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An eight kilogram chunk and more: evidence for a new class of iron silicide meteorites from the Chiemgau impact strewn field (SE Germany)

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Introduction

The find of a big 8 kg weighting iron silicide chunk (Fig. 1) found about 30 years ago in the Chiemgau meteorite impact strewn field (Fig. 1) [1—3 and references therein] has strongly supported the earlier formulated hypothesis [1—3 and references therein] of an extraterrestrial origin for the abundant occurrences of iron silicides (Fig. 2) in connection with the craters in the elliptically formed strewn field sized about 60 × 30 km [1]. Up to now some thousands of iron silicide particles have been sampled, mostly by metal detectors, roughly amounting to a mass of a few kilograms (apart from the 8 kg chunk). Here we report on new analyses, which establish an obviously common formation and origin.

Fig. 1. Location map for the Chiemgau impact crater strewn field. Middle, right: Iron silicide finds addressed analytically in this paper

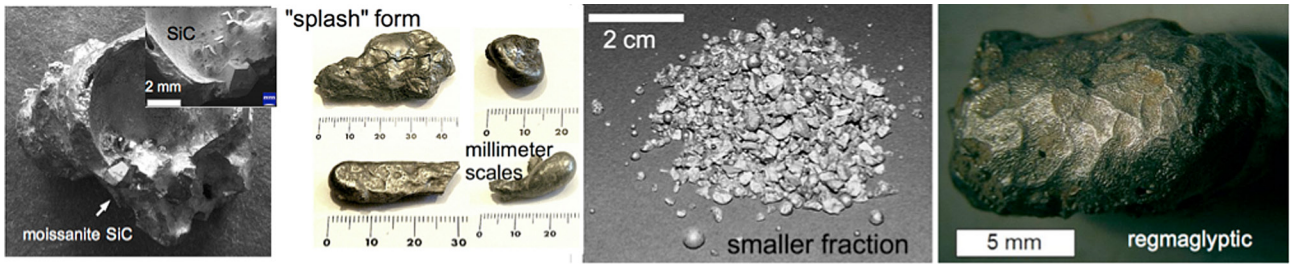

Fig. 2. Various aspects (apart from Fig. 1) of the iron silicide finds from the Chiemgau impact strewn field

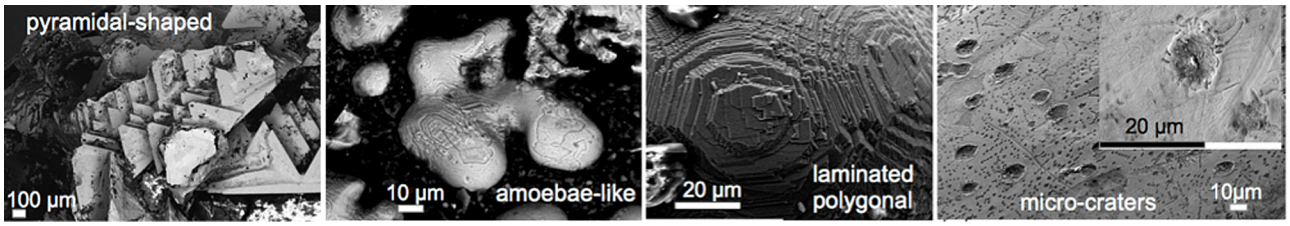

Fig. 3. Internal structure of iron silicides from the Chiemgau strewn field under the SEM

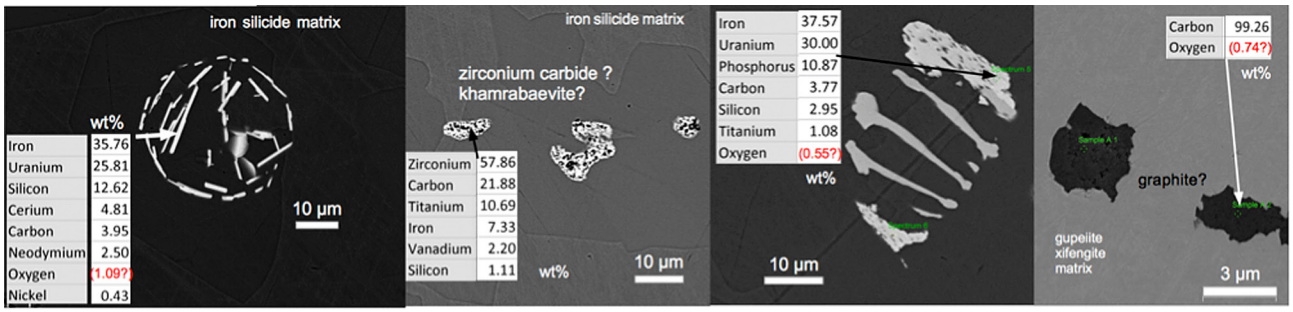

Fig. 4. SEM-EDS micrographs and analyses; samples from Fig. 1, right. Quite comparable analyses have been made in the 8 kg iron silicide chunk (Fig. 1) [3] and in earlier analyses of various finds

Methods and results

Optical microscopy, SEM, TEM and EBSD analyses, Raman spectroscopy.

Elements: Apart from the main constituents Fe, Si more than 30 other chemical elements have been evidenced so far like uranium, the REE cerium, yttrium und ytterbium, or gallium. No decay products of uranium like thorium or lead have been measured.

Iron silicide minerals of the matrix: gupeiite, xifengite, hapkeite, naquite and linzhite; hapkeite Fe_2Si in its cubic polymorph and in its trigonal polymorph (the most stable iron silicide up to 255 GPa).

Identified minerals: Carbides — silicon carbide moissanite SiC (cubic and hexagonal polymorphs), titanium carbide TiC, khamrabaevite (Ti,V,Fe)C, probably zirconium carbide ZrC (Fig. 4) — Graphite C, zircon $ZrSiO_4$; Carbon and TiC/(Ti,V,Fe)C in a matrix of cubic hapkeite and cubic gupeiite; SiC and TiC/(Ti,V,Fe)C as superpure crystals in the iron silicide matrix (Fig. 2). — Calcium-aluminum inclusion (CAI) minerals $CaAl_2O_4$, calcium monoaluminate, krotite, and $Ca_2Al_2O_5$, dicalcium dialuminate.

Shock metamorphism and micro-impacts: planar deformation features (PDF) in moissanite; open, tensile spallation fractures in titanium carbide crystals; cosmic particle impacts (Fig. 3).

Conclusion

Enigmatic internal structures and exotic composition for all sizes of iron silicide samples from the Chiemgau impact crater strewn field establish a common formation process and a common source.

Artificial production, geogenic formation (and e.g. fulgurite formation) can be excluded, which is basically also supported by the find situations in the field [1, 2]. The iron silicides are of extraterrestrial origin.

The iron silicides in their entity belong to the Chiemgau meteorite impact strewn field.

They should constitute a new class of meteorites. For reasons of definiteness we suggest to name the trigonal Fe_2Si polymorph hapkeite — 2T possibly rating a new mineral name [2].

References

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