

# History of Debris Production and River-beds Rising in Kyoto District - A historical interaction between environmental changes and society-

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## INTRODUCTION

Series of ruins around the Kyoto basin indicate that massive developments in mountainous region continued in long time from ancient ages. Verifying chronological sequence of landslide deposits and flood sediments by using AMS carbon dating, we could recognize the relationship between historical process of debris production and developments in mountainous region. Plenty of historical records in Kyoto could be expected to fill chronological gap of landslide deposits. Here, we will describe the chronology of debris production and historical process of river-beds rising as the results of relationship between human activities and excess river sediments concentration.

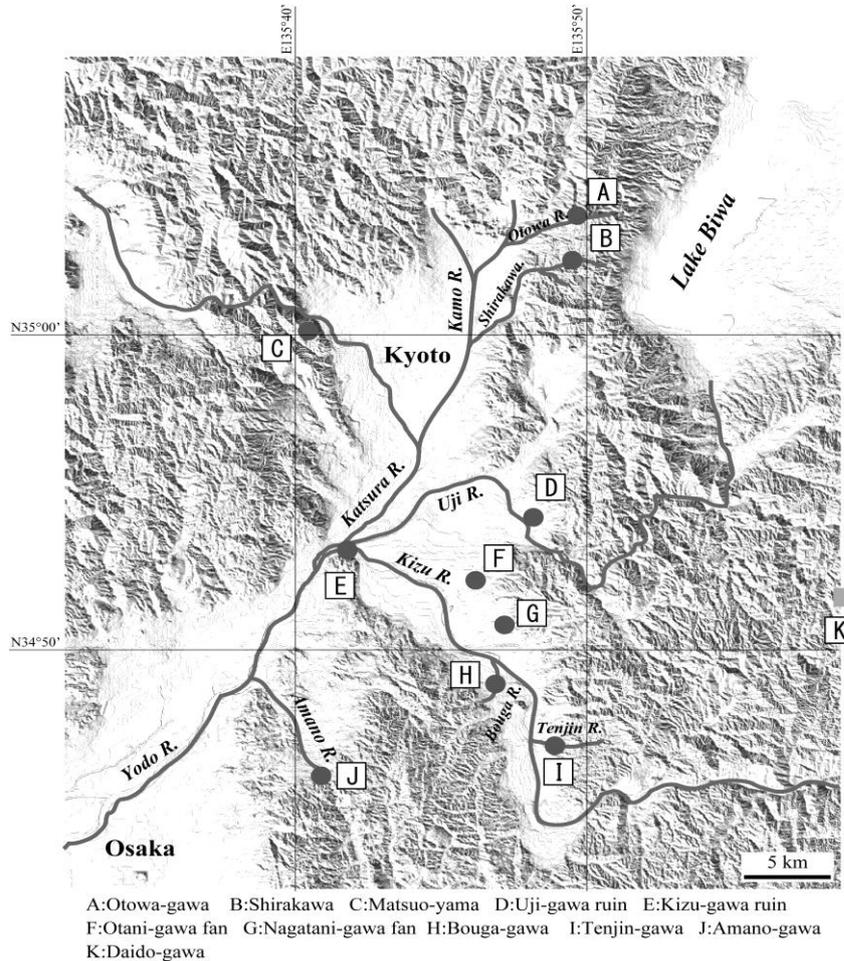
## DEVELOPMENTS in LATE ANCIENT to EARLY MEDIEVAL AGES

**Fig.1** shows distribution of landslide deposits with dating around Kyoto basin. The deposits from 7<sup>th</sup> to 9<sup>th</sup> century discovered at ruins of developments in late ancient ages, and landslides in 10<sup>th</sup> to 11<sup>th</sup> century indicate beginning of regional developments in the eastern mountainous slope around Kyoto basin (at area B in **Fig.1**). Landslide deposits were widely discovered in the eastern mountains of the basin after the beginning of 12<sup>th</sup> century (**Fig.2**). The Genryaku earthquake in 1185 caused serious damage in the eastern mountains of the basin. The landslides in 12<sup>th</sup> century are considered to be the results of strong shaking during the 1185 earthquake. The series of developments from 7<sup>th</sup> century destroyed forest cover in mountainous slopes around Kyoto basin. The landslide deposits in 15<sup>th</sup> century and 18<sup>th</sup> century were found at area A and C in the **Fig.1**. As the result, river sediments increased and caused to make raised-bed rivers in the alluvial fan around the basin after 14<sup>th</sup> century.

## TENJO-GAWA

Raised-bed river should be a typical artificial landforms which became necessary the environmental changes in the upstream region of rivers. Typical raised bed rivers have developed in the western part of Japan, especially Kyoto, Osaka, Nara, Shiga region, induced by artificial fixing of alluvial river channels and increasing of bed load in floods. Archaeological and geological investigations in southern Kyoto region revealed that the raising of river bed started from the 14<sup>th</sup> century and accelerated the raising rate from the 17<sup>th</sup> century (at areas D-J in **Fig.1**). The development of upstream mountainous area, deforestation and keeping grass field in long term period, led to increasing landslides and topsoil erosion in the mountainous slope, so that the bare mountains were common scenery around the advanced developed region in Japan during the ages of raised bed rivers from the 14<sup>th</sup> to the 19<sup>th</sup> century. The backgrounds of the beginning of these exhaustive developments in mountainous slope surrounding of urban region are reflected in the social changes going on the 14<sup>th</sup> century.

Social confusion continues to demise of ancient order forced to take the regional social and economic integration and generated the new integrated villages that they interested to increasing food production by cultivation needed to large quantity of grass supplied from surrounding grass (bare) mountains. The classic landscape of raised bed rivers in Japan which started in the mediaeval ages shows the history of interaction between environmental changes and ancient society.



**Fig.1** Distribution of landslide deposits with dating around Kyoto basin



**Fig.2** Palaeosol covered by the slope deposits in eastern mountains of Kyoto (at area B)



**Fig.3** Wash out of the Midajiro gawa in, 2012

The washout of the Midajiro river in 2012 caused severe floods in recent rapid urbanized residential region in Uji, Kyoto (**Fig.3**). Tenjo-gawa has been a high risk river form still in their modern times.

## CONCLUSIONS

The brief history of sediment discharges in mountain slopes of Kyoto was described. Tenjo gawa is formed as the historical results of over discharges, and artificial fixing of river channels. Thus, the history of slopes around Kyoto represents a typical example of the relationship between artificial environmental changes and society.

**Keywords:** History, landslides, Kyoto, rising river beds