CHEMICAL DIFFERENTIATION OF IMPACT-PRODUCED MELT DROPLETS: EXPERIMENTS AND OBSERVATION. M. V. Gerasimov[1] O. I. Yakovlev[2], Yu. P. Dikov[3], and F. Wlotzka[4]. [1]Space Research Institute, RAS, Moscow 117997, Profsoyuznaya st., 84/32, mgerasim@mx.iki.rssi.ru, [2]Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow 117975, GSP-1, Kosygin st., 19, yakovlev@geokhi.ru, [3]Institute of Ore Deposits, Petrography, Mineralogy and Geochemistry, RAS, Moscow 109017, Staromonetny per., 35, dikov@igem.ru, [4]Max-Plank-Institut für Chemie, Abteilung Kosmochemie, Mainz, Germany.

Introduction: The main problem of the relation of ejected melted spherules and target rocks in impact structures is the unknown degree of their differentiation during the high-temperature stage. An investigation of trends of chemical differentiation of melted droplets during impact simulated processes can give a certain evidence for correlation between melt and target rocks in impact sites. Here we present experimental data on impact-simulated vaporization of obsidian that helps to reveal vaporization signatures in impact glasses formed from acidic and intermediate composition targets.

A certain problem for the relating of melt spherules and target rocks is the mixing of target rocks and projectile material. The formed spherules can represent a continuous row of mixed compositions which is modified by volatilization of elements during high temperature processing.

Experimental technique: Impact-simulation experiments were performed using a laser pulse (LP) technique [1]. Glass spherules with diameters ranging from around one to several tens of microns were found on the surface of the condensed film, which was precipitated on a Ni-foil at ~8 cm from the sample. Chemical analyses of spherules were performed using FESEM/EDS microprobe analyses.

Obsidian composition was (wt.%): SiO_2 57.90; TiO_2 1.32; Al_2O_3 15.02; FeO 9.31; MgO 5.11; CaO 7.37; Na_2O 2.99; K_2O 0.53. We have analyzed 83 glass spherules and 10 microareas on polished cross-sections of glass remnants on the walls of the laser-produced crater. Results of analyses were statistically treated and compared with composition of the starting obsidian.

Results: Figures 1and 2 show negative correlation trends between concentrations of moderately volatile Na and Si and refractory Al in glass spherules. These figures show an increase of Al and decrease of Si and Na concentrations in spherules and in the crater glasses in comparison with that of the starting obsidian. The crater glasses have smaller compositional differentiation than spherules what indicates that they were formed at lower temperatures. Crater glasses have higher K/Na ratio compared with that in the starting obsidian (Fig. 3). This is due to different K and Na vaporization rates that is typical for acidic and intermediate composition melts [2].

The Logoi impact glasses: We tried to identify vaporization effects in natural impact glasses from the Logoi crater (D≈10 km; Belorussia) [3]. The target is a two-layer structure with sandstones overlying granite-gneisses. Impact glasses here were mainly resulted from granite-gneiss melting. Fig. 4 shows the SiO_2 and Al_2O_3 anti-correlation in homogenized impact glasses and values for the average composition of the target granite-gneisses.

Compared to a rather strict anti-correlation of Al and Si for experimental spherules (Fig. 2) Logoi glasses show a wider dispersion of Si vs. Al points (Fig. 4). This can be the result of inhomogeneity of the target rocks and/or mixing of gneisses and sandstones. An approach was suggested to derive a uniform population from Logoi glass compositions by an application of strict experimental trend (Fig. 2). This population is limited within dashed lines (Fig. 4) starting at target granite-gneisses compositions marked by an error bar. Fig. 5,6 demonstrate Na-Al and K/Na-Al correlation trends for impact glasses from the chosen composition field of Fig. 4. On the whole these trends are similar to the experimental ones that confirms the validity of such approach. This approach was also supported by other elements trends also for impact glasses from other craters. The selection of uniform glass populations can also be derived by an application of other strict ratios, e.g. Ca/Al ratio [4].

References: [1] Gerasimov M.V. et al. Physics and chemistry of impacts // In: Laboratory Astrophysics and Space Research. 1999. pp.279-329. Kluwer Academic Publishers. [2] Yakovlev O.I. et al. K and Na vaporization from melts. Vestnik MGU. 1973. N5. pp.85-88. (in Rus.) [3] Glazovskaya L.I. et al. The Logoi Astrobleme. 1991. M. Nauka. 134 p. (in Rus.) [4] Gerasimov, M.V., et al. LPSCXXII, 1991, pp. 437-438.

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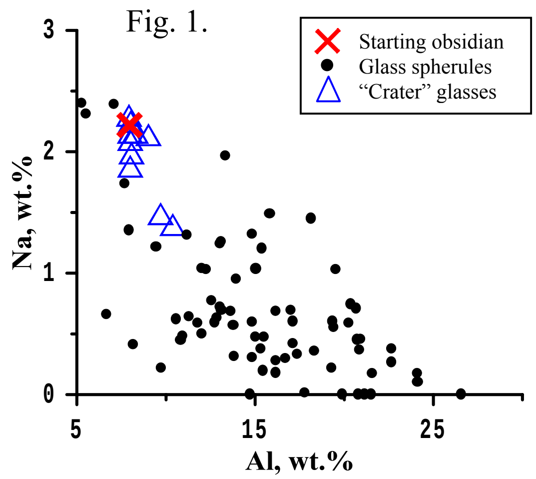
Fig. 1.
Starting obsidian
Glass spherules
"Crater" glasses
Na, wt.%
Al, wt.%
0
1
2
3
5
15
25

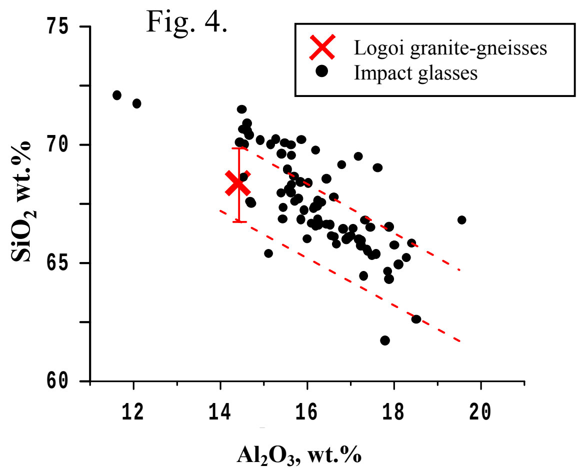
Fig. 4.
Logoi granite-gneisses
Impact glasses
SiO_2 wt.%
Al_2O_3, wt.%
60
65
70
75
12
14
16
18
20

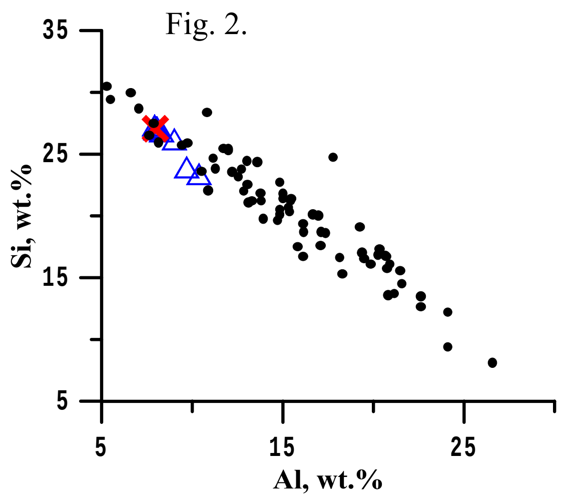
Fig. 2.
Si, wt.%
Al, wt.%
5
15
25
35
5
15
25

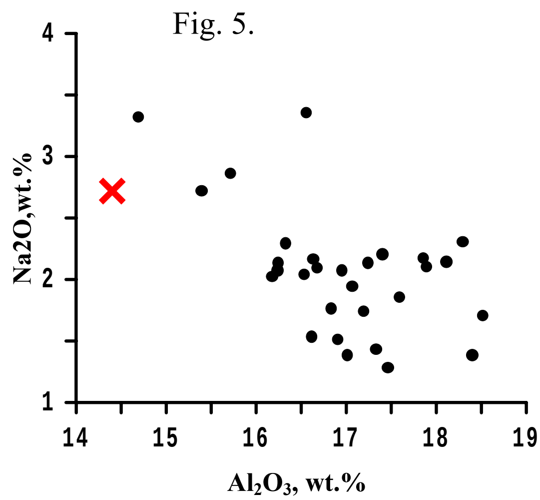
Fig. 5.
Na2O,wt.%
Al_2O_3, wt.%
1
2
3
4
14
15
16
17
18
19

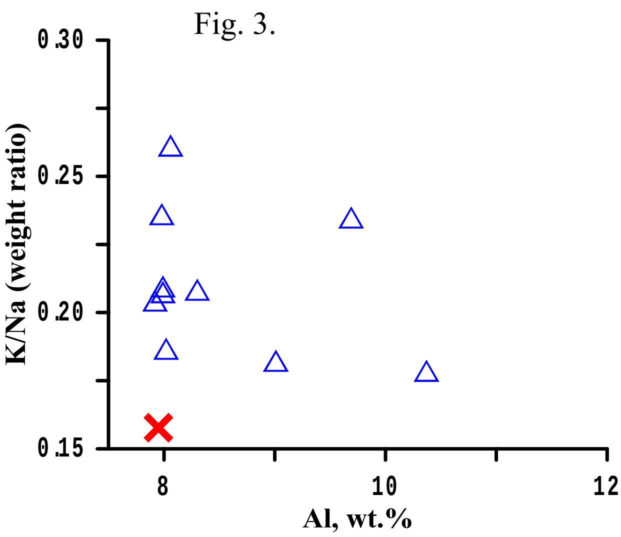
Fig. 3.
K/Na (weight ratio)
Al, wt.%
0.15
0.20
0.25
0.30
8
10
12

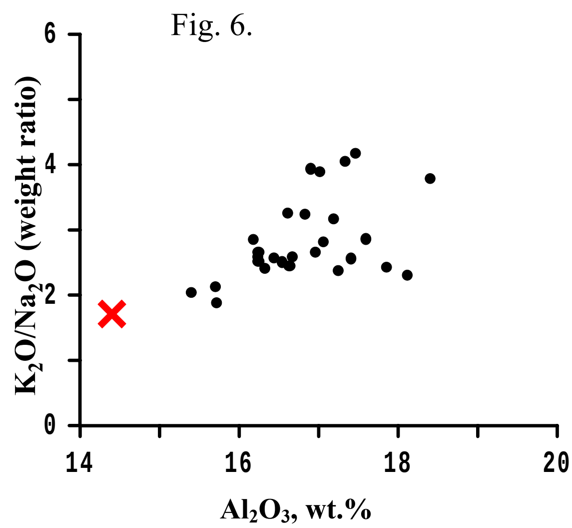
Fig. 6.
K_2O/Na_2O (weight ratio)
Al_2O_3, wt.%
0
2
4
6
14
16
18
20