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William Daily
Abelardo Ramirez

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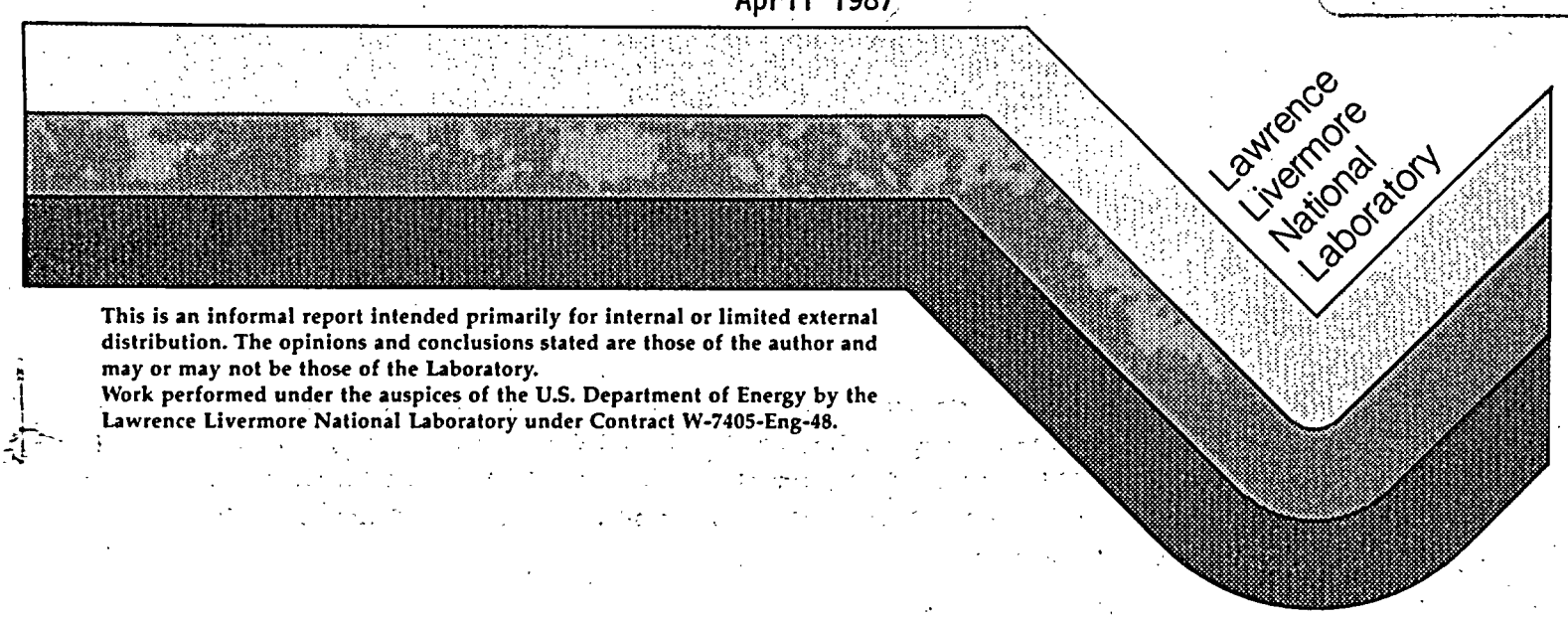

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AN EXPERIMENT TO DETERMINE DRILLING WATER IMBIBITION BY IN SITU DENSELY WELDED TUFF

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Abstract : Experiments were performed to determine the extent of penetration of drill water into Grouse Canyon densely welded tuff during use of normal drilling practices. Core samples were examined from a borehole cored in a rib of the Rock Mechanics drift in G-Tunnel at the Nevada Test Site, Nye County, Nevada. Methylene blue dye was added to the drill water to act as a tracer which stained the rock blue on contact. We found the rock stained blue only in a thin layer about 0.5 mm thick at the surface of the core. However we were concerned about the uniformity of penetration depth observed in the core and this prompted a simple experiment to test the ability of methylene blue to penetrate the matrix of densely welded tuff. We found that in the imbibition process, the dye and water separated such that the water penetrated the matrix to a much greater depth. This result meant that any interpretation of drill water imbibition in borehole core based on this dye as a tracer is unreliable. More important, however, is the conclusion that the presence of methylene blue dye on the rock indicates the presence of tracer water flow, but the absence of the dye does not rule out the presence of water flow.

Introduction

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project is studying the suitability of the tuffaceous rocks at Yucca Mountain, Nevada Test Site, for the construction of a high-level nuclear waste repository. Lawrence Livermore National Laboratory (LLNL),

any pumice or fracturing. The drill water was apparently imbibed very uniformly into the matrix to a depth of approximately 0.2 mm.

Penetration of methylene blue was so uniform that we became concerned whether or not the properties of the dye may have affected interpretation of the results. We wanted to know if this penetration depth was due to a characteristic of the dye and not of the rock. As a result an experiment was designed to examine the dye distribution in small tuff samples after they had been saturated by tracer laden water.

Three pieces of Topopah Spring tuff were chosen from the depth interval 374.8 m in borehole USW-G1 drilled in Yucca Mountain. This rock was chosen instead of the Grouse Canyon tuff because our ultimate interest was in the characteristics of dye interaction with the Topopah Spring tuff. Their volumes were measured by water displacement and they were then dehydrated in a vacuum oven at 50 C for 14 days. At this point, they were considered irreducibly dry, weighed and placed for 20 days in a solution of methylene blue. Each sample imbibed about 7 % of its volume in water during this time. Another sample which we had used in other work, from the same depth in this borehole, had a measured effective porosity of 8.1% by volume (Lin and Daily, 1984). It is likely therefore, that our three samples were nearly saturated with the water-tracer solution. Each sample was then broken in such a way to expose a cross section of the matrix interior.

Figure 2 shows an example of the dye distribution as revealed by one of these broken surfaces. The scale of tick marks along the top shows millimeter spacing. The dye tracer penetrates the matrix about 0.5 mm yet the water must have penetrated essentially the entire sample to result in the water content near 100% saturation for the sample. A similar, and very uniform, dye penetration depth was observed in the other samples, some of which were broken to reveal many different sections of matrix. Apparently during water imbibition some mechanism was responsible for separation of the dye and the water. The dye was deposited only in a very narrow band near the surface and the water continued to penetrate the matrix until it had invaded most of the available porosity.

Methylene blue is a large organic molecule which is used as a dye for fabrics and as a stain for biological and bacteriological samples.

Acknowledgments

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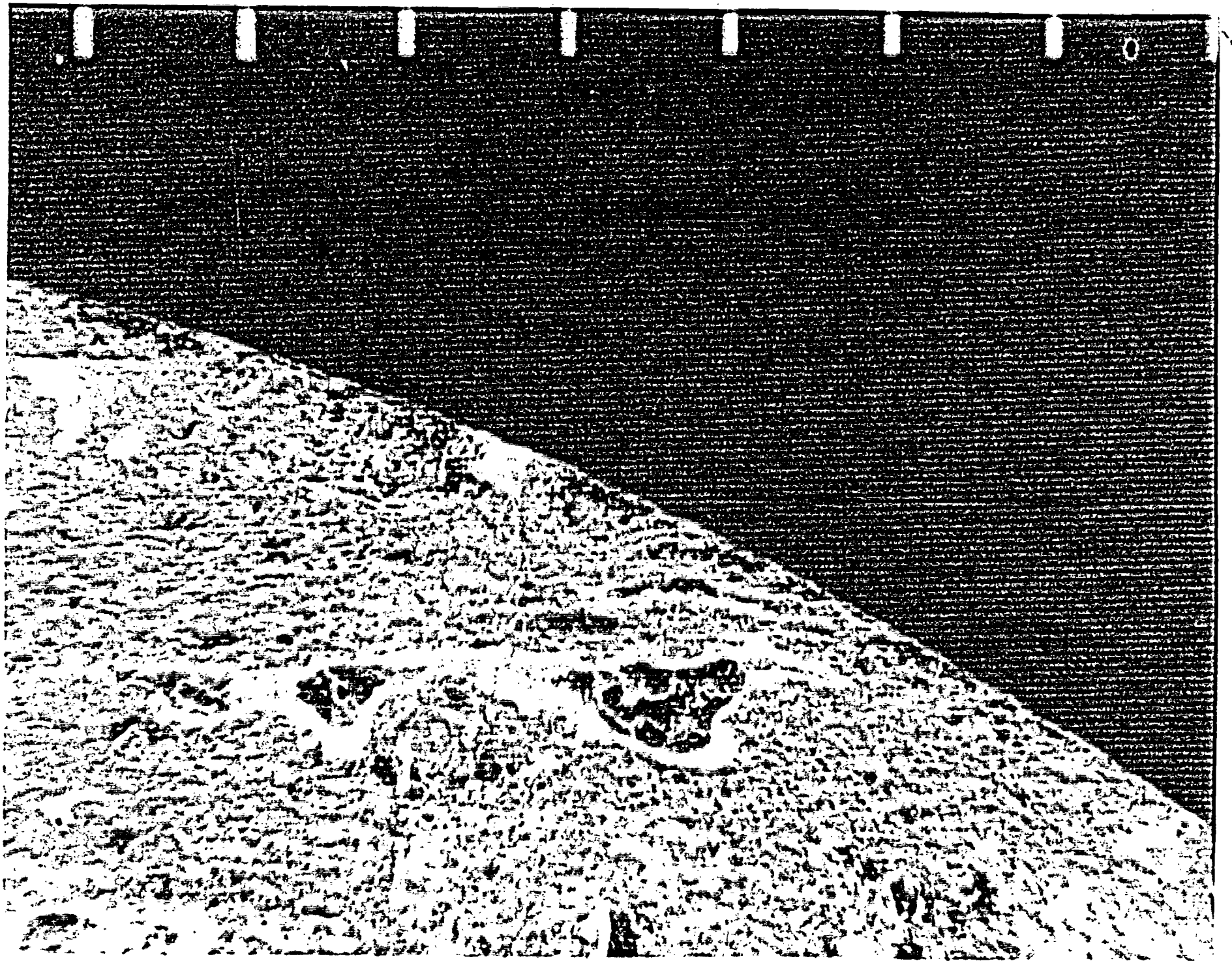

Fig 1

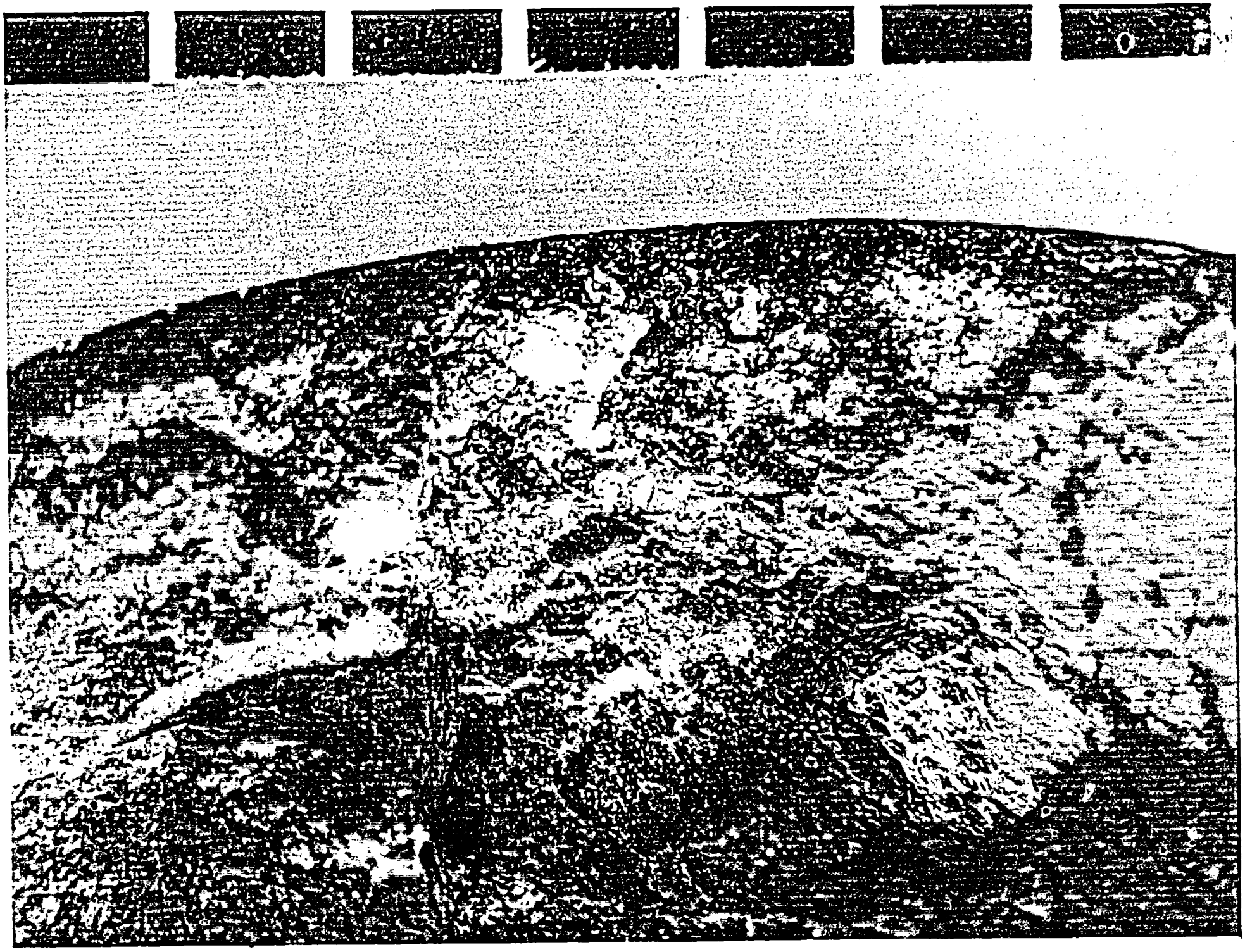

FIG 2

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