MAGNETISM OF TEKTITE-LIKE GLASSES FROM THE ZHAMANSHIN IMPACT STRUCTURE, KAZAKHSTAN.

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Introduction: The tektite-like impact glasses have been collected on the surface of Zhamanshin structure, Kazakhstan (48°24'N, 60°48'E), a ~13 km diameter impact crater formed about 1 My ago [1]. A remarkable feature of the Zhamanshin crater is the simultaneous presence of tektite-like material, locally called irghizites, impact melts containing a significant amount of glass (zhamanshinites), and microtektite like material referred to as microirghizite [2]. Irghizites typically occur as sprays, droplets, dumbbells, strips, twigs, fragments up to 3-5 cm long and weighing from about 50 mg up to 3-4 g. Geochemically, irghizites can be classified as acidic glass, containing > 70-75% SiO_2 and resembling in this aspect classical tektites.

Methods: The initial magnetic susceptibility (K) has been measured with a susceptibility bridge MFK-1FA (AGICO) for over 700 samples. Out of these, natural remanent magnetization (NRM) intensity was measured for 245 samples using a SRM 755 SQUID magnetometer (2G Enterprises, noise level ~ $5 \cdot 10^{-12}$ Am²). Selected samples have been subjected to an in-depth magnetic investigation which included magnetic hysteresis measurements at room temperature (PMC VSM 3900), and measurements of saturation isothermal remanent magnetization (SIRM) and AC magnetic susceptibility temperature dependences between 2 and 300 K (Quantum Design MPMS 3 and PPMS instruments, respectively). Scanning electron microscopy (SEM) has been carried out using a system with focused electronic and ion probes FEI QUANTA 200 3D with an EDAX Pegasus 4000 analytical complex.

Results: The magnetic susceptibility of irghizites forms rather narrow distribution around a median value of $120 \cdot 10^{-9}$ m³/kg consistent with the $136 \cdot 10^{-9}$ m³/kg value found in [3]. However, irghizite samples having K > $300 \cdot 10^{-9}$ m³/kg are clearly anomalous according to both magnetic properties and microscopic structure, constituting ~ 5 % of the whole collection. We therefore refer to the value of $120 \cdot 10^{-9}$ m³/kg as characteristic of normal irghizites. The narrow susceptibility distribution would imply a high degree of homogeneity of the impact glass material in terms of magnetic minerals concentration and composition. Hysteresis and low-temperature magnetic properties indicate that the ferrimagnetic fraction in normal irghizites is dominated by superparamagnetic grains with relaxation times less than 1 s. Magnetically stable component is very small being carried by < 1 % of the total ferrimagnetic fraction, which is itself present in trace amounts, as follows from M_s values of the order of several tens of mAm²/kg.

Origin of anomalous irghizite samples (K > $300 \cdot 10^{-9}$ m³/kg, NRM > $4 \cdot 10^{-6}$ Am²/kg) deserves special consideration. These samples are generally indistinguishable from the normal ones by their outlook, but differ from them both magnetically and microscopically. From the high- and low-temperature thermomagnetic behavior, main magnetic mineral in these samples is titanomagnetite possibly containing also Al and Mg. Hysteresis loops and FORCs measured at room temperature indicate that the ferrimagnetic fraction in pseudo single-domain or even in multidomain state. Relatively large titanomagnetite grains of a rather uncommon habit are observed by SEM. A possible explanation of this dichotomy might be a difference in the initial temperature of the impact melts, from which irghizites were formed. The normal samples could have originated from the high-temperature splashes of melt, and the anomalous ones from the low-temperature ones. Alternatively, large grains occurring in some anomalous irghisites could be of secondary origin.

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References: [1] Florensky P. V., and Dabizha A. I., (1980) *The meteorite crater Zhamanshin*, Moscow, Nauka (in Russian). [2] Glass, B. P. et al. (1983) *Journal of Geophysical Research* 88(Suppl. 1):B319-B330. [3] Rochette, P. et al. (2015) Earth and Planetary Science Letters 432:381-390.