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April 14, 1964

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Attn: J. G. Lewis

PROGRAM	CATEGORY	ORG.	DATE
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INVENTORIED FEB 6 1965 DATE

Dear John:

Why is it taken for granted (or is it?) that deeply buried hardened structures should be in hard rock? When I was last at ../DASA only that possibility was mentioned in talk about possible new installations. It can be argued that alluvium would be better, and better still would be rock under alluvium. Harry Auld has since told me some of you discussed this idea on your European trip and that they are kicking it around at AFWL, so the idea though independent is not original. I have made some estimates of my own, the results of which are indicated in the enclosed graphs.

INVENTORIED AUG 22 DATE

1ST REVIEW DATE 12/16/94 DETERMINATION: CLASSIFICATION CANCELLED
AUTHORITY: ADC
NAME: R. B. Craner
2ND REVIEW DATE: 2/8/95
AUTHORITY: ADD
NAME: J. P. Trodden

To estimate ground motion under surface or near-surface bursts, I started with pressure-distance curves in granite and alluvium as in Figure 1. Figure 1 gives estimates for 400 mt surface bursts on granite and alluvium, assuming 10% energy coupling and a Brode effect of 4, attenuation with distance proceeding as in free-field conditions (i.e., the curves are free-field 10 mt curves). Since structures will be designed to a motion criterion--Harry Auld tells me 20-30 ft/sec is being talked about--these curves were converted by the Hugoniot information of SC-4903 and UCRL-6311 to velocity-distance curves as given in Figures 2 and 3.

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Figure 2 has on it two solid lines which are velocities under 40 mt surface bursts on rock and alluvium, and two dashed lines which are velocities under

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10 mt bursts at 10 feet in granite and 200 feet in alluvium. At this point I have assumed (a) that penetrating weapons suffer a yield penalty of 4 which balances out the increased effectiveness predicted by Brode, (b) that these depths can indeed be reached by these yields, and (c) that the radius of an effect is proportional to the radius of the resulting crater. Figure 3 similarly has solid lines for velocities under 400 mt surface bursts on granite and alluvium, and dashed lines for velocities under 100 mt bursts 10 feet deep in granite or 200 feet in alluvium.

The implication is that a 25 fps structure need only be 2500 feet deep in alluvium under 400 mt, but 5700 feet deep in rock. The difference is not as large for protection from a penetrating attack, but is still there. The really entrancing aspect is that if there is rock under the alluvium, the reflection at the interface caused the transmitted pressure to increase and the transmitted velocity to decrease. Thus if the alluvium is 1000 feet thick under a surface burst, incident pressure and velocity are about 2 kb and 200 fps, impedance mismatch about 7, transmitted 3.4 kb and 45 fps, and the final estimate for required depth of burst of a 25 fps structure only 1400 feet. Similarly 1000 feet under a penetrating burst incident pressure and velocity are 6 kb and 600 fps, impedance mismatch about 8, transmitted 10 kb and 150 fps, and estimated depth required again 2500 feet.

If I had started with some other pressure-distance curves than the one I did (Bishop in SC-4907) the exact numbers would be different but not the general idea. If I had used a displacement instead of a velocity criterion, the net advantage would be less but still in favor of alluvium.

Sincerely,

M. L. Merritt

M. L. Merritt
Division 5412

MLM:fs

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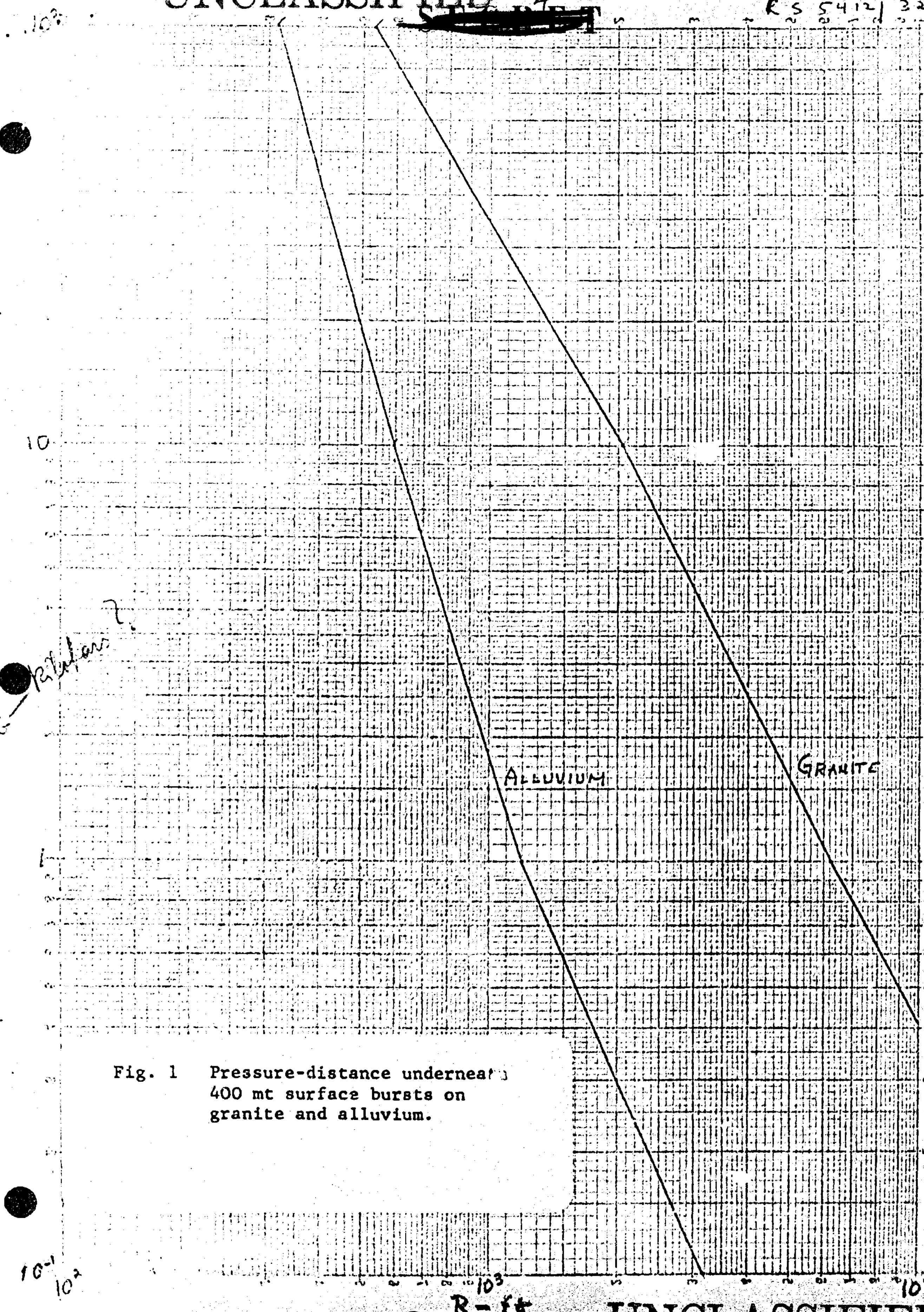

Fig. 1 Pressure-distance underneath 400 mt surface bursts on granite and alluvium.

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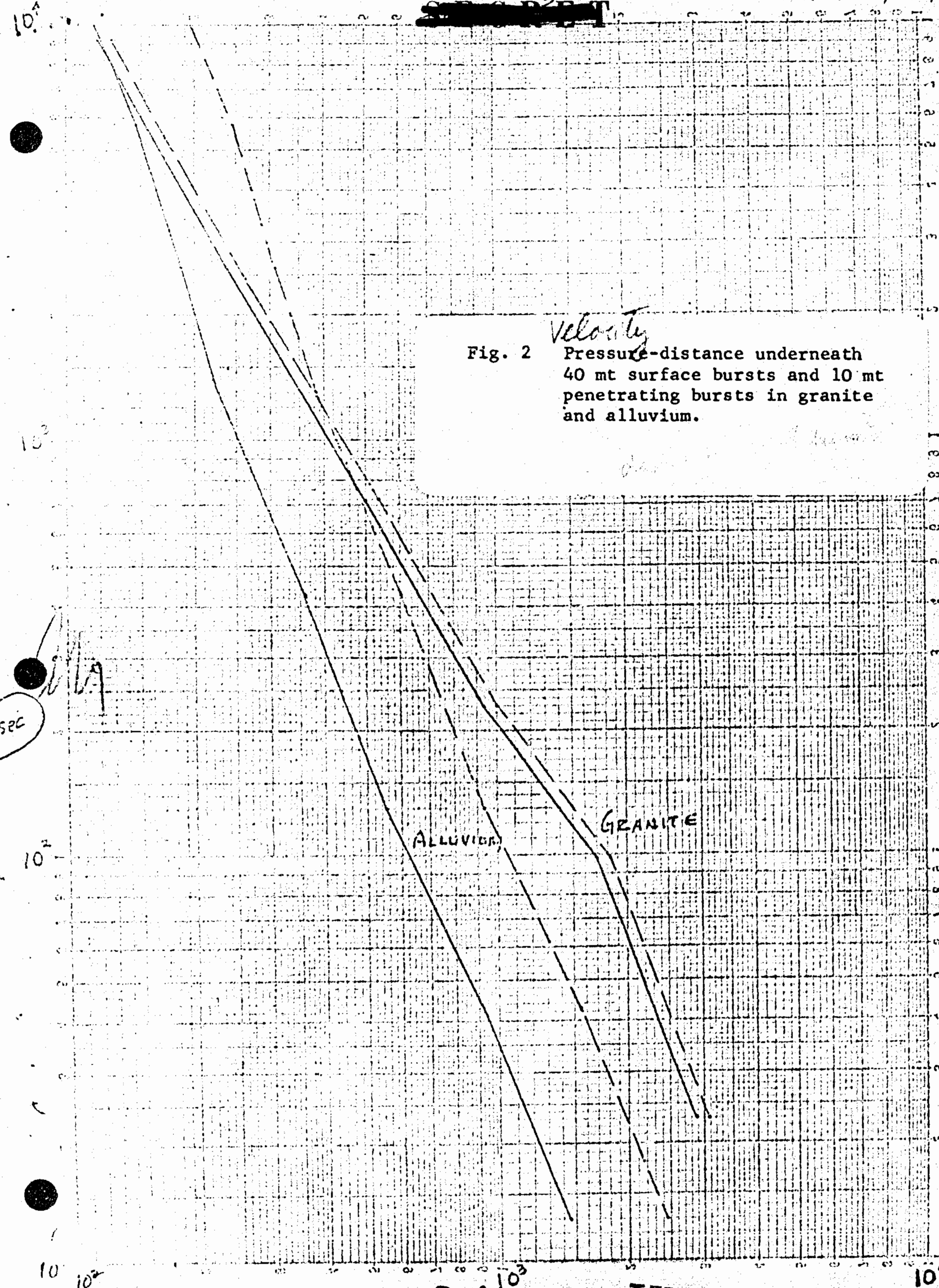

Fig. 2 Velocity Pressure-distance underneath 40 mt surface bursts and 10 mt penetrating bursts in granite and alluvium.

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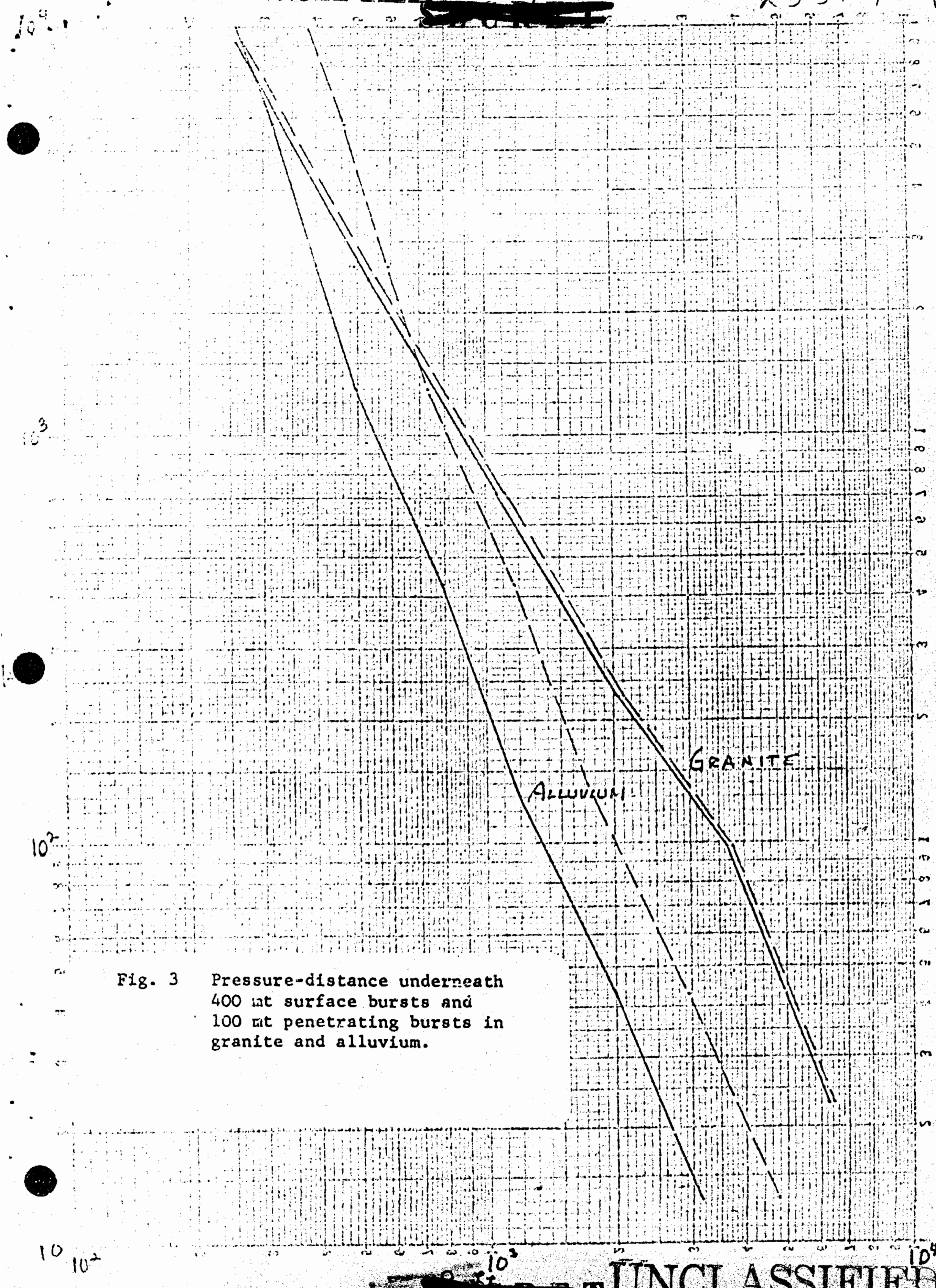

Fig. 3 Pressure-distance underneath 400 mt surface bursts and 100 mt penetrating bursts in granite and alluvium.

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