IMPACTS ON SPHERULES. E. Buchner[1], M. Schmieder[1], M. Strasser[1], A. Strasser[1], and J. Kröchert[1], [1]Institut für Planetologie, Universität Stuttgart, Herdweg 51, 70174 Stuttgart; elmar.buchner@geologie.uni-stuttgart.de.

Introduction: Magnetic spherules have been reported from a large variety of geological environments (e.g., deep sea sediments, beach sands, aeolian sandstones, glaciogenic sediments, soils, or ice cores through geologic time). Their origin has long time been a matter of lively debate and various formation models have been proposed to date: extraterrestrial (cosmic), terrestrial impact, volcanic, sedimentary, biogenic, and anthropogenic-industrial; natural processes, such as forest wildfires or lightning, represent further mechanisms, e.g., [1]. Whereas some research claims magnetic spherules to be mainly of cosmic origin, others consider them to be mainly natural terrestrial objects or contaminations of anthropogenic origin.

Sample location: Magnetic spherules have been discovered in sediments of two caves (~25 km away from each other) that are hosted by Upper Jurassic limestones and marls that build up the karstified plateau of the Schwäbische Alb, Southwest Germany. The caves formed during the Neogene; the possible depositional age of the cave sediments in both karst systems, as well as the age of the spherules, ranges from Miocene to Pleistocene (≥250 ka) [2]. For comparison, we investigated magnetic spherules selected from flue ash extracted from an ash filter of a cement plant.

Morphological properties: Spherules from both caves, generally ~20-200 µm in size, exhibit various shapes (hollow and massive spherical to drop-shaped) and surface textures (smooth to microcrystalline spinifex-textured and coarser crystalline). Besides spherules that are perfectly ball-shaped and undamaged, they show signs of mechanical damage, high-speed particle contacts, and microcratering. Spherules of industrial origin basically exhibit the same surface properties. However, they do not show any evidence for high-speed particle contacts but strongly tend to assemble aggregates by fused point contacts (Fig. 1).

Discussion and results: The internal microstructures and the general appearance of spherules derived from industrial processes are similar to those of cosmic particles. In many cases, it is almost impossible to distinguish between extraterrestrial (including impact) spherules and anthropogenic spherules by their geochemical composition. Characteristic marks of low- and high-speed particle contacts, respectively, may reveal a possible tool to discriminate between spherules of industrial (i.e., low-speed) and cosmic/impact (i.e., high-speed) origin. Whereas industrial magnetic spherules tend to form aggregates, spherules of cosmic and impact origin may be strongly fused and exhibit cratered surfaces (Fig. 2). A wide range of particle velocities must be considered for impacts on spherules; assigning precise velocities is difficult because the targets and/or projectiles are in various stages of cooling and solidification; the projectile velocities range from a few m/s (aggregate-forming processes) to several km/s in order to generate microcraters on the surface of the spherules, e.g., [4].

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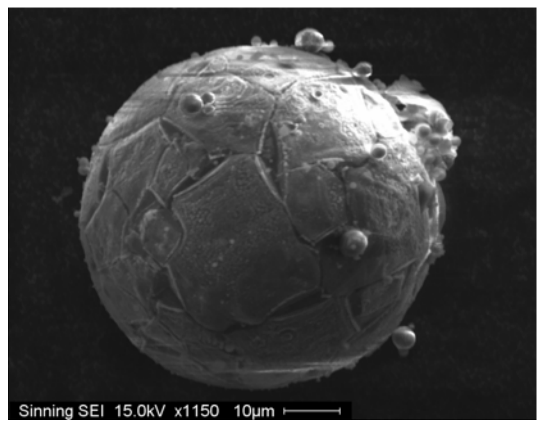

Fig. 1: Aggregate of a larger magnetic spherule and small specimens selected from industrial flue ash.

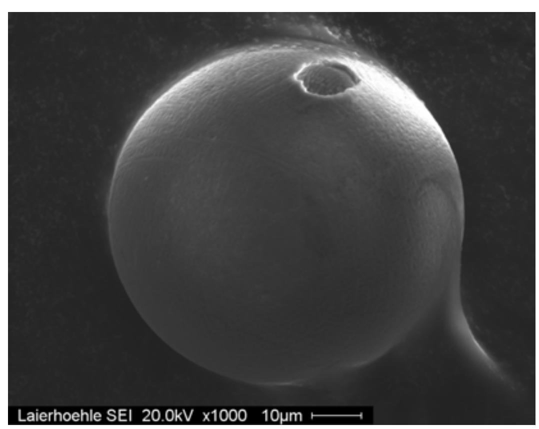

Fig. 2: Magnetic spherule removed from cave sediments of the Laierhöhle (Southwest Germany), most probably of cosmic or impact origin; the hole was generated by an impacting projectile, not by degassing processes.