A meteorite impacted a house in San Carlos, Uruguay

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ABSTRACT

Every year there are now almost two reports of meteorite falls that directly hit human beings or their belongings, which we call "damaging falls". A new damaging fall occurred on September 18, 2015, when a meteorite impacted a house in the city of San Carlos (Maldonado, Uruguay). A 712 g stone broke through the asbestos cement roof and a wooden suspended ceiling. The meteorite and its fragments broke a wooden bed frame and a TV set. We conducted petrological and chemical analysis of the sample. The meteorite is classified as a LL6 chondritic breccia, with low content in siderophile minerals and moderate chondrule size. It has a shock stage S4 and a degree of weathering W0. This is the first Uruguayan meteorite to be confirmed. The prevalence of damaging falls is discussed.

1. Introduction

Meteorites are defined as solid bodies of extra-terrestrial material that penetrate the atmosphere and reach the Earth's surface with a considerable mass. The worldwide accepted clearing-house of meteorites is the Meteoritical Society, which maintains the Meteoritical Bulletin Database (hereafter MBD). Up to Nov. 20 2017, there are 57108 registered meteorite names with their respective taxonomic classification.

Meteorites recovered following observed passage through the atmosphere are called falls; while those which are serendipitously found or they cannot definitely be associated with a passage are called finds. In MBD there are registered 1161 falls with official names. In 2015 the Meteorite Nomenclature Committee of the Meteoritical Society, reanalysed the distinction between falls and finds. The Committee concluded that "for a meteorite to be announced as a fall, two simple conditions need to be met: 1. A fall event has been documented; 2. The recovered meteorite has been connected to the fall event." As "these conditions are subject to considerable uncertainty", they introduced a finer classification, as follow:

- A "Confirmed fall" is a meteorite determined to be a fall beyond reasonable doubt. There was a well-documented fall event, witnessed either visually or with instruments, and collection occurred soon after the event.
- A "Probable fall" is a meteorite found to be a fall by the weight of the evidence, but there remains some degree of doubt.

They also introduced some further categories for finds: "Find, possible fall", "Find, doubtful fall" and plainly "Find".

There are 31 "Confirmed Falls" in the MDB, 22 of them corresponds after the introduction of the new classification scheme.

A subset of the falls that generate a lot of concern are those meteorites that directly hit human beings or their belongings, producing some damages. In spite of the interest, there is no official designation for these cases, neither from the Meteoritical Society nor from the International Astronomical Union.[1] Considering that it is a subgroup of the "confirmed falls", we call them "damaging falls".

Here we present a new case of a confirmed meteorite damaging fall. The event occurred on September 18, 2015 in San Carlos, Maldonado, Uruguay. In Section 2 we present the event. Section 3 describes the meteorite. The search for new fragments is presented in Section 4 and the analysis of the witnesses reports and the estimate of the trajectory in Section 5. In Section 6 we discuss the results and in Section 7 we summarize the conclusions.

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[1] See the definitions adopted by the IAU:https://www.iau.org/public/themes/meteors_and_meteorites/, https://www.iau.org/static/science/scientific_bodies/commissions/f1/meteordefinitions_approved.pdf.

2. Description of the event

In the night of September 18, a young lady was alone in her family house in the Lavagna neighbourhood, in the city of San Carlos, Department of Maldonado, Uruguay. The next morning, she saw light in her parents' room, even though the windows were closed and the lights were off. The sunlight came in from a hole in the roof. A dark rock was found a meter from the bed. The meteorite had damaged the asbestos cement roof and a wooden suspended ceiling, as well as the corner of the wooden bed frame (Figs. 1 and 2).

The time of the fall is uncertain. No one was present in this room that previous day. The young woman, daughter of the house, arrived home at sunset and slept in an adjacent room. After discovering the damage the next morning, she called her parents, which immediately returned home, worried that their daughter might have been at risk from an attack of the house the night before.

The roof was repaired quickly, but their astonishment continued when they turned on the TV set and they found that the TV, on top of a drawer chest, did not work properly. It had also been damaged by a fragment of the incoming rock. A colourful pattern was displayed on the screen, radiating from the point where glass was broken (Fig. 3).

The recovered meteorite, provisionally called "San Carlos", has a thin crust of dark colour, typical of fusion crust (Fig. 4). The exterior has the appearance of having been moulded with fingers, like regmaglypts. Light asbestos streaks (from the roof) are present over the black fusion crust in the lower face. In those areas where the black crust was removed by the impact (top, right), a grey coloured interior material is exposed.

Here, we the present the first results from the analysis of the meteorite and discuss the circumstances of the fall and the frequency of such damaging falls.

3. Methods

One of the corners of the meteorite was sawed and the cut piece was split to create polished thin sections. The main mass as well some fragments were stored in the *Facultad de Ciencias* (Uruguay) (G. Tancredi). Some fragments were sent to the *Museu Nacional* of Rio de Janeiro (Brazil) (B. Zucolotto). Thin sections were stored in the *Museu Nacional* of Rio de Janeiro (Brazil), *Facultad de Ciencias* (Uruguay) and the Museum of the *Dirección Nacional de Minería y Geología* (Uruguay).

The mineralogical and petrographical analysis was performed in two thin and polished sections. They were examined microscopically in transmitted and reflected light using a petrographic microscope (Zeiss Axioplan) and minerals were analysed using a JEOL EPMA JXA-8230 Superprobe at LABSONDA/IGEO/UFRJ.

Quantitative analysis of constituent phases were performed using

Fig. 1. Exterior view of the impacted house. The arrow and the symbol (a) marks the place of the hole of the asbestos cement roof.
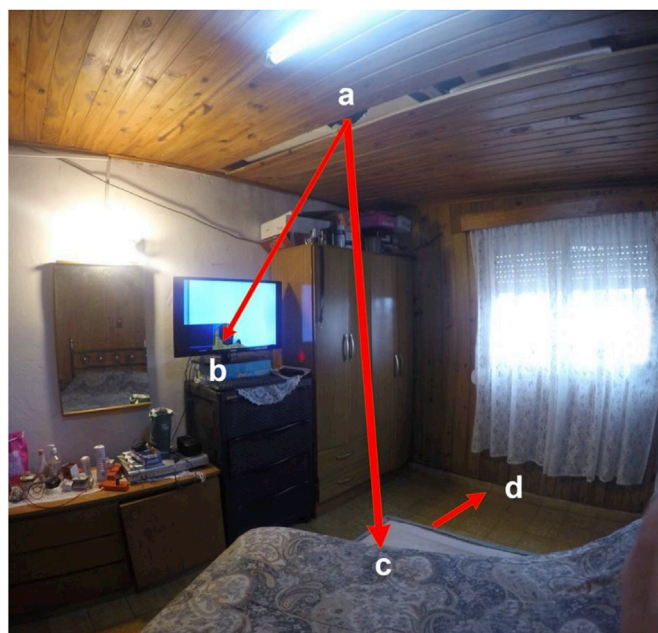

Fig. 2. Interior view of the parents' bedroom. The symbol (a) marks the hole in the rook produced by the meteorite. The thick red line shows the trajectory of the incoming meteorite. The thin red line shows the possible trajectory of the fragment that damaged the TV. The symbol (b) marks the place on the TV led damaged by a fragment. The meteorite broke the bed frame and splinted a floor tile (c). The meteorite rolled until it reached the wall and the final location is marked with the symbol (d). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Wavelength Dispersive Spectrometry (WDS). Beam conditions included an acceleration voltage of 15 KeV, beam current of 20 nA and a spot size of 1 μm for silicates and 20 KeV for opaque minerals. Well-characterized natural and synthetic phases were used as standards, and corrections for differential matrix effects were made with a ZAF factory supplied procedure. During the study, Energy Dispersive Spectrometer (EDS), back-scattered electrons (BSE) imaging and composition mapping image by WDS were also performed.

Micro-Raman spectroscopy was conducted with a Horiba Jobin Yvon LabRam HR at CETEM (*Centro de Tecnologia Mineral*). A 632.8 nm laser standardized with a Si chip and a confocal hole of 300. The analysis was performed using a 100× objective lens on the Raman microscope. The recorded spectra were compared with the RRUFF database[2] for phase identification.

4. Classification of the meteorite

4.1. General characteristics

The "San Carlos" meteorite has a mass of 712 ± 1 g (Fig. 4).

The volume was estimated by immersing the sample in water. The mass of the displaced water was 211 ± 1 g. The water density was estimated by weighting one litre of water; the obtained value was 1.014 ± 0.002 g/cm^3. Therefore, the displaced volume was 208 ± 1.4 cm^3.

The meteorite bulk density is then 3.42 ± 0.03 g/cm^3.

The radius of a sphere of equal volume $\left(R_{eq} = \left(\frac{3\,V}{4\pi} \right)^{1/3} \right)$ is 3.68 cm and the equivalent cross section is 42 cm^2. Nevertheless, the sample has a triangular pyramidal-like shape (3 faces and a base) with a height of 9.1 cm and a triangular base of $b = 6.0$ cm wide and $h = 10.0$ cm length.
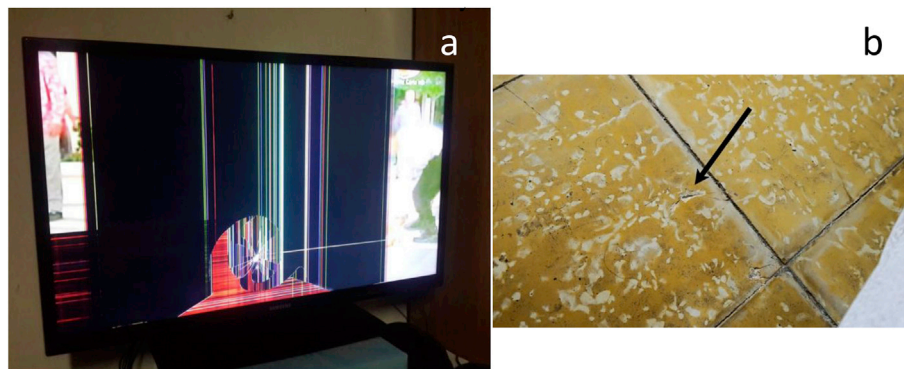

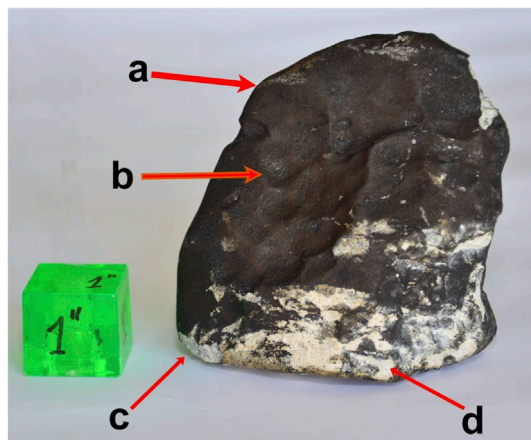**Fig. 3.** a) Close view of the impacted led TV. b) Splint ceramic tile below the bed.

Fig. 4. San Carlos meteorite showing its dark fusion crust (a) with regmaglypts (b), and two chipped crust corners due the impact (c). White asbestos of the impacted roof is welded to the impact surface of the meteorite (d).

The area A of the base is $A = b\ h/2 = 30\,\mathrm{cm}^2$.

The sample has a pyramidal shape, characterized by planar surfaces with rounded edges (Fig. 4). It presents a black fusion crust $\sim$1 mm thick, with elephant skin texture and regmaglypts (or piezoglypts). The lightest streaks at the bottom of the meteorite are pieces of roof's cement asbestos that were welded to the meteorite.

In the observed sections, the meteorite exhibits dark and clear areas typical of a clast-supported oligomictic breccia texture (Figs. 5 and 6). The clasts are clear and angular (pale blue 5PB 7/2- grayish blue green 5BG 5/2) surrounded by a vitreous dark matrix (dark greenish grey 5G 4/1- greenish black 5G 2/1).

Light fragments are rounded to angular in shape with a wide range of size, cut by black veins and broad dark areas. The light areas are highly recrystallized, showing few poorly defined chondrules in the groundmass (Fig. 6). The dark areas are formed by a great number of interconnected black shock veins and melt pockets, composed by silicate and metal phases, giving the rock a brecciated texture (Fig. 5).

4.2. Petrology and mineral chemistry

The brecciated texture of "San Carlos" with angular clasts and dark shock hardened lithologies are shown in Fig. 5. The thin sections show that dark matrix and light clasts with chondrules are composed by the same mineral composition (see Table 1). The major minerals are olivine, low Ca-pyroxene and FeNi metal (kamacite and taenite). Minor minerals are plagioclase, high Ca-pyroxene and troilite. Accessory minerals are chromite and phosphates.

There are black shock-induced melt veins of 0.05 mm in width and up

Fig. 5. Sawed face of the meteorite showing it brecciated structure, light coloured clast interconnected by dark melt shock veins. Bright metallic metal particles can be observed dispersed in clasts and matrix. Light asbestos welded by the impact is present over the black fusion crust in the lower face.

to millimetres crossing the entire observed surface (Fig. 7a). The melt veins are composed of glassy materials, olivine, pyroxene, plagioclase and eutectic intergrowth of metal and troilite. No shock induced high-pressure minerals, as maskelynite and ringwoodite, were found at the melt veins and vicinities even with Raman Spectroscopy.

Small amount of chondrules can be observed under microscope; most of them have fuzzy limits and are dispersed in the clast matrix. Among the clearly identified chondrules, it is possible to observe remnants of barred olivine (BO), porphyritic olivine pyroxene (POP) and radial pyroxene (RP) chondrules (Fig. 8b) grouped according to the textural scheme of Gooding and Keil (1981). The average diameter of chondrules is about 800 microns.

A clear matrix groundmass, composed of large and small euhedral olivine and pyroxene crystals and outlines many indistinct chondrules, are indicatives of high-grade thermal metamorphism of the meteorite.

Olivine is the most abundant phase and it is homogeneous in composition (Table 1). The mean composition of the analysed olivine grains is (the ranges are given between parenthesis): Fayalite (Fa) 29.8 (29.1–31.1) mol%, and Forsterite (Fo) 70.2 mol% (69.0–70.9) (data taken from Table 1 to produce Fig. 8b). Many olivine grains show one set of parallel fractures with a spacing of tens of microns (Fig. 7e). Some olivines near the shock veins show undulose extinction grades into slight mosaicism indicating moderate shock deformation.

The low-Ca pyroxenes have a very uniform compositions with insignificant variations among clasts (Table 1). The mean composition of them
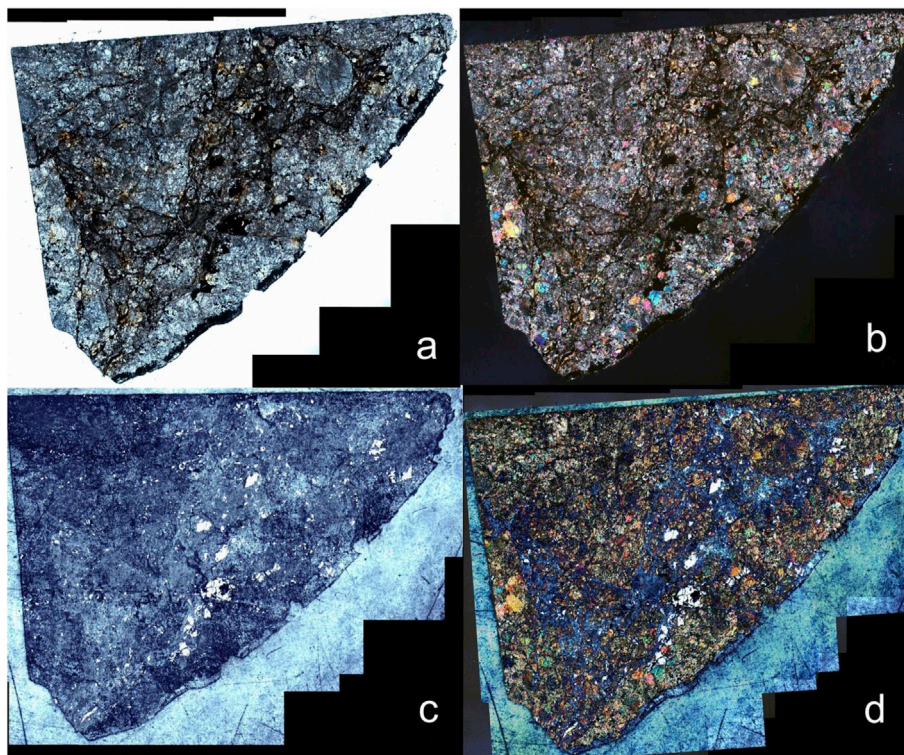
Fig. 6. Photomicrograph of a meteorite polished section showing textural and mineralogical variations. a-transmitted light, brecciated structure, clast limits, and some chondrules limits can be distinguished. b-transmitted polarized light. Crystals and some chondrules are distinguished by the different in birefringence colours. b-Reflected light, bright with spots correspond to the metallic aggregates in the sample. d-composite image by combining the reflected (c) + polarized light (b). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 1
Chemical composition of silicates in chondrules and matrix.

	Low-Ca Px		High-Ca Px	Olivine		Plagioclase	
	Chondrules	Dark Matrix	Dark Matrix	Chondrules	Dark Matrix	Chondrules	Dark Matrix
SiO_2	55.54	54.32	51.55	37.63	37.86	65.39	63.66
TiO_2	n.d.	n.d.	n.d.	n.d.	n.d.	0.00	0.01
Al_2O_3	0.81	0.11	0.23	0.18	0.03	20.74	19.75
FeO	15.43	13.63	7.52	26.70	26.31	0.62	2.54
MnO	0.40	0.35	0.19	0.41	0.41	0.02	0.04
MgO	26.26	24.86	18.01	35.15	35.50	0.13	2.34
CaO	0.83	6.35	20.35	0.03	0.07	2.23	2.02
Na_2O	0.06	0.03	0.11	0.01	0.00	9.72	9.13
K_2O	n.d.	n.d.	n.d.	n.d.	n.d.	1.67	1.74
Cr_2O_3	0.00	0.01	0.01	0.01	0.01	0.01	0.00
Total	99.33	99.66	97.97	100.12	100.19	100.53	101.23
#	10	5	2	20	12	21	10

are (the ranges are given between parenthesis): Ferrosillite (Fs) 24.3 (23.3–25.1), Enstatite (En) 74.1 (72.2–75.4), Wollastonite (Wo) 1.6 (1.0–4.1) mol% (Fig. 8a). A couple of high-Ca Pyroxenes were analysed (Table 1). They are composed by Diogenite and Augite. The pyroxene grains with interference colours from grey to blue usually contain regular fractures with a weak undulatory extinction rarely twinning.

Large plagioclase grains show irregular shape and rather coarse-grained size (>50 microns), reduced birefringence, and irregular undulatory extinction. They generally have normal optical properties indicating that their crystal structure remains intact. Some grains display a partially isotropic nature and they were not transformed to Maskelynite (Fig. 7d). The plagioclase is mainly albitic with the following mean composition (the ranges are given between parenthesis): Albite (Ab) 82.0 (72.0–86.4), Anorthite (An) 9.8 (8.8–15.6) and Orthoclase (Or) 8.2 (4.1–18.4) mol% (Fig. 8c).

Under reflected light, metal and sulfide are dispersed and occur as tiny to larger grains distributed throughout the entire thin sections. The nickel-iron minerals were identified as kamacite, taenite and tetrataenite (Fig. 9). The zoned taenite grains bordered by tetrataenite are more

abundant. Tetrataenite also occurs as isolated grains in contact with troilite. Kamacite are sometimes polycrystalline and present Neumann bands.

Troilite is abundant and is distributed throughout all thin sections isolated or associated to kamacite and chromite. Sometimes troilite are sheared and intruded along the veins or filling the cracks of meteorite (Fig. 7f). Under polarized reflected light, it is possible to observe mosaicism and twinning.

The elemental compositions of these phases are given in Table 1. In general, kamacite has mean Ni and Co concentrations of 4.88 and 2.85 wt %, respectively. The Taenite composition is variable, with Ni content varying from tetrataenite borders (~50%) to a dark taenite core (~33%). Some tetrataenite also occurs as isolated grains. There are numerous taenite blebs in the matrix.

Many small metal grains are distributed all over of the shock veins. Fig. 7f shows an elongated metal phase within a shock vein that cuts and shears a metal grain, which is an indication that veins are essentially formed by friction melting (Stoeffler et al., 1988).

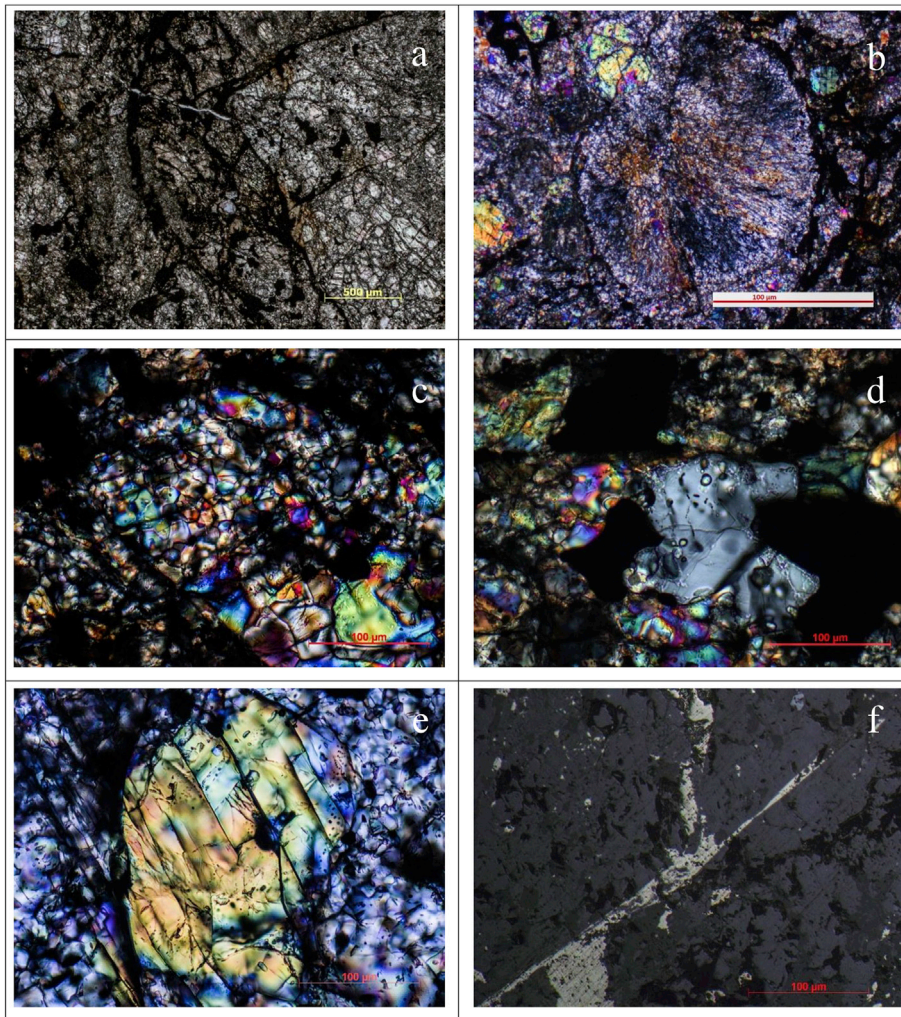The entire sample was affected by microfractures (Fig. 7a). Micro

Fig. 7. a) The meteorite exhibits a great number of interconnected black shock veins and melt pockets, composed by silicate and metal phases, giving the rock a brecciated texture in transmitted normal light. b) A discernible radial pyroxene chondrules in transmitted polarized light (TPL). c) Some areas of the meteorite show evidence of recrystallization with granoblastic texture and triple points (TPL). (d) Large feldspar grains (>100 microns) with undulatory extinction are very common (TPL). e) Many olivine grains show one set of parallel fractures (TPL). f) On analyses by reflected light, we observe the presence of many small metal grains all over the shock veins shows an elongated metal phase within a shock vein that cuts and shears a troilite grain.

veins (pseudotakylites) are filled with glass, and secondary minerals, surrounded by opaque minerals, olivine and pyroxene fragments.

The overall chemical and mineralogical composition of the light portions of the meteorite are consistent with an ordinary chondrites of the LL group. According to the cobalt content in the kamacite (Table 2) and the fayalite content in olivine (Fig. 8d), the meteorite can be classified as LL 3.8 to 6 type chondrite (Rubin, 1990; Krot et al., 2014). Moreover, the homogeneous olivine composition suggests that the meteorite can be classified between LL 4 and 6 petrological type (Huss et al., 2006). The large plagioclase size, the scarcity of chondrules, their diffuse borders, and the highly recrystallized texture of the matrix restrict the classification to type 6 (Van Schmus and Wood, 1967; Huss et al., 2006).

The mosaicism and undulose extinction present in the olivines, the undulose extinction of pyroxenes and plagioclase are indicatives of shock stage S4 of Stöffler et al. (1991). This classification is also supported by the shock melt veins, melt pockets, polycrystallinity of kamacite and mosaicism and twinning of troilite.

As the meteorite is a fall collected immediately after the fall and kept at laboratories the weathering stage is, according to Wlotzka (1993), of type W0.

5. Circumstances of the fall

Four eye witnesses reported seeing a bolide on September 18, 2015, at around 17:45 UT (Fig. 10). A couple were only 3.4 km North-East of the impact point in a by-road with a clear horizon (Fig. 11). The man saw

the bolide at ~17:45 UT (14:45 Local Time in the afternoon) for ~2 s in a direction North-West and with an altitude of ~50 deg. The bolide had a brightness in between that of the full Moon (−13 magnitude) and a clear-sky Sun (−26 magnitude). He did not see any fragmentation. The bolide left a smoke train that persisted for ~15 s.

Two other witnesses were at ~71 and ~75 km East-North-East from the impact point, about ~4 km apart (Fig. 10). One witness was under some high trees and the second was in an open place. Both saw a bright flash close to the horizon (altitude less than 30 deg) towards the East. The time of the observation was also given as 17:45 UT.

The fourth witness, Mr. Enrique Martínez, could not give a precise date and time of his experience, but he remembered that one afternoon in September 2015 he heard sounds outside his house like whistling. When he went outside, he saw a black stone falling from the sky, which he collected.

The Uruguayan Meteorological Institute (INUMET) informed us that, on September 18, 2015, at 14:45 local time, the sky was partly cloudy at the nearest weather station to San Carlos (Laguna del Sauce, at a distance of 17 km). The wind on the ground came from the South at 20 km/h. Unfortunately there is no information about the wind speed and direction at higher altitudes close to the location of the event. The closest station of the upper air sounding network is at Ezeiza, at 330 km from San Carlos (Fig. 12). There were balloon measurements of wind speed and direction at 0 h and 12 h UT on September 18 and 19, 2015. Unfortunately, the measurements on 12 UT Sept. 18 are missing at altitudes over ~6500 m. Based on the trend during Sept. 18, we concluded that the wind velocities were moderate to high and the wind direction was from North-West at
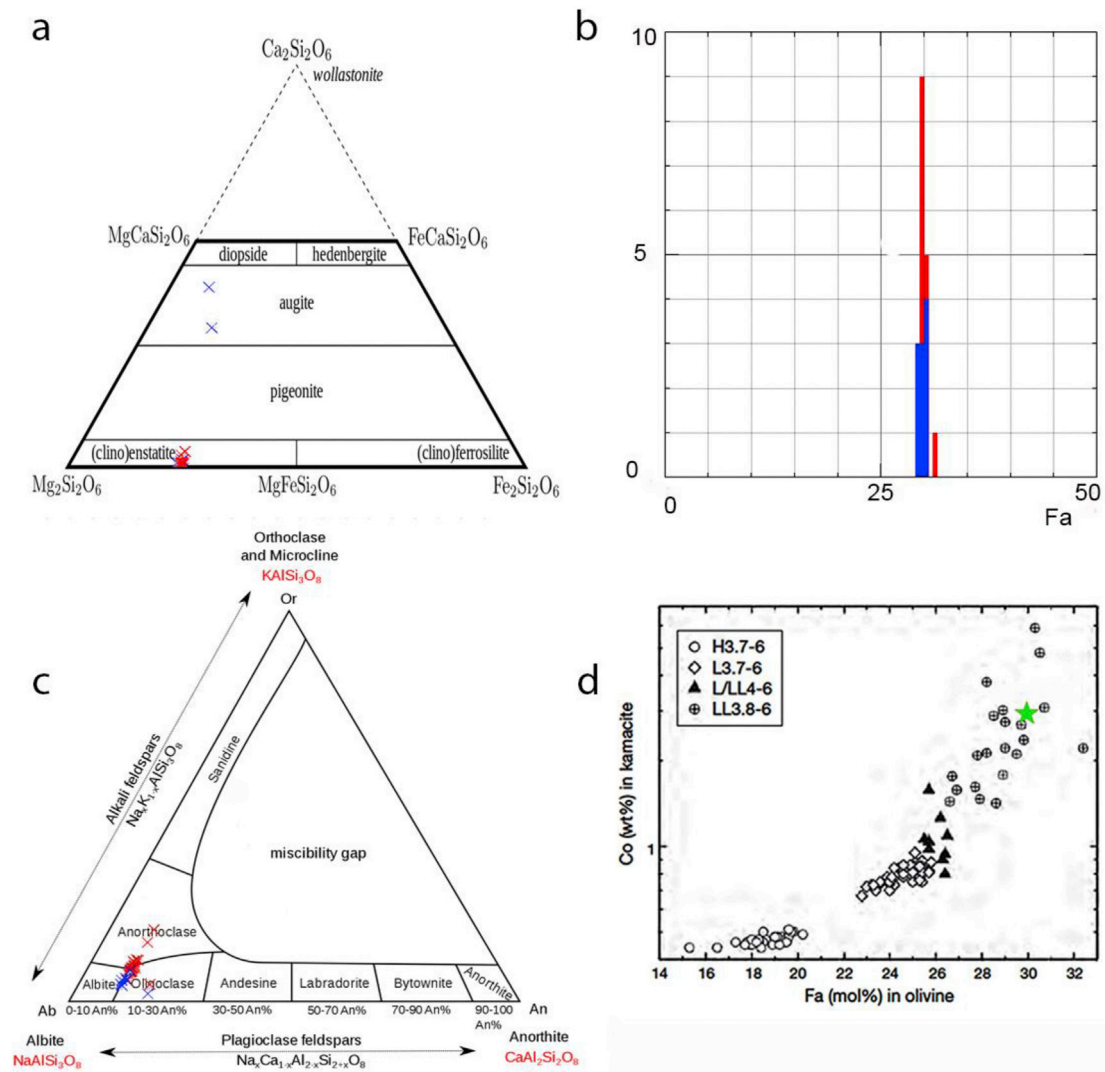
Fig. 8. Compositional plots from Electron Probe Micro-Analyzer (EPMA) analysis of different minerals grains. The colour blue in graphics refers to matrix analysis and red colour to chondrules. a) Triangular diagram of pyroxene-group minerals: Enstatite (En) – Ferrosilite (Fs) – Wollastonite (Wo). b) Histogram of Fayalite content (in mol%) of olivine from chondrules and matrix. c) Triangular feldspar diagram of plagioclase showing an albitic chemical composition. d) A diagram of Fayalite in Olivine versus Cobalt content in the Kamacite for different chondritic meteorites (replotted from Krot et al., 2014). The location of the San Carlos meteorite is marked with a green star, as well as the corresponding values in the *x* and *y* axis. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)
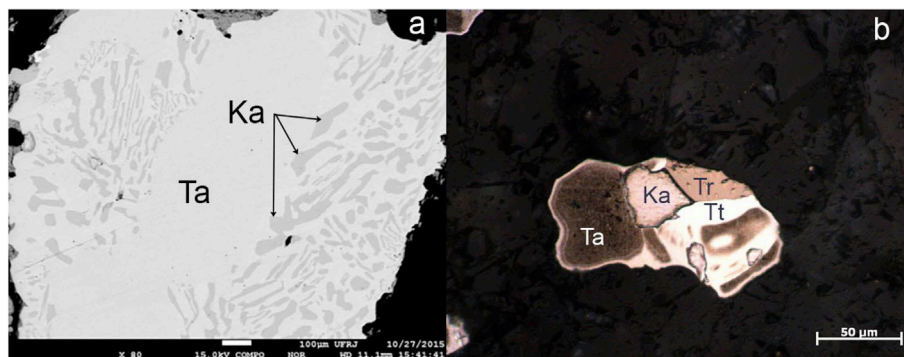
Fig. 9. Metal phase. A) back-scattered electron (BSE) image of a zoneless plessite particle showing the taenite-kamacite exsolution, B) Microphotography in reflected light of a showing a zoned taenite + kamacite particle. K: kamacite, Ta: taenite, Tr: troilite, Tt: tetrataeinite (2% nital etched).

Table 2
Chemical composition of metal phases.

Element	Kamacite	Taenite	Troilite	Chromite	Tetrataenite
Fe	90.06	63.55	61.94	22.72	48.04
Ni	4.88	33.68	n.d.	n.d.	50.48
S	0.01	n.d.	35.91	n.d.	n.d.
Co	2.85	1.21	0.01	n.d.	0.48
Si	0.00	0.00	0.01	0.09	0.00
Cr	n.d.	n.d.	0.01	32.77	n.d.
Total	97.80	98.44	97.88	55.58	99.00
#	5	12	11	1	5

altitudes over ~5000 m.

When a larger meteoroid fragments in the atmosphere, small and large fragments are separated in the strewn field along the meteoroid trajectory. To learn more about the direction of that trajectory, two search campaigns for additional fragments were organized on 2 and 12 October 2015, with 13 and 16 participants respectively.

Areas 1–2 km from the house were muddy and some parts were covered by shallow waters. We combed the area with participants separated by 2 m. The areas covered in the two campaigns are highlighted in Fig. 12 (red for the first campaign, blue for the second one). The total area searched for fragments was ~40 hectare = 0.4 km². Assuming that the most probable area was the inner circle ted of 1-km
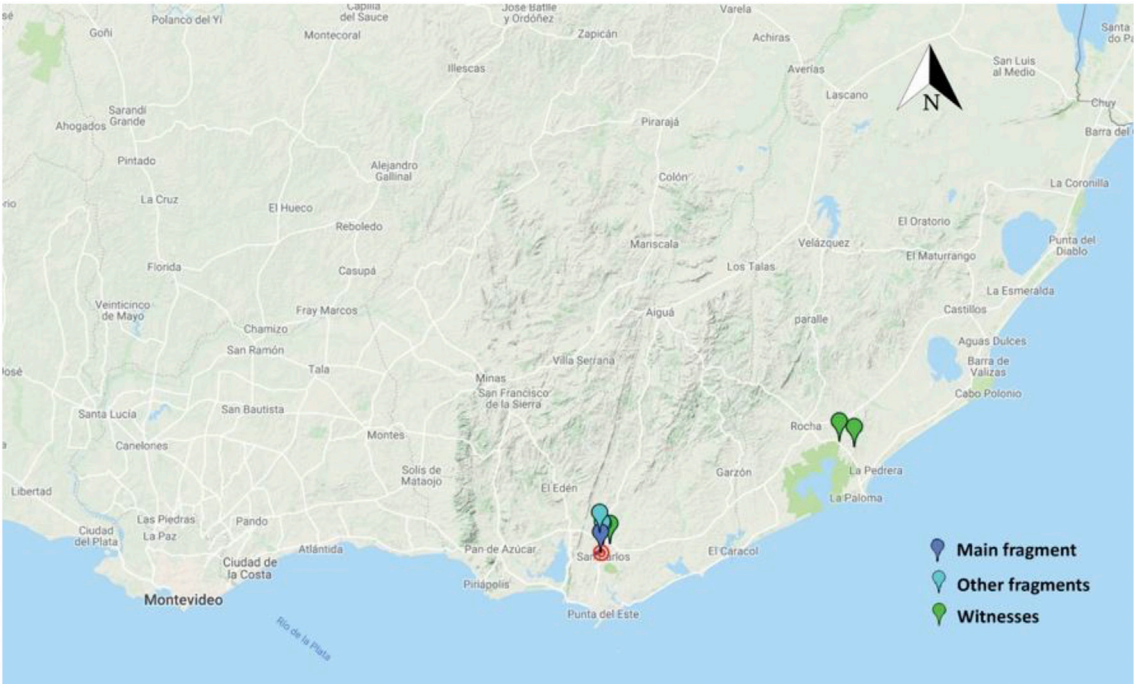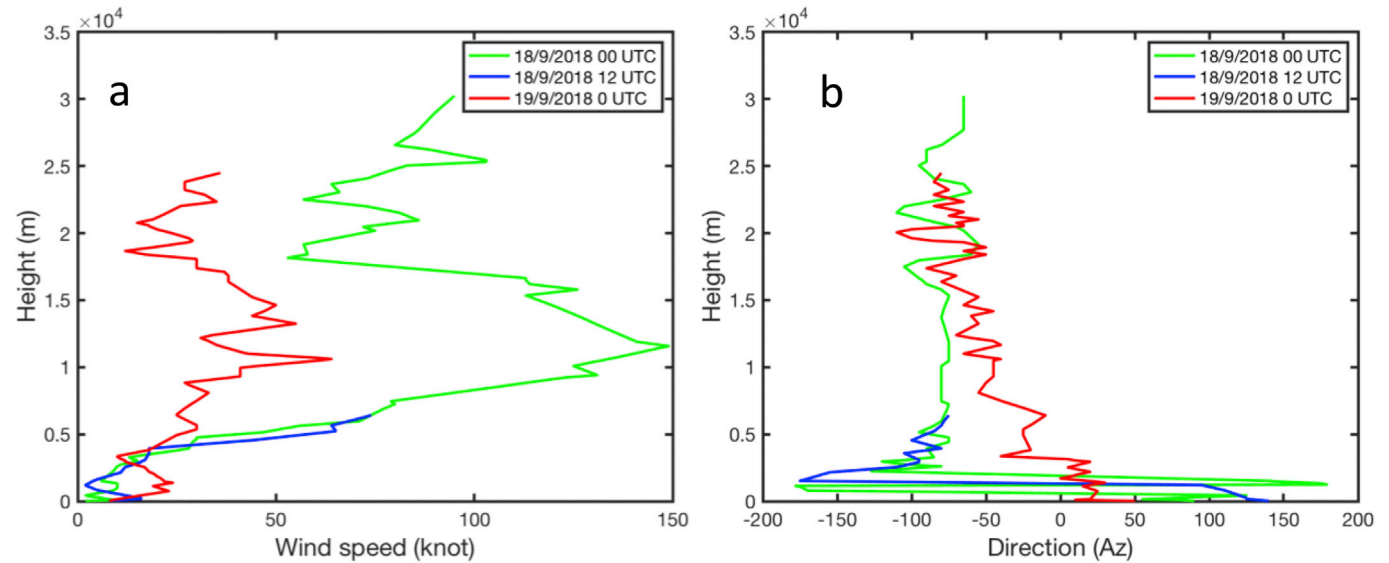

Fig. 10. Map of the witnesses.

Fig. 11. a) Wind speed as function of height for the station Ezeiza (#87576 SAEZ). b) Wind direction as function of height for the station Ezeiza (measured from North in clockwise sense).
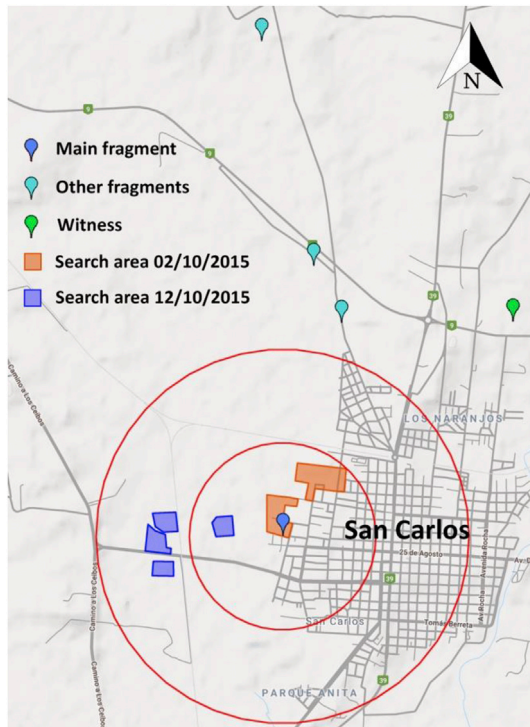
Fig. 12. Map of the location of the fragments and the search area.

Table 3
Number of falls and damaging ones since 1946 to 2017, in periods of 12 yr.

Period of 12 yr	# Total falls	# Damaging falls	% Damaging/Total
1946–1957	68	5	7
1958–1969	71	9	13
1970–1981	73	7	10
1982–1993	63	10	16
1994–2005	72	14	19
2006–2017	87	22	25

radius (centred on the house where the meteorite impacted, Fig. 12) with a surface of 12 km², the ratio between the searched and total area is only 3%. No fragments were found in these searches. Considering the lack of success, we estimate that there should be less than ~30 fragments larger than 100 g in the central part of the strewn field.

Two of us (JMM and VP) did further searches for fragments. On September 16, 2016, almost a year after the event, we found a new meteorite with identical characteristics as the main fragment. The location is marked in Fig. 12. The second fragment was found 2.4 km north from the main fragment. This second fragment has a mass of 1.45 g. Another two fragments were found by JMM later: one of 50 g and another one of 4.5 g. The location of these fragments are also shown in Fig. 12.

A fifth fragment was reported by Mr. Enrique Martinez, a farmer from San Carlos, who also witnessed the meteor, as reported earlier. No mass or size information is available.

6. Discussion

The reported time of the bolide is consistent with the absence of people from the house. The recovery of one of the meteorites immediately following the bolide also confirms the time of the fall. Based on the eye witness accounts and the distribution of the recovered meteorites (Fig. 12), and factoring in the wind drift (in a South-Eastern direction), the general impact trajectory of the bolide was from a North-North-West direction, moving South-South-East.

When small <1-kg meteoroids fragment above 20 km altitude, they fall with a terminal velocity determined by an equilibrium of the force of gravity and friction with the air. The terminal velocity (V_t) is calculated as $V_t = \sqrt{\frac{2\,m\,g}{\rho\,A\,C_d}}$, where m is the mass of the falling object, g is gravitational acceleration at the Earth's surface, C_d is the drag coefficient, ρ is the density of the fluid the object is falling through, and A is the object's cross-sectional area. The drag coefficient of a cone is a function of the vertex angle (Hoerner, 1965). The vertex angle for our sample is ~50 deg, and the corresponding drag coefficient is ~0.5. The object's cross-sectional area is the area of the base (30 cm²). The air temperature at the time of impact was 15 °C, and the corresponding air density is 1.225×10^{-3} g/cm.[3] From this, the terminal velocity was about 87 m/s. This high impact velocity is in concordance with the damage produced by the meteorite when hitting the house. Even after damaging the roof and a wooden bed, the remaining velocity was strong enough to cause a splint in a ceramic tile (Fig. 3b).

How unusual was it that a house was hit by a meteorite? How frequent are such meteorite falls that hit human belongings and produce damage? Damaging falls are not considered a separate category by the Meteoritical Society.

We collected information about such damaging falls from the reports of the Meteoritical Bulletin Database. We found a total of 76 reports of damaging falls starting from the 18th century until present. The most recent statistical data are summarized in Table 3. The number of reported falls has been quite stable in the last century, with a small increase in the last decade, possibly as a consequence of an increase interest in the subject and the globalization of the communications.

The fraction of damaging falls appears to have gradually increased in recent decades. In the last 12 years, there have been 87 reports of falls and 22 of damaging ones, implying a rate of 7.3 and 1.8 reports per year, respectively. This information about the rate of damaging falls could be used to estimate the impact rate over the entire Earth; but this calculation is outside the scope of this paper.

The "San Carlos" meteorite fall can be considered as a new case of a damaging fall.

The report with the proposed classification for the "San Carlos" meteorite has been recently submitted to the Meteorite Nomenclature Committee of the Meteoritical Society in order to be included in the MDB.

After acceptance, the meteorite San Carlos (Maldonado) will become the first confirmed meteorite from Uruguay. In the MDB there is a record of a meteorite from Uruguay, known as the Baygorria meteorite. But, this is a well-known case of a meteorite scam.[3] The meteorite has exactly the same composition as "Campo del Cielo" meteorite. In addition, the contact information that appears in the MDB record is false. Due to the strict Argentinian laws regarding the commercialization of meteorites, some people have been smuggling meteorites from Argentina to Uruguay and trying to sell them as Uruguayan meteorites. In parallel with the submission of the report of the San Carlos meteorite, we have asked the Meteorite Nomenclature Committee to withdraw the record of Baygorria from the MDB. Another similar case was related to the Berduc (Argentina) meteorite fall in 2008; when purported meteorites with the name "Arroyo Malo" started to appear in the market. Arroyo Malo is a small village less than 20 km from Berduc, but in the Uruguayan territory. One of us (G.T.) openly denounced the situation and the fake did not prosper.[4]

7. Conclusions

The "San Carlos" meteorite is the first confirmed meteorite of

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[3] See e.g. "The Baygorria scam": http://www.imca.cc/old_site/metinfo/ScamBaygorria.html.

[4] Berduc entry in the MDB: https://www.lpi.usra.edu/meteor/metbull.php?code=48975.

Uruguay. It is an ordinary chondrite monomictic breccia LL6, with low content in siderophile minerals and moderate chondrule size. It has a shock stage S4 and a degree of weathering W0. The meteoroid fell on September 18, 2015 at 17:45 UT in daytime from a NNW direction, fragmented and produced at least 5 fragments that scattered north of San Carlos, Maldonado. A 712 g stone hit a house and broke through the asbestos cement roof and a wooden suspended ceiling. The meteorite and its fragments broke a wooden bed frame and a TV set and significantly dented a ceramic floor tile.

The frequency of the meteorites that directly impact human beings or their belongings, the damaging falls, is increasing. There are now ~1.8 reports of damaging falls per year.

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