MAGNETIC PROPERTIES OF IMPACT MELTS FROM THE ZHAMANSHIN CRATER, KAZAKHSTAN.

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Introduction: This study is concerned with the peculiar magnetic properties of the impact melts 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), melts containing a significant amount of glass (zhamanshinites), and microtektite like material referred to as microirghizite [2]. Investigated zhamanshinites are represented by bombs, "sprays" formed from massive glass, slags, pumice typically 3-15 cm in size, totaling 61 samples. According to the results of measurements of the magnetic susceptibility, 41 representative samples were selected for further study. 80 % of these samples are represented by massive glass. By chemical composition, samples can be divided into acidic and basic, respectively.

Methods: The initial magnetic susceptibility (K) has been measured with a susceptibility bridge MFK-1FA (AGICO). The same instrument connected with a CS-4 furnace has been used to trace temperature dependences of susceptibility up to 700°C. Magnetic hysteresis loops at room temperature and backfield DC demagnetization curves have been measured in a 1.5 T maximum field with a vibrating sample magnetometer (PMC VSM 3900), and, for selected samples, in a 7 T maximum field with a Quantum Design MPMS 3 instrument. The same instrument has been used to measure temperature dependences of saturation isothermal remanent magnetization (SIRM) between 2 and 300 K. 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: According to the magnetic hysteresis parameters, the studied zhamanshinites can be divided into three groups. The first group (15 samples) includes rather heterogeneous material: slags and pumice (9 samples) and massive glass (6 samples). The range of values of the magnetic susceptibility K is expectedly wide: from $2.5 \cdot 10^{-7}$ m³/kg in the pumice sample to $116 \cdot 10^{-7}$ m³/kg in the slag of the basic composition; the average value is $30 \cdot 10^{-7}$ m³/kg. Zhamanshinites of this group appear to contain a mixture of stable single domain and larger grains, as attested by a rather wide range of coercivities. The second group includes 9 samples of massive glass. The magnetic susceptibility ranges from 1.7 to $20.5 \cdot 10^{-7}$ m³/kg, the average value is $6.7 \cdot 10^{-7}$ m³/kg. In this group, in addition to single domain (and possibly larger) grains, it is possible to identify an admixture of particles with small relaxation times $\tau < 10$ s, behaving as superparamagnetic (SP). The third group (17 samples of massive glass, $K_{av} = 7.7 \cdot 10^{-7}$ m³/kg) differs sharply from the two others in its magnetic characteristics. The ferrimagnetic fraction of these samples is dominated by superparamagnetic particles with $\tau < 10$ s, which are characterized by extremely high values of the coercivity ratio $H_{cr}/H_c = 12 - 66$.

We hypothesize that a genetic relationship may exist between the zhamanshinites' magnetic properties and their formation conditions. In our case, all studied zhamanshinites can be arranged into a sequence from samples that contain very little, if any, SP particles to the samples where these latter dominate the magnetic hysteresis behavior. The above division of zhamanshinites into three groups thus appears largely *ad hoc* and likely reflects the initial temperatures and cooling rates of the impact melt fragments. Therefore, the fraction of the superparamagnetic material might serve as an indicator of the initial temperature and the cooling rate of the impact melt. The presence of a large number of samples containing mainly SP particles with small relaxation times and highly uniform magnetic characteristics would then imply a uniformity of impact-related rocks formed apparently from the superheated impact melt at extremely high cooling rates. Accordingly, the difference in the characteristics of the magnetic domain structure of impactites could be due to the differences in the initial temperature and cooling rates of the impact melt fragments from which the impactites were formed.

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