

SCG064-P05

Room:Convention Hall

Time:May 24 10:30-13:00

## Laboratory experiments about wavy topographies on non-movable beds generated by rotation of rigid bodies

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Wavy topographies can be seen ubiquitously, such as sand ripples on desert dunes and "steps and pools" in mountainous rivers. In geology usually we consider wavy beds formed in natural environments due to fluid motions such as water or air flows. However, especially in civil engineering other kind of wavy topographies are known as "washboard roads" that are formed on unpaved road due to passing of automobiles, i.e. caused by wheels. Obviously wheels are not fluids but solid. We can classify wavy topographies according to materials about the type of bed (movable or fixed) and a driving medium (fluids or solid). Hereafter we refer to "fixed beds" as "non-movable", because beds should be eroded to become wavy and not strictly fixed, but do not allow re-deposition. Three types of the four in the above classification, wavy topographies of movable bed - fluids (e.g. sand ripples or dunes), non-movable bed - fluids (e.g. cyclic steps or "steps and pools") and movable bed - solid (washboard roads) were previously investigated through controlled laboratory experiments, but the conceivable fourth type, ones of non-movable bed - solid is not known well. To understand universal mechanism (if exists) of ubiquitously formed wavy topographies, we investigate the fourth combination of materials, i.e., non-movable bed - solid. In experiments, metal cylinders rolled many times due to the gravity on the 5 degrees slope consisted of hard but fragile sponge forms. We used three cylinders, one of aluminum and two of copper, one of which was heavier than but the same sized as the aluminum one and other was smaller than but the same weighted as the aluminum one. Results can be summarized as follows: (1) in the system of non-movable bed - solid, wavy topographies can be formed; (2) a heavier but the same sized cylinder produced larger amplitudes and wavelengths; (3) a cylinder of the larger diameter but the same weight generated similar wavelengths but smaller amplitudes. However we do not consider the difference in surface properties between different metals so far, and detailed investigation is the future work.

Keywords: Wavy topography, non-movable bed