短 報

Noriyuki NASU*: Interpretation of Sedimentation Phenomena in Terms of Fluid Dynamics

(Preliminary Note)**

It is well known that the settling velocity of grains smaller than about 0.1 mm follows the Stokes' law. In other words, the rate of settling is abruptly reduced for grains within the range of the Stokes' law. Thus, grains within this range can be easily transported far beyond the shore by turbulent flow in suspension. So the writer interprets the mechanism of following several geological agencies by this phenomenon.

1. Sharply Banded Alternations (Discontinuous Graded Bedding)

In alternations consisting of sand and mud layers, a sharp boundary is generally present between the top of a mud layer and the base of a sand layer, and also a comparatively sharp boundary is present between the top of a sand layer and the base of a mud layer as in Fig. 1.

M: mud layer. S: sand layer

Fig. 1

The former condition has been noticed by most investigators, but the latter, namely the presence of discontinuity of grain sizes within one graded bedding has been generally overlooked.

According to the results of mechanical analyses made by the writer, the main assemblage of grains in sand layers shows a value larger than those within the range of the Stokes' law, but the value in mud layers is within the range of the Stokes' law.

The discontinuity of grain size in one graded bedding or the boundary between sand and mud layers therefore must be the result of separation of the suspended materials into two parts. The sandy part, which does not behave according to Stokes' law, is deposited quickly, but the muddy part the which follows the Stokes' law is deposited slowly.

2. The Sorting of Fine Sands

The rate of the change of settling velocities due to the difference of grain sizes is smaller as the grain diameters deviate farther from the Stokes' law. Namely, when $d \gg 0.1$ mm, the probability of the mixing of different size grains is rather large. So the sorting is bad in this range. On the other hand, when $d \ll 0.1$ mm, the grains are suspended in water too long to concentrate

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in one place.

Therefore grains having a diameter of about 0.1 mm lie near the boundary of the two ranges, each controlled by distinctly different fluid dynamic action. For this reason they show the best concentration or the best sorting.

Also, grains of this size are most easily moved from the bottom under the influence of the laminar boundary layer of the current, which the writer proposes to discuss in another paper.

3. The Profile of Typical Delta

Fig. 2

Fig. 2 shows a typical delta profile. The slope of the front margin of a delta is generally supposed to conform to the angle of repose of sands.

It may be said that the delta mainly consists of sandy materials.

If there were no critical point in settling velocities, the materials which flow out through the mouth of a river would be deposited monotonously from coarse to fine according to the distance from the shore. As a result, the profile of these deposits would be as in Fig. 3.

Fig. 3

The actual case, however, is quite different. The typical delta deposits consist of coarser materials than those of that conform to the Stokes' law, and the finer materials pass over the delta surface in suspension far beyond the shore. Data on the delta of the Obitsu River, Chiba prefecture, clearly support this fact.

The details supporting these conclusions will be published in the near future.

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