DYNAMICS OF CLASTIC MATERIAL DISTRIBUTION IN ALLOGENIC BRECCIAS AND SUEVITES OF THE KARA ASTROBLEME. V.L.Masaitis, M.S.Mashchak, T.V.Selivanovskaya, V.A.Ezersky. All-Union Geological Research Institute (VSEGEI), Leningrad, USSR.

The Kara astrobleme about 60 km in diameter is situated on the Kara Sea coast, to the north - east of the Pai-Khoi anticlinorium. An uplift of shattered Paleozoic sediments and diabases (1) is confined to its central part. The socle is composed of weakly metamorphosed folded strata from the Ordovician to the Permian limestones, shales, siltstones and mudstones and the overlying sandy-clay Paleogene and Cretaceous sediments. The crater is filled by almost equal amounts of allogenic breccias and suevites, whereas tagamites display a limited development (1,2,3).

The authors have studied grain size and composition of clasts in suevites and allogenic breccias (except klippen types). More than 150 quantitative calculations were made, calculations of 10-1000 mm fractions being carried out on outcrops those of 5-50 mm, from drill core, 0-1,5 mm, in thin sections. The analysis of the results obtained, as well as a detailed study of all the outcrops available and of the core from more than 40 boreholes 80 to 700 m in depth, have shown that two distinct "layers" might be distinguished in the crater filling: lower (from the bottom upwards), klippen breccias, megabreccias, block-agglomerate suevites, block breccias and block suevites and upper, lapilli-agglomerate suevites and coptoclastites (psammitic-silty breccias). The thickness of the lower "layer" is 0,7-0,9 km, that of the upper one, 1,0-1,2 km.

The lower "layer" is an accumulation of unsorted clasts, no regularity being observed in their compositional distribution and size; the composition and distribution of the cementing mass does not display any regularities, as well. However, there is a certain agreement between a predominant composition of clasts and that of the underlying basement rocks in place of breccia occurrence. Only block breccias and block suevites (Fig.1) are an exception to this. Irrespective of their occurrence, most clasts (especially large ones, up to 0,1 m) are represented by rocks the composition of which corresponds to that of the rocks of central uplift, among them diabases.

In the vertical section of the upper "layer" the size and number of rock and impact glass fragments increase downwards; whereas the amount of the cementing groundmass (less than 0,1 mm) decreases (Fig.2). In the upper part the percentage of clastic material of psammite - silty dimensions is rather high, clasts larger than 1 cm are rarely found, whereas impact melt inclusions are either totally absent or their number is quite limited; in the lower part blocks and, sometimes, isometric or flattened impact glass bombs appear. Clasts mostly vary from 2-5 mm to 3-5 cm in size. As a whole, downwards the section the glass content changes from 0 to 24,0%, that of rock clasts from 5,2 to 53,4%, mineral fragments, 20,0 to 1,5%, and cementing mass, 94,5 to 27,4%. The composition of rock clasts in the upper part of the section (in coptoclastites) is uniform; these
are mostly rocks of Cretaceous and Permian age, in the lower part (in lapilli-agglomerate suevites) is more variegated. The lithoidal clasts are represented by sedimentary rocks from strata of Ordovician up to and including Cretaceous age, rarely by diabases. Clasts of different lithology display an irregular distribution over an area. In the section of suevite strata clasts ranging from several millimeters to dozens of centimeters are distributed in the basis of their size (4). It is assumed that such a distribution reflects a common act of crushing of material and its precipitation from a well mixed suspension. However, allowance should be made for differences in the aggregate state of material which underwent crushing and dusting, i.e. solid rocks and liquid melt. Apparently, it is this fact that causes the appearance of the second maximum on the curve of size distribution of clasts (4), since glass inclusions are always slightly larger than lithoidal ones.

Reconstruction of the crater formation process shows that at the time of an impact event the northeastern slope of Paik-Khoi lay within the shallow continental shelf (5). The target had a three-layered structure: a water layer, a layer of non-lithified or weakly lithified, gently dipping sediments and a layer of metamorphosed folded rocks. Considerable heat consumption for evaporation of water and a low density of the second target layer resulted in generation of a relatively small melt volume compared to the overall volume of crushed and displaced rocks. Water vapour expansion lead to an additional effect of destruction and dissipation of target rocks, as well as dissipation of the melt generated. The displacement of the crushed material had the form of continuous breccia masses on crater rims, mud-stony streams, sliding along the true floor surface, along low trajectories, as well as the form of a gas-dust clast-saturated cloud. Appearance of large rock fragments, derived from the central uplift, mostly in the lower part of the section of lapilli-agglomerate suevites, indicates that an abrupt bulging-up and breaking-away and outburst of crushed rocks occurring there took place in case of an early modification of a transition cavity, after the beginning of the movement of a reverse tidal wave. This wave, moving centripetally within the crater funnel, carried away both large block of rocks and smaller clasts, including those precipitated from a gas-dust cloud. Differences in dynamics of transport and deposition of clastic material gave rise to two so-called "layers" in the strata of breccias and suevites.

The upper layer made of lapilli-agglomerate suevites and coptoclasesites were formed under gradual deposition in water, mostly, of clasts precipitated from a gas-dust cloud; when violent turbulent flows of a reverse tidal wave had already quieted down, and clastic material was deposited vertically from strongly roiled sea water. Block suevites and block breccias, were formed from the material ejected along low trajectories; block-agglomerate suevites, megabreccias and klippen breccias, of lower "layer" were deposited from mud-stony flows as they was displaced in centripetal and centrifugal directions along the surface of a true crater floor.
Fig. 1. Cyclograms of clast composition in suevites A, B, C, D, E, F, G, H, I - calculation points. 1, distribution field of Permian deposits; 2, the same for Carboniferous, Devonian, Silurian and Ordovician; 3, the same for suevites and allogenic breccias; 4, boundary of distribution of suevites and allogenic breccias; 5, cyclograms of lapilli-agglomerate suevites; 6, the same for block suevites; 7, the same for block-agglomerate suevites; 8-10, composition of clasts (0.1-5 mm fraction): 8, Permian and Cretaceous rocks; 9, Carboniferous, Devonian, Silurian and Ordovician rocks; 10, minerals; 11, groundmass (<0.1 mm fraction).

Fig. 2. Change of contents of rock clasts, altered impact glasses and groundmass (<5 mm fraction) in lapilli-agglomerate suevites in the section of boreholes drilled in the rim area of the southeastern sector of the astrobleme, 1, rock fragments; 2, fragments of impact glasses; 3, groundmass; 4, levels at which calculations were made.

Distribution of clastic material in suevites and allogenic breccias of the Kara astrobleme reflects, on the one hand, differences in the distribution of rocks of different lithology and different strength in the basement, and on the other hand, features of mechanisms of crater-formation phases in aqueous medium, succeeding each other.