

THE FALL AND RECOVERY OF THE GREAT SALT LAKE METEORITE

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Introduction: On the morning of August 13, 2022, a daytime fireball streaked across the sky over northern Utah. The fireball was witnessed by dozens of residents of Colorado, Utah, Wyoming and Idaho and shortly thereafter, tens to hundreds of thousands of Salt Lake City metro residents were startled by several piercing sonic booms. There were numerous reports of dogs cowering and homes shaking from the volume and force of the explosions. Local government officials quickly confirmed the sonic booms/explosions were not from any military air operations or detonations, so it seemed likely that a meteor had exploded over Salt Lake City! Did any pieces make it to the ground as meteorites?

Doppler radar data: The Salt Lake City NEXRAD (KMTX), the Salt Lake City Terminal Doppler Weather Radar (TSLC), and the NEXRAD at Pocatello, ID (KSFX) recorded signatures consistent with falling meteorites. The first detection came at 14:32:22 UTC and 9538 m altitude above sea level by TSLC, only 55s after the fireball occurred. Another signature was detected by KMTX at 14:32:46 UTC and 4,473m with a calculated mass of 3,920g. The mass value is estimated by calculating the mass of a spherical meteorite that would traverse the distance along an aerodynamically limited flight path between the end of the fireball and the detected altitude of the radar signature, in the time difference between the fireball terminus and the radar detection. The Jörmungandr dark flight model was used for all calculations [1]. The final radar detection occurred at 14:40:30 UTC, 543s after fireball terminus. Total elapsed time for radar detection is 543s, or eight minutes and eight seconds. Eleven separate radar sweeps showed falling meteorites, with a range of mass estimates from 3,920g to 0.02g.

Recovery: The Doppler data predicted a strewnfield near the southern end of the Great Salt Lake, just north of Interstate 80 and the community of Lake Point (Fig. 1). On August 16, 2022, Sonny Clary recovered the first meteorite from the strewnfield, a 217g stone (Fig 2). The initial find is a roughly pyramidal or fin-shaped stone with 93% fusion

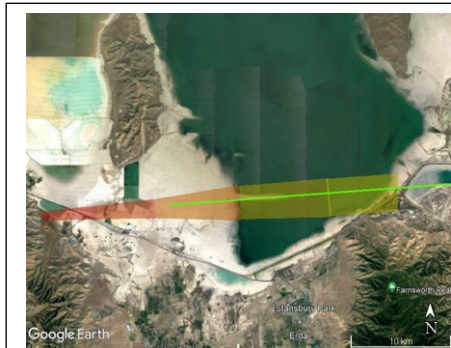


Figure 1. Dark flight strewnfield model.

crust. The crust is matte black and shows a couple of chondrule outlines; a few small areas of broken crust show a light gray matrix with orange, mm-sized halos around metal/sulfide grains. A 21g piece from the first find was brought to the University of Utah as a type specimen and was used for classification (now officially named Great Salt Lake [2]), and is under permanent curation at the Cascadia Meteorite Laboratory.

Petrography and classification: The sample is dominated by regions lacking clear difference between chondrules and matrix and composed largely of anhedral olivine ($Fa_{19.6\pm 0.2}$) and Low-Ca pyroxene ($Fs_{17.0\pm 0.4}Wo_{1.3\pm 0.3}$) grains, along with abundant FeNi metal and iron sulfides. Plagioclase feldspar grains are $\leq 50 \mu m$

across, despite integrated textures, and are often found in inclusion-filled clusters. Smaller regions of sharply defined chondrules and partial chondrules with fine-grained feldspathic mesostases are sprinkled throughout. Radial pyroxene, porphyritic olivine, and barred olivine chondrules range in diameter from $\sim 0.25 \mu m$ to $> 2 \text{ mm}$. Metal grains, consisting of kamacite, taenite, and plessite, appear to have been fluidized, as they have scalloped edges where they surround silicate grains, and contain silicate inclusions. BSE imaging shows no evidence for replacement of metal by iron oxide/hydroxide weathering products, despite the orange halos seen in visible light.

The meteorite has been classified as an ordinary chondrite (H5). Olivine and pyroxene grains are homogenous, consistent with an H-group chondrite of petrographic type 5 or 6, while plagioclase feldspar size is most consistent with a type 5. The magnetic susceptibility was measured as $\text{Log } X=5.4$, also consistent with H chondrites.

References: [1] Fries, M.D. *LPS LIV* Abstract #2806 [2] *Meteoritical Bulletin*, No. 111 (2023).



Figure 2. The Great Salt Lake meteorite.