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1 November 1965

Fluorescent Tracer: Transport in Distance and Depth in Beach Sands

Abstract. *Foreshore tidal-cycle transport of sediment along a beach profile can be traced in distance and depth by the use of fluorescent pigments. Sediment cores are obtained from locations on the profile, dyed in horizontal segments, and returned to their original positions in the beach. Analyses of flood- and ebb-tide samples of sediment reveal the pattern of littoral zone sedimentation.*

Investigations of sediment transport currently employ two basic injection and sampling procedures (*1*). In the space-integration method, counts of tracer particles over a sampling grid reveal the pattern of particle distribution, with the time-rate of change indicated by repeated sampling without replacement of tracer. The time distribution of tracer particles is determined, in the time-integration method, by sampling along a section transverse to the flow. Both techniques are limited to essentially surface transport along the length and breadth of the area being studied. The depth of foreshore erosion has been determined by placing vertical columns of tracer-labeled sediment in the beach (*2*).

A new procedure was devised in connection with a recent beach study, by which the sequence of tidal-cycle scour, transport, and deposition of particulate tracer grains can be followed along the beach profile; quantitative measurements of depth and particle numbers can also be obtained. The method thus adds a third dimension, that of depth, to the established sediment-transport techniques.

The technique was tested on sandy pocket beaches at Indian Harbour and Smith Cove, Guysborough County, Nova Scotia. Confined by headlands, incoming waves are refracted so as to break normal to the shoreline, thus minimizing sediment transport along the length of the beach.

At low water preceding the period of observation, two 6-cm-diameter cores of sediment were taken from the beach: one at the upper swash limit, and the other at mid-foreshore along the same profile. Small auxiliary cores were also taken from the same sites. The top 12 cm of sediment in the two larger, plunger-type, core tubes was removed in three equal horizontal increments. The six segments of sand thus obtained were dyed with different fluorescent colors by the method of Yasso (*3*). The segments of coated particles were then returned to the core tubes in their original positions to preserve the character of the layers in the beach. The mid-foreshore tracer core was designated X, the colored segments being blue, yellow, and red from the top down; the swash-limit tracer core was designated Y, the colors from top to bottom being pink, green, and orange (Fig. 1).

At low water on the day of observation, the tracer cores were returned to their original positions. Thin metal guide rods were driven into the beach 50 cm to each side of the tracers and their exposed heights were recorded. During the tidal cycle the beach profile adjacent to the tracer area was measured hourly (*4*); as the tide rose the exposures of guide rods above the sand-water interface were measured (*5*).

When tracer-core X was located in the lower portion of the flood-tide swash-backwash zone, samples A, B, C, and D were taken: the first three in core tubes with an inside diameter of 4.5 cm; the last in a 230-g container. The procedure was similar in obtaining samples E, F, G, and H during the ebb when tracer-core Y became located in a comparable position. In both instances the upper sample core (A–E) was located just seaward of the then-prevailing upper swash limit; the middle sample core (B–F), at the tracer-core site in the lower swash-backwash zone; the lower core (C–G), in the breaker zone; and the container sample (D–H), in the shoaling wave zone beyond the base of the step, as in Fig. 2 and (*6*).

These procedures were followed twice at the Smith Cove beach and four times at the beach at Indian Harbour.

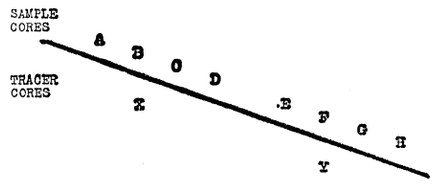

Fig. 1. Designation of sources of tracer and sample cores.

Hourly profiles were plotted for each tidal cycle, and surface-level changes at the guide rods were calculated. Analyses of grain-size distribution were made for each 4-cm increment of the small auxiliary cores that were taken when the sediments to be dyed were cored.

Each core sample, A, B, C, E, F, and G, was divided into two equal horizontal increments designated 1 and 2 from the top down; these were 3 to 5 cm in thickness, depending on the length of the core. Container samples D and H were split in a sediment-sample divider to make their volumes of the same order of magnitude as the other sample segments. Analyses of grain-size distribution were then made for each sample, and the number of particles of each fluorescent color in each size range in the samples was recorded. Thus, for each increment in depth of the core samples, and for the container samples, the grain-size and tracer-particle distributions were obtained and tabulated.

The plotted profiles and surface-level changes at the guide rods, together with visual observation of the tracer cores and sample cores, support the tidal-cycle sequence of phases of initial deposition, scour, and step deposition outlined by Strahler (*6*). A pattern of littoral-zone tidal-cycle sedimentation may be developed from the tabulation of data on grain-size and tracer-particle distribution, based

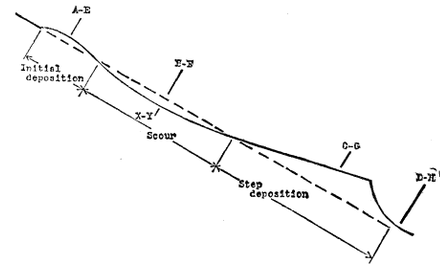

Fig. 2. Detail of sources of sample cores at time of sampling.

upon the logical premise that the tracer cores were eroded from the top down and that the sample cores were deposited from the bottom up.

The efficacy of this procedure in integrating the depth parameter into fluorescent tracer techniques appears to be supported by my experiments. Further refinement of field and analytical methods should make the procedure a valuable tool adaptable for investigations of a wide variety of regimes.

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3 November 1965

Magnesium Pemoline: Enhancement of Brain RNA Polymerases

Abstract. *The stimulation by magnesium pemoline of systems that synthesize brain nucleic acid was studied in vivo and in vitro. There are differential effects between true RNA polymerase and pseudo-RNA polymerase. The selective stimulation of true RNA polymerase by magnesium pemoline was not observed with stimulants of the central nervous system and psychotropic agents.*

Many investigators (*1*) have attempted to establish a functional relation between nucleic acid or protein metabolism (or both) and various aspects of brain function. Development of an agent which stimulates synthesis of brain nucleic acid and enhances learning would further strengthen the hypothesis that nucleic acids function as the informational engram in the brain. Magnesium pemoline (*2*), a stimulant of the central nervous system, enhances brain nucleic acid synthesis both in vivo and in vitro.

We have prepared a nuclear aggregate by the method of Barondes (*3*) and assayed it for ability to incorporate a radioactively labeled ribonucleotide into RNA (*4*). The activity was measured both in the presence of all four nucleoside triphosphates (4-NT reaction, true RNA polymerase) and in the presence of only one nucleoside triphosphate (1-NT, pseudo-RNA polymerase).

Magnesium pemoline was administered intraperitoneally (20 mg/kg) to Sprague-Dawley white rats (250 to 300 g). Groups of 6 to 10 animals were killed at intervals after treatment with magnesium pemoline, and the nuclear aggregate was prepared from the pooled brain tissue of these animals. The control group did not receive the drug, and the brain tissue was collected and processed simultaneously with the brain tissue from the treated groups. The nuclear aggregate preparation derived from each group was assayed for true and pseudo-RNA polymerase activities (Fig. 1).

While the pseudo-RNA polymerase activity showed a more rapid rate of increase initially, the activity reached a maximum and remained constant after approximately 30 minutes. The true RNA polymerase activity was lower than the pseudo-RNA polymerase activity at first but showed a linear and continuous increase in activity as a function of time. The value for the ratio of the activity of true to pseudo-RNA polymerase exceeded 1.0 at about 1 hour and remained greater than 1.0 thereafter. One of the possible explanations for the kinetics observed under our conditions is that there are two different enzymatic activities in the nuclear aggregate preparation and that each is activated by magnesium pemoline at a different rate.

Since magnesium pemoline caused activation in vivo of the RNA synthetic enzymes, we studied the effect of magnesium pemoline added in vitro on the activity of a nuclear aggregate enzyme prepared from the brain tissue of nontreated animals (Table 1). When the enzyme preparation had been aged for 24 hours at −25°C prior to assay, there was some enhancement of the enzyme activities and particularly an enhancement of the true RNA polymerase activity. The ratio of true to pseudo-RNA polymerase was approximately 6, as opposed to 1.0 or slightly less with a fresh preparation. The results with our aged enzyme preparation are in agreement with those reported by Barondes (*3*). The lack of any effect by the aqueous suspension of magnesium pemoline on the aged enzyme preparation was due to the extreme insolubility of the drug in water. Dimethyl sulfoxide partially solubilizes magnesium pemoline and once magnesium pemoline has been solubilized, a pronounced and preferential activation of the incorporation of ribonucleotides into RNA in the presence of all four nucleoside tri-

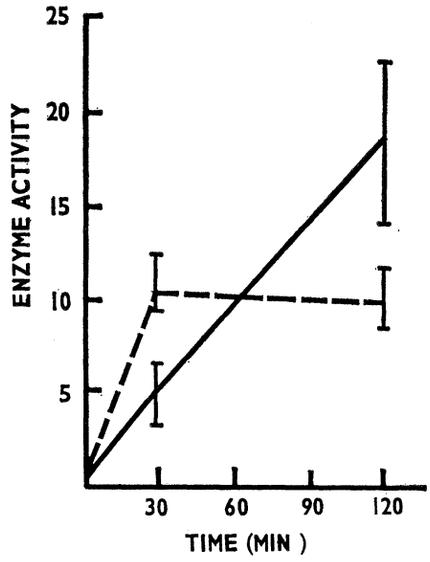

Fig. 1. Effect of magnesium pemoline (20 mg/kg, intraperitoneally) on activities of brain RNA polymerase in vivo. The 1-NT incubation mixture contained: tris buffer, *p*H 8.0, 100 μmole; $MgCl_2$, 10 μmole; KCl, 1 mmole; NaF, 40 μmole; cysteine, 10 μmole; phosphoenolpyruvate, 2 μmole; pyruvate kinase, 100 μg; GTP-α-P^{32} (specific activity, 100 μc/μmole), 0.1 μmole; enzyme, 1.0 mg protein in a final volume of 2.0 ml. The 4-NT incubation mixture was the same as the 1-NT incubation mixture except for the addition of 0.1 μmole each of ATP, CTP, and UTP. The mixture was incubated at 37°C for 12 minutes, the reaction was terminated by the addition of 0.1 ml of 4 percent sodium pyrophosphate and 5.0 ml of 10 percent trichloroacetic acid, and the incorporation was determined by the Millipore-filter method. The enzyme activity is expressed as picomoles of GMP incorporated into RNA per milligram of protein in 12 minutes. The vertical bars represent the range of enzyme activities observed under each experimental condition. Solid line, tris RNA polymerase; dotted line, pseudo-RNA polymerase.