ACC RETIONARY PARTICLES: PRODUCTION AND EQUILIBRIUM ON 12054
J.A.M. McDonnell, Univ. of Kent, Canterbury, U.K.

Introduction
Accretionary particles generally exceed micron dimension micro-
crater areal densities and so can contribute more towards certain surface
properties than the prime eroding agent of meteoroid impact. Generated either
by impact comminution on rocks or regolith gardening or possibly levitated by
a number of other suggested mechanisms, accreta has been poorly characterised,
often ignored. We distinguish as in other studies (1,2) splash accreta
representing firmly bounded nearby crater ejecta material, and particulate
accreta sometimes angular sometimes spherical which contacts the exposed rock
at low velocities (<100m/s), hereafter termed just accreta. Sample 12054, a
well exposed flat faced chip of smooth glassy material, exceptionally clean
prior to lunar exposure, reveals many characteristics of lunar accreta
behaviour.

Accreta Populations  Figure 1 shows accreta populations measured in crater
pits, crater spall zones, the exposed substrate and on substrate exposed
during sample cutting only. We deduce from detailed consideration of the
spread of distributions, and a particularly comprehensive study of the largest
crater of pit diameter 160µM on accreta production distribution, and from this
show the expected accreta distribution calculated at several assumed values
of the sputter rate. A comparison of the observed and expected distributions
leads to the conclusion that for an assumed sample exposure age of 8.6×10^7 yrs
determined from comparison with the age and crater density on 60015 (3), a
"sputter rate" of .05Å yr^-1 to .1Å yr^-1 would be indicated. This is, however,
the maximum value, and particle removal by any other mechanism would reduce
this value deduced. This is thought unlikely at submicron dimensions, where
statistics show the first contact is sufficient to produce a secure attach-
ment. Care must be exercised in that the "sputter rates" used in Figure 1
represent feature removal rates. With an average redeposition rate of 50% for
the moon (4), the effective interchange of atoms for a flat exposed surface
is 1.5 times the true sputter rate. The feature removal rate is hence 3 times
the net loss of atoms from a surface including redeposition. A reduction of
the tentatively assumed sample age from 8.6×10^7 yrs to 3.10^7 yrs demanded if the
observed 100µM crater density is referred to current flux estimates from
satellites (5), would alternately lead to an increase of the deduced sputter
rate.

Accreta Characteristics Summarised
1. On all surfaces observed, accreta beneath .2µM is retained on contact and
is then sputtered away at a rate not exceeding some .1Å yr^-1. A clear
transition from production to equilibrium can be observed on all crater
populations characterised beneath 1µM.
2. On flat surfaces accreta retention on contact decreases from 1 at .2µM to
~.1 at 1µM and ~.01 at 10µM. Particles which do stick for long enough are
similarly sputter degraded whereon sputter welding increases their bonding.
3. Crater accreta infilling lifetimes are now shown to be very much lower than
any other known loss mechanism (2), and their effect on microcrater dis-
ACCRETIONARY PARTICLES

McDonnell, J.A.M.

Figure 1 Partial data on accreta statistics in crater pits of 10µM-50µM diameter. From a very young crater (10% of sample age) the production distribution is calculated over the sample age; expected equilibrium transitions are generated at several possible values of the sputter rate. At 1µM to 10µM accreta diameter, substrate populations are depleted relative to pit populations probably by subsequent impact shocks.

The histogram of crater "accreta ages", Figure 2, shows a clear depletion of old craters caused by the obscuration of accreta. The flux of mobile accreta which does not stick or is subsequently released and available for participation in lunar phenomena may be 10 times the observed densities accumulated during exposure at dimensions of >1µM. Sub-micron accreta is bonded on contact.
ACCRETIONARY PARTICLES

McDonnell, J.A.M.

FIGURE 2

FRACTION OF PIT AREA
COVERED BY ACCRETA

NO. OF
CRATERS

CRATER AGE

NO OF CRATERS/AGE INTERVAL

SAMPLE AGE

5 6 \log_{10}(CUMULATIVE ACCRETA, \text{CM}^{-2}) \geq 1 \mu M

Acknowledgements This research is supported by the Science Research Council (UK)

References

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System