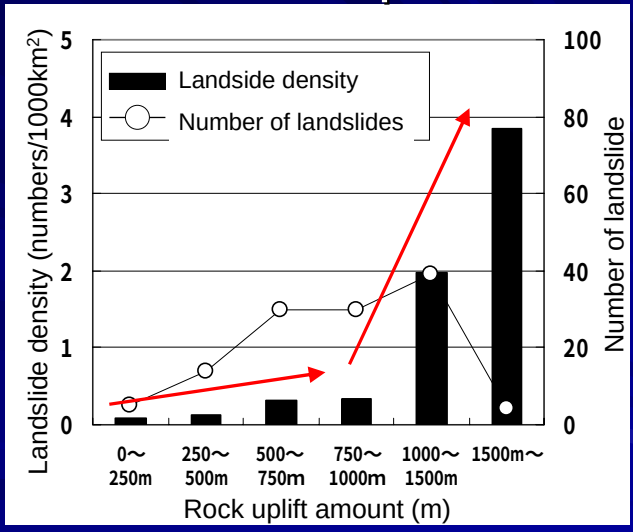
  This map shows total rock uplift amount from the beginning of the Quaternary.

- Geology

  We used “seamless geological map” (Geological survey Japan, AIST)

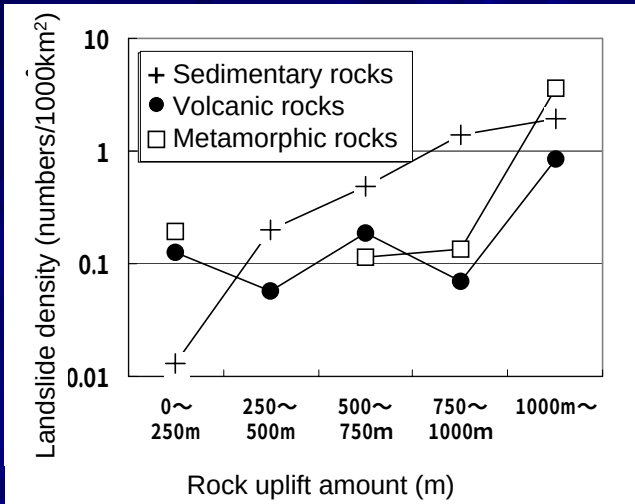
  We classified into twelve areas in terms of “rock type”, “geological age” and “geological structure (accretionary prism or not).

Role of rock uplift rate



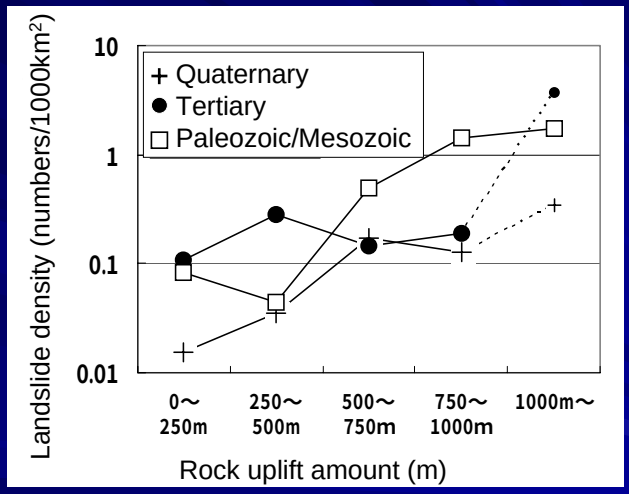
Landslide density increased with the increase of rock uplift rate.
The relationship between rock uplift rate and landslide density was not linear.

Role of Rock type



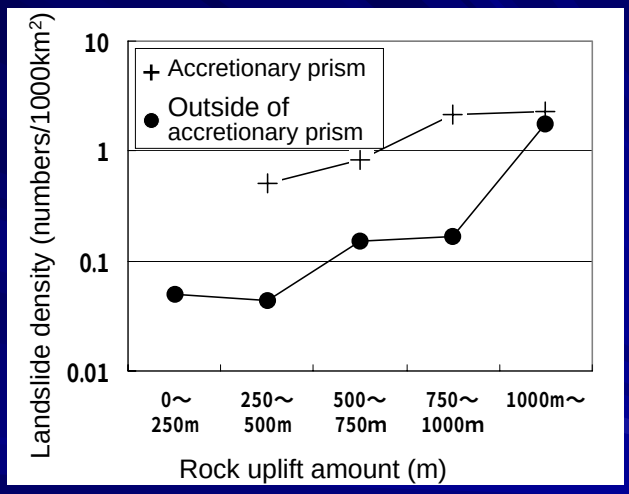
Role of rock types on landslide density was not clear
Landslide density increased with rock uplift rate, regardless of rock type

Role of Geological age



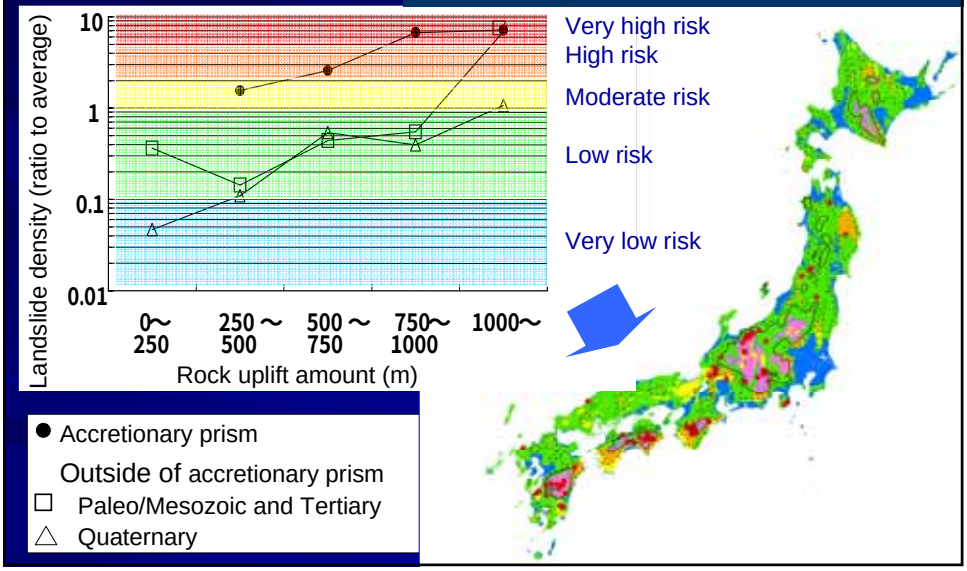
Geological age control on landslide density was relatively small compared with rock uplift rate
Landslide density in the area where underlain by Quaternary rocks were relatively smaller than that in older areas

Role of geological structure



Landslide density in the accretionary prism is much higher than that of outside of accretionary prism regardless of rock uplift rate.

Large catastrophic landslide hazard map of Japan



Conclusions

- Rock uplift rate was strongly affected the risks of large catastrophic landslide.
- Geology was small impacts on risks of large catastrophic landslide, compared with rock uplift rate.
- Effects of geological structure is large, compared to rock type and geological age.
- Based on these results, we developed a new hazard map for large catastrophic landslide in Japan