CHELYABINSK: AN ORDINARY CHONDRITE FROM A SPECTACULAR FALL IN RUSSIA.

Y. Liu[1], J.M.D. Day[2], C. Ma[3], K.P. Hand[1], N.P. Pokhilenko[4] and L.A. Taylor[5]. [1]Jet Propulsion Laboratory, Caltech, Pasadena, CA 91109, USA, Email: yangliu@jpl.nasa.gov. [2]Scripps Institution of Oceanography, UCSD, La Jolla, CA 92093, USA; [3]Division of Geological & Planetary Sciences, Caltech, Pasadena, CA 91125, USA; [4]Siberian Branch, Russian Academy of Sciences, Novosibirsk, Russia; [5]Planetary Geosciences Institute, Earth & Planetary Sciences, Univ. of Tennessee, Knoxville, TN 37996, USA,

Introduction: The asteroidal explosion that occurred over Chelyabinsk, Russia on Feb 15, 2013 was the first-witnessed occurrence that caused significant damage to humans and their properties. The bolide responsible for this extraordinary event was estimated to be 17-20 m in diameter, traveling at a speed of ~18 km/s. Although it coincided with the fly-by of $2012DA_{14}$ (a ~45 m asteroid), the Chelyabinsk bolide has been estimated to be derived from the main asteroid belt [1]. Here, we report our study of two pieces of this meteorite, both completely covered by fusion crust and amounting to a total mass of ~5 g.

Results: We prepared three thin sections from one ~2.5 g fragment. The other 2.7 g piece was crushed and is being used for ongoing determination of bulk-rock geochemistry and spectral reflectance data, some of which will be presented at the conference. These thin sections display relics of chondrules of different textures, including barred olivine (BO), radial pyroxene (RP), porphyritic olivine, and/or pyroxene (POP), and cryptocrystalline chondrules with diameters up to 5 mm. The boundary of smaller chondrules is diffusive. Individual olivine and diopside fragments are also common in the sample. Large metal and sulfide grains contain olivine and albite, and appear to reside between chondrules. The matrix in chondrules and between chondrules is crystallized.

Silicate minerals are remarkably homogenous with compositions of: $Fo_{71.0\ \pm0.4}$ for olivine, $En_{74.7\ \pm0.3}Wo_{1.4\ \pm0.2}$ for orthopyroxene, $En_{46.4\ \pm0.5}Wo_{45.1\ \pm0.9}$ for diopside. The matrix compositions are largely albitic ($Ab_{83\ \pm4}Or_{6\ \pm3}$), but K-rich compositions are also observed ($Ab_{34\text{-}42}Or_{56\text{-}47}$). Accessory minerals include ilmenite, chromite, apatite, merrillite, Fe and FeNi metals (kamacite, taenite), and troilite. Taenite grains often contain Fe, Cu, troilite, phosphide, and possible lawrencite ($FeCl_2$), which quickly oxyhydrated to akaganéite, probably from terrestrial water vapor.

Based on the mineral compositions, abundances, and the texture, this sample represents an equilibrated, LL4-5 ordinary chondrite, similar to other LL4-5 finds/falls [2]. The parent body of Chelyabinsk has been estimated to be part of the Apollo asteroids [1]. Chelyabinsk therefore offers new insight into the composition and nature of this group of Near Earth Asteroids (NEAs).

References: [1] Zuluaga, J.I and Ferrin I. (2013) (http://arxiv.org/abs/1302.5377). [2] Brearley, A. J. and Jones R. H. (1998). Rev. Min. 36, Chapt. 3.