

RECONSTRUCTION OF ORIGINAL MORPHOLOGY OF THE KARA IMPACT STRUCTURE AND ITS RELEVANCE TO THE K/T BOUNDARY EVENT. M.A.Nazarov(1), D.D.Badjukov(1), L.D.Barsukova(1), and A.S.Alekseev(2) - (1) Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow, 117975; (2) Moscow State University, Geological Faculty, Moscow, 119899, USSR

Introduction. It has been suggested [1-3] that the Kara impact structure may be associated with the K/T boundary event. The structure is supposed to consist of two adjacent impact craters, the Kara and Ust-Kara craters (Fig.1, dotted circles). The Kara crater is located on land and has a diameter of 65 km [3]. The Ust-Kara crater is mainly underwater and has only limited suevite onshore exposure (Fig.1). A diameter of the crater was estimated to be 75 or 155 km [3]. However there is doubt that the Ust-Kara crater exists [4] because: (1) gravity data do not indicate any clear evidence for the crater at the proposed site, whereas the Kara crater is expressed distinctly in gravity fields; and (2) a drilling project showed that a thickness of the Ust-Kara suevites is less than 100 m and the suevites have not a continuous extension. On the other hand the Ust-Kara suevites cannot be considered as fallout of the Kara crater. The suevites are different in texture and chemistry from the Kara uppermost suevites and they cover Permian deposits and megabreccias but not Cretaceous sediments which constituted an uppermost layer of the target before the impact [5]. An additional problem with the Kara/Ust-Kara structure comes from a suevite outcrop at the Sydmayakha River which is outside the Kara and the Ust-Kara craters (Fig.1). The suevites overlie also Permian rocks and therefore cannot be fallout of the Kara crater. Thus the presence of the Ust-Kara crater is controversial, and, hence we cannot determine exact power of the Kara impact event that is important for further illumination of a possible connection between the Kara structure and the K/T boundary event. In the paper we attempt to reconstruct original morphology and dimension of the Kara/Ust-Kara structure on the basis of altimeter measurements.

Altimeter measurements. Using topographic maps we carried out altimeter measurements on the land area around the Kara impact site. 60 radii were drawn from the Kara crater center in directions of 0° - 360° with the interval of 6° . Altimeter measurements were made along the radii with the interval of 1 km up to a distance of 90 km from the crater center. Obtained data were averaged. A resulting altimeter profile (Fig.2) demonstrates an average altitude \pm a standard error of the mean vs a distance from the crater center. The profile shows that topography is centered relative to the impact center and there is a big ring depression associated with the impact center. An apparent rim-to-rim diameter of the depression is about 120 km (Fig.1, dashed circle). The depression consists of an inner deep depression of about 65 km diameter and an outer ring of about 27 km width. The inner depression is relative flat and has a poor expressed central mount. This depression corresponds to the Kara crater, which is filled with suevites and overlying sediments and has a 20-mgal gravity anomaly over it. The relief of the outer ring of the 120 km depression is characterized by terraces (Fig.2) which are connected with concentric faults decorated by river valleys (Fig.1). There is no a gravity anomaly over the outer ring but the ring is marked by a concentric orientation of gravity isolines [4]. The Ust-Kara suevites are into the outer ring (Fig.1).

Discussion. Morphology of the Kara 120 km depression is very similar to that of complex impact craters [6] which are characterized by central deep depression filled with suevites and expressed in gravity fields, and a terrace zone. It was shown for terrestrial craters [7] that a diameter of a center depression (D_t) and a rim-to-rim diameter (D_r) are related by $D_t = 0.57 D_r$. Using the equation at $D_t = 65$ km one can calculate the Kara rim-to-rim diameter to be 114 ± 8 km that coincides with the estimate inferred from the altimeter profile. Thus the Kara 120 km depression has impact crater morphology. Original topographic forms of the structure are only modified but not completely erased by erosion and tectonic movements. All of the suevite outcrops are into the big depression (Fig.1) and hence it represents a single (but not twin) impact structure. The Kara crater described earlier is only a central depression of the structure. The Ust-Kara crater does not exist. The Ust-Kara suevites are remnants of a suevite sheet which covered the outer ring of the big structure and was erased by erosion.

The age of the Kara structure is reported to be in the range of 65-75 Ma [3,8,9], but its age of 65-70 Ma seems to be more plausible [10]. Thus during the interval of <10 Ma from 65 to <75 Ma two huge impacts could take place and both of them ejected a continental material. However a probability of formation of two and more continental craters different in their ages and bigger than 120 km during <10 Ma is only <0.012 at the normal rate of cratering. Therefore there is a probability of >0.988 that the Kara and K/T impacts are the same, or simultaneous or production rate of impacts during K/T transition was increased. Although the Kara structure has

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the 100 km diameter postulated initially for the K/T crater [11], it seems that the structure is not big enough to be responsible for the K/T unique biotic crisis. Geochemical studies suggest that the K/T impact could be more powerful and the K/T ejecta should be dominated by a basalt material [12]. The Kara structure could provide the K/T sediments with the shocked continental material, but the kara ejecta contains only about 50% of a basalt component. Therefore it can be suggested that the main K/T object(s) impacted the ocean crust and the K/T biotic crisis was caused by several simultaneous (or close in time) ocean and continental impact events. The impact structures of Kara, Manson, and, perhaps, Kamensk could be formed by the K/T bombardment. Possible candidates for K/T ocean impact sites have been proposed [13-15] and should be studied in detail.

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