# A Global Fireball Observatory

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The meteorite collections contain a very rich picture of what the early solar system would have been made of, however the lack of spatial context for these samples is an issue. The asteroid population is equally as rich in surface mineralogies, hence mapping the two populations together is a major challenge for Planetary Science. Providing a geological context for extraterrestrial materials is a key driver behind a $billions effort on the part of the world's space agencies, in the form of sample-return missions to comets and asteroids. These missions will deliver the most pristine primitive material ever recovered, map asteroids at unprecedented resolution, and provide 'outcrop' context for returned samples. Fireball networks, calculating pre-atmospheric orbits for meteorites, complement this last headline goal. Fireball networks have been operating for over 50 years, but the number of successful meteorite recoveries has increased significantly in the last 10/15 years.

It has recently been shown that the current fireball observation hardware is precise enough to infer source regions of meteoroids, however there is a significant deficit of meteorites found by these techniques (by a factor of 4 at least). Systematic issues in the way observation data are analysed may contribute to this, but the difficulties to locate meteorites likely accounts for most of this deficit.

The Global Fireball Observatory (GFO) collaboration was established in 2017 and brings together 14 institutions (from Australia, USA, Canada, Morocco, Saudi Arabia, and the UK) to maximise fireball observation time and therefore meteorite recoveries. The members have a choice to operate independently, but they can also choose to work in a fully collaborative manner with other GFO partners. This efficient approach leverages the experience gained from the Desert Fireball Network (DFN) pathfinder project in Australia. The state-of-the art technology (DFN camera systems and data reduction) and experience of the support teams is shared between all partners, freeing up time for science investigations and meteorite searching. The DFN now has a dedicated team working on automated meteorite searching techniques using a combination of robotic surveying with UAVs, and recent breakthroughs in object recognition using deep learning. Once validated in Australia, this approach can be ported to other parts of the world, and the recovery rate will improve significantly. The GFO has the objective of covering 2% of the Earth by 2020; other groups such as the well established European Network (Central Europe), FRIPON (Western Europe) are well under way to covering a significant part of the EU area. This combined effort is going to bring new, fresh, extra-terrestrial material to the labs, yielding new insights about the formation of the Solar System.

With now close to 40 meteorites recovered with orbits, we already have several samples of less common meteorites (notably HEDs, carbonaceous chondrites, enstatite chondrite, ureilite). Although not quite a statistical anomaly yet, the recovery of an iron meteorite is overdue, and will certainly be one of the highlights in this growing field of research over the next few years.