Geological and hydrological investigations of boulders deposited by the 2011 Tohoku-oki tsunami along the Sanriku coast, Japan

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There are many enigmatic boulders along the coast in the world. However, many of their origin and transport process are uncertain. It is suggested that high energy waves such as tsunami and storm wave can transport boulders. However, criteria to distinguish origin of boulders whether they were deposited by tsunami or storm wave has not been established. In fact, boulders with clear tsunami origin have been reported rarely. In this study, we report the survey results of boulders along Sanriku coast, Japan, which were deposited by the 2011 Tohoku-oki tsunami in order to establish criteria for distinguishing boulders deposited by tsunami or storm wave. We also estimate wave height and velocity from field data using simple model.

During survey, we measured long axis, short axis, height and density of boulders as well as their sedimentological features. The boulders we could identify as tsunami origin were limited to the following cases: (1) boulders that are deposited at the places where aerial photographs or satellite images are available, (2) remains of marine organisms are attached on the boulders, and (3) boulders that have features indicative of their marine origin such as round shape. On the other hand, boulders that were not transported by the tsunami are partially buried by sand or gravel and/or are located fixed position just in front of the cliff without space for movement.

We further estimated minimum flow depth of tsunami using revised Nott (2003) model and the results showed that calculated values are generally fit to the field observation data, although further validation is required and assumption of Froude number should be reconsidered.

