CALCIUM-ALUMINUM-RICH INCLUSIONS (CAIs) IN IRON SILICIDE (XIFENGITE, GUPEIITE, HAPKEITE) MATTER: EVIDENCE OF A COSMIC ORIGIN

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Introduction: CAIs are a mineralogically and chemically diverse group of structures mainly known from carbonaceous chondrites. They consist of various minerals that formed from a high temperature gas at early stages of the Solar System formations. We found CAIs in peculiar metallic, millimeter to centimeter-sized particles in the subsoil of the Alpine Foreland that have been suggested to be possible extraterrestrial matter [1, 2].

Results: SEM, TEM and EBSD analyses of several samples yielded a stoichiometrically heterogeneous iron silicide matrix of xifengite, gupeiite, hapkeite and other Fe_xSi_y phases. The matrix was shown to host extremely pure crystals of cubic moissanite SiC and titanium carbide TiC, and a broad variety of other elemental constituents. The CAIs proved to be $Ca_2Al_2O_5$ (dicalcium aluminate) and the calcium aluminate $CaAl_2O_4$. An EBS image of the CAIs in conjunction with moissanite and TiC inclusions in an iron silicide matrix is shown in Fig.1.

Discussion: $Ca_2Al_2O_5$ is formed at high pressures and temperatures only, e.g. at 2.5 GPa and 1,273 K (eg., [3]), and is stable between 4 and 9 GPa and at about 1,500 K. $CaAl_2O_4$ was first (2001) attested to exist in nature embedded in calcium-aluminum-rich inclusions in the NWA 470 meteorite [4] and later also found in the NWA 1934 chondrite [5]. The close association of these CAI minerals with iron silicides known from the most reduced meteorites (ureilites, enstatite chondrites, achondrites), and the hapkeite known on Earth from the Dhofar 280 lunar meteorite [6], is strong evidence of a non-terrestrial formation.

Conclusions: From these analyses, the early supposition the strange metallic matter from the Alpine Foreland might have a cosmic origin appears to be confirmed suggesting a relation to the Holocene Chiemgau impact event [2].

References [1] Hiltl, M. et al. 2011. Abstract #1391. 42nd Lunar & Planetary Science Conference. [2] K. Ernstson et al. 2010. *Journal of Siberian Federal University Engineering & Technologies* 1, 3: 72-103. [3] Kahlenberg, V. et al. 2000. *American Mineralogist* 85: 1061-1065. [4] Ivanova, M.A. 2001. Abstract #1957. 32nd Lunar & Planetary Science Conference. [5] Sweeney Smith, S.A. et al. 2010. Abstract #1877 41st Lunar & Planetary Science Conference. [6] Anand, M. et al. 2003. Abstract #1818. 34th Lunar & Planetary Science Conference.

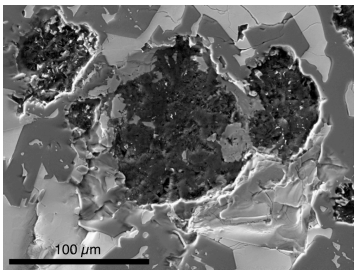

Fig. 1. Iron silicide matrix (light gray) with inclusions of TiC (dark gray), moissanite SiC with black C (graphite, diamond?) film and light edging CAI's.