Migration speed of barchans under oscillatory water flows: experimental study

Noritaka Endo[1]; Tsuguo Sunamura[2]; Hidehito Kubo[3]

[1] Earth and Space Sci., Osaka Univ.; [2] Earth and Space Sci, Osaka Univ.; [3] KES

Barchans, isolated crescent-shaped bedforms, are formed where available sediments are sparse, and are heretofore regarded as a mark indicative of a unidirectional flow. A previous experimental study, however, demonstrated that oscillatory flows with a short period such as one second could generate barchan beds, if the direction of net sand transport is constant for a long time. In the previous study, the trend of migration speeds of the experimental barchans was only observed qualitatively. Here we discuss the migration speeds through dimensional analysis and attempt to modify the relational expression to integrate the data from the laboratory and the field.

Field observations have shown that larger barchan dunes migrate more slowly than smaller ones in the same field: the migration speed of barchans is inversely proportional to their height. Now comparison between data from experiments and the field needs to deal physical amounts other than the height (such as flow velocity, grain diameter, relative density of sediment, coefficient of kenematic viscosity and gravitational acceleration) to introduce dimensionless parameters.

Although the data somewhat scatter, a general trend of relation between migration and other physical amounts for ripple-sized barchan in the laboratory and barchan dunes in the field is expressed by the same equation with a different coefficient. Difference in the coefficient between the experiments and nature would probably stem from discrepancy in the selection of representative value for the flow velocity due to a limitation on availability of wind condition data. The dimensional analysis demonstrates that the migration speed of barchan ripples is proportional to the cube of the flow velocity and is inversely proportional to their heights. The dimensional analysis also suggests that the migration speed varies in the proportion to the kenematic viscosity and in the reciprocal proportion to the relative density, the power of 1.5 of the sediment grain diameter and the power of 1.5 of gravity acceleration, although experiments altering these parameters have not been performed.