METEOR(OLOGY / ITICS) UNITE!: MULTI-INSTRUMENT-ENABLED DISCOVERY OF A NEW, OBRITALLY-CONSTRAINED METEORITE STREWN FIELD. S. L. Anderson[1]* H. A. R. Devillepoix[1], A. G. Tomkins[2], H. E. A. Brand[3], A. Tait[2], L. Winchester[2], J. Soderholm[4], E. K. Sansom[1], M. C. Towner[1], M. Cupák[1], *(seamus.l.anderson@gmail.com), [1]Curtin University - School of Earth and Planetary Science, Kent St, Bentley, WA, Australia , [2]Monash University - School of Earth Atmosphere and Environment, 9 Rainforest Walk, Clayton, VIC, Australia, [3]Australian Synchrotron, ANSTO, 800 Blackburn Rd., Clayton, VIC, Australia, [4]Australian Bureau of Meteorology, 700 Collins St, Docklands, VIC, Australia.

Introduction: On the afternoon of 31 July 2013 (2:20 pm local time) US government satellites [1] detected a large bolide event in the skies ~100 km North of Port Augusta, South Australia. The meteoroid, estimated to originally be 1.5 m in diameter and having a mass of 6 tons, exploded during the event, releasing approximately 920 GJ of energy (~220 tons of TNT) [2]. Just after the visibly observable portion of the event, the surviving meteorite shower appeared on three separate sweeps, from the nearby Woomera weather radar, matching the predicted ballistic trajectories that falling meteorites would follow.

By combining the satellite and radar data, we calculated a strewn field where the meteorites most likely landed, based on their expected size [2]. The first exploratory field trip (in September 2022) to the fall site returned with 10 meteorites after only a few hours of ground searching. This spawned a more substantial visit the following month, which yielded 34 additional meteorites (giving 44 total to date).

Methods:

Remote Sensing. Using the publicly available satellite data for bolide events [1], we cross-matched the 16 events that occurred over Australia since 2002 with weather radar data from nearby ground stations [3]. For this event, the station at Woomera detected radar returns at three ascending elevation sweeps: 8.5, 10.5, and 13 km), indicating significant size sorting. We then used WRF atmospheric modelling and darkflight simulation software to predict the strewnfield location [4].

Meteorite Searching. Both field trips employed traditional strewn field searching techniques of basic ground walking and observation, and although the second field trip employed the use of a drone [5,6], most of the searching ground proved to be inconducive to this methodology, as terrestrial-origin black/dark rocks appeared somewhat commonly in the search area, resulting in too many false positives from the detection algorithm to be of any use. Lowering the drone's automated survey height to distinguish these meteor-wrongs from the meteorites was not possible due to terrain elevation variation and the high risk of colliding with trees.

Meteorite Analysis. Four of the recovered specimens were sampled to make thin sections for analyses via both scanning electron, and optical microscope.

Results & Discussion: In total, 44 individual meteorites ranging from 9 to 390 g have been recovered with a total recovered mass of 4.093 kg. Although the meteorite has not yet been officially registered with the meteoritical society, EDS and optical microscopy data indicate that this meteorite is an H5, S4, W0-1 Ordinary Chondrite. Although not every stone has been examined for classification, inspection of their fusion crusts and broken surfaces (where present) indicate they are also likely H chondrites.

Although drone-based exploration was not helpful in his case, the system is still in relatively early stages of development, and will be iterated. In the future, using a lens with a longer focal lens or enabling terrain tracking could help to mitigate the problems we encountered. We will likely revisit the strewn field to extend the limits of our search. We will also analyze more of the recovered specimens to identify any possible variations within the same, large impactor.

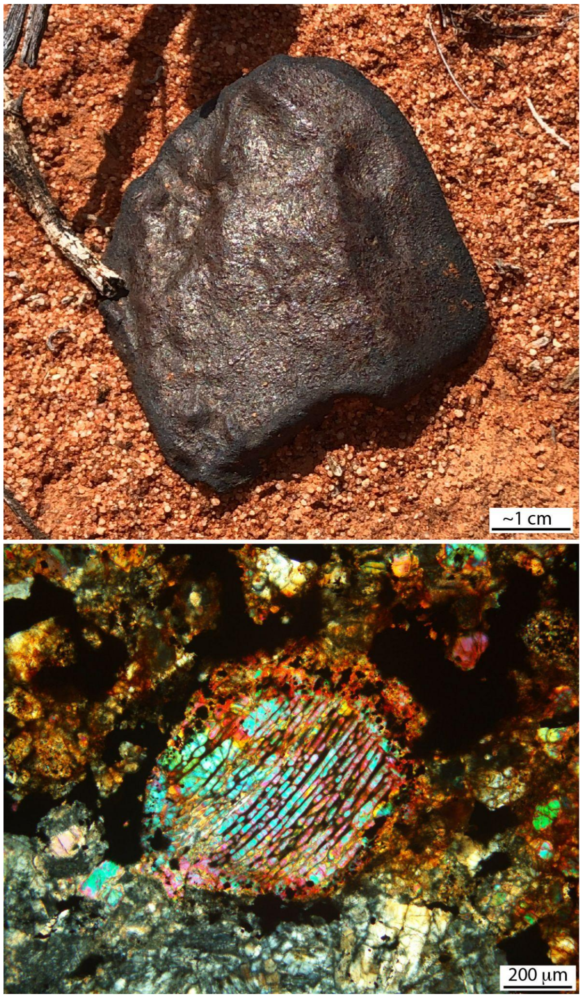

Figure 1. *Examples of the features of the meteorites. Top: Meteorite as found in the field. Bottom: a partially equilibrated barred olivine chondrule with indistinct edges, typical of the textures seen in petrographic type 5 chondrites.*

Conclusions: Traditionally, recovering meteorites with well-characterized orbits is most easily enabled by fireball camera networks, and although they will likely play a main and continued role in orbital meteorite recovery, the successes encountered here have further cemented the utility of combining alternative observation sources to hunt for particularly large meteorite falls where fireball networks may not be present [7,8,9].

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References:

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