with long oceanic gravity waves, their quadratic attenuation at the bottom is also plotted on Fig. 3. The lack of similarity between the two curves indicates that no appreciable noise is contributed by surface waves in the band centered around 20 cycle/hr. The nature of the background noise in this area is uncertain. It could be explained by seismic fluctuations of the ocean floor, with a vertical amplitude of the order of 2×10^{-3} cm r.m.s. (20 μm) within the band, 10 to 30 cycle/hr acting against the 4.4-km water column. It may represent instrumental noise and may contain some noise due to higher-frequency signals such as those associated with microseisms.

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9. I thank Drs. C. S. Cox, G. Groves, and R. L. Snyder for comments and suggestions. The opportunity of a Scripps Institution of Oceanography cruise to collect present data is appreciated.

19 March 1970; revised 22 May 1970

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Composition Differences at Surfaces Detected by Adsorption and Desorption of Radiotracers

Abstract. *A novel method for the detection of composition differences on solid surfaces is based on differences in the adsorption and subsequent partial desorption of a radiotracer by heterogeneities of the surface.*

The detection of trace amounts of materials on surfaces is important in many applications in research work and industrial problems. Although there are a variety of methods such as radiotracer counting, measurements of contact angle, and ellipsometry by which one may detect trace residues and small differences in composition, each method has certain drawbacks and no one method is generally applicable. Thus there are many problems that would benefit from the application of a simple and sensitive method of broad applicability. We report here on such a method that makes possible the detection of subtle differences in composition at the surface of many solid materials such as glass, and the detection of adsorbed foreign materials on most solid surfaces.

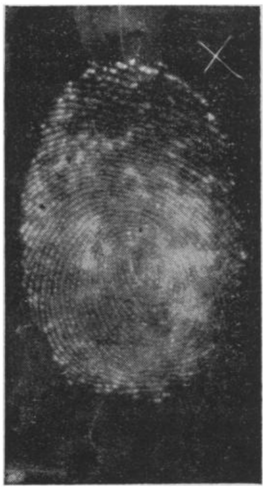

Fig. 1. Autoradiograph of a thumbprint on a zinc borosilicate glass slide after adsorption of ^{14}C-labeled stearic acid from benzene solution and subsequent partial desorption with 1,1,2-trichlorotrifluoroethane. Industrial x-ray film was used with an exposure time of 120 hours.

In essence this method depends on the adsorption and subsequent partial desorption of radiotracers from solid surfaces, with autoradiography used as the means of detecting the distribution of adsorbed tagged material. The differences in adsorption and desorption arise from the inherently different adsorption/desorption characteristics of heterogeneities at the surface. An important feature of this method is that tagged compounds are used only to detect the differences in composition on the substrate of interest—the species constituting the surface itself need not be composed of tagged materials.

To illustrate the method, we describe its use to detect a thumbprint removed from a glass slide by means of a heat treatment and water rinse. A cover glass was cleaned by heating for 30 minutes in air at 450°C. A thumbprint was impressed on this cover glass [Corning No. 2935, a zinc borosilicate glass reported by Corning to have the following nominal composition (in percentage by weight): SiO_2, 62; Na_2O, 7; K_2O, 7; ZnO, 7; B_2O_3, 9; Al_2O_3, 2; TiO_2, 5; trace elements, 1], after which the slide was subjected to another 30-minute heat treatment at 450°C. At this point the thumbprint was still recognizable because of sodium chloride residues. After copious rinsing with distilled water, no traces of the thumbprint were visible to the naked eye, nor did examinations with ordinary light microscopy, transmission electron microscopy, scanning electron microscopy, and electron microprobe analysis reveal traces of the print. However, as the autoradiograph in Fig. 1 shows, the method described here did succeed in revealing the thumbprint after the heat treatment and rinsing procedure cited above. The thumbprint was made visible after the slide was immersed in a solution of ^{14}C-labeled stearic acid in benzene (2 mc/liter) for 26 hours and then was rinsed with 1,1,2-trichlorotrifluoroethane to remove excess stearic acid. The autoradiograph was made by exposing a sheet of industrial x-ray film (Cronex 506) to the slide for 120 hours.

We believe that in this particular case the heat treatment at 450°C caused enough ion exchange of Na^+ ions with other cations in the glass to bring about detectable differences in the adsorption/desorption characteristics of the substrate for stearic acid. Thus we have a method for detecting the rather subtle differences in cation surface densities in glass.

In other experiments in which semiconductor-grade silicon was used as the substrate ion exchange did not play a part in the process and adsorbed contaminants *on* the surface were detected rather than components in the surface. Other experiments in which gold and Mylar polyester film were used as substrates demonstrated that this technique is applicable to many substrates and contaminants. The wide choice of temperature, tagged adsorbent, time, and solvents available makes detection of a particular species feasible on virtually any solid substrate.

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30 April 1970