Relationship between isolated dune forms and flow conditions depending on the angular variation and intensity ratio of two flows

Keisuke Taniguchi[1]; Noritaka Endo[2]; Hideo Sekiguchi[3]

[1] Earth and Space Sci., Osaka Univ; [2] Kanazawa U. Earth Sci.; [3] DPRI, Kyoto Univ.

Sand dunes are formed by the interactions between sand particles and the surrounding fluid. The process is not yet understood in detail due to the large time and space scale of the deformation. A series of flume experiments were conducted aiming to understand the formation process of isolated sand dunes under bidirectional flows with angular variation. The bidirectional flows were assumed to provide an analogue of the seasonal change in wind direction.

The angular variation of two flows is the most effective on the resultant types of topography. The directional shift of sand movement due to the flow direction change led three kinds of deformation process depending on the angular variation. The resultant topographies after repetition of bidirectional flows can be categorized into four types where they are formed by one or two of the deformation processes. Therefore, it can be concluded that the angular variation is the dominant condition. On the other hand, the intensity ratio of two flows influences only the shape of crest lines whether linear or crescentic, not effective on the kind of deformation process. In addition, particular topographies were formed under flows with 75, 90 and 180 degrees angular variation.

Based on the results, a new diagram of relationship between dune shapes and conditions in respect to bidirectional flows is presented. This phase diagram makes it possible to investigate the bidirectional flows that have a large influence on the formation of dune topography. The angular variation can be firstly estimated by the type of topography, and then the intensity ratio can be evaluated from the shape of the crest line. The particular topographies in the cases where the angular variations are 75, 90 and 180 degrees can indicate stricter flow conditions than other topographies. The diagram were applied to the three dune fields on Earth and Mars and gave detailed information about the flow condtitions.