# THE TWANNBERG (IIG) IRON STREWN FIELD, SWITZERLAND: STATUS OF EXPLORATION AND RELATION WITH QUATERNARY DEPOSITS

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**Introduction:** Knowledge about the Twannberg IIG iron meteorite in the Swiss Jura Mts. has developed from a few isolated masses, the first and still largest being Twannberg mass 1 (TW1, 15.9 kg) found in 1984, to a large strewn field comprising more than 550 meteorites with a total known mass of ~70 kg. 38 (33.8 kg) masses were found in the Gruebmatt area in proximity to the first find of 1984, another 78 (2.1 kg) in the Twannbach river and most recently 450 masses (29.7 kg) on Mt Sujet. Here we report on the status of exploration, size distribution and relation of finds with the geological substrate and provide a preliminary model to explain the observed distribution. Results of a study on noble gases and cosmogenic isotopes are reported in [1].

**Search methods and test for pairing:** Search for meteorites is carried out with metal detectors enabling the detection of 10 g to 100 g iron meteorites at depths of up to 30 cm. The natural surfaces of recovered potential meteorites are systematically analyzed using a hand-held X-ray fluorescence analyzer, allowing the discrimination of scrap and meteorites within 2-15 seconds. Selected samples are cut. Pairing with Twannberg is then often confirmed by the presence of characteristic large skeletal schreibersites and further analyzed for Ni by XRF, typically yielding values between 4.0 and 4.5 wt%, close to values of 4.3-4.8 wt% reported for Twannberg iron metal [2], lower than in most iron meteorites. Selected samples were analyzed with LA-ICP-MS and compared with TW1.

**Results of fieldwork:** Meteorite searches carried out from 2009 to present yielded 445 additional masses ranging in size from ~1 g to 5.75 kg. Three find complexes were identified: Twannbach river (TR), Gruebmatt (GR) and Mont Sujet (MS). TR samples (n = 78) were mostly recovered by M. Eggimann and J. Weiss from heavy mineral traps in the gorge of the Twannbach stream at an altitude of ~700 m. Median mass is 11 g. They are obviously transported. GR masses (n = 38) were found in proximity (65 to 1100 m) to the find place of the first find (TW1). These samples are found on/in a thin cover of moraine covering limestones of Upper Jurassic age, just outside of the maximum extent of the last glaciation. The altitude is close to 1000 m. These finds were made by different collectors after recovery of TW80, the first find close to TW1, by Marc Jost in 2013. Median mass is 55 g. The size distribution is very heterogeneous. MS is the most extensive find complex with 450 samples found all over the MS plateau (altitude 1150-1360 m), covering an area of ~4.5x0.6-0.8 km. All MS finds were made between April 2015 and May 2016. The size distribution is quite homogeneous with a significant size increase of individual masses from east to west. Median mass is 38 g. Mass distributions for four quadrants, each about of the same size as the GR find complex, confirm the systematic mass increase from east to west.

**Characteristics of recovered meteorites:** Meteorites recovered from the GR and some from the TR find complexes show thick rinds of weathering products with inclusions of angular quartz sand grains derived from glacial deposits. No fusion crust is preserved. Samples from the MS complex form two groups: i) those found in silty clay typically are heavily weathered; ii) meteorites recovered from limestone regolith containing humose soil are often well preserved, showing regmaglypts, remnants of fusion crust including flow lines, and heat affected zones. Weathering often penetrating <1 mm deep is surprising, considering the terrestrial age of 165±58 ka [1]. Noble gas data of five MS samples show that they are from less shielded positions of the meteoroid compared with TR and GR samples, confirming an origin from a different part of the original strewn field.

**Interpretation of findings:** Based on GR and TR finds, no information about the primary orientation or size of the strewn field can be derived, as both find complexes appear to consist of transported masses. The MS find complex is located at higher elevation and lack evidence of secondary transport. These finds are interprted to be close to their fall location. The systematic increase of the masses of individuals from ENE to WSW over 4.5 km are taken as indication of the general orientation of the strewn field. The limits of the distribution of meteorites is not yet finally known, but it is most consistent with primary finds being restricted to areas not affected by alpine ice during the second last ice age (~180-120 ka). Glacially transported finds (GC find complex) are located in moraines likely deposited during the second last ice age. No finds were made in moraines of the last ice age. The geological evidence is consistent with the terrestrial age of 165±58 ka [1].

**References:** [1] Smith, T. et al., *Abstract, 79th Annual Meeting of the Meteoritical Society*. [2] Hofmann B.A. et al. 2009. *Meteoritics and Planetary Science* 44:187-199.

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