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Rock failure of welded tuff in Sounkyo valley, Hokkaido, on September 2013

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A rock failure occurred at the left valley side of the Ishikari River in Sounkyo, Hokkaido, on 8th September 2013. Although Route 39 runs along the Ishikari River, rocks did not reach on the road, because the road is 170m distance from the collapse slope in the other side of the Ishikari River. However, the rock debris buried a part of the river, and formed a 200m-long flooding area at the upper reach. The type of this rock failure is a rock slide to a debris avalanche with high velocity flow.

Paleogene shale of the Hidaka Supergroup is overlain by Sounkyo welded tuff at the valley wall. Sounkyo welded tuff consists of two facies. The lower is a soft non-welded part, and the upper is a welded part with developed columnar or platy joints. Sounkyo valley has been formed by erosion of the pyroclastic flow deposits (30Ka), Sounkyo welded tuff, from Ohachidaira Caldera by the Ishikari River. In consequence, steep cliffs have developed in the valley. At the collapse point, only the uppermost 30m of the slope is steep cliff, but the lower 140m is about 40 degree. According to air photo interpretation, the surface with gently roughness profile develops on the 40 degree slope. This shows talus deposits as past collapse debris overlie the slope.

The area of the slope failure, erosional and depositional area, is 190m in height, 90-100m in width, and 365m in length. The equivalent coefficient of friction is 0.52. The volume of the collapse is more than 33,000m^3. Sounkyou welded tuff is exposed on the upper slope with 90m height, and the debris of the collapse covers on the lower slope with 95m height. A debris slump, 45m height and 20m width, is locates on the lower center part of the debris slope. A part of the past talus deposits is exposed by this debris slump. The Hidaka Supergroup shale is covered with talus deposits. Springs from the piping halls eroded the gullies in talus, and the talus deposits were wet state at the investigation of two days after the failure.

The debris from the collapse slope was spread in lobe-shapes over the valley flat. Arcuate ridges and troughs, 1-2m high, shaped concentric half circles in the center axes of the main lobe. This suggests flow-type mass movement. The debris is distributed on 130m in length and 120m in width of the valley flat. The most of the debris is grayish white welded tuff, and the pale reddish welded tuff originated from the uppermost slope is distributed around the ridges. Shale of the Hidaka super group is rare. The squeeze of the mixture of the soil deposits, composed of woods and organic matters, and volcanic ash is distributed in front of the ridges and in gaps in the troughs. This was dragged from the base of the moving body of the collapse, and played a role in a flow layer, matrix facies, of debris avalanche. The talus deposits would be fluidized. The debris would run with high velocity at the front part of the depositional area. According to the estimating equation (Sceidegger, 1973), using the equivalent coefficient of friction, the velocity is estimated by 38m/s at the foot of the slope.

The rock failure was occurred by the bellow mechanism. Rock slide was occurred near the boundary, the Hidaka Soupergroup shale and the non-welded part of the tuff, and the upper slope broke down. Ground water concentrates in the permeable layer of the non-welded tuff on the impermeable layer of the shale. Because the pyroclastic flow, the Sounkyo Welded Tuff, buried the former valley slope of the Hidaka Soupergroup shale in 30,000 years ago, the boundary is incline toward the river, and also the structure of the tuff is incline. This rock failure was occurred at the instability slope, which consisted of soft non-welded tuff with concentrated groundwater beneath heavy welded tuff. The columnar joints, the collapse surface, at the uppermost of the slope have opened before the rock failure, because moss grows on the joint surface.

Keywords: rock failure, welded tuff, rock slide, debris avalanche