

Grain abrasion of gravel–sand in fluvial–beach systems: the case study of Tenryu River to Enshu Coast, central Japan

*Takako UTSUGAWA¹, Masaaki Shirai¹

1. Department of Geography, Tokyo Metropolitan University

Clastic sediment grains are “abraded (rounded)” as a result of alternating succession of angulation and rounding during transport process from river to beach. It is general that as the fluvial gravel is finer, the roundness which represents the smoothness of particle outline becomes lower (more angular) (Sneed and Folk 1958). Utsugawa (2017MS) confirmed the tendency with an analysis of the roundness of gravel–sand (0.5–128 mm in diameter) obtained from the Japanese river (the watershed of Watarase River). Difficulty of rounding accompanying with the grain size reduction may have been caused mainly by (i) the finer grain tends to be irrefragible; i.e., high durability (Kodama 1994) and/or inactive collision among grains, and by (ii) the input of pristine and angular grains produced from coarser grains as a result of breaking and abrasion (Utsugawa and Shirai 2016). We examined the changes in roundness of sand grains, which had not shown distinct rounding in fluvial environment, around river to beach.

“Fragile” shale and “hard” chert which are composed by very fine grains and rarely include “recycled grains” were selected, and the changes in roundness of grains (0.5–2 mm in diameter) obtained from 6 sites in ca. 62 km from the downstream reaches of Tenryu River to the Enshu Coast were investigated in this study. Approximately 110–130 grains of each rock type and size fraction were randomly extracted using a VHX-1000 digital microscope (KEYENCE Co., Ltd.). Using the image analyzing software PIA-Pro installed in FF-30micro (Jasco International Co., Ltd.), a roundness parameter “O. Bluntness” (Pirard 1993MS) was obtained. O. Bluntness was converted to “Krumbein roundness” based on roundness chart of Krumbein (1941).

At the furthest site along the Enshu Coast, the most irrefragible coarse-grained chert sand achieved its highest roundness. It is generally accepted that quartz sand grain is significantly rounded in coastal environment than in fluvial environment due to rolling on the beach by swash. As a whole, fragile shale and hard chert grains showed similar tendency of quartz grains. Note that, shale grains between river mouth to proximal beach sites on both grain size fraction did not become rounded even though the grains were transported on beach. Gravels (mainly 2–64 mm in diameter) supplied from Tenryu River are broadly distributed on beach surface near the river mouth, and are usually saltated and rolled by swash. Since gravels frequently collide each other due mainly to the swash, the gravels would be broken and/or abraded, and active production of pristine angular sand grains would cause decrease in roundness around river mouth.

References

- Kodama, Y. 1994. *Jour. Sed. Res.* A64: 76–85.
- Krumbein, K. C. 1941. *Jour. Sed. Pet.* 11: 64–72.
- Pirard, E. 1993MS. Doctoral Thesis submitted to Univ. of Liege (in French).
- Sneed, E.D. and Folk, R.L. 1958. *Jour. Geol.* 66: 114–150.
- Utsugawa, T. 2017MS. Doctoral Thesis submitted to Tokyo Metro. Univ.
- Utsugawa, T. and Shirai, M. 2016. Abstract of JpGU 2016: HGM14-P07.

Keywords: sand, roundness, grain abrasion, Tenryu River, Enshu Coast