ROCAS del ESPACIO

Pavel Gabzdyl & Jakub Cenkl

Albatros

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Peekskill (1992)
Meteor Crater, Arizona
Chixculub crater
Campo del Cielo
Ensisheim (1492)
Ries crater
Chelyabinsk (2013)
Sikhote-Alin (1947)
Hoba meteorite

ROCKS from SPACE

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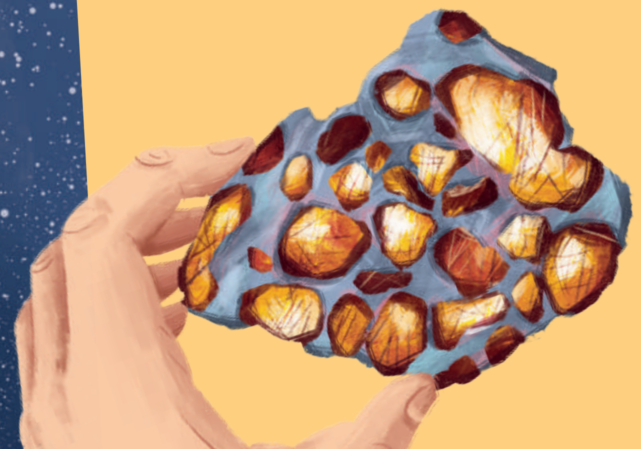
B4U Publishing

CONTENT



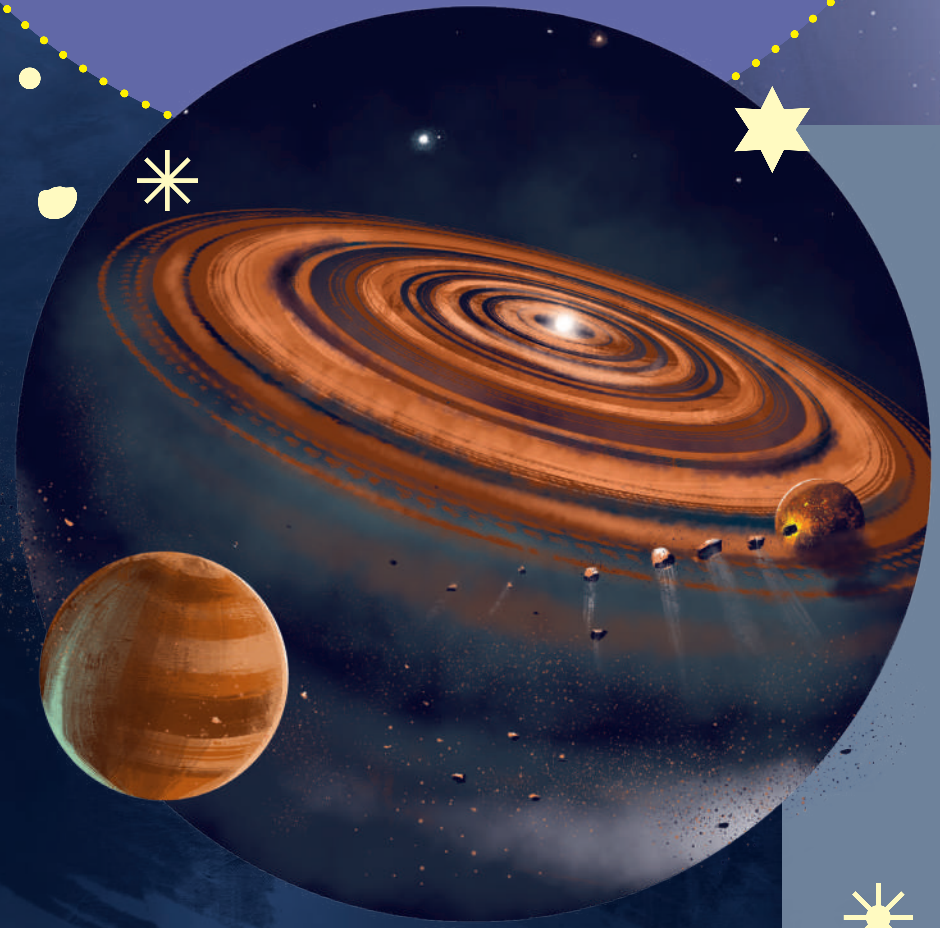
SPACE DEBRIS

The night sky is truly a delight to behold. Sometimes it shows us a crescent moon, and it is no rarity to spot a planet. Far from the city lights, we can gaze on thousands of stars and the hazy Milky Way. In addition to enormous planets and unimaginably large star systems, our universe contains a great deal of space junk unidentifiable even through the largest telescope. Most of this is made up of tiny particles of dust or stone, although some rocky debris is the size of a detached house. This cosmic garbage drifts about the interplanetary space. We may call it garbage, but it is immensely valuable to us. As well as teaching us what the worlds in our cosmic neighbourhood are made of, it can show us when and how Earth originated, and it fuels our curiosity about life on other planets.

ZODIACAL LIGHT

If you are lucky enough to find yourself in a place with no disturbing big-city lights on a clear, moonless night, you may get to see a faint cone of light extending from below the horizon, from where the Sun is. This narrow cone follows the line of the zodiac, i.e. the belt which the planets follow around the Sun. For this reason, it is known as zodiacal light. This special glow was first described in the 11th century by Persian scholars, who had no idea of the cause of the phenomenon. We know today that it results from sunlight scattered by interplanetary dust produced by comets and asteroids. Particles may be mere tenths of a millimetre across, yet they provide further proof that the space between planets is anything but empty.

ZODIACAL LIGHT IS SUNLIGHT SCATTERED BY FINE COSMIC DUST.



CLEANING UP THE SOLAR SYSTEM

Where did the junk in our planetary system come from? Well, believe it or not, it has been there from the beginning. Indeed, our solar system originated from a giant cloud of gas and dust. Out of this, ever larger bodies came together, eventually forming planets and their moons. Left-over material formed asteroids, comets and the rocks known as meteoroids. The junk that remained was attracted or repelled by the Sun; in the latter case, it was expelled into deepest space. As you know, cleaning up isn't always easy. It is an ongoing process. This can be said of the solar system, too. Small celestial bodies are forever colliding with one another, making ever more fragments. From one orbit of our day star to the next, a comet will lose up to a million tons of its mass. The Sun and the larger planets deal with this waste to keep the interplanetary space as clean as they can.

SHOOTING STARS

Have you ever seen a shooting star? If so, you have witnessed the last moments of a tiny cosmic pilgrim that roamed the universe for millions of years. You have not seen the extinction of a star, however: that enormous ball of fire is too far away and too massive to fly across the sky while shining brilliantly, before going out in an instant. A shooting star produces tiny grains of cosmic dust that pass through Earth's atmosphere at tremendous speed. By friction with air molecules, it gets so hot that it can maintain the glow only for a short time. The result is an impressive light phenomenon known to us as a meteor. It is said that if you see a shooting star, you should make a wish. But you must be quick about it: meteors tend to be visible for a fraction of a second only.

A METEOR IS A STREAK OF LIGHT, A METEORITE IS A ROCK THAT HAS FALLEN TO EARTH FROM SPACE, AND A METEOROID IS A ROCK FLYING THROUGH SPACE.

TEARS OF ST LAWRENCE

On a moonless night, we can typically see about five meteors per hour. If there are many more than this and they are coming from one place, we are probably looking at a meteor shower. This occurs when Earth passes through a stream of dust particles shed by comets on their way through space. We have learned to recognize many such showers over the years. The most popular, the Perseids, is also known as the 'tears of St Lawrence'. The explanation for why the 'tears' are so popular is a simple one. The Perseids' activity culminates between 11-13 August, when nights are warm – meaning that we can watch it in comfort as we lie in the open air in our sleeping bags. This annual stream of dust particles departs from the northern edge of the Perseus constellation, produced by the comet Swift-Tuttle. In the best conditions, we get to see up to 110 meteors per hour.

FIREBALLS

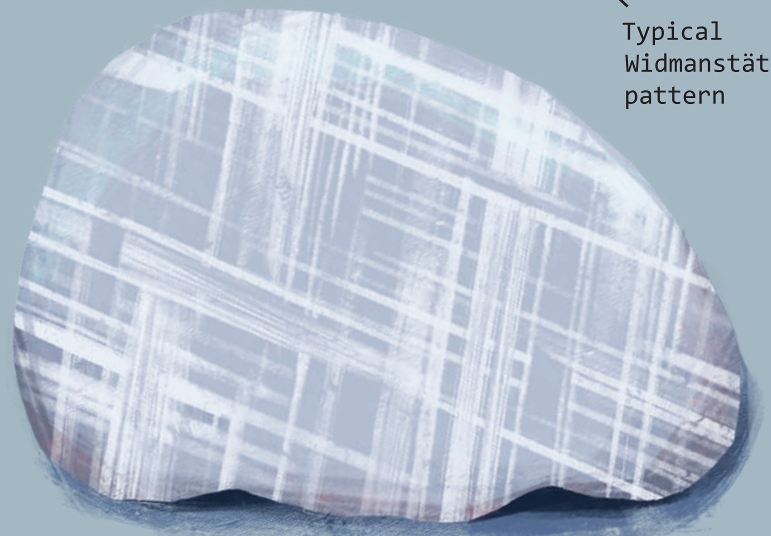
Each year, our planet collides with tens of thousands of tons of cosmic material. Although much of this interplanetary junk evaporates on its way through the atmosphere, larger pieces sometimes reach Earth's surface; we describe such 'rocks' as meteorites. Only the heaviest space-travelling boulders survive a fiery flight through Earth's atmosphere, however; mere specks of dust don't stand a chance. Entry of such a boulder to Earth's atmosphere creates a bolide (or fireball), a breath-taking spectacle. Its shine can surpass that of the brightest star, planet, or even the full Moon. The brightest bolides are visible during the day. Many bolides leave an impressive smoke trail in their wake.

METEOR STORM

A meteor shower occasionally develops into a meteor storm. Such an event took place over the United States on 13 November 1833, when 200,000 bright meteors lit up the sky in the course of a single night! Eyewitnesses described seeing as many stars in the sky as snowflakes in a blizzard. Bells rang the alarm, and frightened people ran from their homes. This breath-taking spectacle was produced by the Leonids, a meteor shower which appears in the sky in mid-November every year. The shower becomes a storm once every 33 years, when the comet Tempel-Tuttle (where the particles of this meteor shower originate) comes our way. A recent major meteor storm occurred on 12 October 2012, when the Draconids produced a great outburst with around 40 meteors in the space of one minute.

HOW TO RECOGNIZE A METEORITE

It happens quite often. Someone finds a strange, dark-coloured rock in a field or by a path; a rock that doesn't seem to belong there. So how did it get there? Could it be a rock from space, blackened by its flight through the atmosphere? In the vast majority of cases, it is no such rock, unfortunately. The probability of your happening across a meteorite is very slight. What's more, some meteorites disguise themselves so well among ordinary terrestrial stones that even the experts struggle to identify them. Fortunately, meteorites possess certain qualities that they share with no other rocks. To recognize these qualities, we must explore them a little and shine the light of the X-ray on them; sometimes we must cut them, polish them, cause them to erode, or dissolve them in acid. Only after such actions will a meteorite reveal its cosmic origin. Scientists say that meteorites are like books: they give us nothing unless we open them.



Typical Widmanstätten's pattern

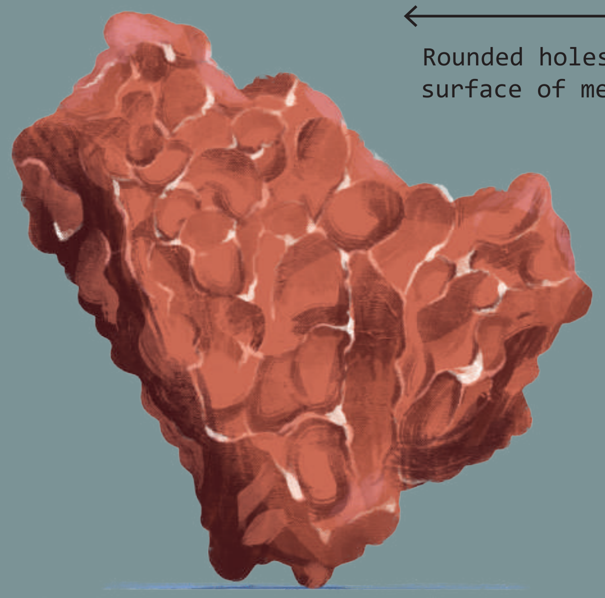
PATTERNS THAT GIVE THE GAME AWAY

Unusually heavy, dark and shiny, iron meteorites are pretty odd stones. But just as all that glitters is not gold, not every piece of natural iron is a rock from space. Fortunately, there is one sure sign of an iron rock's origin in space. It was discovered in 1808 by pure chance, by Alois Widmanstätten, director of the Imperial Porcelain Works in Vienna. By flame-heating slabs of iron meteorite, he discovered within them a regular network of paler lines in the shape of an isosceles triangle. In honour of their discoverer, these formations are known as Widmanstätten's patterns. Scientists went on to determine that these patterns form only in the hot core of a planetesimal.

A crater on the Moon is named after Alois von Beckh Widmanstätten.

HEAVIER THAN GRANITE

In many cases, a meteorite is identified as such by its mass – or perhaps we should say its density. On weighing a meteorite in your hand, you will notice how much heavier it is than an ordinary rock. This is because meteorites contain a lot of iron; indeed, some of them are nothing but iron. While common terrestrial rock – such as granite, limestone, basalt and sandstone – is no heavier than 3 grams per cubic centimetre, the commonest types of meteorite average 3.4 grams per cubic centimetre. Meteorites of iron are 2.5 times denser than terrestrial rock. Naturally, you can feel the difference when you pick them up. This does not mean that every heavy rock is a meteorite, of course.

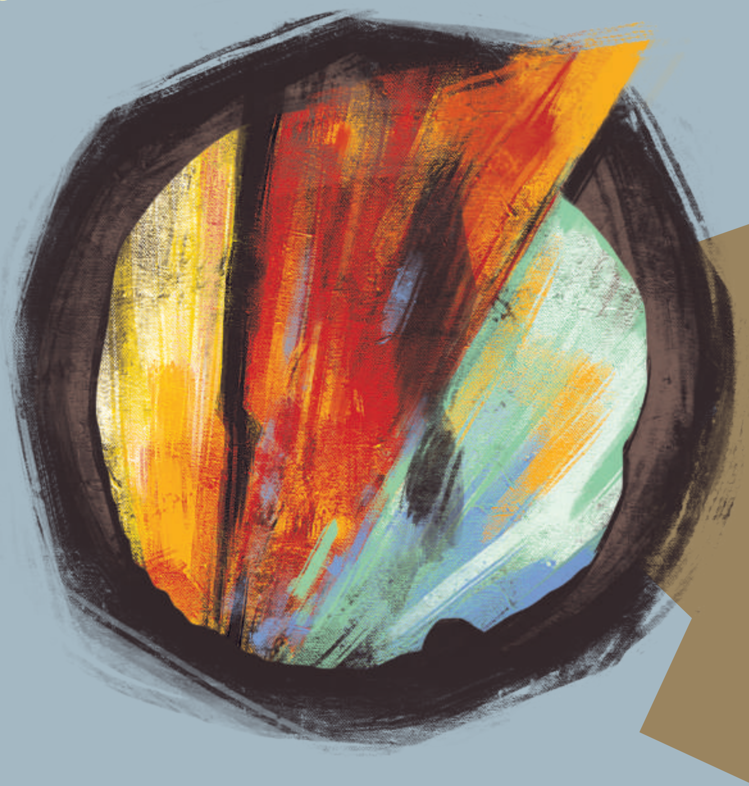


Rounded holes on the surface of meteorites

THE AIR AS STONE CARVER

On their rapid flight through Earth's atmosphere, meteorites are badly scarred. In fact, over four fifths of their overall mass melt away in the process! Meteorites have neither sharp edges nor flat surfaces, for these melt away first. To get an idea of what goes on, drop an ice cube into a glass of water and watch it dissolve; you will see that the sharp edges go first. If a sharp edge does form on a meteorite, then only on a fresh break brought about by disintegration in the final stage of the baptism of fire.

Fingerprint-like rounded holes on the surface of iron meteorites are the work of our atmosphere. They are made by supersonic eddies of hot air.



BEATEN BY FIRE

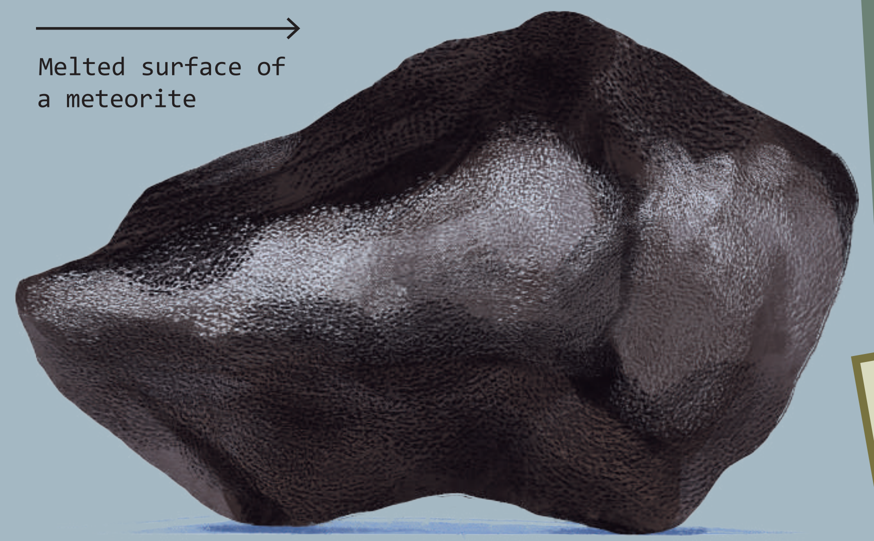
Before these messengers from space reach us on Earth, they must pass through a baptism of fire. On their way to us, cosmic rocks must penetrate Earth's atmosphere – and they do so at about 70,000 kilometres per hour! At such furious speed, air drag causes the rock to become so hot that its surface begins to melt. This explains why a 'new' meteorite has a dark molten crust, giving it a flame-beaten look. As a rule, the molten layer is darker in colour than the inside of the meteorite – so if the rock in question is the same colour on its surface as it is when broken, you can be pretty sure that it isn't a meteorite. Bear in mind that the molten crust of a meteorite is very thin; only in rare cases is it thicker than 1 millimetre.

CHONDRULES ARE STRANGE BALLS IN METEORITES.
CHONDRITES ARE METEORITES WITH CHONDRULES IN THEM.

MYSTERIOUS BALLS

If there is one thing by which we can distinguish an ordinary-looking rock from a rock from space, it is the presence of chondrules. A chondrule is a spherical body, of which the smallest has a diameter of half a millimetre and the largest is the size of a pea or walnut, and it is clearly seen in a section or break on a meteorite. The most common type of this celestial rubble is the chondrite. These shiny balls are a sure sign that the rock you are dealing with is not from Earth. If you examine a chondrite under a microscope, it will reveal mineral grains in beautiful colours. Scientists have established that these are molten grains from dust clouds which went on to form the nuclei of the planets of our Solar System. Which means that chondrites are older than all the planets! We do not yet know what caused these grains of dust to melt. All we know is that something must have brought them to a temperature of over 1,000 degrees Celsius.

Melted surface of a meteorite



COLOUR AND 'WRITING'

It may sound strange, but one way of testing to see if a rock is a meteorite is to try writing with it – but on glass, not paper. If a sharp edge of the stone in question scratches the glass, then in all likelihood it is not a meteorite. This is because meteorites do not contain quartz, a common element of terrestrial rock. Quartz is recognized by its colourlessness, shine and glassiness. The surest indicator that you are dealing with quartz, however, is extreme hardness; quartz is the only common mineral that can leave a scratch on glass. You can test dark, heavy stones that look like iron meteorites in the same way, but by moving them against a white ceramic tile or the bottom of an unglazed white coffee cup. If the scratch is rust-coloured, you have in your hand a mineral called hematite. If the scratch is a strong grey, what you have is probably magnetite. If the stone were a meteorite, the scratch would be colourless or a very faint grey.

One thing that tells us that a rock is from space is the presence of chondrules. A chondrule is a spherical body found in some types of meteorites.

Rocks from Space
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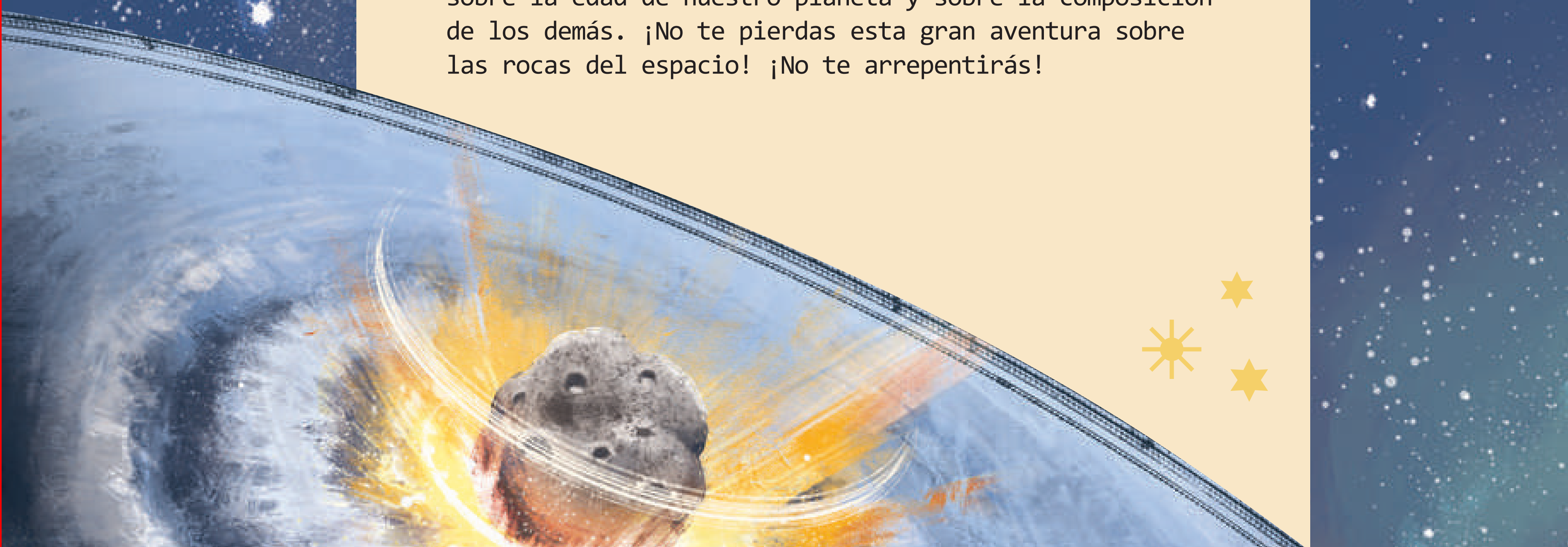
TODO LO QUE NECESITAS SABER SOBRE LOS METEORITOS

ROCAS del ESPACIO

Escrito por Pavel Gabzdyl e ilustrado por Jakub Cenkl

¿Podrías distinguir una piedra corriente de un meteorito, o sea, una roca de origen cósmico? No te preocupes si la respuesta es no: en este libro encontrarás todo lo que necesitas saber sobre meteoritos. Después de leerlo, sabrás cómo se forman, lo que ocurre cuando vuelan por el espacio e incluso la velocidad que alcanzan antes de caer sobre la Tierra. Conocerás los impactos de meteoritos más famosos: algunos divertidos y otros terroríficos. Y algo quizá aún más importante: a diferenciarlos de las piedras comunes. Si eres de los que piensan que todos los meteoritos son iguales, estás muy equivocado. Un solo fragmento puede decirnos mucho sobre la edad de nuestro planeta y sobre la composición de los demás. ¡No te pierdas esta gran aventura sobre las rocas del espacio! ¡No te arrepentirás!



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