

# Channel incision history with knickpoint retreat in the Kushira River after the deposition of Ata pyroclastic flow, Osumi Peninsula, Kyushu, Japan

\*Shintaro Takanami<sup>1</sup>

1. Meiji University

The Ata welded ignimbrite (110 ka B.P.) lies concealed in the Osumi pumice fall deposits and the Ito pyroclastic flow deposits (non-welded, 30 ka B. P.), having been exposed along the Kushira River valley in the northern margin of Kasanohara ignimbrite plateau, southern Kyushu of Japan (Aramaki and Ui 1966). The Kushira River has a number of knickpoints along its course. Riverbed of Kushira River is composed of the Ata ignimbrite in the upstream reach after the Tanida waterfall. The preceding research by Yokoyama (2000) revealed rapid erosion processes on the Ito non-welded ignimbrite plateau. By contrast, almost no studies reported on the processes of the Ata ignimbrite exposed along Kushira River. Here, to gain a better understanding of this topic, the present study estimated the recession rates of knickpoints in various duration (i.e., from 110 ka to 30 ka, from 30 ka to present and during 110 kyrs), by restoring and comparing the three longitudinal profiles based on field observation and existing borehole data.

In this study, the bottom elevation of Osumi pumice fall deposits in the Kushira River valley was identified as the maximum elevation of riverbed just before the deposition of Osumi pumice. And the elevation of riverbed immediately after the Ata pyroclastic flow was also provided by the distributional top of the Ata ignimbrite. At 11 outcrops, unconfined compressive strength of the Ata ignimbrite was evaluated by KS-type Schmidt rock hammer.

Restored longitudinal profile of 110 ka indicates that the Kushira River had a marked knickpoint at the edge of Ata ignimbrite plateau that was 16 km away from present river mouth. The recession rate of this knickpoint is estimated to 5.4 cm/yr considering that it has retreated to the present position of Tanida waterfall. Estimated unconfined compressive strength of the Ata ignimbrite is gradually decreasing toward its upper part, and showing the exceptionally highest value at the “lower-positioned” Tanida waterfall ( $421 \times 10^6 \text{N/m}^2$ ). Taking this into consideration, another knickpoint located now observed at 26 km from the present river mouth is also candidate for the original knickpoint at 110 ka and had retreated from the edge of Ata ignimbrite plateau to such above position (26 km inland). In this latter case, the recession rate of the knickpoint in the past 110,000 years is calculated as 8.6 cm/yr. The maximum elevation of estimated riverbed at 30 ka indicates that the Kushira River had a steeper gradient than any other timing (probably except for LGM) and incised deeper into the Ata ignimbrite plateau along the downstream side. At that time, the former Tanida waterfall was likely situated in the downstream side of 19 km from the present river mouth. Therefore, its recession rates were estimated more than 2.6 cm/yr during the period from 110 ka to 30 ka, and less than 10 cm/yr in the last 30,000 years. Based on these, this study concludes that continuous bedrock incision might have been occurred with knickpoint retreat since the formation of Ata welded ignimbrite until the deposition of Osumi pumice fall. And it is highly probable that this incision in the Kushira River valley was definitely controlled by the sea level lowering during the period of LGM.

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References

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