RECOVERING THE 07 MAR 2018 METEORITE FALL INTO THE OLYMPIC COAST NATIONAL MARINE SANCTUARY

M. Fries[1], J. Waddell[2], OET and crew of E/V *Nautilus*[3], SOI and crew of R/V *Falkor*[4], B. Pugel[5], R. Zeigler[1], R. Harvey[6], L. Welzenbach[7], F. McCubbin[1], and P. Abell[1]
[1]NASA JSC, [2]NOAA Olympic Coast NMS, [3]Ocean Exploration Trust, [4]Schmidt Ocean Institute, [5]NASA GSFC, [6]Case Western Reserve U., [7]Rice U. Email: marc.d.fries@nasa.gov

On 07 March 2018 at 20:05 local time (08 March 03:05 UTC), a dramatic meteor occurred over the Olympic Coast Marine Sanctuary off of the Washington state coast. Eyewitnesses reported the sky brightening significantly and those near the coast reported sonic booms loud enough to shake homes and cars, although the number of witnesses to the actual fireball was limited by cloud cover. Data from seismometers (including several mounted on the seafloor), weather radars, and even a moored weather buoy indicate that a massive meteorite fall resulted from this event, with many kilograms of meteorites deposited into the ocean around 47.441713° N 124.661732° W. Dominant winds were out of the WSW, and so the largest meteorites landed at the western end of a strewn field approximately 11 km long, with progressively smaller meteorites trending towards the east. Weather radar data indicate that this was the largest meteorite fall to occur within the range of the NOAA NEXRAD nationwide radar network since the system went online in the mid-1990s, during which time over two dozen meteorite falls have been recorded by the network (*Fig.1*). The falling meteorites included individual rocks large enough to create splashes recorded by the KLGX radar (Langley Hill, WA) in multiple lowest-elevation sweeps.

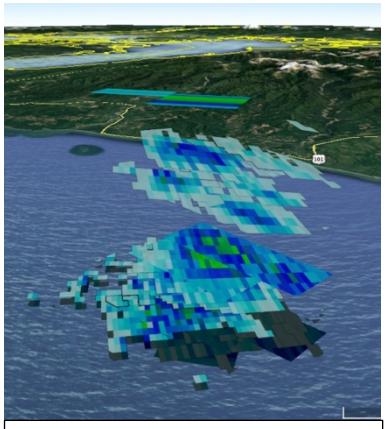

Figure 1: Composite image of NEXRAD signatures of falling meteorites. Credit: Google Earth

The size distribution of meteorites observed on radar indicate a scientifically important feature - this meteorite fall was mechanically much tougher than all meteorite falls observed in NEXRAD data to date. Total mass estimates are provided by the Niðhöggr radar-based mass estimate model in terms relative to the Park Forest, IL meteorite fall (27 Mar 2003)[2]. From the 1-10g meteorite range, the Washington coast fall is 4.9x the mass of Park Forest, and for the 10-1,000g mass interval it is 9.5x the mass of the same interval of the Park Forest fall. This fall has favored the survival of large meteorites, suggesting that the meteorite is significantly tougher than the Park Forest L5 chondrite, or other meteorites (almost all OCs) analyzed using Niðhöggr to date. This makes recovery of meteorite(s) scientifically important for two reasons. One, whatever type of meteorite this is more capable of causing more damage on the ground than the average meteorite fall. Second, knowing the meteorite type will allow identification of future falls through weather radar alone.

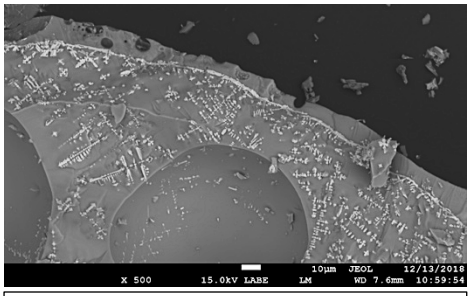

Figure 2: SEM image of melt spherule recovered in the R/V Nautilus expedition. This 2mm-diameter sphere features magnetite dendrites throughout, minor carbonaceous inclusions, and a thin vesicular silicate rim. These features are consistent with a recently fallen meteorite melt spherule [1].

In June 2018, the Ocean Exploration Trust and the crew of the E/V *Nautilus* attempted recovery of meteorites at the fall site. During an eight-hour ROV dive, *Nautilus* recovered seven samples of seafloor sediment but did not locate large stones. Analyses produced a single 2mm-diameter sphere of unweathered, melted meteorite material (*Fig.2)*. Raman spectroscopy and SEM/EDS reveal the spherule is predominantly silicate glass with abundant magnetite dendrites, minor carbonaceous inclusions, and minor sulfides consistent with mildly distorted pentlandite. However, unmelted material is needed to address the primary science questions of the full identity of the meteorite and its mechanical strength.

The Schmidt Ocean Institute (R/V *Falkor*) will attempt a second recovery effort in early June 2019. The primary goal is to recover at least one meteorite fragment containing unmelted meteorite material, preferably >5g in mass. This effort will draw upon lessons learned from the *Nautilus* expedition, focusing on small material in the "small end" of the meteorite strewn field, with secondary search targets drawn from splashes seen in KLGX data and calculated landing sites of the largest meteorites seen on radar.

References: [1] Harvey, R.P. et al, 1998. Geology, 26(7), pp.607-610. [2] Fries, M., et al 80th MetSoc (2017) Abstract #6251.