Relationship between the distribution of crevasse-splay deposits and the inundation distance of the October 2019 flooding of the Chikuma River, central Japan

*Masaki Yamada[1], Hajime Naruse[2], Yuhei Matsuda[1], Tetsuya Shinozaki[3], Tetsuya Tokiwa[1]

1. Faculty of Science, Shinshu University, 2. Faculty of Science, Kyoto University, 3. Center for Research in Isotopes and Environmental Dynamics, University of Tsukuba

On October 13, 2019, the disastrous flooding of the Chikuma River was caused by concentrated heavy rainfall in central Japan. The 30-m-wide levee revetment was breached over a length of 70 m in Hoyasu, Nagano City, located on the left bank of the river. As a result, the 6-km-wide lowland was inundated up to 2.2 km from the breached levee. This study aims to reveal the relationship between the distribution of sandy and muddy crevasse-splay sediments and the inundation distance of the flooding by field surveys immediately after the flooding event. The inundation area by this flooding is relatively larger among flooding events that have occurred in Japan in recent years and is equal to those caused by recent tsunamis. Clarifying the relationship between the inundation distance and the distribution of crevasse splay and tsunami deposits should be useful in identifying deposits of past events in geologic strata.
We set up three river-perpendicular 1.4–2.2-km-long transects and investigated crevasse-splay deposits at about 100 m intervals together with the current direction and water depth along each transect. The measured elevation is lowering until 1.2 km from the levee and is getting higher from that point onwards. The crevasse-splay deposits were composed of a lower sand layer and overlying mud layer near the breached levee, but they were massive muddy sediments at the area distant from the levee. The thickness of the sand layer shows a thinning trend toward the foot of mountains, while the thickness of the mud layer varies in association with the topography rather than the distance from the levee. Along the 2.2-km-long transect from the breached levee, the sand layer extended to 0.8 km from the levee, whereas the mud layer was distributed until 1.6 km from the levee. The distribution of sand layer is affected by the distance from the breached levee, but not by water depth, indicating that the deposition of sandy sediments during a river flooding is affected by current velocity probably correlated with a distance from the breached levee. There were no sediments near the limit of the flooded area, between 1.7 and 2.2 km from the levee. This is probably because the stagnant floodwater took a relatively short time to recede at around the inundation limit since the elevation is higher than the area where the thick muddy sediments were observed.
The maximum limit of the sand and mud layers along three transects extended to 0–36% and 73–84% of the inundation distance, respectively. The maximum limit of the recent sandy tsunami deposits, in contrast, extended to over 90% of the inundation distance where the inundation distance is less than 2.5 km (Abe et al. 2012, Sedimentary Geology). The difference between the distribution of a sand layer by crevasse splay and tsunami is probably attributable to the difference in their hydraulic behaviors. It is considered that the crevasse-splay flow is too weak to transport sand grains to the area distant from the breached levee.

Keywords: Flood deposit, Crevasse splay

