THE KARA AND UST-KARA IMPACT STRUCTURES (USSR) AND THEIR RELEVANCE TO THE K/T BOUNDARY EVENT; C. Koeberl[1,2], M.A. Nazarov[3], T.M. Harrison[4], V.L. Sharpton[1], A.V. Murali[1], and K. Burke[1] [1]Lunar and Planetary Institute, 3303 NASA Road One,Houston,TX 77058 [2]Institute of Geochemistry, Univ.of Vienna, A-1010 Vienna, Austria [3]Vernadsky Institute of Geochemistry and Analyt. Chemistry, Academy of Sciences, Moscow 117975, USSR [4]Dept of Geological Sciences, SUNY at Albany, Albany, NY 12222.

The Kara and Ust-Kara craters are twin impact structures situated at about 69° 10'N; 65° 00'E at the Kara Sea (northern shore of the USSR, Arctic Ocean). Kara is situated completely on land whereas the Ust-Kara is mostly underwater with modest onshore exposure close to the estuary of the Kara river. The structures are barely discernable in aerial and space photography thus their sizes are not well constrained. For Kara a diameter of about 55 km would be a very conservative estimate, and field observations indicate a maximum current diameter of about 60 km. Since the structure is heavily eroded an initial diameter of at least 65 km seems reasonable. The presence of the second structure (Ust-Kara) is inferred from several outcrops of suevites, shocked country-rocks, impact melts, and impact glasses onshore in the vicinity of Cape Polkovnik. The diameter of Ust-Kara has to be larger than 16 km. A better extimate might be 25 km but in all likelihood it is even larger. Suevites and impactites from the Kara area have been known since the beginning of the century, but had been misidentified as glacial deposits. Only about 15 years ago the impact origin of the two structures was demonstrated, following the recognition of shock metamorphism in the area.

Kara is situated in a marshy tundra plain with numerous swamps, small lakes, and rivers. The bedrocks comprise terrigenous Paleozoic sediments, mostly Permian sandstones and shales. A few places near the Kara river also expose Paleozoic limestones and diabases. In the center of the structure is a uplifted core composed of Lower to Middle Paleozoic sediments that are intruded by diabase dikes. The rocks constituting the ~10 km wide uplift are brecciated and show signs of shock, although samples collected at the central uplift are not as heavily shocked as samples from other locations. The crater is filled with allogenic breccias, suevites, impact melts and also impact glasses. The impact melts, often called tagamites, are very similar in appearance to basalt flows and occur as large lenticular bodies within the breccias and suevites. The impact derived materials are overlain by up to 100 m of Pliocene-Quaternary sedimentary deposits. All impactite outcrops (and most suevite and impact melt outcrops) are exposed only in areas where rivers cut across the structure. Large shattercones (up to more than 1 m in length) were found at these locations. A recent (1987) expedition to the Kara impact site (including one of us, M.A.N.) led to the collection of numerous samples of target rocks, shocked country-rocks, suevites, impact melts, and impact glasses, in addition to performing a detailed survey of the crater.

The composition of the target rocks is mirrored by the composition of the clasts within the suevites. In the southern part of Kara, Permian shales and limestones are sometimes accompanied by diabasic dykes, similar to in the central uplift. Due to the high degree of shock metamorphism the shocked magmatic rocks are not easily identified, although most of them seem to be of diabasic or dioritic composition. The impact melts (tagamites) are grey to dark grey fine grained crystallized rocks showing very fine mineral components (quartz, plagioclase etc.) and are the product of shock-melting with later recrystallization. The impact glasses are rather inhomogeneous and small in comparison to the impact melts and are of an appearance and structure that is similar to some Zhamanshin impact glasses (especially Si-rich zhamanshinites). They show a layered structure, inclusions, and vesicles, and have colors ranging from translucent white over brown and grey to black. For our study, aimed at a complete geochemical characterization of the Kara and Ust-Kara impact craters, we have analyzed more than 40 samples of target rocks, shocked rocks, suevites, impact melts, and impact glasses for major and trace elements. Another set of about 70 samples is also currently being analyzed in Moscow to provide additional data. This database will help establish the relationship between target rocks and the impact derived rocks, the degree of impact mixing, and the possible presence of a cosmic component.

Kara and Ust-Kara have been tentatively associated with the K-T boundary [1,2] but published ages are associated with large uncertainties (57 $\pm$ 9 my [3], 63.1 $\pm$ 2.1 [2]). In an effort to test the link between the Kara, Ust-Kara structures and the K-T boundary event additional age determinations are being performed and we here report preliminary analytical results. A new K-Ar determination on impact melts and glasses (in Moscow) gives an isochron of 66.1 $\pm$ 0.8 my and seems consistent with a K-T link. However, a $^{40}Ar/^{39}Ar$ determination (in Albany) yields an age of 74.9 ± 0.3 my (Figure 1) indicating that these structures are not of K-T age. We are currently attempting to reconcile the ages with additional determinations, fission-track measurements and paleomagnetic studies. Whether or not Kara and Ust-Kara are K-T impact structures, they represent a major accretionary event in late Cretaceous-early Tertiary times that must have produced wide-spread, possibly global atmospheric, geological and even biological effects. We are currently searching for the geological signatures of these effects.

References. [1] Sharpton, V.L. and K. Burke, Meteoritics, 22, 499, 1988. [2] Badjukov, D.D., M.A. Nazarov, and A.S. Alekseev, Lunar Planet. Sci XVIII, 40-41, 1987. [3] Grieve, R.A.F, Geol. Surv. Sp. Pap. 190, 25-37, 1982.

Figure 1