Interdepartmental letterhead

75/344

Mail Station L- 13

Ext: 8301

May 29, 1974

M E M O R A N D U M

TO: Distribution

FROM: Milo D. Nordyke

SUBJECT: The Indian Explosion

Accepting the numbers given by the Indians at face value for their recent nuclear event (10-15 kt at 100 meters), I have played a few games with our depth-burst curves as shown in the attached figures and the following table. 10-kt at 100 meters will be a scaled depth of burial of 51 $m/kt^{1/3.4}$. Conversely, 15-kt at 100 meters would be a scaled depth of burial of 45 $m/kt^{1/3.4}$. This places the explosion, assuming it was in dry, hard rock, to be halfway between Danny Boy and Sulky. Since we believe the dimensions in this region, particularly the depth, to be quite variable, we would not at all be surprised to see a retarc as is implied in the various eyewitness accounts. It seems particularly difficult to accept the hypothesis that this explosion was in an alluvial material such as Sedan because this would have lead to a very significant crater with measurable radioactivity venting at either of these scaled depths of burial.

	10-kt	15-kt
Dob = 100 meters	51 $m/kt^{1/3.4}$	45 $m/kt^{1/3.4}$
R_s implied	30 $m/kt^{1/3.4}$	39 $m/kt^{1/3.4}$
Diameter for implied R_s	118 m (386 ft)	172 m (568 ft)
D_s implied (but variable)	13 $m/kt^{1/3.4}$	21 $m/kt^{1/3.4}$
Depth for implied D_s	26 m	47 m

The above depths of burial for hard, dry rock imply a scaled radius ranging between 30 and 39 meters which would translate into actual diameter of 118-172 meters. Published accounts speak of a raised mound with a diameter of about 200 meters. Although Figs. 1 and 2 show a curve for radius and depth between Danny Boy and Sulky, we know that such a curve would be very unreliable, particularly in the case of depth, and that a mound instead of a crater could very well be produced at any depth of

burial in this region. The diameter of any such mound would be roughly the same as the true crater radius, which is about equal to the depth of burial for these scaled depths; but the depth would be quite variable and in some cases nonexistent.

The distance of 4 kilometers (2.5 miles) for the observer point sounds quite close and implies that what was expected was complete containment or at worst a Sulky-type of venting. It also implies that the Indians had a high degree of confidence in the yield and the predicted effects. The descriptions of being able to walk up to within 100 meters of the "crater" is consistent with the Sulky results in which there was no particulate debris vented.

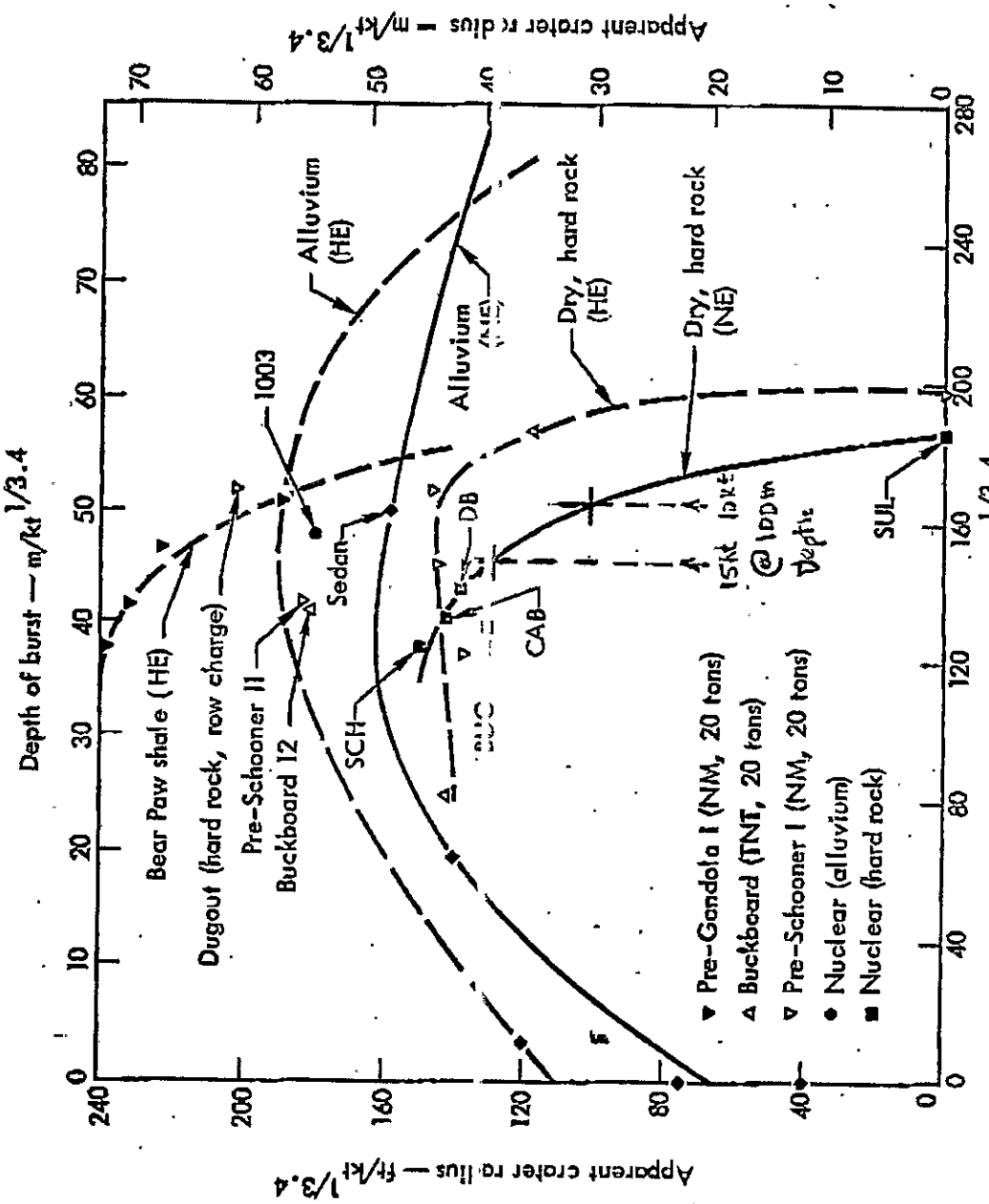
All in all, the information made available is all consistent with the Indian explosion being a retarc with dimensions quite similar to those that we would expect in dry, hard rock. Such a structure is strikingly similar to those depicted in the enclosed LLL drawing (Fig. 3) for the purpose of demonstrating the technique of chemical mining. Reference to Fig. 4 from UCRL-12180 Rev. 2 shows that such a depth of burial is near the maximum breakage volume for hard, dry rock and that about 4×10^6 tons of rock would be expected.

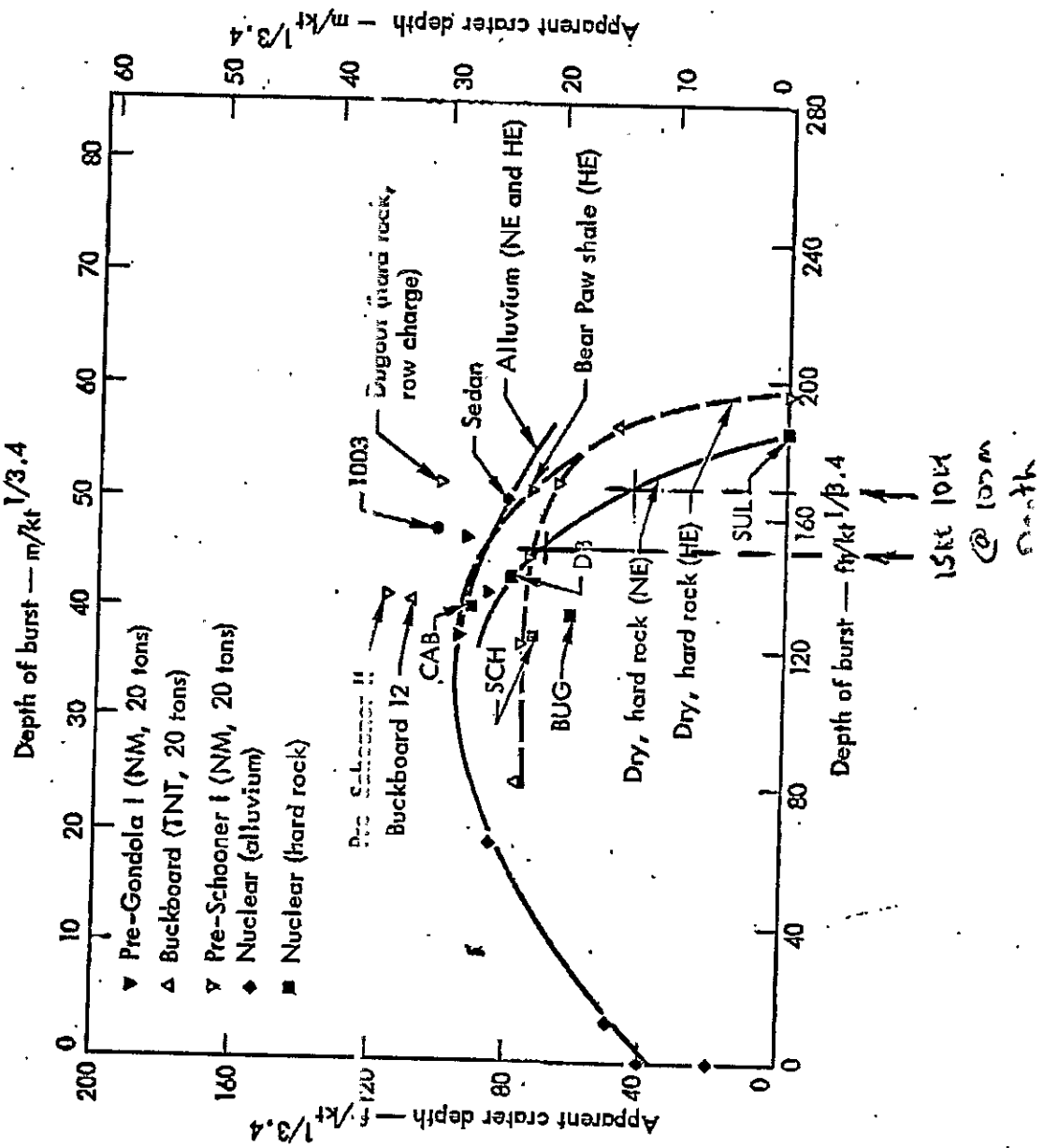
Chemical mining is, of course, one of the PNE applications most discussed by the Indians as the purpose of their nuclear explosion development. One of the deposits the Indians discussed at the IAEA as a target for a PNE application is the Khetri Copper Belt in the same state where the nuclear test was carried out, Rajasthan. This deposit is located several hundred kilometers east of the reported site of the nuclear explosion in the Great India Desert. This deposit appears to outcrop at the surface and consists essentially of pyrrhotite and chalcopyrite, a primary copper ore. The copper content of the ore is reported from a representative sample to be about 2.8% -- high enough to be recoverable by conventional mining methods. If this event was a test of the rock-breaking capability of their explosion, it should be noted that a retarc with a volume of 4×10^6 tons of ore at only 1% Cu would contain 4×10^4 tons of Cu worth $\$40 \times 10^6$ at \$0.50/lb -- a very considerable sum. In summary, all the known facts appear to support the Indian statements that their nuclear test was carried out to further their PNE program.

Milo D. Nordyke

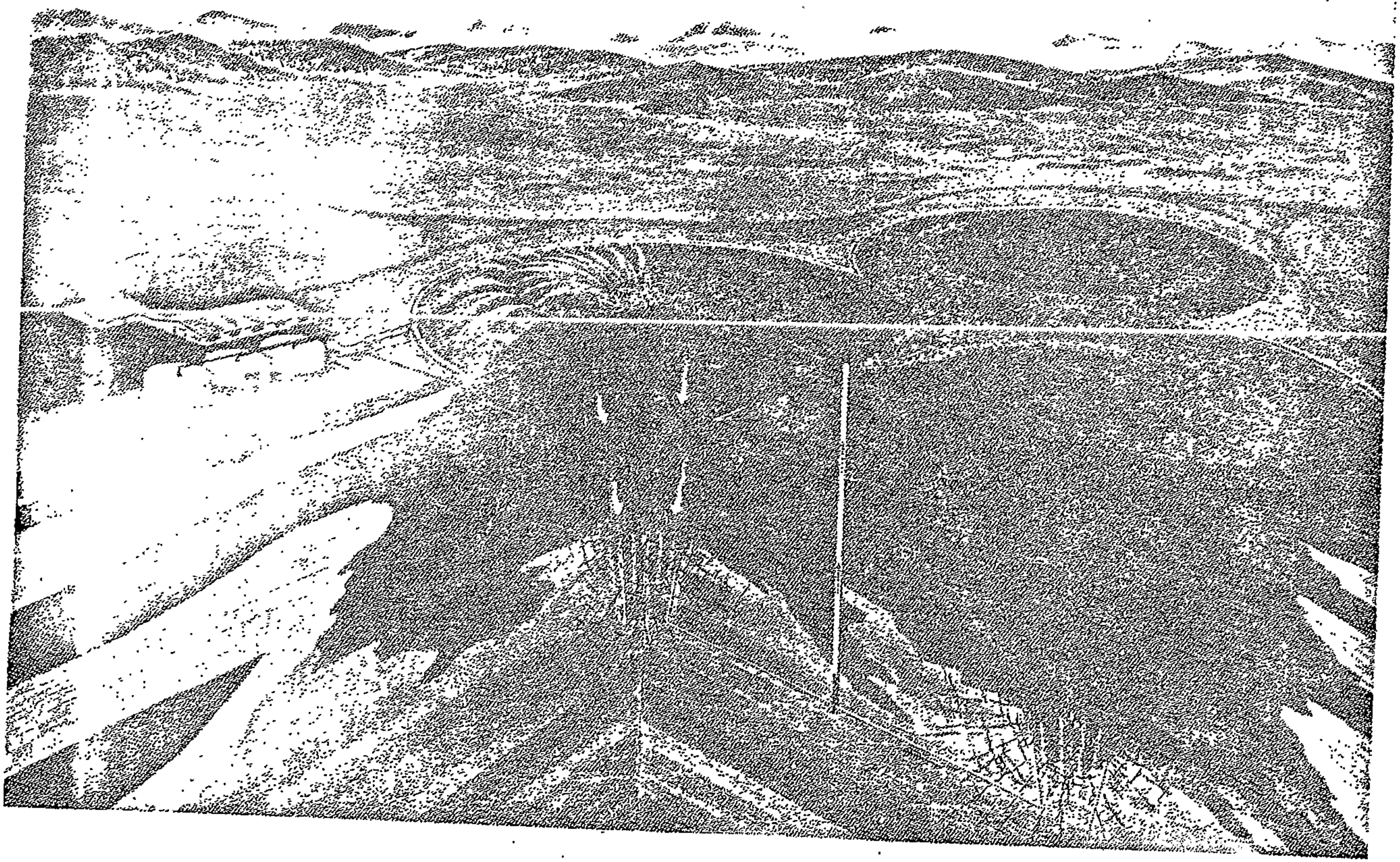
MDN:sbp
Attachments

cc: R. Batzel
E. Fleming, DAT
F. Holzer
J. King
M. May
M. McClelland
J. Toman
G. Werth


Apparent crater radius — m/kt^1/3.4
Depth of burst — m/kt^1/3.4
Apparent crater radius — ft/kt^1/3.4
Depth of burst — ft/kt^1/3.4
Alluvium (HE)
Alluvium
Dry, hard rock (HE)
Dry, hard rock (NE)
1003
Sedan
DB
CAB
SCH
SUL
Bear Paw shale (HE)
Dugout (hard rock, row charge)
Pre-Schooner II
Buckboard 12
Pre-Gondola I (NM, 20 tons)
Buckboard (TNT, 20 tons)
Pre-Schooner I (NM, 20 tons)
Nuclear (alluvium)
Nuclear (hard rock)


Apparent crater depth — m/kt 1/3.4
Depth of burst — m/kt 1/3.4
Apparent crater depth — ft/kt 1/3.4
Depth of burst — ft/kt 1/3.4
Pre-Gondola I (NM, 20 tons)
Buckboard (TNT, 20 tons)
Pre-Schooner I (NM, 20 tons)
Nuclear (alluvium)
Nuclear (hard rock)
Buckboard 12
CAB
SCH
BUG
1003
Sedan
Alluvium (NE and HE)
Bear Paw shale (HE)
Dry, hard rock (NE)
Dry, hard rock (HE)
SUL
15kt 10K
@ 1000
South

RETARCS FOR IN-SITU LEACHING



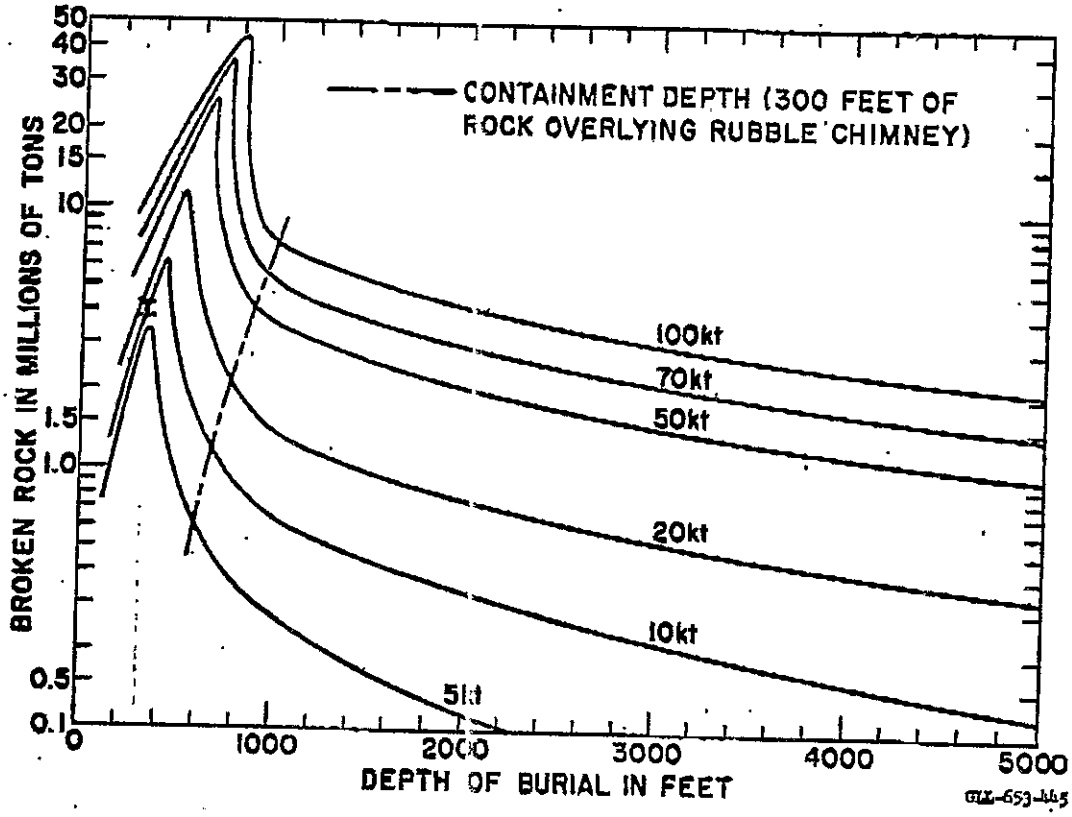


Fig. 4 Tonnage curves of rock broken by underground explosions.