IMPACT CRATERS AND THE FLUX OF COSMIC DUST ON THE MOON

H.A. Khan*, S.A. Durrani and J.H. Fremlin, Physics Department, Birmingham University, Birmingham B15 2TT, England.

INTRODUCTION The lunar surface is exposed to nuclear charged particles and dust particles which produce latent damage trails and craters respectively. The study of these phenomena are of great interest and pioneering work has already been done(1-4).
This paper describes some further work carried out on charged particle tracks and impact craters in lunar glassy spherules. Studies have been made of (a) the size and mass distribution of cosmic dust particles, (b) relationships between dust and charged particle fluxes and (c) effects of crater formation on particle tracks in the region of the crater. In particular, a new approach has been made to the study of the variation of the micrometeorite flux in the past by "dating" the microcraters with diameters $\gtrsim 5\ \mu m$.

EXPERIMENTAL PROCEDURE Simulation experiments were carried out using iron dust particles (mean dia. $\bar{d} = 1.47\ \mu m$) from a 2 MV dust particle accelerator and the craters thus formed in quartz (vitreosil), soda lime and tektite glasses, mica and lunar glass spherules were examined with optical and scanning electron microscopes. Eighty one light brown glass spherules (diameters 300-350 μm) from sample 15301,84 were studied by methods as described by others(1,2,4) and craters formed by the "primary" particles were identified according to the criteria given in reference 4. Spherules (before and after polishing) were etched and the cosmic ray tracks on them examined. Charged particle exposure ages were derived from the track densities of small, abundant etch pits of solar and galactic origin.

RESULTS AND DISCUSSION The simulation experiments on the glasses showed that (a) impact craters produced on tektite glasses have morphologies similar to those produced on lunar light brown glasses, (b) soft glasses like soda lime glass yielded larger craters than those formed in harder materials like fused silica, (c) spall to diameter increases with increasing crater size, (d) craters with melted bases on tektite glasses had a mean depth to diameter ratio of 0.96 and (e) the depth to diameter ratio does not depend on crater size.

---

* On leave from Pakistan Institute of Nuclear Science and Technology, (PINSTECH), Nilore, Islamabad, Pakistan.

IMPACT CRATERS ... ON THE MOON

Khan H.A. et al.

Studies of natural craters on brown lunar glass spherules yielded the following.

1. The diameter distribution of craters shows a steady fall off in numbers with increasing diameter, as found previously.

2. The depth to diameter ratios for natural craters fall into three groups, possibly corresponding to three groups of dust particles (Fig. 1). One group has a depth diameter ratio very close to that found for iron particle craters in simulation experiments. Further work is continuing on these aspects, utilizing different bombarded dust particles.

3. A plot of crater density vs. track density (Fig. 2) shows that spherules with high track density have relatively even higher crater densities. These results,along with the assumption borne out by some other studies, that the charged particle flux has remained constant over the last 10^6-10^7 years leads to the conclusion that the dust particle flux has decreased over this period. This is in disagreement with the work of Morrison et al[3].

4. The number densities and diameters of tracks under craters (TUC) are different in general from those away from the craters (TAC). This may be explained by the annealing effect of the dust particle impacts. The ratio $A(C) = \rho_{TUC}/\rho_{TAC}$ is related to the time since the impact and may be used to date the impact craters. In this way, all the craters with diameters $\gtrsim 5\ \mu m$ were dated. The results show that relatively fewer craters were produced in the later stages of the age of these spherules, tending to confirm the probable decrease in dust particle flux. Further experiments are in progress to examine these results.

In the course of the study of natural craters, a crater was found which was occupied by a projectile, which microprobe analysis showed to consist mainly of Fe. The ratio A(C) for this crater was almost zero and the event was probably a most recent one (see Fig. 3).

References

1. Neukum G., Schneider E., Mehl A., Storzer D., Wagner G.A., Fechtig H. and Bloch M.R. (1972). Proc. Third Lunar Sci. Conf., Geochim. Cosmochim. Acta Suppl. 3, Vol. 3, pp. 2793-2810.

2. McDonnell J.A.M., Ashworth D.G. and Flavill R.P. (1972). Proc. Third Lunar Sci. Conf., Geochim. Cosmochim. Acta Suppl. 3, Vol. 3, pp. 2755-2765.

3. Morrison D.A., McKay D.S., Heiken G.H. and Moore H.J. (1972). Proc. Third Lunar Sci. Conf., Geochim. Cosmochim. Acta Suppl. 3, Vol. 3, pp. 2767-2791.

4. Horz F., Hartung J.B., and Gault D.E. (1971). J. Geophys. Res. 76, 5770-5798.

IMPACT CRATERS ... ON THE MOON

Khan H. A. et al.

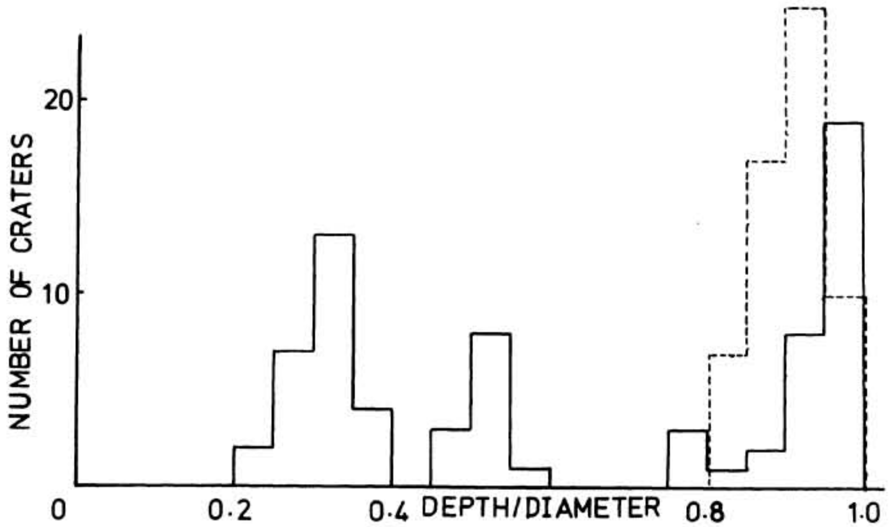

Fig. 1

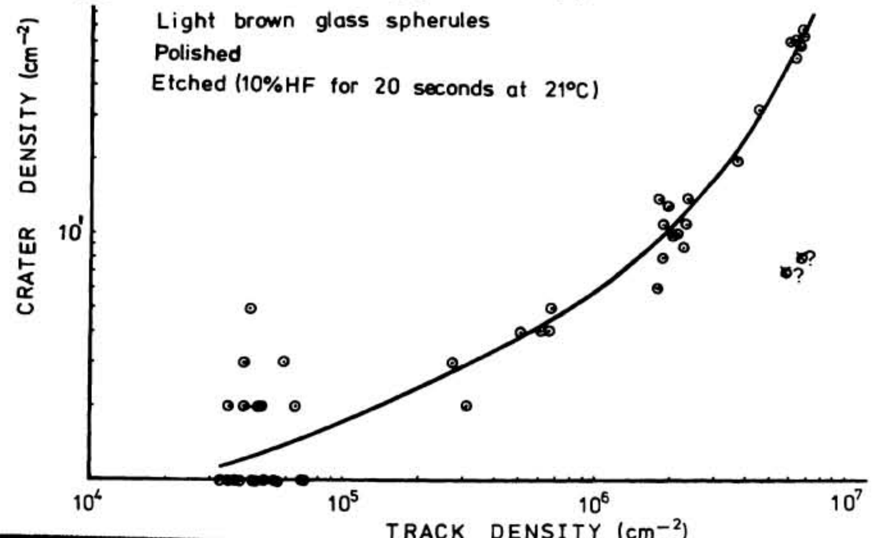

Fig. 2

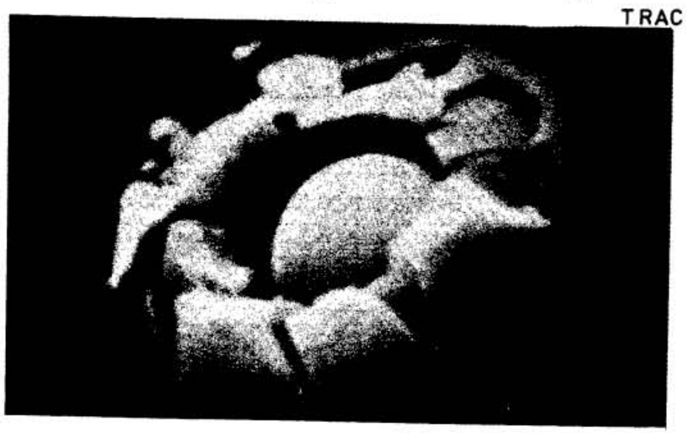

Fig. 3