GRAIN SIZE DISTRIBUTION AND RELATIVE LENGTH OF FRAGMENTS IN ALLOGENE BRECCIAS OF THE METEORITIC CRATERS JANISJARVI, KARELIA, AND KARA, THE POLAR URAL. A.T. Basilevsky, L.B. Granovsky, B.A. Ivanov, V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry; E.V. Lomonosov Moscow State University; O.Yu. Shmidt Institute of Physics of the Earth, Moscow, USSR

The work presented has been done under the scientific-research institutions collaboration organized under initiative of Laboratory of Comparative Planetology, Vernadsky Institute of USSR Academy of Sciences, for study of impact cratering. The present work purposes on the examples of meteoric craters Janisjarvi and Kara to describe some poorly studied characteristics of crater allogene breccias and try to obtain some planetological interpretations. The geologic setting and evidences on impact nature of these features had been reported in (1, 2, 3).

Janisjarvi feature represents the crater having near 10 km diameter and formed approximately 700 my ago in quartz-biotite schists of the Ladoga group of the Precambrian. Kara feature have a diameter near 50 km. It was formed in Lower Cretaceous in argilites, siltstones and sandstones of Permian age.

Grain-size distribution and relative length \( \left( \frac{d_{\text{min}}}{d_{\text{max}}} \right) \) of fragments in allogene breccias have been studied in outcrops of the Janisjarvi crater and in a drill-hole within the Kara crater (fig.1). In the Janisjarvi outcrops the similar procedure was also applied to fragment-saturated tagamites (consolidated impact melts) from the contact zone between tagamites and breccias (fig.2). The measurements have been resulted in plots of fragments cumulative frequency, normalized to 1 m\(^2\), vs. fragment diameter and in histograms of relative frequency of fragments having the different relative length (fig.3 and 4).

The functions \( N_\gamma(d) \) in the interval of diameters from several mm up to tens of cm are similar both for Janisjarvi outcrops as well as within the 400 m-section of Kara drill-hole and can be approximated by the equation \( N_\gamma(d)=Ad^\gamma \), where \( \gamma \approx -2 \), and \( A=700-800 \), if \( d \) is measured in cm. The value \( \gamma \approx -2 \) in functions of such kind is considered usually as evidence of single fragmentation (4). At the considered case the preservation \( \gamma \approx -2 \) after the deposition of breccia-forming material and the absence of significant variations of \( N_\gamma(d) \) dependence in lateral (Janisjarvi) and vertical (Kara) direction indicate on the deposition of allogene breccias of these craters from well-mixed highly turbulized cloud of the explosion.

For near-contact fragment-saturated tagamites of Janisjarvi granulometric spectrum is well approximated by the equation \( N_\gamma(d)=Ad^\gamma \), also, where \( \gamma \approx -2 \), \( A=400 \). The similarity of granulometric spectra of fragments in these near-contact tagamites and in allogene breccias is considered, taking into account a number of field-geology observations, as an evidence of active emplace-
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ment (at this place) of tagamites into breccias. Under the opposite situation when the fragments emplace (by sinking or rising) into melt a sorting of fragments under their movement through viscous media should be probably expected.

For the fragments distribution according to relative length a clear mode falling at \( \frac{d_{\text{min}}}{d_{\text{max}}} = 0.6-0.7 \) is observed both for Janisjarvi and Kara breccias. For fragments less than 5 mm (have been studied in Kara breccias only) the second very prominent mode (\( \frac{d_{\text{min}}}{d_{\text{max}}} = 0.9-1.0 \)) is observed. This second mode is probably an artifact due to insufficient accuracy (+1 mm) of the measurements because under the fragments size increase the second mode disappears. The similarity in \( \frac{d_{\text{min}}}{d_{\text{max}}} \) distribution for breccias formed from very different Tertiary rocks (metamorphic shists of Janisjarvi and slightly altered argillites siltstones and sandstones of Kara) demands further study including the data for additional craters. Until now the suggestion could be proposed that under the fragmentation by crater-forming shock wave the peculiarities of target rocks structure do not influence upon the resulted fragments relative length.

The results of study of terrestrial meteoritic craters are important for understanding of processes due to impact cratering on another terrestrial planets. In particular the problem of crater ejecta movement during large scale phenomena has a special interest. An intensive turbulence of explosion cloud during the formation of large impact craters on the Earth is probably the joint effect of atmosphere presence and shock-induced mobilization of volatiles in target rocks. If so, the formation of impact craters on Mars is expected to be accompanied by generation of fragment-saturated and turbulized cloud of the explosion. On the Moon, Mercury and small atmosphereless bodies the ballistic flight of crater ejecta should be dominant but the dynamics of evaporated material of target and projectile could distort the pure ballistics (5).

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References

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Fig. 1

Fig. 2

Janisjarvi

Breccias

+tagamites

Kara, Breccias

Fig. 3

Cumulative frequency per 1 m²

$N > d$

$1 \text{m}^2$

$10^2$

$10^3$

$10^4$

$10^5$

$d, \text{cm}$

Fig. 4

The Moon

Δ ejectas from 540 m-crater

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