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The meteorite of Gresia - Teleorman County (Romania)

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Abstract: This preliminary paper gives the first petrographic description of the meteorite of Gresia, southern Romania. We identified it as chondritic meteorite in October 2012, based on the petrographic analysis of a small sample under the optical microscope. The meteorite was preserved almost entirely, being one of the biggest fallen in Romania. There is no information about its fall. The medium to advanced degree of weathering suggests a terrestrial age of a few hundred years, even more.

Keywords: meteorite, chondrules, petrography, Gresia, Romania

1 Introduction

Thirty years ago, a peasant digging a hole in the garden of his house in Gresia village, on the right bank of the Vedea River, found a large, hard, egg-shaped boulder at a depth of more than one meter. He drew it out and put it in the back of his house, where the boulder remained until the discoverer's son presumed that it could be a meteorite and brought a very small sample of it to the Geological Institute of Romania. We confirmed his supposition by microscopic examination of a few thin sections and polished sections and we identified the boulder as a lithic meteorite of chondritic type. The owner asked for an identification certificate, which the Geological Institute of Romania issued under our signatures.

2 Macroscopic description

The meteorite of Gresia (Fig. 1) has the shape of a triaxial ellipsoide, with the long axis of 39 cm, the medium axis of 29 cm and the short one of 18 cm. It weights 26,9 kg, being the second heaviest in Romania, after the one fallen in 1882 near Mociu, Cluj County, which weighted 35 kg. The meteorite surface is smooth and impregnated with Fe-hydroxides so that its general colour is reddish-brown, with diffuse spots of its original dark brown colour. Three fragments of the meteorite are missing, representing about 1/3 of its volume. They were probably detached at the impact or shortly before that. The broken zones have irregular surfaces of reddish colour due to a more advanced weathering.

If the Gresia meteorite should have been preserved entirely, it would have weighted about 37-38 kg. Its location at more than one meter in depth was probably due to both the impact and subsequent deposition of recent sediments.

3 Petrographic analysis

The microscopic analysis of the meteorite revealed a breccious structure, in which the constituents are granules, fragments of crystals and crystals of olivine and orthopyroxene, chondrules and fragments of chondrules and glass, in a matrix of microcrystalline material, iddingsite and Fe-hydroxides (goethite and

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lepidocrocite) with relics of pyrrhotite and pentlandite. The Fe-Mg silicates and sulfides are primary minerals, of extraterrestrial origin, while the goethite, lepidocrocite and iddingsite are secondary minerals, formed by weathering in terrestrial conditions. The presence of iron and nickel sulfides confers magnetic properties to the meteorite.

Small-sized crystals and granules of olivine and orthopyroxene usually form mono- or bimineral aggregates of irregular shape. The monomineral aggregates are olivinic and frequently show porphyritic internal textures, with rare granules in a glassy matrix (Fig. 2 c, e). The more compact aggregates are of olivine granule ± pyrrhotite inclusions, on the margins, and packs of olivine laths, in the central area (Fig. 2 f, g). The bimineral aggregates (lithic fragments?) have polygonal contours and are formed of olivine thin laths and euhedral or fibrous crystals of orthopyroxene (Fig. 2 d).

The larger crystals are either isolated or grouped in monomineral aggregates of orthopyroxene, with intergranular glass, and polymineral aggregates (lithic fragments?) of olivine and orthopyroxene in pyrrhotite matrix or olivine in fibrous pyroxene matrix. The isolated crystals of orthopyroxene are frequently deformed (microfractures, ondulatory extinction).

The chondrules are spherical polycrystaline formations characteristic for chondritic meteorites. The chondrules in the Gresia meteorite have submillimetric dimensions, rarely 1-2 mm, and show very varied internal textures. The most frequent, these correspond to the main textural types described by Wasson (1974): fibroradiating, barred, porphyritic and glassy.

The chondrules with fibrous textures (Fig. 2 c, e, g) are made of fibrous pyroxene, optically undeterminable. Many of them are fibroradiating, with curved fibres diverging from a single point situated on the circumference so that these ones resemble a shell (Fig. 2 g). Sometimes, the fibroradiating chondrules include small crystals (clasts?) of olivine. Others fibrous chondrules contain many fasciculi of right fibres, converging in the central area (Fig. 2 g). The contours of some fibrous chondrules show concavities without deformation traces.

The barred chondrules (Fig. 2 d, e, f) are formed of olivine laths with glass or rare laths of orthopyroxene between them. The olivine laths, sometimes intergrown with pyrrhotite, are parallel or divergent, with the divergence point on the chondrule circumference. Sometimes, the laths are grouped in packs convergent in the central area of the chondrule. The shape of the chondrules with parallel laths approaches to that of a hexagon (Fig. 2 d). Frequently, the circumference of barred chondrules is outlined by a inner ring of olivine grains (Fig. 2 f).

The porphyritic chondrules (Fig. 2 b, c, h) consist of olivine and glass, rarely of orthopyroxene and glass. The olivinic chondrules often have one or two subhedral crystals (clasts?) in the central area, surrounded by smaller roundish grains (Fig. 2 c). The porphyritic chondrules can also be of irregular to quasicircular shapes, like a light bulb for example (Fig. 2 b). These ones can be considered porphyritic aggregates rather than chondrules.

The glassy (microcrystalline) chondrules, sometimes with imperfect circular shapes, contain devitrified glass and usually show homogenous textures (Fig. 2 g). Rarely, in the glassy chondrules we recognized some feathery olivine crystals.

Other textural types of chondrules observed can be defined as equigranular, composed of small rounded olivine grains, and holocrystalline, composed of one or more euhedral crystals of orthopyroxene with olivine inclusions (Fig. 2 c). It is possible that these textural types represent in fact mineral aggregates with rounded contour.

4 Weathering processes

The weathering processes in terrestrial conditions affected most of the sulfides and, to a lesser extent, the silicates. The secondary minerals resulted by weathering form a matrix composed of iddingsite, goethite and lepidocrocite (Fig. 2 g, h).

Fig.1. Photographs of the Gresia meteorite. The inferred places of the three missing fragments can be seen, one in (a) and two in (b). The place from which the studied sample was cut can be seen in (b, left side).

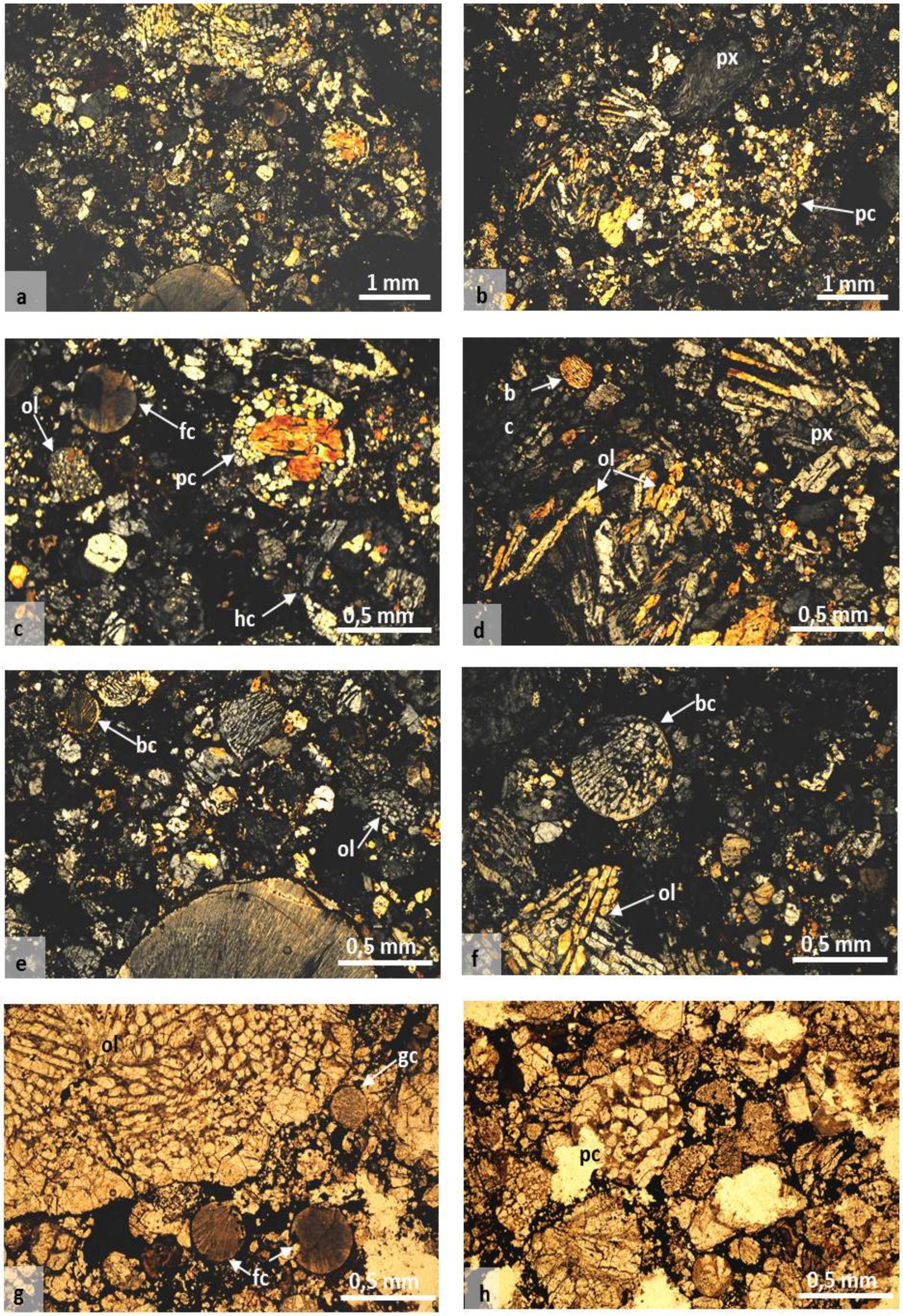

Fig. 2. Photomicrographs in transmited light of the Gresia meteorite, with crossed (a-f) and parallel nicols (g, h); (a, b) - general images (30x) showing the breccious structure; (c-h) - detailed images (100x) showing olivine (ol) and orthopyroxene (px) aggregates and different types of chondrules: fibrous (fc), barred (bc), porphyritic (pc), glassy (gc) and holocrystalline (hc). Detailed explanations in the text.

The goethite, associated with the lepidocrocite, is formed on the pyrrhotite and pentlandite, minerals which are preserved as relics with highly corroded contours. The pyrrhotite also appears as rims on the olivinic chondrules or as small drops in the olivine.The iddingsite appears as compact aggregates on the olivine, as filling of the fissures and as thin rims on the olivinic chondrules.

From a quantitative point of view, the present mineralogical composition of the meteorite consists of 60-65% Fe-Mg silicates, about 5% sulfides and 30-35% secondary minerals. Taking into consideration the weathering degree, we estimate an initial composition of 85-90% Fe-Mg silicates and 10-15% Fe-Ni sulfides.

5 Speculations regarding the terrestrial age of the meteorite

Taking into account the quite advanced degree of weathering, we appreciate, before any other speculations, that the Gresia meteorite has a terrestrial age of at least 200 years.

The Gresia village appears on the statistic map of southern Romania since 1835, counting 37 houses (Giurescu, 1957), which means that it existed even at the end of the 18^{th} century. Since we could not find information regarding the fall of a meteorite in this village, though such reports exist for other localities in Romania, even from more ancient times, we may presume that the phenomenon took place before 1800. In 1786, in the evening of September the 8^{th}, a fall of meteteorites took place in the Făgăraş Mountains region, described by eye witnesses from Curtea de Argeş and Oradea (Corfus, 1975). One of these meteorites could have fallen at Gresia.

The terrestrial age of 200 years represents enough time for the meteorite to be covered by recent sediments, in the case it fell exactly in the place where it was found. According to the topographic and geological maps, the Gresia village lay on Upper Holocen fluviatile deposits (Ghenea et al., 1971). Since the fluviatile deposits do not have constant sedimentation rate, we cannot make an estimation of the period of the meteorite burial. Moreoever, the possibility arises that it has been brought from upstream of the Vedea River by catastrophic floods, the violent water transport causing its breaking. After 1786, such catastrophic floods are reported on Vedea River in 1814 and 1837 (Corfus, 1975). It is possible that the meteorite arrived in Gresia by that time.

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