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Crater Diameter-Depth Relationship from Ranger Lunar Photographs

IN 1965, Baldwin¹ investigated the relationship between diameter and depths for some lunar craters from *Ranger VII* photographs. He used the values from the *Ranger Lunar Charts* (RLC) published by the Aeronautical Chart and Information Center. Baldwin found that the diameter-depth relationship for these craters may be represented by the equation

$$D = 0.0256d^2 + d + 0.6300 \quad (1)$$

where D and d are the logarithmic diameter and depth of craters in feet.

Recently, I measured the cross sections of some primary craters from the *Ranger VII*, *VIII* and *IX* photographs². Fig. 1 shows the measured values of logarithmic diameter (D) and depth (d) in metres. There is no difference between the diameter-depth relationship for craters, photographed by the three different *Ranger* missiles

Fig. 1. Logarithmic diameter D versus logarithmic depth d (both in m) from *Ranger VII* (○), *Ranger VIII* (×) and *Ranger IX* (●) photographs.

in different lunar regions. The crater diameter-depth relationship, shown in Fig. 1, may be represented by the equation

$$D = 0.96d + 0.98 \quad (2)$$

where D and d are the logarithmic diameter and depth of craters in metres. The relationship between D and d is practically linear for craters, diameters of which are between 29 and 17,100 m. This fact shows that the well known Ebert's rule is not valid for small lunar craters.

The results obtained are not a contradiction of the meteoritic-impact theory of the origin of lunar craters and it seems that most of the small craters are of meteoritic origin. I thank Professor H. Haffner, director of the Hamburg Observatory, for the hospitality of this institution and for many informative discussions.

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Kamacite-Taenite Relationships in Iron Meteorites

A NUMBER of investigators¹⁻³ have used the method of electron probe X-ray microanalysis in the examination of metallic meteorites. For those simple octahedrites which are free of visible thermal metamorphism there is general agreement that the various morphological forms of taenite are distinctly non-homogeneous with respect to nickel, whereas the bulk of the kamacite is of more uniform nickel content, although there is a decrease of nickel within the kamacite where it comes into contact with taenite^{1,3}. Extensive measurements of this effect have been made by Agrell, Long and Ogilvie³ on a sample of the Canyon Diablo meteorite, for which they found a nickel content of 6.8 ± 0.2 per cent for the bulk kamacite as compared with about 5.7 at the interface. In the machine used by Agrell, Long and Ogilvie the X-rays could be collected in a direction lying in the plane which contained the normal to the specimen surface and the intersection of the kamacite-taenite boundary with the surface. This simple geometry minimizes the anomalous effects which can arise if X-rays generated in one phase are absorbed by passage through another phase.

In the present work an A.E.I. SEM2 microprobe analyser was used. This is a fully focusing machine of different geometry from that used by Agrell. The meteorite specimens were cut in such a way that the kamacite-taenite interfaces under examination were perpendicular to the surface of the specimen; the traverse of the probe was perpendicular to the interface and also coincided with the Rowland circle of the spectrometer.

Some specimens of the Canyon Diablo meteorite contain crystals of the carbide phase, cohenite, whereas other specimens are free of cohenite and it is not clear which type of material was examined by Agrell. In the present work samples of both cohenite free (CF) and cohenite rich (CR) Canyon Diablo material were examined. In addition, samples of artificially shock hardened CF material were available at 138 and 228 kbar shock wave pressures respectively. Both samples showed the acicular kamacite structure which is characteristic of cosmically shock hardened meteorites and both samples were subject to microprobe examination. Finally, samples of the cosmically shock hardened meteorite Trenton were examined. In all cases the microprobe examination was conducted on unetched specimens after a detailed metallographic