III—57 東海村海岸の一特性について

—沿岸流の類型および構造に関する考察—

東京大学工学部 正員 本間 仁
o東京大学工学部 正員 鮮于 澈

INTRODUCTION The authors have conducted a coastal investigation at Tokaimura, Ibaragi Prefecture, Japan, since July, 1958, at the request of the Japan Atomic Power Co. with objectives of evaluating the prevalent beach processes and thus providing information useful to the future planning and design of a cooling water supply system. The overall project of investigation consists of the geomorphological study of the beach and submarine topographies, the natural forces acting on the area such as winds, waves, tides and currents, and the subsequent movement of sediment in the littoral zones. This report presents the preliminary results of the littoral current observation performed during July to November, 1958, with special emphasis on the types and structures of the currents together with a brief appraisal of their significance as the sediment transporting agent.

GEOGRAPHICAL SETTING The investigation area is the northern half of an almost straight shoreline, approximately 12 km long, marked by rocky bluffs at both ends and facing the Pacific Ocean in the east (Fig.1).

INSTRUMENTS The measurements were made by pursuing the current floats (Fig.2) by transits or visual observation.

TYPES OF CURRENTS Two distinctions were noted in the types of the currents. One was a slow, fluctuating drift of surface water usually found under ordinary wave conditions, where both velocities and directions were extremely susceptible to time and position. The other type was a succession of violent swashes produced directly by the storm waves breaking at an angle against the shoreline. Mostly these two types existed as a transient state, where the pronounced rip currents occurred frequently.

ORDINARY CURRENTS Under ordinary conditions with waves breaking perpendicularly to the shoreline, several independent current systems were present simultaneously along the entire length of the beach under investigation. Between the systems were the stagnant zones where the opposing currents met to produce small eddies or a circulation involving a faint rip, or separated to cause irregular disturbances (Fig.3). The velocities seldom attained 1 knot at 1-m depth from the surface. Repeated observations have shown that the velocity dropped sharply as the depth from the surface increased; for instance, in the water about 7 to 10 m deep the velocity components parallel to the shore line at 2-m depth fell to half the values at the surface (Fig.4). The velocities grew, almost linearly, slightly lar-

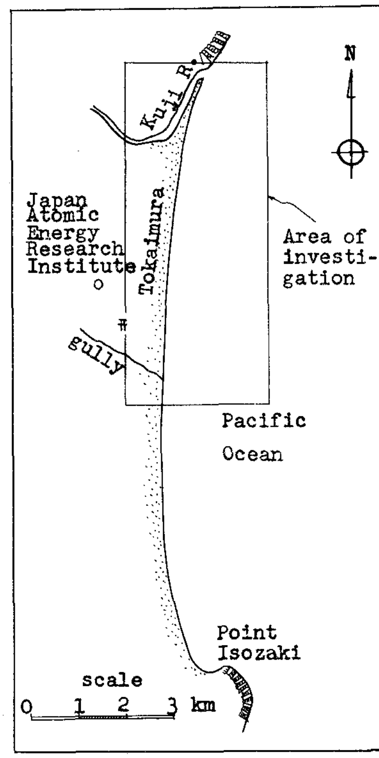

Figure 1- Geographical setting of Tokaimura

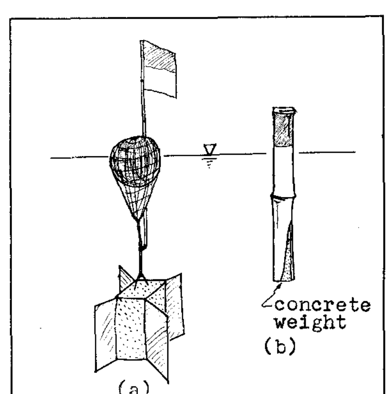

Figure 2 - Current floats;
(a) subsurface cross
(b) surface tube

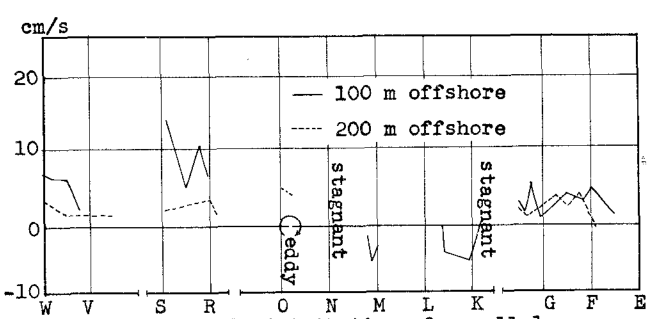

Figure 3 - Areal distribution of parallel components of littoral current velocity (visual).

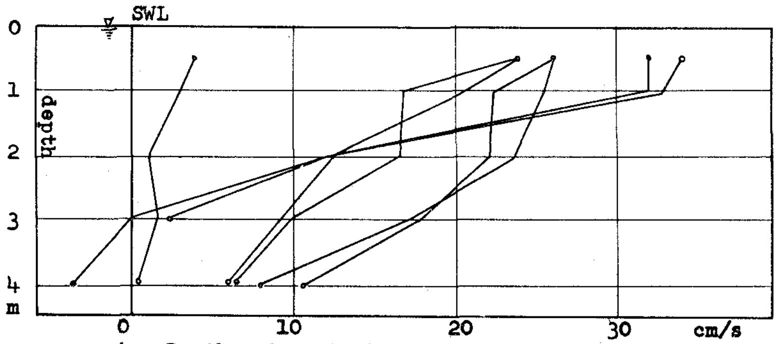

Figure 4 - Depthward variation of parallel components (transit)

ger or smaller with the distance from the shoreline (Fig.5), but the effects were practically negligible. The current velocities as well as directions fluctuated considerably with time (Fig.6). It is interesting to note in Fig.6 that regardless of the distance from the shoreline the phase of fluctuation is strikingly similar even though the different types of current floats were used. During the ordinary currents there was no remarkable exchange of water across the breaker line except for diffusion of turbidity.

SWASH CURRENTS The currents observed under violent wave conditions are distinguished in every respect from the ordinary currents. During Typhoon 5921 which assailed this area in September, 1958, sending huge waves with incident angle about 30°, the broken waves as high as 4 or 5 m were transformed into swashes running in a zigzag pattern along the beach face and producing the velocities up to 3m/s (6 knots). The currents did not maintain a smooth surface any more, but they were a rapid succession of swashes transporting the current floats in a continual,jerky motion (Fig.7). For smaller wind waves, however, the currents were often interfered by minor beach topographies such as cuspate forms.

SEDIMENT TRANSPORTATION During the ordinary state with breaker heights about 1.5 m and current velocities from 5 to 27 cm/s, the brick fragments, 16 m/m in median diameter, were dumped in the shore water just in front of the apex of a beach cusp. Some of them were discovered at the updrift side of the downward apex in 13 minutes after completion of dumping, while none was traced at the bay area. Seaward of the breaker line no sizable movement of sediment was found, except that during the typhoon strong swashes swept the beach face clean of irregularities such as cusps while transporting the concrete blocks as heavy as 30 kg over the distance of 2 km in the depth of 5 to 8 m. It seems that under ordinary state the disturbances caused by breakers put bed materials in suspension to be carried even by a slight current in a hopping motion from one apex to another. On the other hand, the swash currents are sufficient to cause effective sediment movements all by themselves.

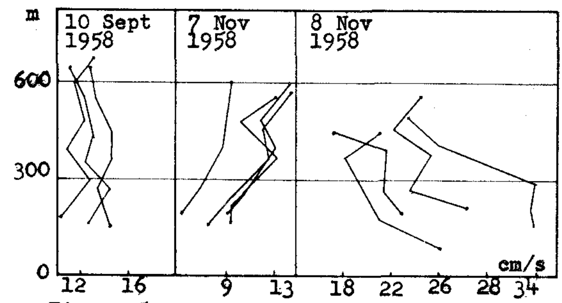

Figure 5 - Perpendicular variation of parallel components (transit)

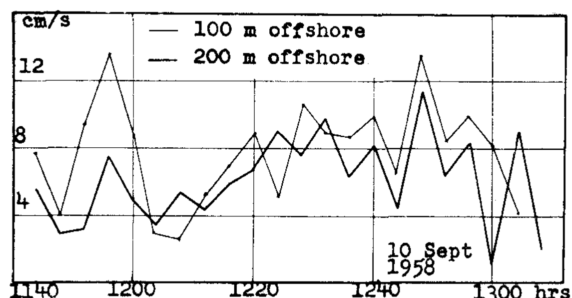

Figure 6 - Temporal fluctuation (visual)

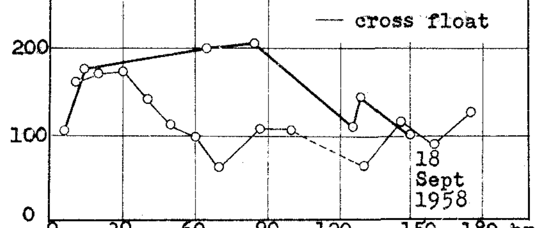

Figure 7 - Parallel components during Typhoon 5821 (visual).

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