# 14230

DRAFT

## Drive Tube

76.7 grams

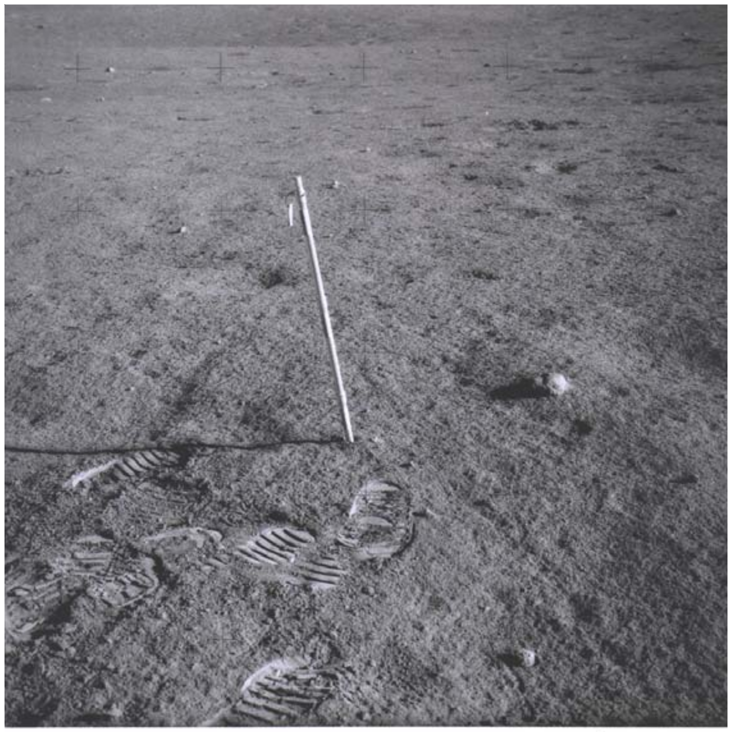


*Figure 1: The lunar surface is entirely smooth. Photo of drive tube 14230 (a triple!). AS14-68-9455.*

**Introduction**

Drive tubes 14220 and 14230 were collected about 5 meters away from the Soil Mechanics Trench – see section on 14149 (Fryxell and Heiken 1971). 14230 was collected using the same tube originally used at Cone Crater, where the material fell out. It was actually the bottom portion of a set of three that were planned to be driven in (figure 1). It went in 45 cm (greater than the bottom segment), but when it was pulled out material was lost from both the top and the bottom of the core so that only 12.5 cm of core material of uncertain depth remained (figure 2, 3). It is thought to still be in stratigraphic order, however.

14230 was the first core dissected and broadly distributed (Duke and Nagle 1976). Earlier cores were used for the quarantine experiments and added to the "biopool" sample.

**Petrography**

Graf's 1993 catalog discusses King's seiving and gives lots of data on grain size (figure 7). McKay et al. (1972) also give grain size data. Morris (1976) determined the maturity index (Is/FeO = 50-57).

McKay et al. (1972) and Carr and Meyer (1972) tabulate modal data for different depths in the core. There is a high percentage of agglutinates, indicating this core is mature thruoughout.

Billy Glass (1972) and Carr and Meyer (1972) reported the glass types in 14230. Judging from the descriptions, much of it is fused soil (agglutinate glass).

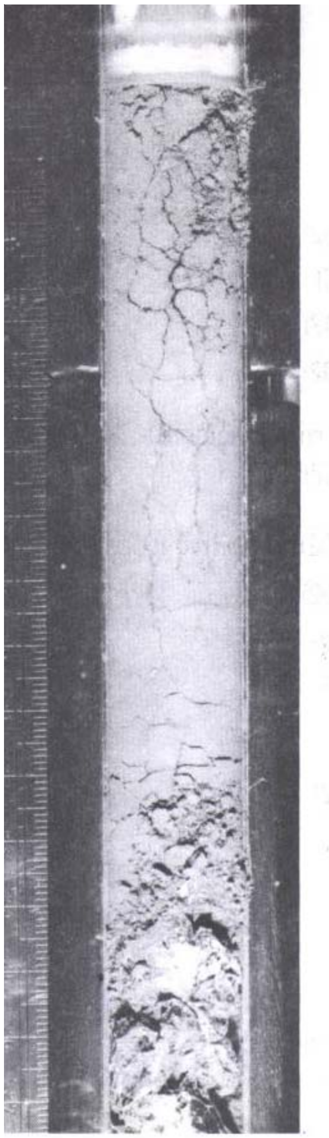


Figure 2: Core tube 14230 after opening, before dissection.

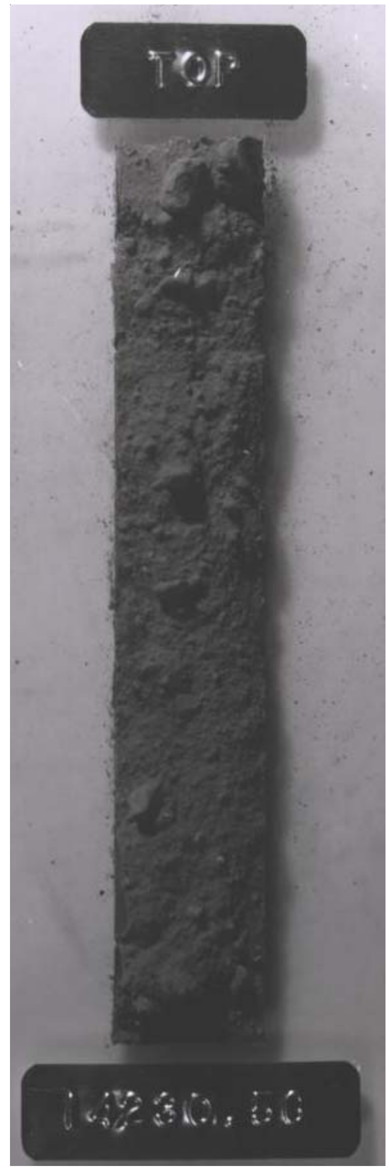



Figure 3: NASA photo S72-35253 showing drive tube 14230 after dissection.

**Modal content of core sample 14230**

*90 – 150 microns*

*From McKay et al. 1972*

| | 8 cm | 13 cm | 17 cm |
|---|---|---|---|
| Agglutinates | 53.2% | 57 | 51.5 |
| Basalt | 0.3 | 1.7 | 2.1 |
| Breccia | 13.5 | 20.6 | 27.4 |
| Anorthosite | | | |
| Norite | | | |
| Gabbro | | | |
| Plagioclase | 6.5 | 3.3 | 3.4 |
| Pyroxene | 7.4 | 3.6 | 3 |
| Olivine | | | 0.4 |
| Ilmenite | | | |
| Glass other | 18 | 13.3 | 11.2 |

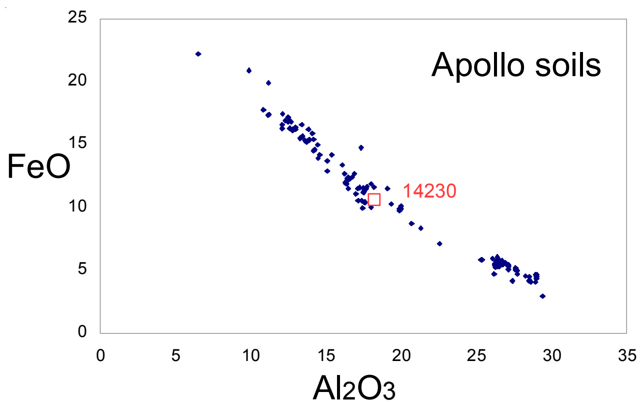



*Figure 4: Composition of lunar soils with 14230.*

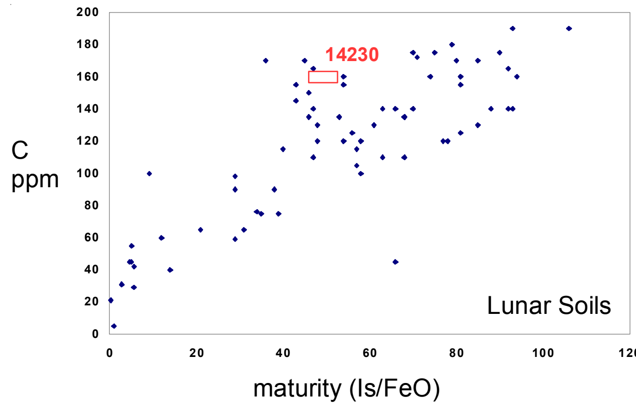



*Figure 5: Maturity index and carbon content for lunar soil with 14230 (data from Morris 1976; Moore et al. 1972).*

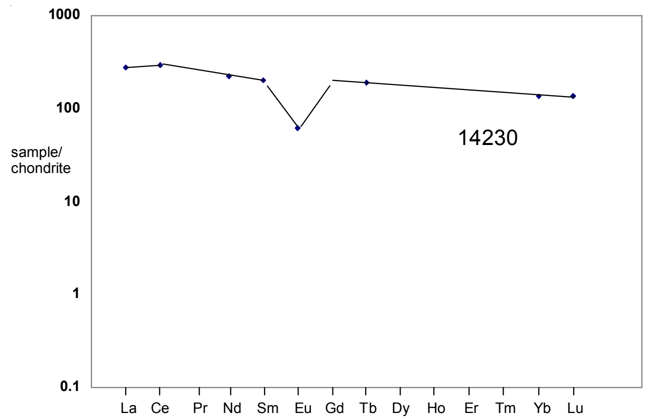



*Figure 6: Analyses of different depths in 14230 all plot together on a REE plot (homogeneous).*

## Chemistry

Lindstrom et al. (1972), Philpotts et al. (1973), Laul et al. (1972) all analyzed samples from along the length of this core (table 1, figure 6).

Moore et al. (1972) reported 150 ppm C, typical of a mature soil (figure 5).

## Other Studies

Bogard and Nyquist (1972) reported rare gas data for 14230. Hoyt et al. (1972) studied the thermoluminescence of samples from this core (figure 8). Bhandari et al. (1973) studied the nuclear particle tracks as a function of depth (figure 10).

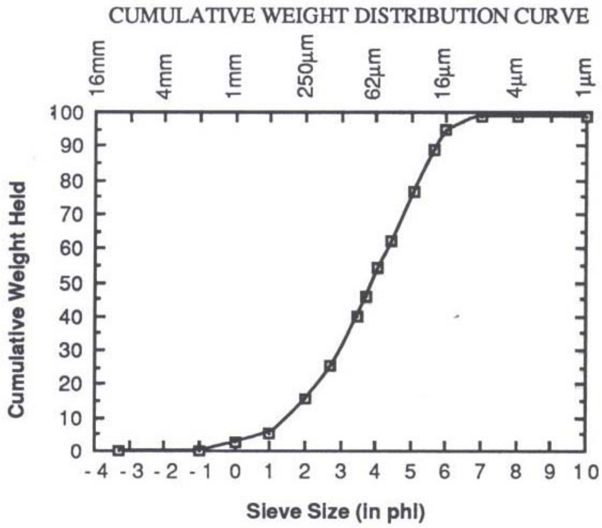
## Processing

This lunar core tube was cut open lengthwise and the core was dissected by Fryxell and Heiken using techniqes akin to those of paleontology. Some samples from each depth were collected under red light (RL) conditions in an attempt to preserve thermolunescence (see simplified table).

## Table 1. Chemical composition of 14230.

| *reference* | Lindstrom72 | | | | Philpotts72 | | | | Laul 72 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *weight* | ,112 | ,119 | ,129 | | ,105 | ,114 | ,123 | | 14 cm | 19 cm | 22 cm | |
| SiO2 % | | | | | 48.2 | 48.4 | 48 | (b) | | | | |
| TiO2 | | | | | 1.66 | 1.73 | 1.62 | (b) | 1.7 | 1.6 | 1.7 | (a) |
| Al2O3 | | | | | 17.27 | 17.03 | 17.6 | (b) | 18.1 | 18 | 18.7 | (a) |
| FeO | 10.4 | 10.7 | 10.3 | (a) | 10.17 | 10.21 | 10.09 | (b) | 9.3 | 10.1 | 9.7 | (a) |
| MnO | | | | | 0.12 | 0.13 | 0.13 | (b) | 0.122 | 0.125 | 0.129 | (a) |
| MgO | | | | | 9.43 | 9.54 | 9.45 | (b) | | | | |
| CaO | | | | | 10.78 | 10.94 | 10.8 | (b) | 11.2 | 12.5 | 11.6 | (a) |
| Na2O | 0.68 | 0.72 | 0.73 | (a) | 0.7 | 0.7 | 0.7 | (b) | 0.714 | 0.741 | 0.714 | (a) |
| K2O | 0.476 | 0.5 | 0.46 | (a) | 0.56 | 0.56 | 0.56 | (b) | 0.6 | 0.48 | 0.55 | (a) |
| P2O5 | | | | | 0.48 | 0.48 | 0.49 | (b) | | | | |
| S % | | | | | | | | | | | | |
| *sum* | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Sc ppm | 20.9 | 22 | 21.5 | (a) | | | | | 18.8 | 20 | 20 | (a) |
| V | | | | | | | | | *50* | *64* | *34* | (a) |
| Cr | 1290 | 1350 | 1260 | (a) | 1300 | 1300 | 1300 | (b) | | | | |
| Co | 42.4 | 36.2 | 36.4 | (a) | | | | | 32 | 33 | 34 | (a) |
| Ni | | | | | | | | | | | | |
| Cu | | | | | | | | | | | | |
| Zn | | | | | | | | | | | | |
| Ga | | | | | | | | | | | | |
| Ge ppb | | | | | | | | | | | | |
| As | | | | | | | | | | | | |
| Se | | | | | | | | | | | | |
| Rb | | | | | | | | | | | | |
| Sr | | | | | | | | | | | | |
| Y | | | | | | | | | | | | |
| Zr | 990 | 900 | | (a) | | | | | 550 | 600 | 700 | (a) |
| Nb | | | | | | | | | | | | |
| Mo | | | | | | | | | | | | |
| Ru | | | | | | | | | | | | |
| Rh | | | | | | | | | | | | |
| Pd ppb | | | | | | | | | | | | |
| Ag ppb | | | | | | | | | | | | |
| Cd ppb | | | | | | | | | | | | |
| In ppb | | | | | | | | | | | | |
| Sn ppb | | | | | | | | | | | | |
| Sb ppb | | | | | | | | | | | | |
| Te ppb | | | | | | | | | | | | |
| Cs ppm | | | | | | | | | | | | |
| Ba | 750 | 780 | 700 | (a) | | | | | 850 | 800 | 800 | (a) |
| La | 62.3 | 66.1 | 65.1 | (a) | | | | | 64 | 66 | 68 | (a) |
| Ce | 167 | 170 | 176 | (a) | | | | | 162 | 160 | 170 | (a) |
| Pr | | | | | | | | | | | | |
| Nd | | | 100 | (a) | | | | | | | | |
| Sm | 27.8 | 29.9 | 29.4 | (a) | | | | | 29 | 32 | 30 | (a) |
| Eu | 2.9 | 3.26 | 3.44 | (a) | | | | | 2.7 | 2.5 | 2.6 | (a) |
| Gd | | | | | | | | | | | | |
| Tb | 5 | 6.7 | 6.9 | (a) | | | | | 6 | 5.8 | 6.4 | (a) |
| Dy | | | | | | | | | | | | |
| Ho | | | | | | | | | | | | |
| Er | | | | | | | | | | | | |
| Tm | | | | | | | | | | | | |
| Yb | | | | (a) | | | | | 22 | 23 | 24 | (a) |
| Lu | 3.15 | 3.28 | 3.28 | (a) | | | | | 3.2 | 3.2 | 3.3 | (a) |
| Hf | 22.4 | 23.4 | | (a) | | | | | 21 | 21 | 22 | (a) |
| Ta | 3.9 | 4.5 | 5 | (a) | | | | | 2.8 | 2.5 | 2.8 | (a) |
| W ppb | | | | | | | | | | | | |
| Re ppb | | | | | | | | | | | | |
| Os ppb | | | | | | | | | | | | |
| Ir ppb | | | | | | | | | | | | |
| Pt ppb | | | | | | | | | | | | |
| Au ppb | | | | | | | | | | | | |
| Th ppm | | | | | | | | | 13 | 12 | 14 | (a) |
| U ppm | | | 2.1 | (a) | | | | | 3.5 | 3 | 3.4 | (a) |

*technique: (a) INAA, (b) atomic absorrption*



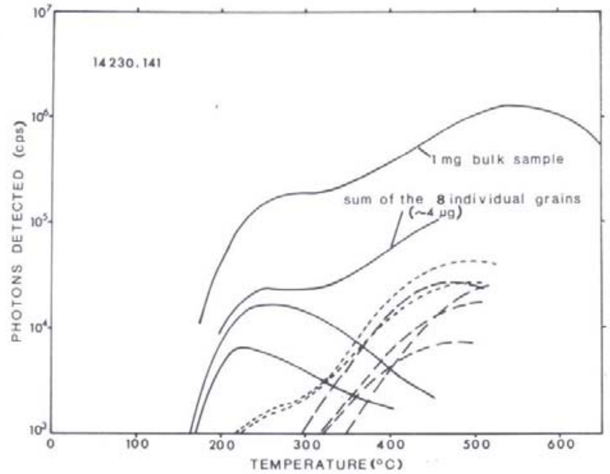




*Figure 8: Glow curve for 14230 and eight fragments (Hoyt et al. 1972).*

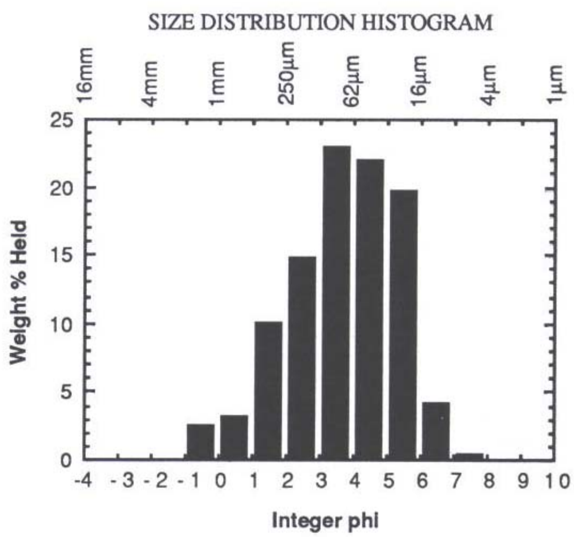



*Figure 7: One of many size distribution curves determined for different depth in 14230 (from Graf 1993, from data by McKay et al. 1972).*

## Subsamples of 14230 (simplified)

| | weight grams | depth cm. top | red light RL |
|---|---|---|---|
| ,53 | 0.92 | 0 - 0.5 | ,54 |
| ,51 | 0.83 | 0.5 - 1.2 | ,52 |
| ,49 | 1.2 | 1.2 - 1.9 | ,50 |
| ,46 | 0.96 | 1.9 - 2.4 | ,47 |
| ,44 | 0.9 | 2.4 - 3.0 | ,45 |
| ,42 | 0.6 | 3.0 - 3.5 | ,43 |
| ,40 | 1 | 3.5 - 4.0 | ,41 |
| ,38 | 1 | 4.0 - 4.5 | ,39 |
| ,36 | 1 | 5 - 5.3 | ,37 |
| ,34 | 1.8 | 5.2 - 5.7 | ,35 |
| ,32 | 1 | 5.7 - 6.2 | ,33 |
| ,30 | 0.7 | 6.2 - 6.7 | ,31 |
| ,28 | 1.1 | 7.1 - 7.5 | ,29 |
| ,22 | 1.1 | 7.2 - 7.7 | ,23 |
| ,20 | 1.3 | | ,21 |
| ,18 | 0.5 | 9 - 9.2 | ,19 |
| ,15 | 0.7 | 9.2 - 9.7 | |
| ,13 | 0.9 | 9.7 - 10.2 | ,14 |
| ,10 | 0.4 | 10.2 - 10.8 | ,12 |
| ,8 | 0.4 | 10.8 - 11.2 | ,9 |
| ,6 | 0.3 | 11.2 - 11.8 | |
| ,64 | 6.3 | bottom | biopool |

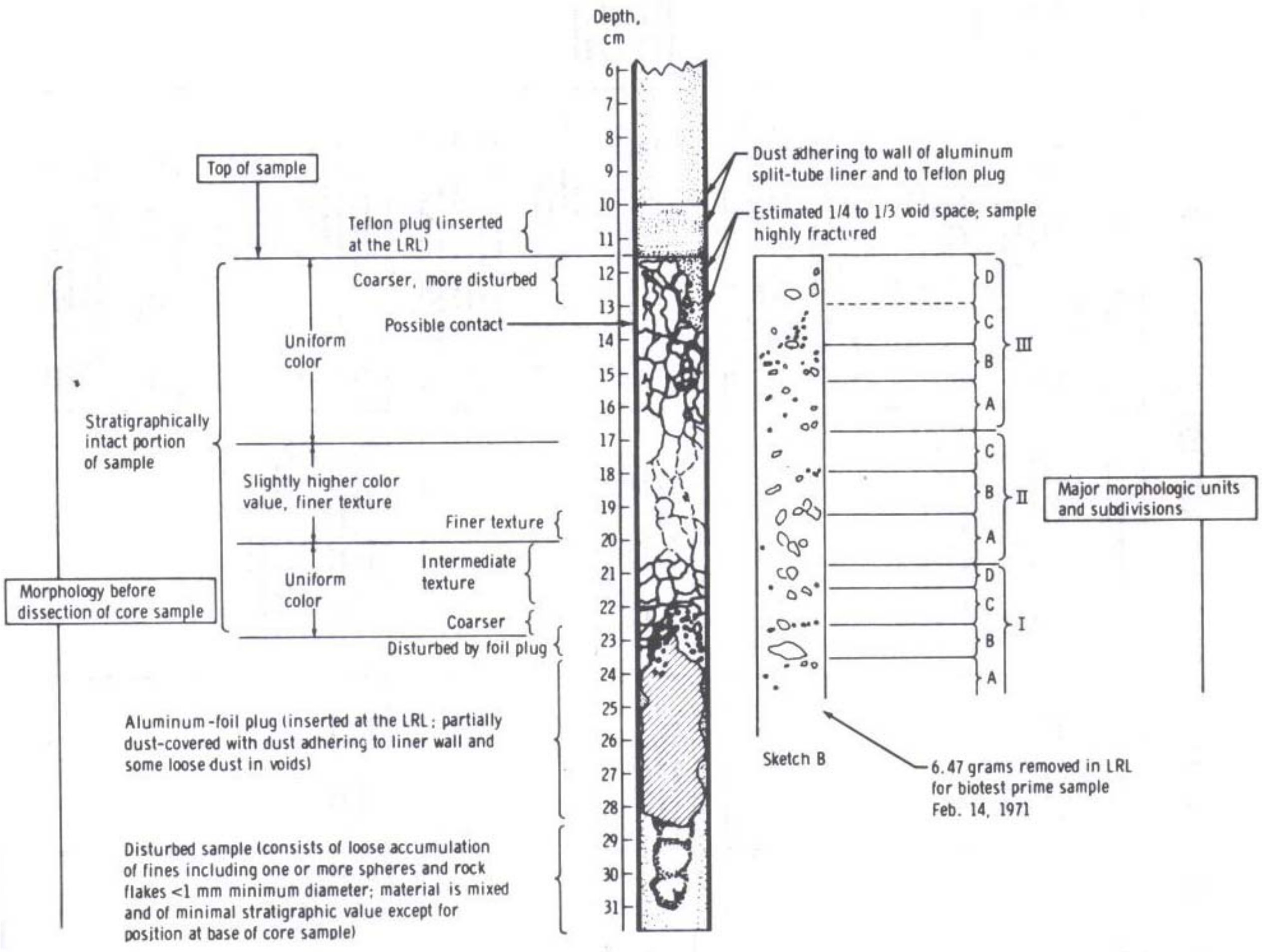



*Figure 9: An interpretation of drive tube 14230 (Fryxell and Heiken 1971).*

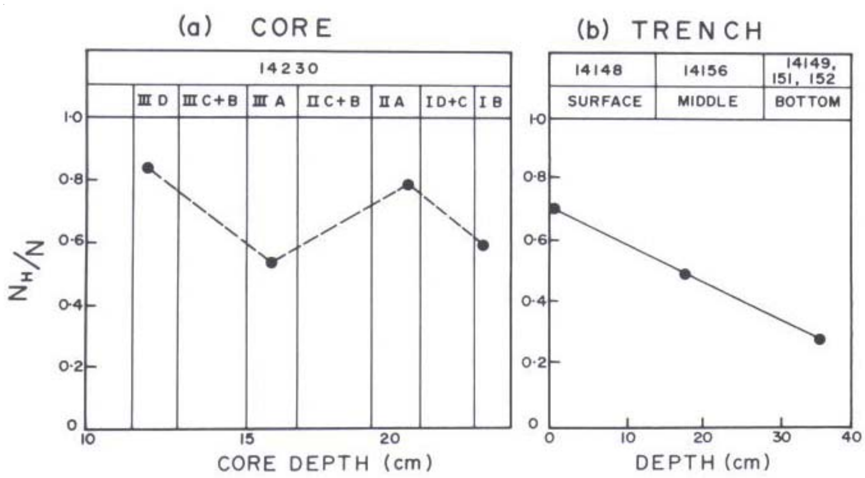



*Figure 10: Fraction of surface irradiated grains as function of depth (Bhandari et al. 1973).*

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