

**LEAVE NO STONE UNTURNED: SEARCHING FOR A METEORITE FALL NEAR STONE, UK.**

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**Introduction:** With the spread of fireball camera networks around the world, witnessing fireballs that drop meteorites is becoming more and more frequent, along with their successful recovery. However, successfully searching for meteorites, particularly in Northern Europe's farmland remains challenging. Here we report the fireball observations, search campaign, and lessons learned for a recent meteorite fall near the town of Stone in the UK.

At 3 am UTC on Monday the 6<sup>th</sup> May 2024 a fireball was witnessed across the UK by cameras of the UK Fireball Alliance (UKFALL – a collaboration between the UK's six fireball camera networks, academic institutions and curation facilities to observe fireball and recover freshly fallen meteorites with orbits) including four SCAMP-FRIPON, seven GMN cameras and two AllSky7 cameras (Fig. 1). The 3 am arrival coupled with cloudy conditions over much of the UK meant the fireball was not widely seen by the public or reported in the media. Our models predicted that 200-600g of material survived atmospheric entry and fell near the town of Stone to the south-east of Stoke-on-Trent, UK. This relatively small mass is close to UKFALL's low-mass end for consideration for a search. However, the steep angle of entry meant the strewn field was constrained to a relatively small area 2-3 km long, while several fragmentation events in the fireball images raised the chances for several small pieces along the strewn field. The meteoroid also had a near Earth pre-atmospheric orbit, and the fall site was largely grassland which would make searching easier (Fig. 1). Given these factors, alongside the possibility of finding the 'Stone' meteorite (can you imagine!), a search was organised.

Two dark flight models were produced from weather conditions and windspeeds either side of the fireball arrival time which predicted a spread of small 5-10 g fragments over an area 1 km wide. A third dark flight model was later run which was consistent with the first two. A small team of five people arrived in the area on Tuesday 7<sup>th</sup> May night to meet with local landowners and get permission to search the land along the fall line on Wednesday 8<sup>th</sup> May. Meteorite collection kits and business cards had already been prepared in anticipation of a search to hand out to local residents. Most landowners granted permission to search their fields except those with bulls or calves for health and safety reasons, or grass that was due to be mown to make silage. With permission to search obtained, we sought volunteers from UKFALL and nearby planetary scientists.

An international team of > 20 volunteers helped search the strewn field for two and a half days. Our strategy was to first search the low mass 5-10 g fragments and focus on fields that were barren or had sheep to keep the grass low, followed by grassland being grown for silage, before extending our search into the area where the main mass was predicted to have fallen. The local environment contained a lot of meteor wrong candidates including black flint, grey siltstone, industrial slag, coal and charcoal, as well as various animal faeces. These meteor wrong objects were reasonably obvious in the environment even in tall grass, giving confidence that it would not be impossible to find the meteorite. The weather was hot (for the UK) and sunny, which made searching challenging, particularly in exposed barren land, while the high pollen count made searching tall grass gruelling for hay fever sufferers. After most of the easily searchable land had been completed sadly no meteorite was found, and so the search was paused.

A press release has been distributed to raise awareness about the recent meteorite fall and it is our hope that the meteorite may yet be found.



Figure 1. Image of the fireball observed by a FRIPON camera in Manchester (left) and example images of the search terrain (centre and right).

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