DESTRUCTION OF ROCKS BY LOW VELOCITY IMPACT.
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We have been conducting low velocity (50 - 500 m/sec) impact
experiments on rocks to clarify a nature of collision process of
planetesimals (Matsui et al., 1982; Waza et al., 1983). Impact
velocity, material property, relative size and mass, and config-
uration of colliding bodies were the important parameters con-
trolling the low velocity impact phenomena. Boundaries marking
the transition between collision types such as rebouncing, and
longitudinal splitting and catastrophic destruction of target
were functions of the above parameters. However, the relations
between them are rather complex and so only the qualitative re-
sults were reported in the previous papers. In this study we
give more detail analysis on the relations between them.

The largest fragment mass \( M_t \) has been used as a parameter
the collision types quantitatively: for example, \( M_t / M_t < 1 \) for
rebouncing, \( 1 < M_t / M_t < 0.2 \) for longitudinal splitting, and
\( M_t / M_t < 0.2 \) for catastrophic destruction, where \( M_t \) is a target
mass. \( M_t / M_t \) is related to imparted energy density \( E_i \) which is
defined as released kinetic energy divided by the target mass.
\( M_t / M_t \) is plotted against \( E_i \) in Figs. 1 and 2. Open and solid
symbols in the figures represent spherical and cubic targets,
respectively. The \( M_t / M_t \) versus \( E_i \) relation seems to be depend-
ent on impact velocity. As shown in Fig. 1, the relation de-
erived from the high velocity (\( \sim 2 \) km/sec) impact experiment
(Fujiwara et al., 1977) is clearly deviated from our data points.
Configuration of target also affects the relation. As seen in
Figs. 1 and 2, solid symbols are mostly distributed below open
symbols. However, effect of difference in configuration of tar-
got on the relation is not so large. The most interesting re-
result is that irrespective of large difference (about one order
of magnitude) in compressive strength between tuff (\( \sim 27 \) MPa) and
basalt (\( \sim 220 \) MPa) we cannot see any clear difference in the \( M_t / M_t \)
versus \( E_i \) relation between them. If we plot the data for ice
reported by Lange and Ahrens (1981), they are distributed in the
much left region in these diagrams. In this respect we can see
a strength effect on the \( M_t / M_t \) versus \( E_i \) relation. Because com-
pressive strength of ice is about similar to that of tuff.

However, as experimental conditions of Lange and Ahrens are
different from ours we cannot compare both results equally. Then,
we keep from going into details on this problem until we complete
low velocity impact experiment on ice. The \( M_t / M_t \) versus \( E_i \) rela-
tions fitted by a least square method are given as follows:
\[
\begin{align*}
M_t / M_t &= 5.1 \times 10^4 E_i^{-0.81 \pm 0.05} \quad \text{for spherical basalt,} \\
M_t / M_t &= 5.8 \times 10^3 E_i^{-0.70 \pm 0.14} \quad \text{for cubic basalt,} \\
M_t / M_t &= 7.6 \times 10^3 E_i^{-0.68 \pm 0.05} \quad \text{for spherical tuff and} \\
& \quad M_t / M_t = 1.3 \times 10^3 E_i^{-0.62 \pm 0.08} \quad \text{for} \quad \text{E_i}.
\end{align*}
\]

Size distribution of fragments is well expressed by an
inverse power law relation,
\[ n(\ell) d\ell = \ell^{-\delta-1} d\ell, \]
where \( n(\ell) \) is an incremental number of fragments within the size range of \( \ell \) to
\( \ell + d\ell \). The slope of the size distribution seems to become
steep with increasing the imparted energy density. In Fig. 3,
the exponent $\alpha$ for the catastrophic destruction of basalt sample is plotted against $E_i$. We can see a clear tendency of increasing $\alpha$ with increasing $E_i$: $\alpha \approx -0.6 + 0.36 \log E_i$. However, we cannot see such tendency for tuff. $\alpha$ for the catastrophic destruction of tuff sample is almost constant against $E_i$. It probably means that the imparted energy density is high enough to cut off the bonding of each pair of grains composing tuff. As mentioned by Waza and Matsui (this volume), for basalt number of very fine fragments increases with increase in $E_i$ but not for tuff. This observation supports the above view.