FALL, SEARCHING AND FIRST STUDY OF THE CHELYABINSK METEORITE. M. A. Ivanova[1], D. D. Badyukov[1], K. M. Ryazantsev[1], C. A. Lorenz[1], S. I. Demidova[1], D. A. Sadilenko[1], N. Artemieva[2], A. V. Korochantsev[1], A. Ya. Skripnik [1], A. V. Ivanov[1], and M. A. Nazarov[1]. [1]Vernadsky Institute, Moscow, Russia, e-mail addresses: meteorite2000@mail.ru. [2]Institute of Geosphere Dynamics RAS, Moscow, Russia.

At 9.22 am, February 15, 2013, thousands of people observed a bright fireball in the sky over the city of Chelyabinsk. The flash was followed by a powerful sonic boom which destroyed windows across the area of ~ 5000 km^2 injuring more than 1500 people, mainly by broken glass. Numerous video recordings of the event have allowed us to reconstruct the body's trajectory and fragmentation history with a high degree of accuracy. The entry angle was low, ~ 17° to horizon; an observed trajectory length in the atmosphere exceeded 250 km. A few flashes occurred between altitudes of 40-20 km. The pre-atmospheric size of the meteorite was ~ 15-20 m, the total mass was ~7,000-10,000 t with the total energy of (100-500) kton TNT. Only a small fraction of this mass was found near Chelyabinsk as meteorites (ChM).

Thousands stones (average size, 3-6 cm, weight from mg to 1.8 kg) fell as a shower around Deputatskiy, Pervomayskiy, and Yemanzhelinka villages ~40 km south of Chelyabinsk. We collected ~450 samples with total weight of ~ 4 kg. The total mass collected by local people is > 100 kg and perhaps > 500 kg, but it is only <0.02% from the estimated pre-atmospheric size, but 99% of the main mass was not found and probably presents atmospheric loss. The ChM pieces were collected out of snow by local people. Some people collecting the stones immediately after the fall noticed that they were warm (~ 40-50^o C). Our ChM collecting continued for almost two weeks as the weather was clear until the snow storm begun. Despite the fact that snow cover was ~70 cm, meteorite fragments were easily detected with the holes in the snow surface. We noted that big fragments reached a frozen ground surface while small fragments got stuck in the snow, in rare cases the smallest fragments were lying on the thin ice crust over the snow. Stuck in the snow meteorite fragments were surrounded by dense shell of coarse-grained snow continuing into a vertical column of 15-25 cm in height, named "snow carrots" above which the channel in the snow led to the surface. The channel walls were not cylindric but had irregular topology and were composed of the coarse-grained snow also. The snow could be punched through by slow melting if stones were "warm". Unlike people observations, some model calculations showed that pieces with fusion crust of 1 mm thick and some internal warming cool very fast and could have arrived "cold". Since formation of the "snow carrots" is a specific feature of searching the ChM in a deep snow we discuss internal and external sources of heating in their formation.

Based on the texture, mineral chemistry, bulk chemical and oxygen isotopic compositions the ChM is LL5 chondrite (OC), S4, and WG 0 [1]. It contains two lithologies – (A), light chondritic material and (B) – dark impact melt, that was even presented by small individual fragments among all samples. LL5 chondrites are 2% among OC falls. On the territory of Russian Federation no fall this large has been observed. It was the biggest meteorite fall since the Tunguska event in 1908. We can propose that the ChM fall is the most dramatic LL5 chondrite fall.

References: [1] Galimov E. M. et al. 2013. Science (submitted).