
Space Gems
TM

Meteorites

- What are they?
- Where do they come from?
- What are they composed of?
- How and where can you find them?
- What are they worth?
- What can you do with them?
- How are they used in the gem & jewelry industry?

Meteoroids, Meteors & Meteorites

- A meteoroid is what we call a rock while it is in orbit around the sun and before it is decelerated by the Earth's atmosphere.
- A meteor is the visible streak of light that occurs as the rock passes through the atmosphere and the exterior of the rock is heated to incandescence, also known as a "shooting star".
- A meteorite is a rock that was formed elsewhere in the Solar System or universe, was orbiting the sun or a planet for a long time, was eventually captured by Earth's gravitational field, and fell to Earth as a solid object.

How can I see a shooting star?

Go to a rural location with minimal lights in the area, as far from cities and towns as possible. Pick a night with minimal cloud cover. Find a comfortable spot to lie on your back, be patient, gaze at the heavens and eventually you will see a small bright light streak across the sky.

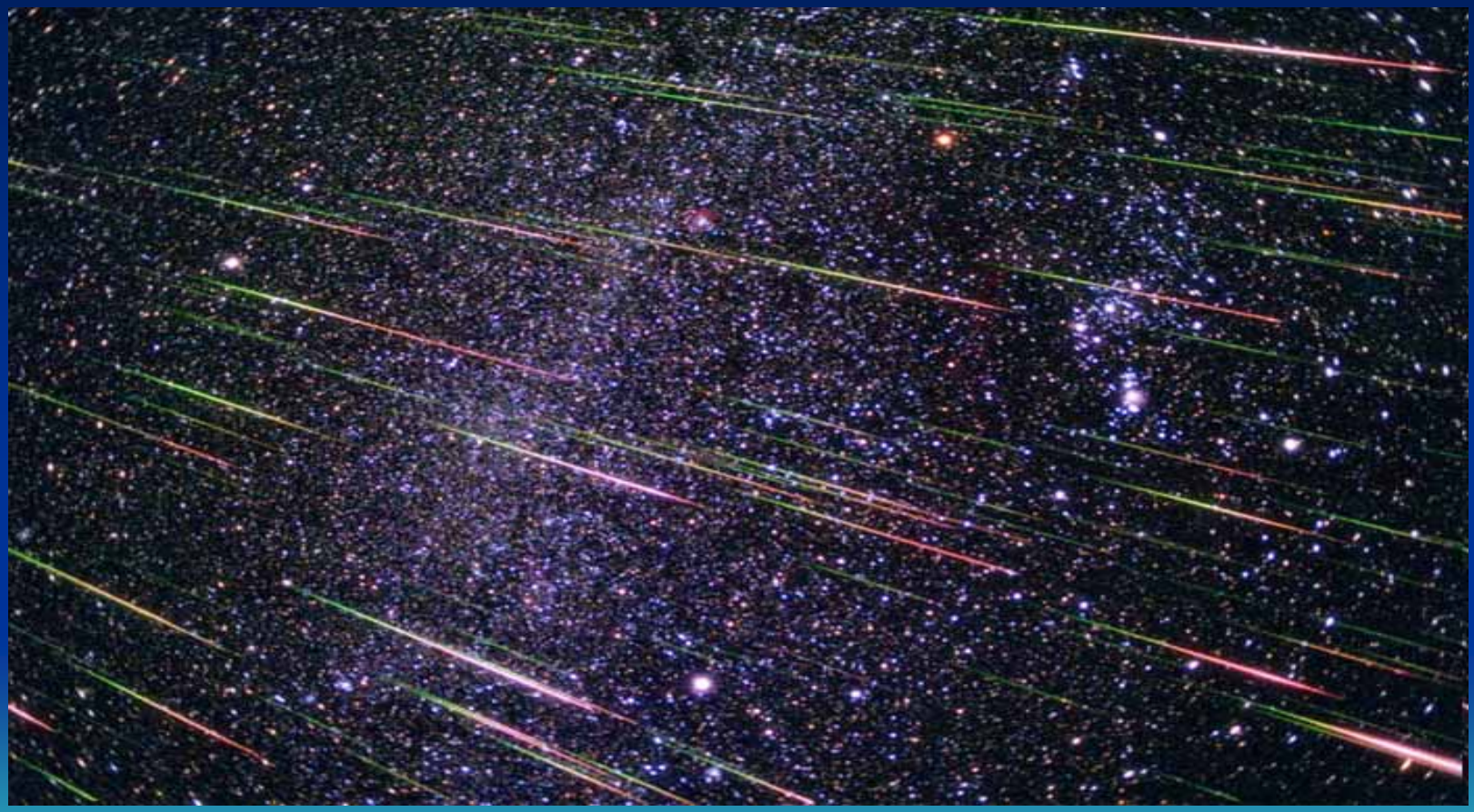
There are eleven major annual meteor “showers”

Meteor showers are usually named after the constellation from which they emanate (trace their paths backward and they appear to come from one place in the sky - their radiant). The Quadrantids are named after an obsolete constellation named Quadrans Muralis. The peak is generally January 3/4. Its Zenithal Hourly Rate (ZHR), or the amount of meteors expected an hour during its peak, is 90, or about 1 every 40 seconds

Splash down

Roughly 70% of the Earth is covered with water. Therefore, about 70% of the meteorites falling to the earth's surface are lost in oceans, lakes and rivers.

Time lapsed photo of a meteor shower



Not to be confused with satellites

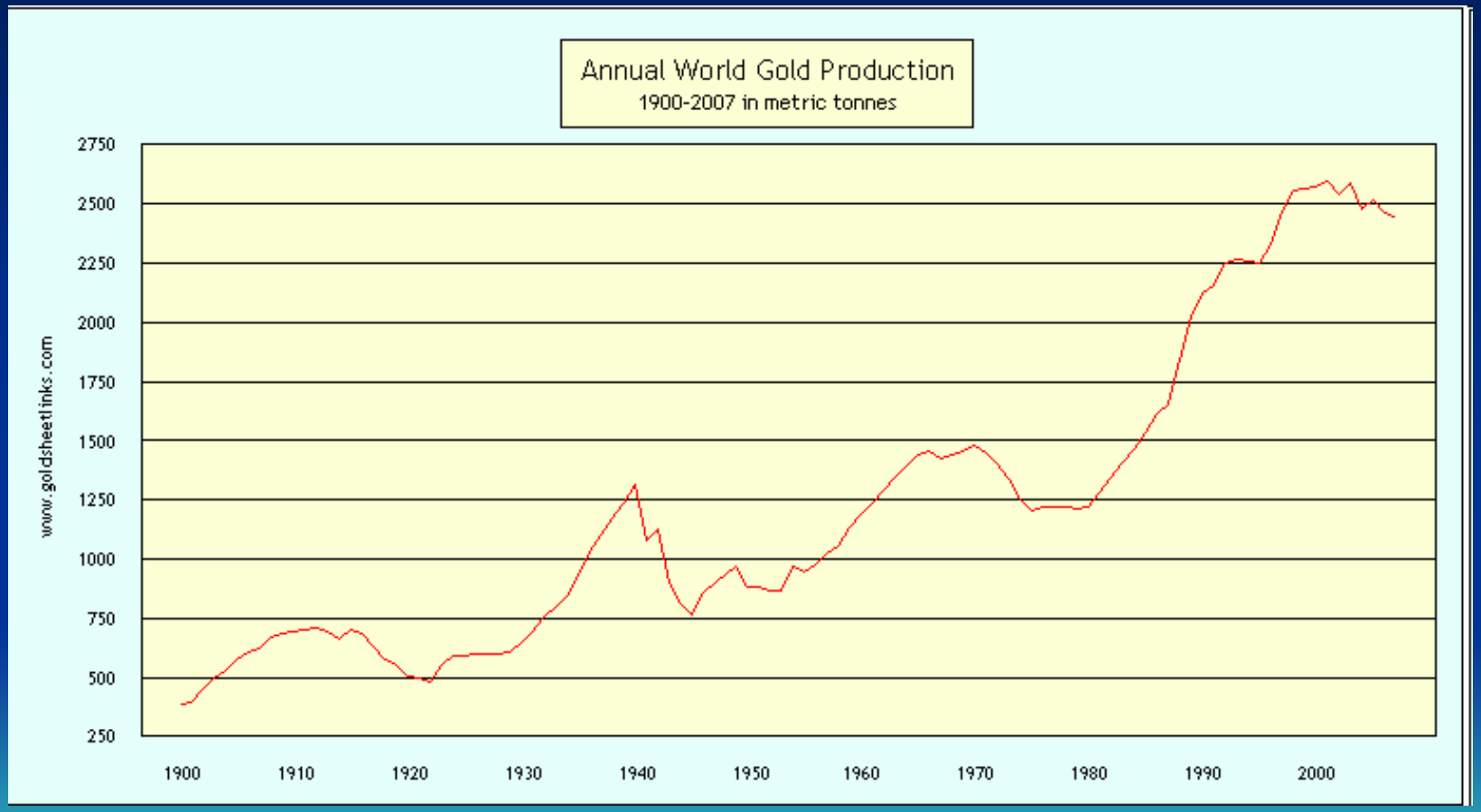
Don’t mistake fireflies for meteorites

Meteorite “Fireball” also called a “Bolide”.

Meteoroid to meteor to meteorite

- If a meteor does not get burned up in its dash through our atmosphere, and lands on the earth, we now have a meteorite.
- Approximately 600 metric tonnes of meteorites have been recovered to date.
- Let’s compare that with world gold and diamond production…

World gold production history



Meteorites, gold & diamonds

- Total world wide meteorite recovery is less than 1/2 of 1% (0.005%) of world gold production in the last 100 years.
- Diamond extraction from primary deposits (kimberlites and lamproites) started in the 1870's after the discovery of the diamond fields in South Africa. Production has increased over time and now an accumulated total of 900 metric tonnes have been mined since that date.

Where do they come from?

- Debris from comets passing through our solar system
- Asteroids and asteroid fragments
- Very rarely, ejecta from Lunar and Martian meteor and comet impacts.

Primary classification

- Witnessed called “Falls”
- Un-witnessed called “Find’s”
- As of mid-2006, there are approximately 1,050 witnessed falls having specimens in the world's collections. In contrast, there are over 31,000 well-documented meteorite finds.

Witnessed fall of a fireball meteor which reached the earths surface

Witnessed indeed!

What are the odds?

The most famous (and, indeed, the only accepted) injury caused by a meteorite occurred in Sylacauga, Alabama in 1954. Mrs. Annie Hodges was taking a nap one afternoon when she was awoken by an "explosion." She then noticed that she was seriously bruised on her left hip and that a meteorite had crashed through her roof, bounced off of a radio, and then hit her. The incident was picked up quickly by the press and is therefore the only verified strike to a human (in the eyes of some).

Doctor and Mrs. Annie Hodges

What are meteorites made of?

1. Stoney
2. Mixed Stoney and Iron
3. Iron

All meteorite finds and falls are separated into these three categories of meteorite classification.

Stoney meteorite classification

- Chondrites (containing chondrules)
- Achondrites (without chondrules)

Chordrite composition

Chondrites are stony meteorites that have not been modified due to melting or differentiation of the parent body. They formed when various types of dust and small grains that were present in the early solar system accreted to form primitive asteroids. Prominent among the components present in chondrites are chondrules, millimeter-sized objects that originated as freely floating, molten or partially molten droplets in space.

Chondrite composition

Most chondrules are rich in the silicate minerals olivine and pyroxene. Chondrites also contain refractory inclusions (including Ca-Al Inclusions), which are among the oldest objects to form in the solar system, particles rich in metallic Fe-Ni and sulfides, and isolated grains of silicate minerals.

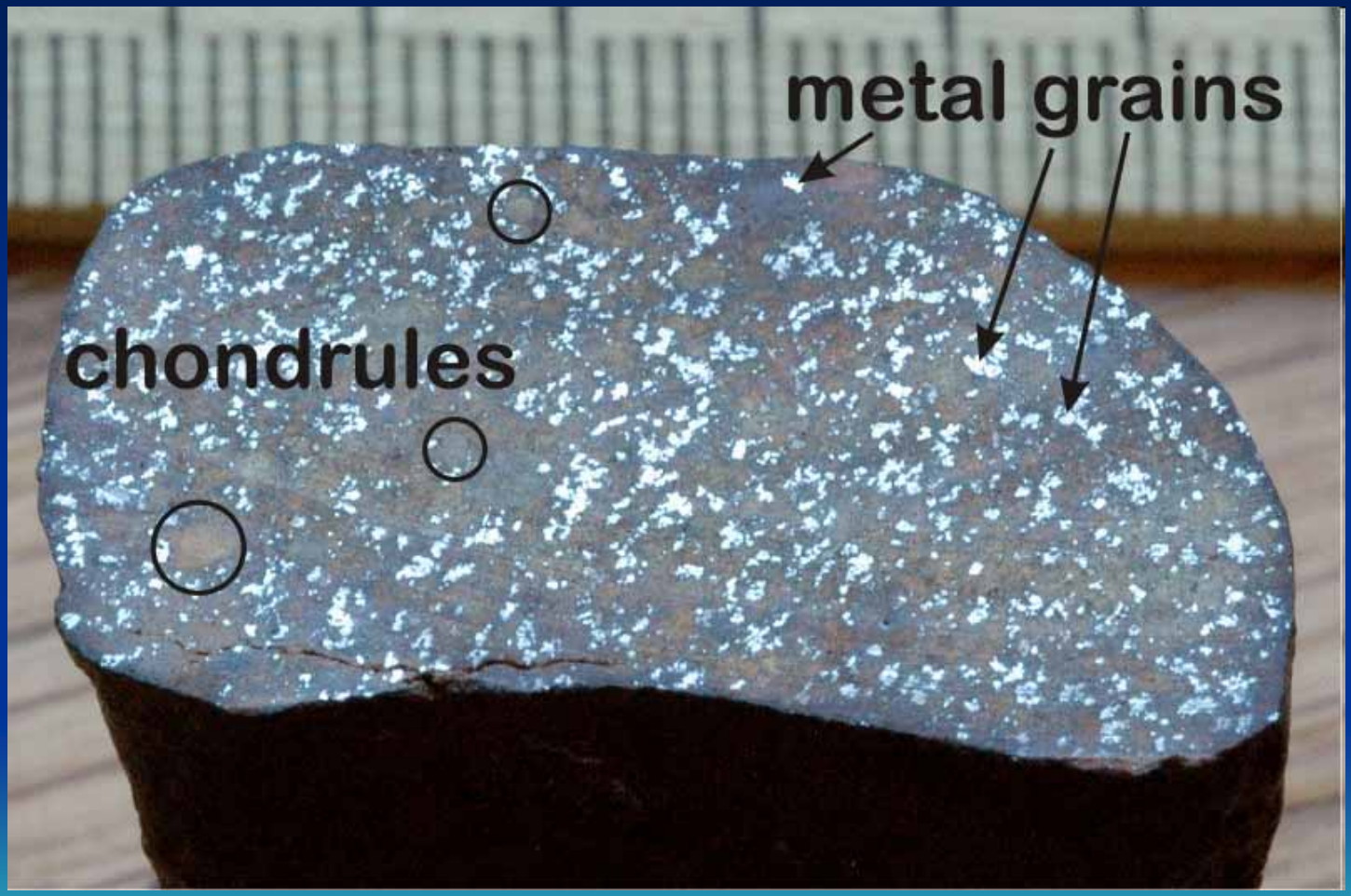
Chondrite composition

The remainder of chondrites consists of fine-grained (micrometer-sized or smaller) dust, which may either be present as the matrix of the rock or may form rims or mantles around individual chondrules and refractory inclusions. Embedded in this dust are pre-solar grains, which predate the formation of our solar system and originated elsewhere in the galaxy.

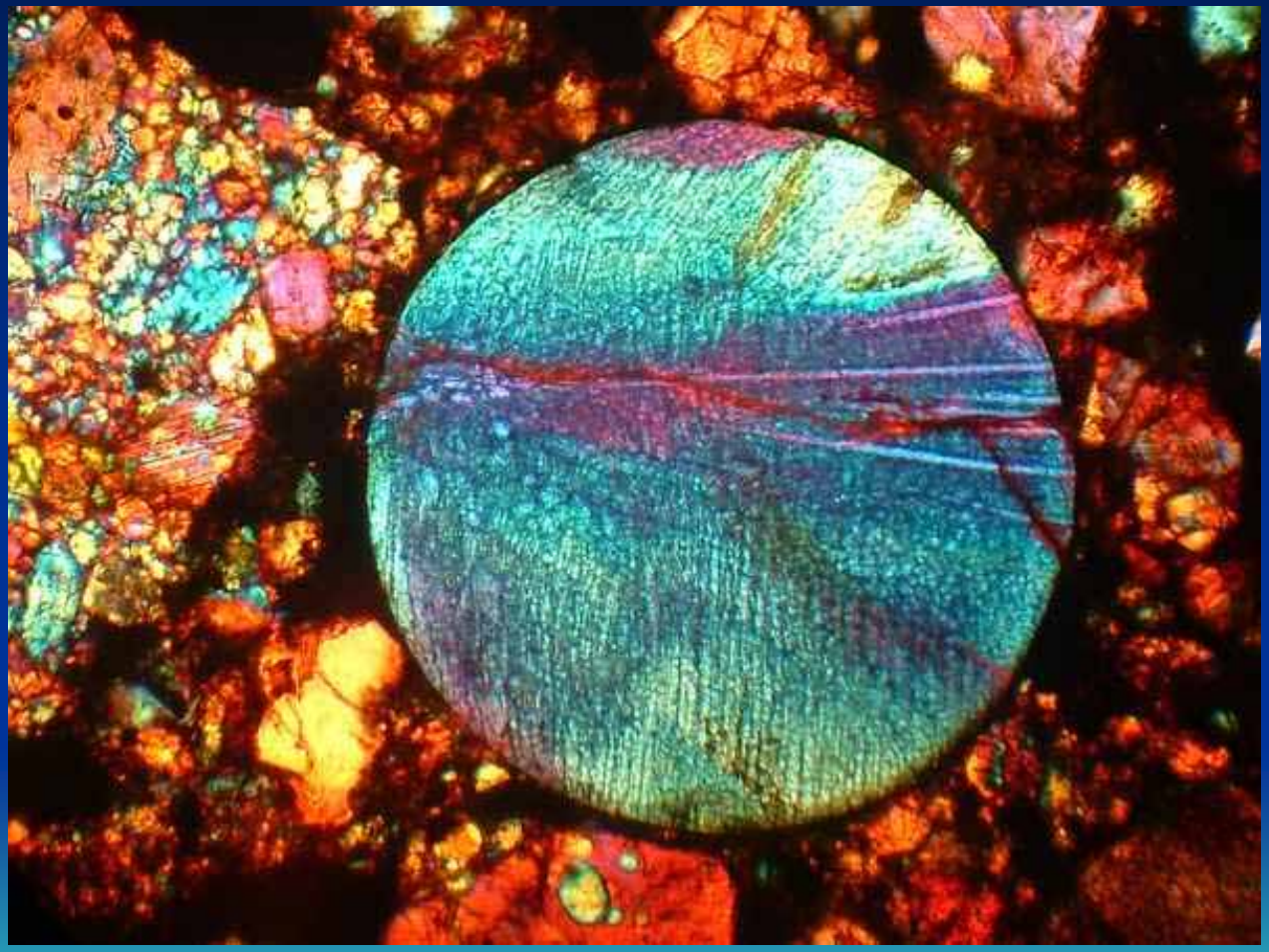
Most meteorites that are recovered on Earth are chondrites: 86% of witnessed falls are chondrites as are the overwhelming majority of meteorites that are found. There are currently over 27,000 chondrites in the world's collections. The largest individual stone ever recovered, weighing 1770 kg, was part of the Jilin meteorite shower of 1976 in north eastern China.

Chondrite falls range from single stones to extraordinary showers consisting of thousands of individual stones, as occurred in the Holbrook fall of 1912, where an estimated 14,000 stones rained down on northern Arizona.

A typical chondrite



Thin section with chondrule



Ordinary chondrite pebbles found in the Sahara desert

Carbonaceous chondrites

Carbonaceous chondrites or C chondrites are a class of chondritic meteorites comprising at least 7 known groups and many ungrouped meteorites. They include some of the most primitive known meteorites. Carbonaceous chondrites represent only a small proportion (4.6%) of all meteorite falls and finds.

Carbonaceous chondrites

Several groups of carbonaceous chondrites contain water as well as organic compounds. They are composed mainly of silicates, oxides and sulfides, while the minerals olivine and serpentine are characteristic. The presence of volatile organic chemicals and water indicates that they have not undergone significant heating (>200°C) since they formed, and their compositions are considered to be close to that of the solar nebula from which the solar system condensed.

Chondrites with organic compounds

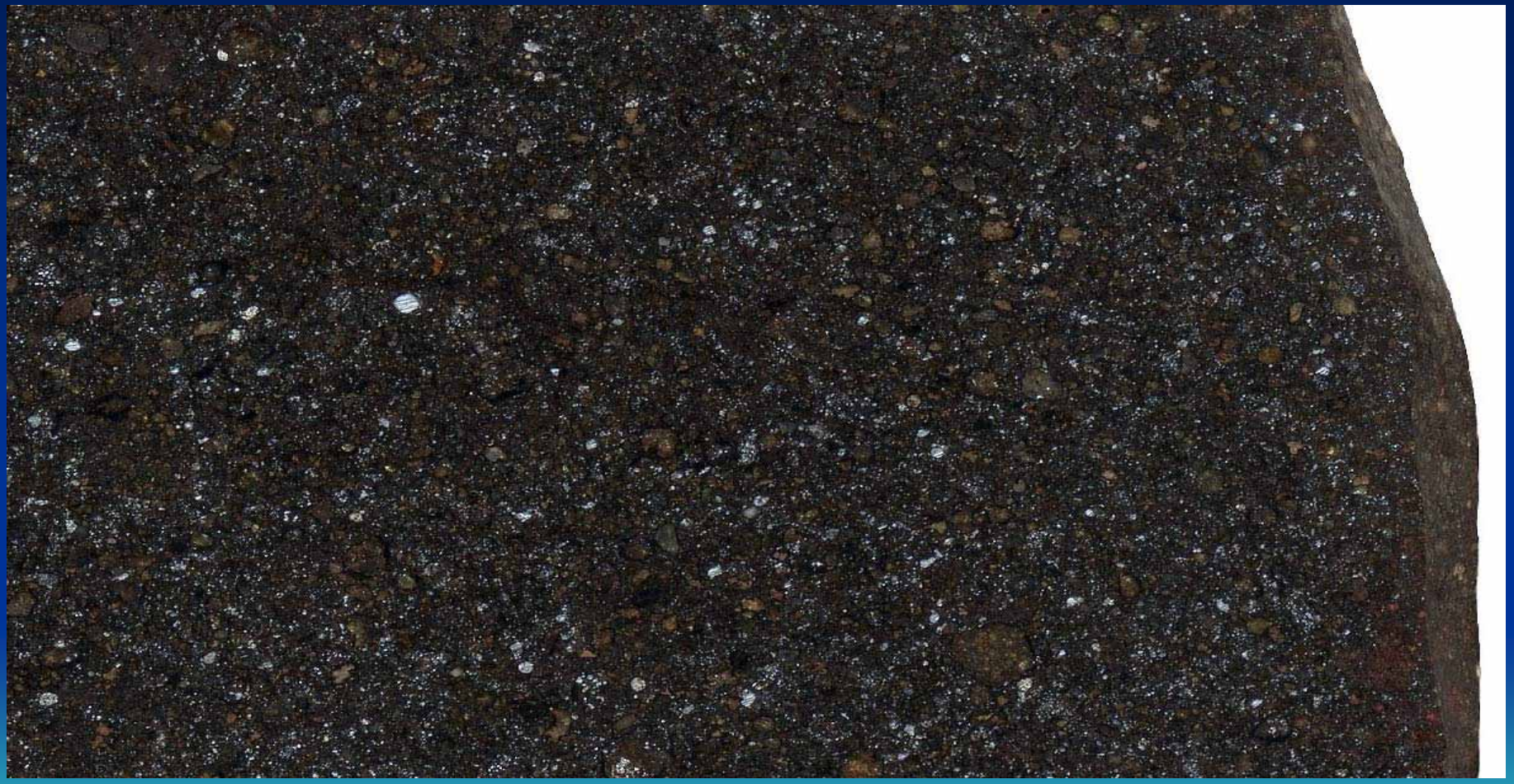
One group of carbonaceous chondrites contain a high proportion of water (up to 22%) and organic matter in the form of amino acids .

Amino acids are critical to life, and have a variety of roles in metabolism. One particularly important function is as the building blocks of proteins, which are linear chains of amino acids.

Chondrites with organic compounds

Organic matter in meteorites is a subject of intense interest to scientists because this material formed at the dawn of the Solar System and may have seeded the early Earth with the building blocks of life.

Carbonaceous chondrite



Diamonds in meteorites

The first good evidence of diamond in a known meteorite was published in 1888, by Jerofejev and Lacbinov. In a stony achondrite meteorite which fell in September 1886, near Novo Urei, Russia, they found grayish grains which were regarded as diamonds. The famous American mineralogist Kunz was able to procure a small piece of the same meteorite and substantiated their conclusion.

Kunz, Tiffany's & space diamonds

Diamonds had been noted previously in Russian meteoric stones. Particles of this substance obtained were so minute that ordinary chemical tests could not be applied to them. Mr. Kunz suggested that if enough clean grains could be obtained to polish a diamond, the nature of the substance would be definitely determined. About 200 pounds of the meteor was examined, and specimens which appeared to contain diamonds were dissolved in acids.

Kunz, Tiffany’s & space diamonds

The exhibition of diamond-cutting in the Mining Building of the 1893 World's Fair gave the opportunity for trying the experiment, and Tiffany & Co. made preparations for the test. A diamond-polishing wheel was specially planed down, and prepared with radiating scratches so as to be easily charged with diamond powder.

Kunz, Tiffany’s & space diamonds

The wheel was run at 2,500 RPM, and a diamond was tried on it for five minutes without any polish resulting. The wheel was then charged with the meteorite powder mixed with oil. As soon as the diamond was placed on the wheel a hissing noise indicated that it was being cut. In three minutes one face of the diamond was polished. After a series of experiments with this powder, Mr. Kunz said he was satisfied that it is diamond, "or a substance with the same hardness, color and brilliancy."

Modern scientific study

The occurrence of diamonds in the Novo Urei meteorite has been confirmed by X-ray diffraction. Chemical and mineralogical studies of this meteorite suggest that it is an intensely metamorphosed carbonaceous chondrite.

Novo Urei

These enigmatic achondrites of uncertain origin are arguably the ugliest of all meteorites, but also the most fascinating, one reason: diamonds!

Carbonado – Diamond Meteorites

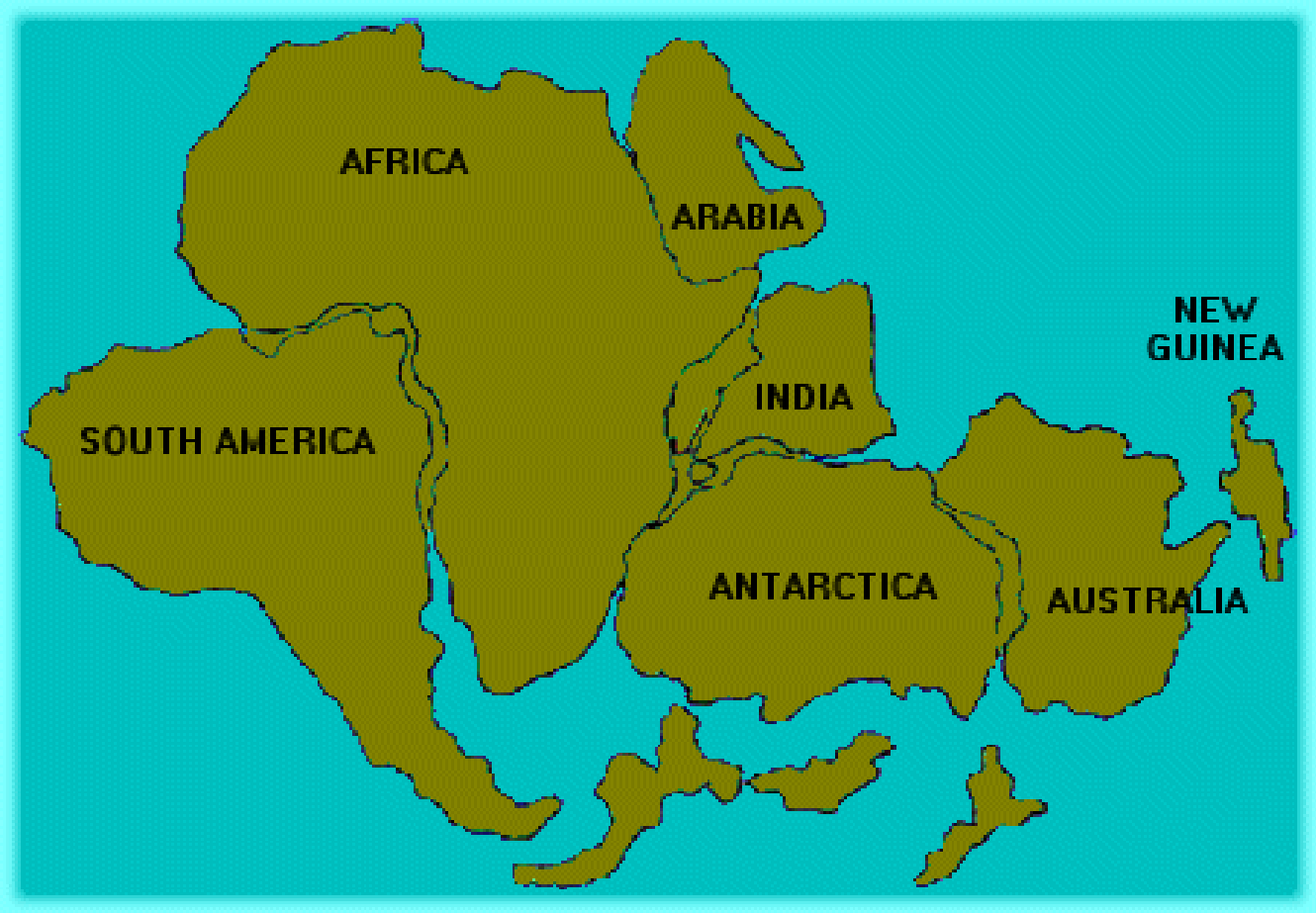
The name carbonado, meaning burnt or carbonized in Portuguese, was given to this material upon its discovery in Brazil in the 1840's. This dark gray to black variant of diamond has been mined in the Bahia Province of Brazil since that time. Due to its much greater hardness than typical diamond, it is used industrially for drills and for edges in cutting implements.

Carbonado – Diamond Meteorites

Carbonado was subsequently found to occur in the same sedimentary geological horizon on a separate continent—in the Ubangui region of the Central African Republic. It has never been found during any conventional diamond mining and processing operations around the world. The largest recorded carbonado was found in Brazil and weighed 3,167 carats, about 60 carats heavier than the famous Cullinan diamond

In the ongoing debate to explain the circumstances surrounding the terrestrial occurrence of this unusual diamond, the theory propounding its arrival during a Precambrian (late Archaean) impact event has been gaining ground. This conjectured impact delivery to Earth occurred 2.6–3.8 b.y. ago, at a time when the present-day continents of South America and Africa formed a unified supercontinent.

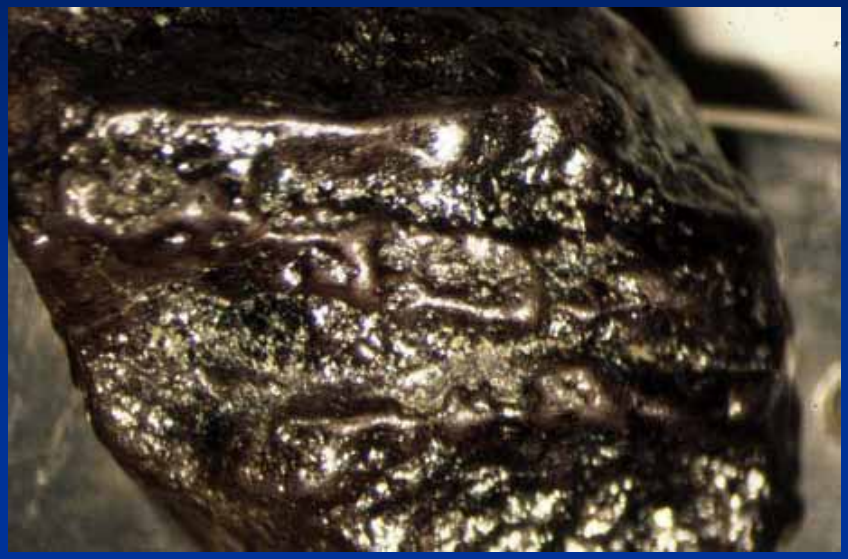
Gondwana


AFRICA
ARABIA
NEW GUINEA
INDIA
SOUTH AMERICA
ANTARCTICA
AUSTRALIA

Arguments for extraterrestrial origin

The nodules have a polished surface rind reminiscent of a fusion crust. The interior is highly vesiculated, with some vesicles measuring up to 1 mm in size. It is believed that entry, and impact-related processes including partial ablation at extremely high temperatures in Earth's primordial, oxygen-poor atmosphere, melted an initially porous surface texture.

Carbonado – Diamond Meteorites



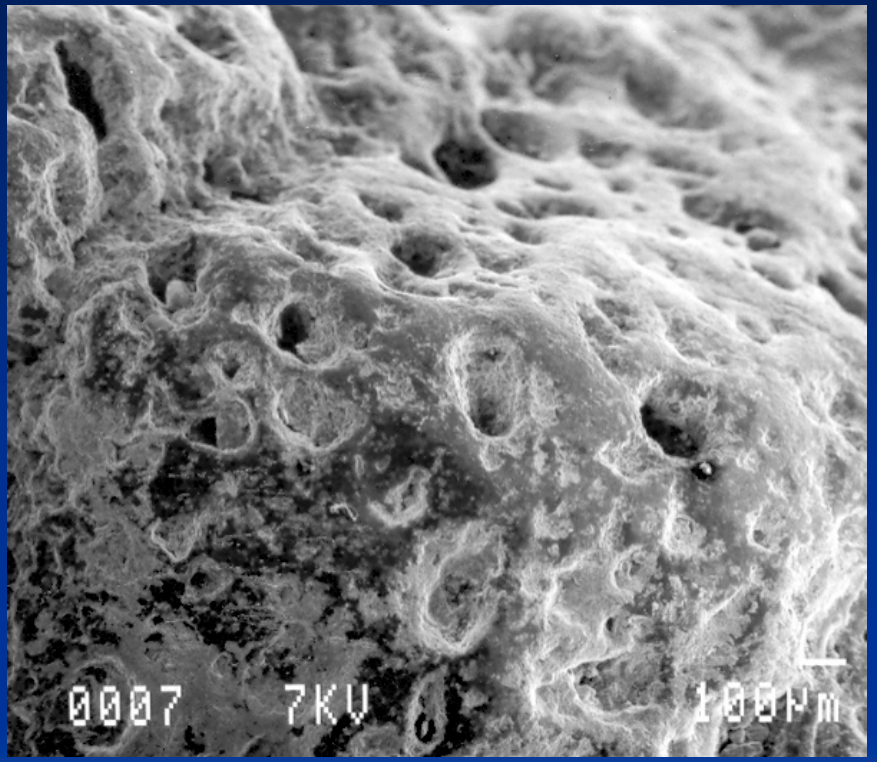
Arguments for extraterrestrial origin

While the C- and N-isotopic compositions and N abundances of carbonados recovered from Central Africa and Brazil are indistinguishable from each other, they are unlike any known terrestrial-sourced diamond varieties. However, these unusual values, such as the isotopically light C content and the low N abundances, are consistent with an extraterrestrial origin.

Arguments for extraterrestrial origin

Spectroscopic analyses of mineral inclusions in carbonado diamond matrices from Brazilian and Central African source locations revealed the presence of highly reduced metals and metal alloys, including Fe, Si, Ti, Ni, Ag, FeNi-metal, FeCr-metal, and NiCr-metal, as well as the carbide SiC. This provides further evidence for an extraterrestrial origin for carbonado. The mineral osbornite (TiN) has also been identified in carbonado, a mineral previously found only in certain meteorites and recently encountered through NASA's Stardust mission to comet Wild 2.

Black diamond characteristics

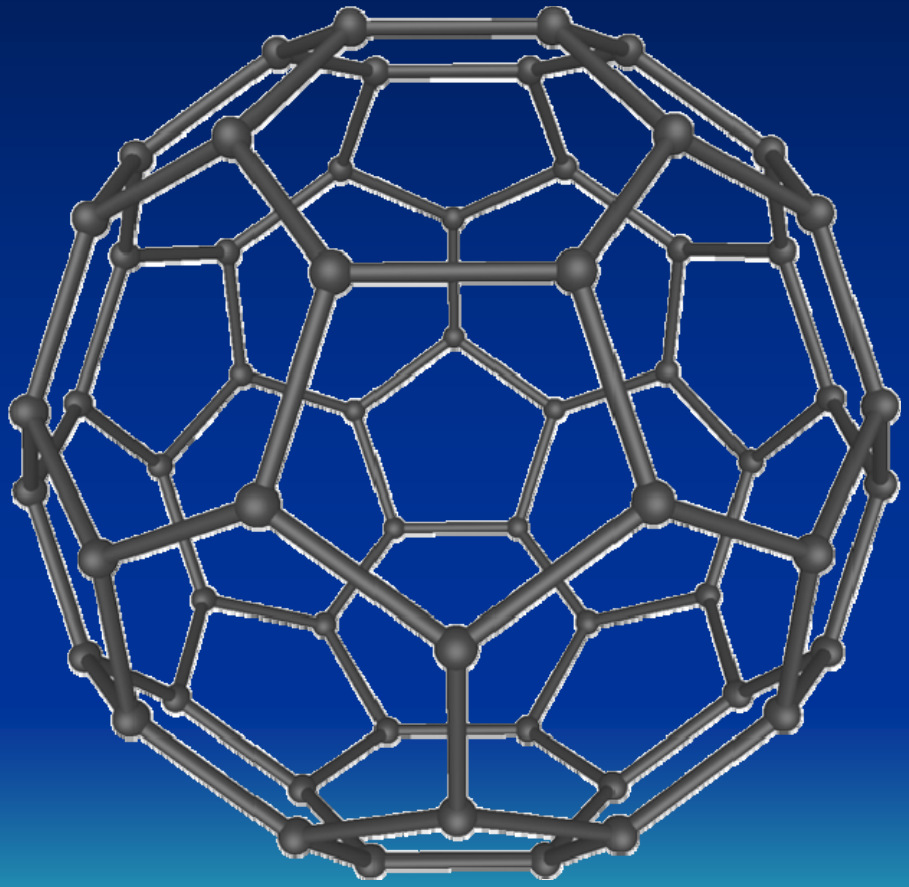


Note the sintered appearance
(bubbly voids in a glassy or microcrystalline matrix) and rough surface

Buckminsterfullerenes

Buckminsterfullerene (C60) was named after Richard Buckminster Fuller, a noted architectural modeler who popularized the geodesic dome. Buckminsterfullerenes have a similar shape to that sort of dome. In the scientific community they are affectionately known as “Bucky balls”

A “Buckyball”



From theory to discovery

Fullerenes were first theorized by Japanese scientist Eiji Osawa in 1970. In 1985, five scientists discovered C60, and shortly thereafter came to discover fullerenes. With mass spectrometry, discrete peaks were observed corresponding to molecules with the exact mass of sixty or seventy or more carbon atoms. Three of the sceientists were awarded the 1996 Nobel Prize in Chemistry for their roles in the discovery of this class of compounds. Fullerenes are found in the form of C60, C70, C76, C84 and even up to 100 carbon atoms are common.

Fullerenes in C chondrites

Unknown to mankind until the 1980's, fullerenes have been around since before the formation of our solar system, and are common in carbonaceous chondrites. They were first reported by NASA scientists in 1987 studying the Allende meteorite, the largest carbonaceous chondrite ever found on Earth. The fireball was witnessed at 1:05 a.m. on February 8, 1969, falling over the Mexican state of Chihuahua.

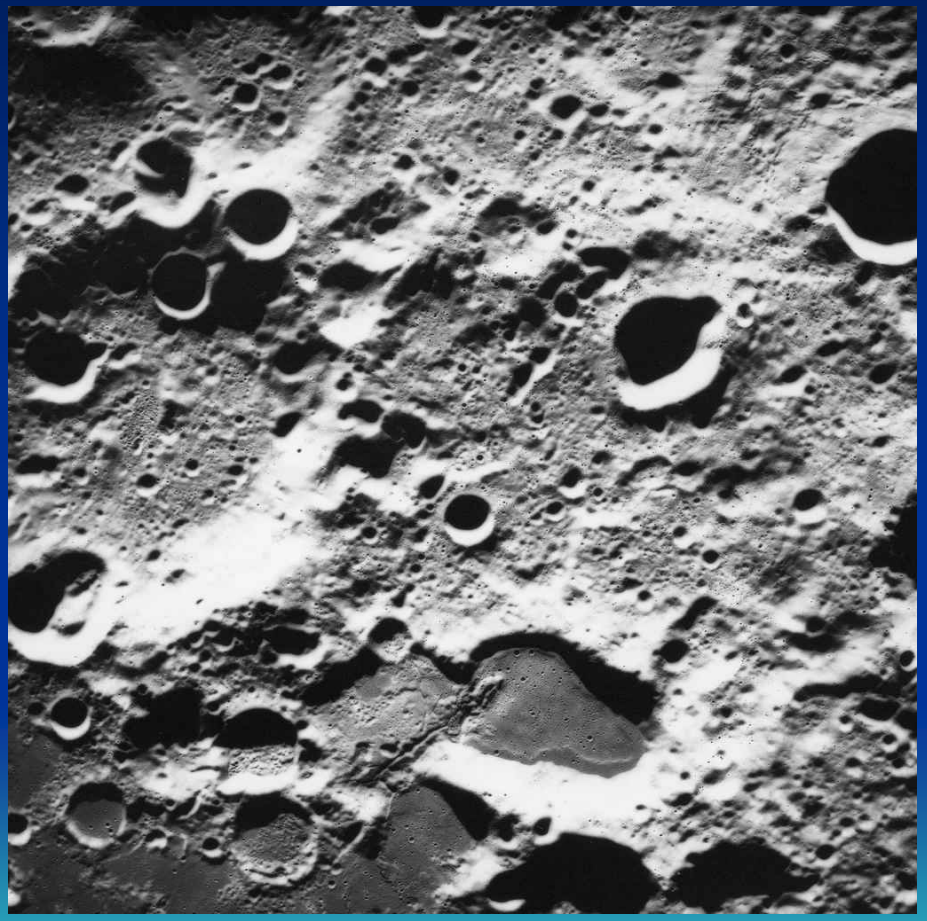
Achondrite meteorite

An achondrite is a stony meteorite that does not contain chondrules. It consists of material similar to terrestrial basalts or plutonic rocks and has been differentiated and reprocessed to a lesser or greater degree due to melting and re-crystallization on or within meteorite parent bodies. As a result, achondrites have distinct textures and mineralogies indicative of igneous processes. Achondrites account for about 8% of meteorites overall.

Lunar and Martian meteorites

Occasionally, ejecta from lunar and martian meteoroid or comet impacts reaches the earth's surface. These rare and highly sought after achondrite meteorites make up about 0.2% of the total known meteorites collected. The total mass of all known lunar meteorites is only about 33 kg. The total mass of all known Martian meteorites is far less.

Lunar and Martian surface



Moissanite in meteorites

Mineral moissanite was discovered by Henri Moissan while examining rock samples from a meteor crater located in Canyon Diablo, Arizona in 1893. At first, he mistakenly identified the crystals as diamonds, but in 1904 he identified the crystals as silicon carbide (SiC). The mineral form of silicon carbide was named moissanite in honor of Moissan later on in his life. The discovery in the Canyon Diablo meteorite and other places was challenged for a long time to be carborundum contamination from human abrasive tools.

Moissanite in meteorites

Until the 1950s no other source, apart from meteorites, had been encountered. Later moissanite was found as inclusion in kimberlite from a diamond mine in Yakutia in 1959, and in the Green River Formation in Wyoming in 1958. The existence of moissanite in nature was questioned even in 1986 by Charles Milton, an American geologist

Moissanite crystal (~ 1mm)

Moissanite in meteorites

Moissanite, in its natural form, is very rare. It has only been discovered in a small variety of places from upper mantle rock to meteorites. Discoveries have shown that moissanite occurs naturally as inclusions in diamonds, xenoliths, and ultramafic rocks such as kimberlite and lamproite. They have also been identified in carbonaceous chondrite meteorites as presolar grains.

Moissanite in meteorites

Analysis of SiC grains found in the Murchison carbonaceous chondrite meteorite has revealed anomalous isotopic ratios of carbon and silicon, indicating an origin from outside the solar system. 99% of these SiC grains originate around carbon-rich Asymptotic giant branch stars. SiC is commonly found around these stars as deduced from their infrared spectra.

Synthetic Moissanite as a diamond simulant

Transparent synthetic Moissanite sent shockwaves through the international gem & jewelry trade as it had similar thermal characteristics to diamond, and passed the thermal probe test, thus “proving” it was diamond to many dealers, jewelers and pawn shops.

Disregarding simple gemology, the majority of the trade did not wake up until the illustrious John Koivula uttered the simple yet clearly profound statement: “It’s doubly refractive, stupid!”.

Iron Meteorites

While they are fairly rare compared to the stony meteorites, comprising about 5.7% of witnessed falls, they have historically been heavily over-represented in meteorite collections. This is due to several factors:

- They are easily recognized as unusual even by laymen, as opposed to stony meteorites.
- They are much more resistant to weathering.
- They are much more likely to survive atmospheric entry, and are more resistant to the resulting ablation, hence they are more likely to be found as large pieces.

Classic iron with regmaglypts and flow lines

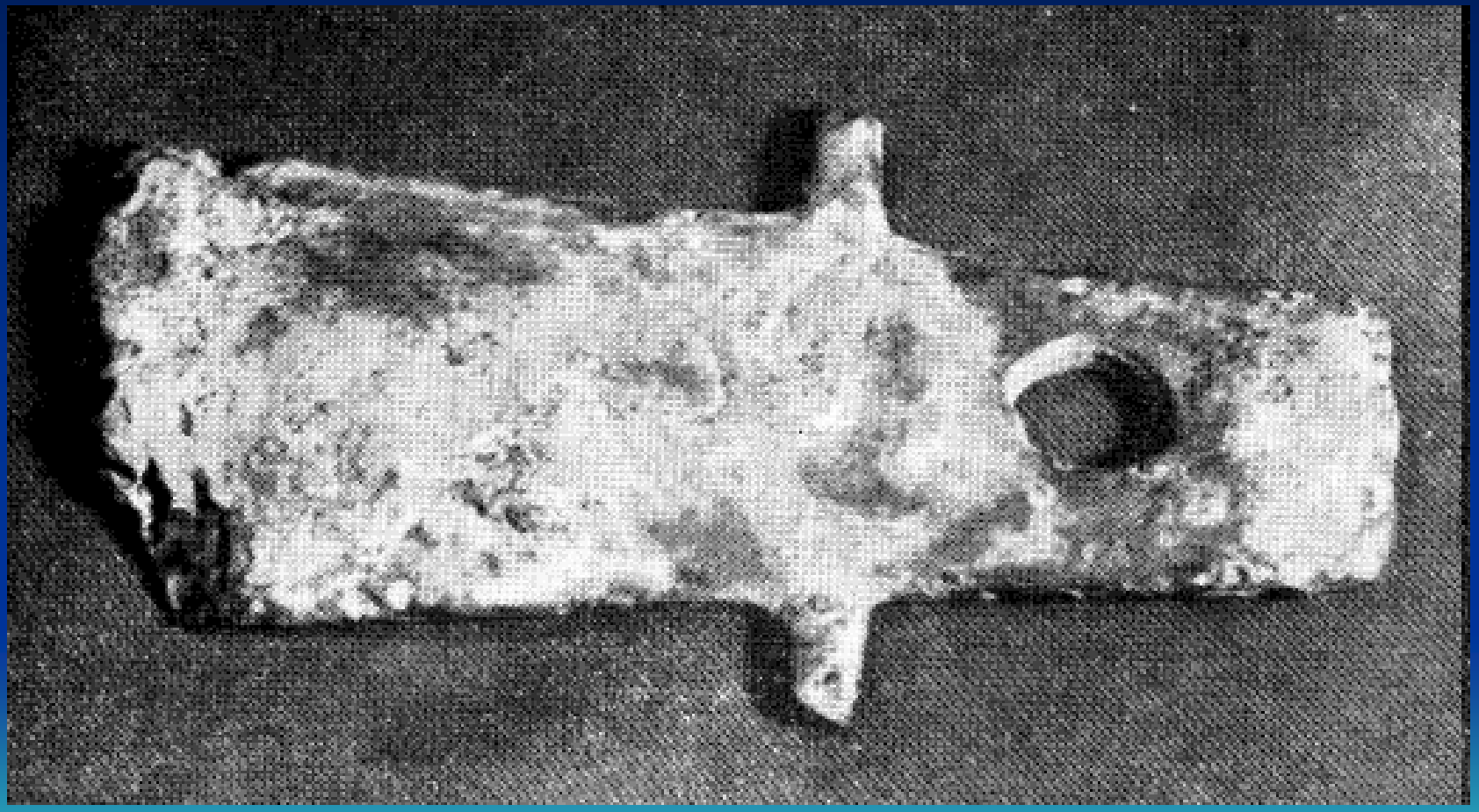
In fact, Iron meteorites account for almost 90% of the mass of all known meteorites, about 500 tons. All the largest known meteorites are of this type, including the largest -- the Hoba meteorite.

The Hoba is a meteorite that lies on a farm not far from Grootfontein, Namibia. It has been uncovered but, because of its large mass, has never been moved from where it fell. The main mass is estimated at over 60 tons, and it is the largest known meteorite (as a single piece) and the most massive naturally-occurring piece of iron known at the Earth's surface.

Iron meteorites consist overwhelmingly of nickel-iron alloys. The metal taken from these meteorites is known as meteoric iron and was one of the earliest sources of usable iron available to man.

Meteoric iron tools from the Shang Dynasty have been found in China dating back possibly as far as 1700 BC.

3,000+ year old meteoric iron tool

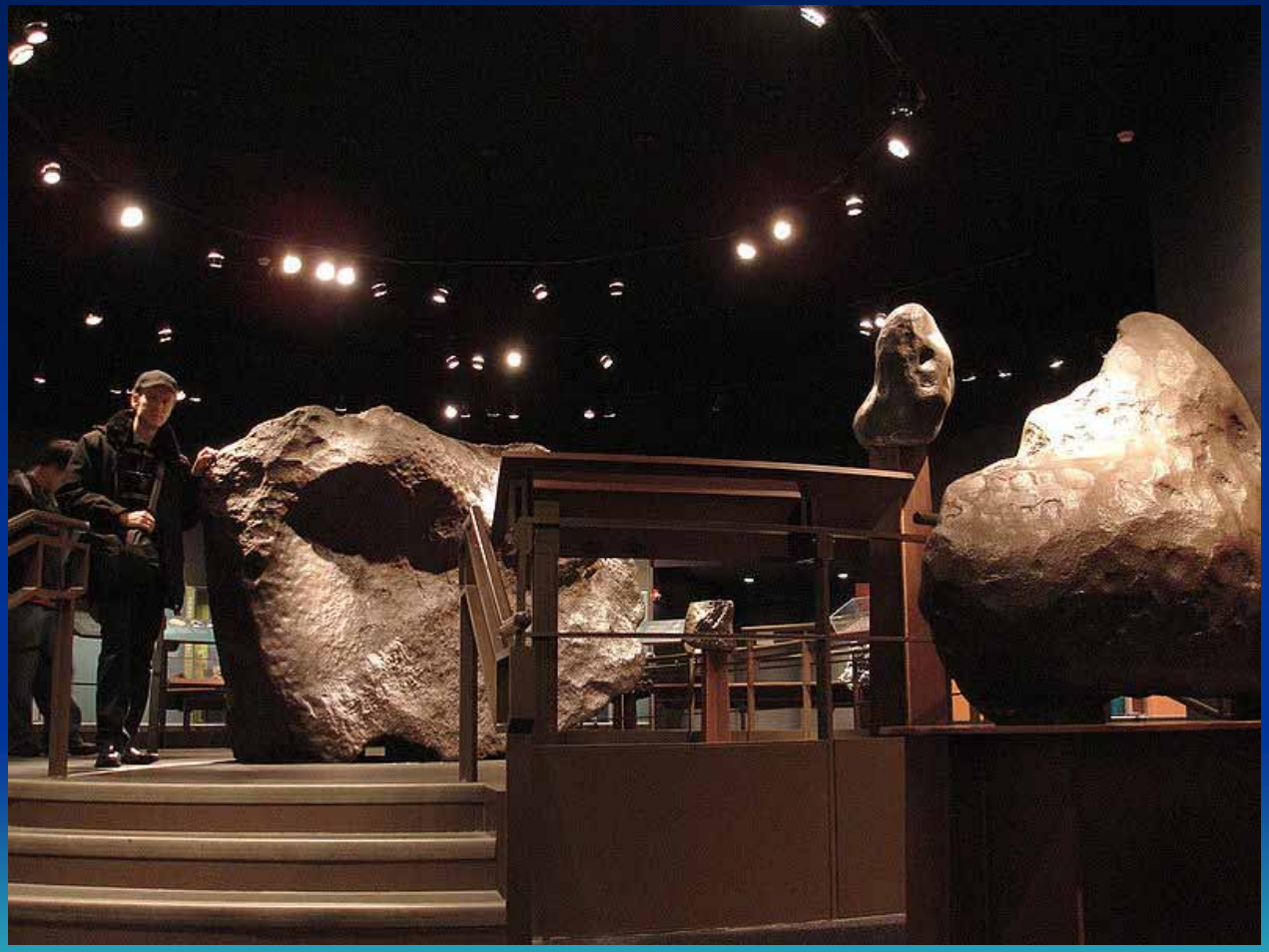


The Cape York meteorite, which collided with Earth nearly 10,000 years ago, is named for Cape York, the location of its discovery in Greenland. Several pieces reached the earths surface.

For centuries, native Inuit living near the meteorites used them as a source of metal for tools and harpoons.

Inuit harpoon tipped with meteoric iron

This sample is called Ahnighito. It weights 31 tons and stands in American Museum of Natural History.



Another view of Ahnighito

The overwhelming bulk of these meteorites consists of the Fe,Ni-alloys kamacite and taenite. The chemical composition is dominated by the elements Fe, Ni and Co, which make up more than 95%. Ni is always present, the concentration lies between 5 and about 25%. This fact can be used to distinguish meteoritic irons from man made products, which usually contain much lower amounts of Ni.

Iron meteorite classification

- Hexahedrites: low nickel, no Widmanstätten pattern.
- Octahedrites: average to high nickel, Widmanstätten patterns, most common.
- Ataxites: very high nickel, no Widmanstätten pattern, rare.

Widmanstätten patterns

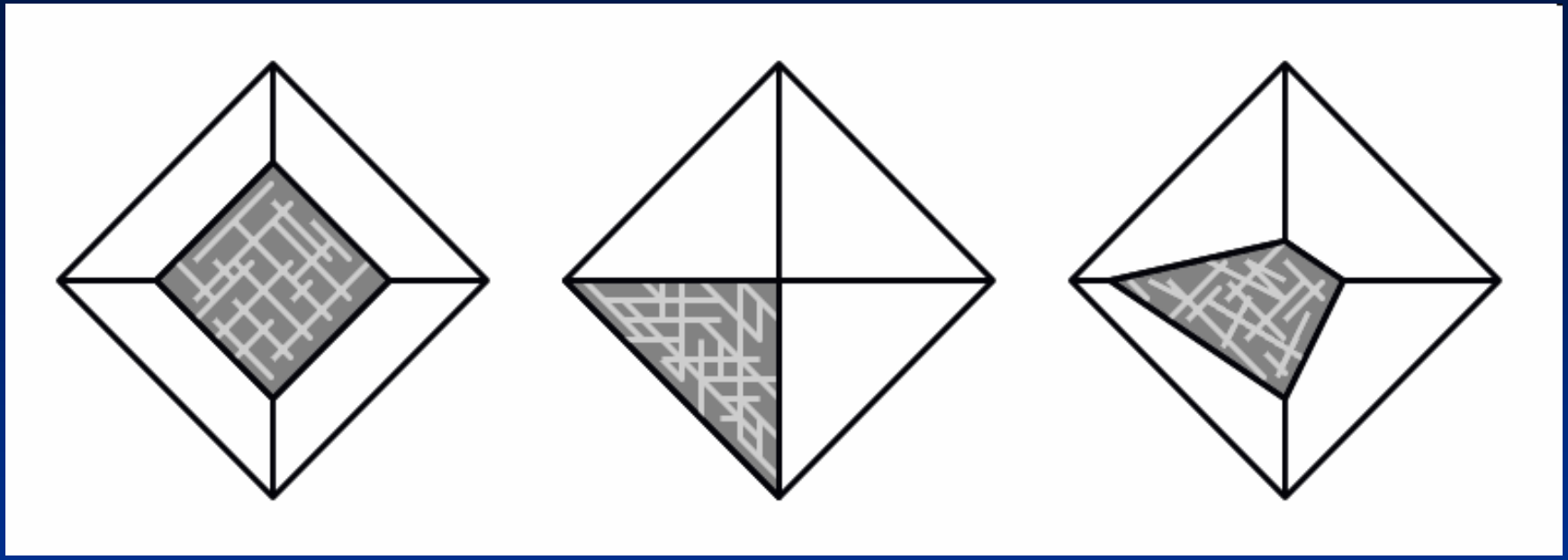
Widmanstätten patterns, also called Thomson structures, are unique figures of long nickel-iron crystals found in the octahedrite iron meteorites and some pallasites (Stony Irons).

Widmanstätten patterns are the result of etching with nitric acid

Close-up of a Widmanstätten pattern

Octahedrite meteorites have a nickel content intermediate between the norm for kamacite and taenite. This leads under slow cooling conditions to the precipitation of kamacite and growth of kamacite plates along certain crystallographic planes in the taenite crystal lattice.

The formation of Ni-poor kamacite proceeds by diffusion of Ni in the solid alloy at temperatures between 700 and 450°C, and can only take place during very slow cooling, about 1 to 100 degrees per one million years. This explains, why this structure cannot be reproduced in the laboratory.



- Perpendicular cut to one of the three (cubic) axes: two sets of bands at right angles to each other
- Parallel cut to one of the octahedron faces (cutting all 3 cubic axes at the same distance from the crystallographic centre) : three sets of bands running at 60° angles to each other
- Any other angle: four sets of bands with different angles of intersection

Stony Iron Meteorites

- Pallasites
- Mesosiderite group

Mesosiderite Meteorites

Mesosiderites are a class of stony-iron meteorites consisting of about equal parts of metallic nickel-iron and silicate. They are breccias with an irregular texture; silicates and metal occur often in lumps or pebbles as well as in fine-grained intergrowths. The silicate part contains olivine, pyroxenes, and Ca-rich feldspar

Mesosiderite sample

Saving the best for last!

A pallasite meteorite consists of cm-sized forsterite olivine crystals of peridot quality in an iron-nickel matrix. Forsterite (Mg_2SiO_4) is the magnesium rich end-member of the olivine solid solution series. In 2005 it was also found in cometary dust returned by the Stardust probe.

Coarser metal areas of pallasite meteorites develop Widmanstätten patterns upon etching. Minor constituents are schreibersite, troilite, chromite, pyroxenes, and phosphates (whitlockite, stanfieldite, farringtonite, and merrillite)

Backlit Pallasite slices showing opaque to transparent olivine crystals

Huge pallasite slice

Etched Pallasite showing Widmanstätten patterns

Pallasite and Peridot

Meteoric Peridot

Meteoric peridot can now be positively identified and distinguished from earth peridot. Internal characteristics visible under magnification are conclusive. Therefore, a GIA laboratory report will identify them as “Pallasitic Peridot“.

This is the only known transparent facetable gem that comes from outer space, truly a “Heavenly Jewel”.

GIA report terminology…

Species: Pallasitic Peridot

Additional comments: Pallasitic Peridot is extraterrestrial in origin and comes from a type of stony-iron meteorite known as pallasite. These meteorites are composed of fragments of olivine (peridot) encased in a matrix of nickel-iron.

Cat’s-eye meteoric peridot

Richard Stinson of Kansas reported extremely rare chatoyant cat's-eye peridot (August 2006) in a pallasite meteorite he was cutting. Some of the faceted and cat's-eye peridot gems that Richard cut later appeared in an issue of "Gems and Gemology“.

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Pallasite, a type of stony-iron meteorite first described in the 18th century, is known for the yellowish green olivine that can be extracted from it. Yet pallasitic peridot, the gem variety of olivine, is extremely rare. (See J. Sinkankas et al., “Peridot as an interplanetary gemstone,” Spring 1992 *Gems & Gemology*, pp. 43–51.) At the 2008 Tucson gem shows, meteorite hunter Steve Arnold of Kingston, Arkansas, showed *G&G* editors several pallasitic specimens including one faceted peridot and one oval peridot cabochon showing chatoyancy. According to Mr. Arnold, the American Museum of Natural History in New York later identified the cause of chatoyancy as parallel, tube-like hollow inclusions.

How do you find meteorites

First, learn the field tests for meteorites!

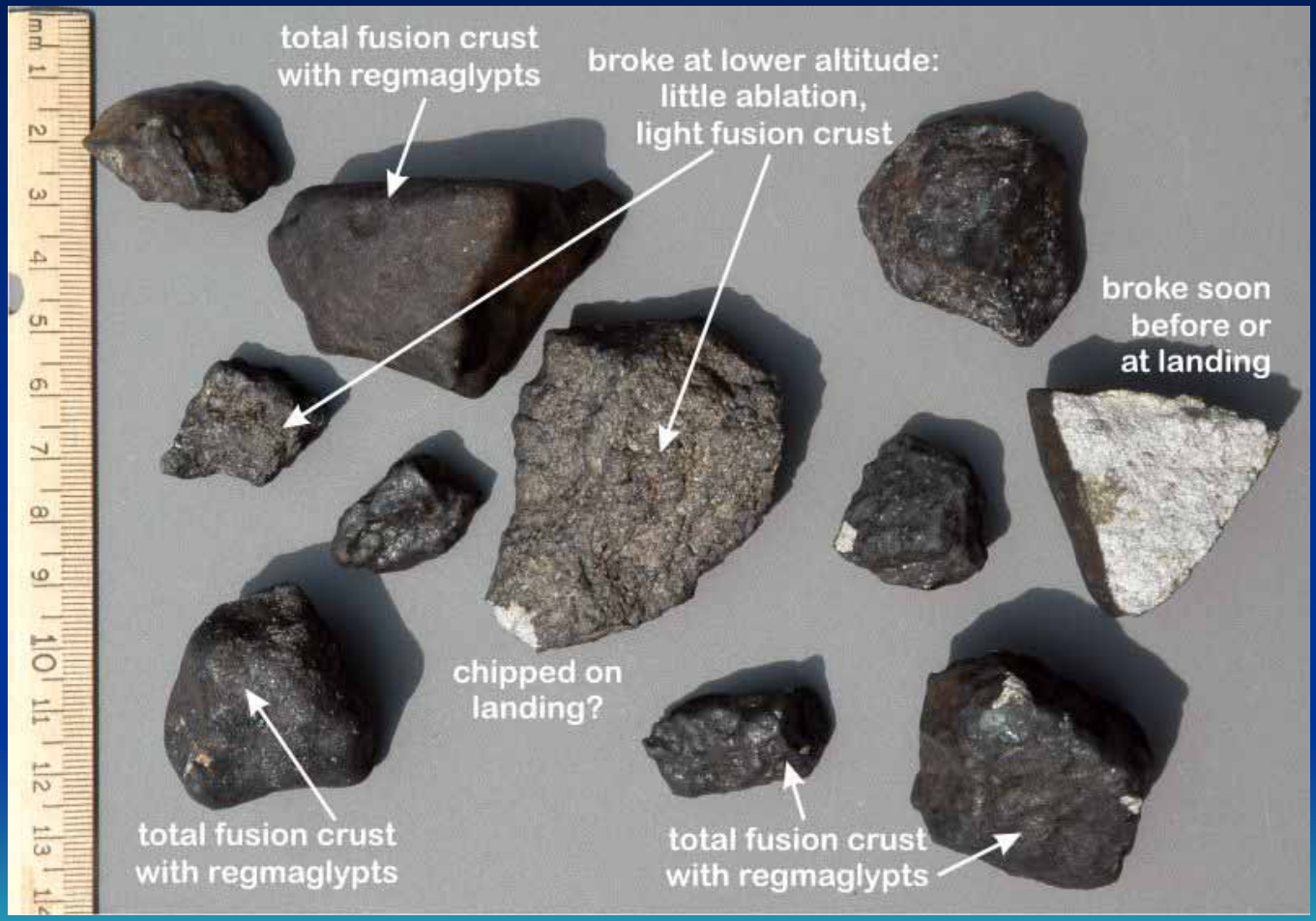
A. Most meteorites are magnetic. Buy a magnet and carry it with you when you are hunting for meteorites. This is the first diagnostic test.

B. Most meteorites have surface characteristics which distinguish them from terrestrial rocks such as fusion crusts and frequently regmaglypts (thumbprints).

C. Any rock with visible metal particles or any solid metal object not obviously man-made is a potential meteorite.

D. Bring every rock with any of these characteristics back to the lab for further analysis.

Fusion crust



Fusion crust

Meteoroids enter the atmosphere at speeds of many miles per second. At those tremendous speeds, the air in the path of the meteorite is severely compressed. When air is compressed rapidly, its temperature increases. This hot air causes the surface of meteoroids to melt.

Fusion crust

The melted portion is so hot and fluid that it immediately ablates (sloughs off) and new material is melted underneath. A meteoroid can lose most of its mass as it passes through the atmosphere. When it slows down to the point where no melting occurs, the last melt to form cools to make a thin, glassy coating called a fusion crust.

Fusion crust

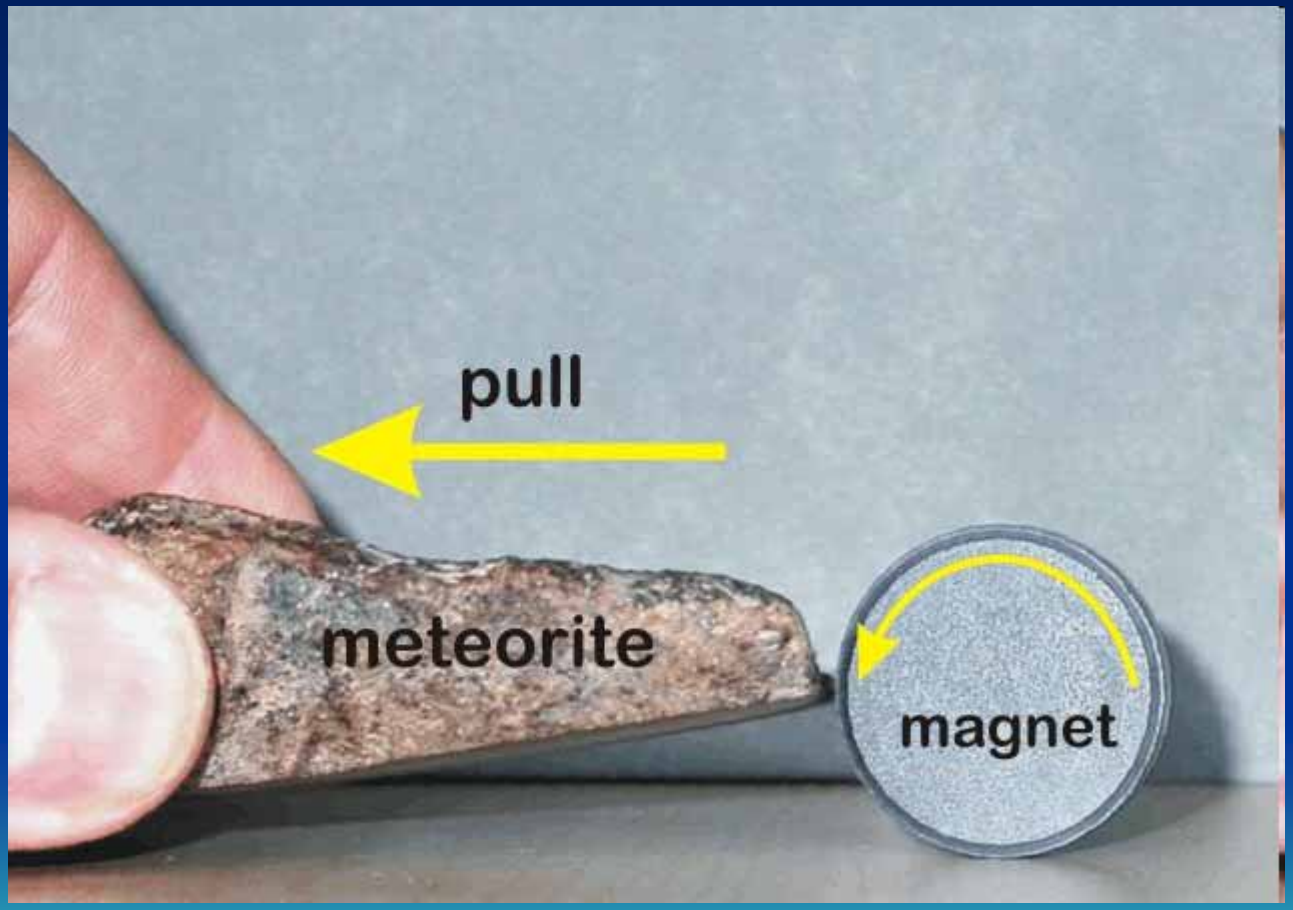
On stony meteorites, fusion crusts are seldom more than 1 or 2 mm thick. Except for some lunar meteorites (less that 1 in 1000 of all meteorites), fusion crusts are not distinctly vesicular - there are no bubbles. Some fusion crusts will show flow features; others may cover regmaglypts, (thumb prints).

Fusion crust

An “oriented” meteorite showing flow lines and thumb prints.

A non-oriented meteorite showing fusion crust.

Most meteorites are magnetic



However…

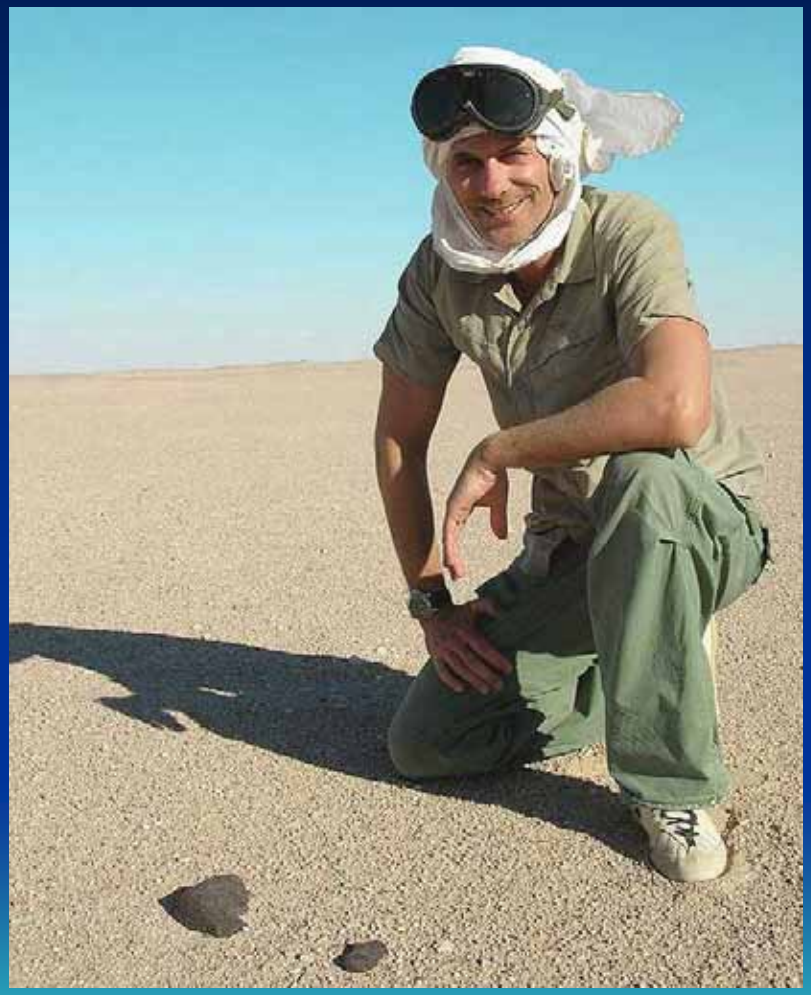
Some of the rarest kinds of meteorites, however, are not magnetic (achondrites, lunar meteorites, Martian meteorites). Most terrestrial rocks are also not magnetic, but some are. Magnetic Earth rocks are those that contain magnetite or some other iron-rich minerals. Natural Earth rocks never contain iron-nickel metal.

Where do you find meteorites

The best places to find meteorites are areas of low rainfall. Water is the #1 enemy of meteorites causing rapid weathering and deterioration to the point where they become either unrecognizable as meteorites or crumble into sand and dust.

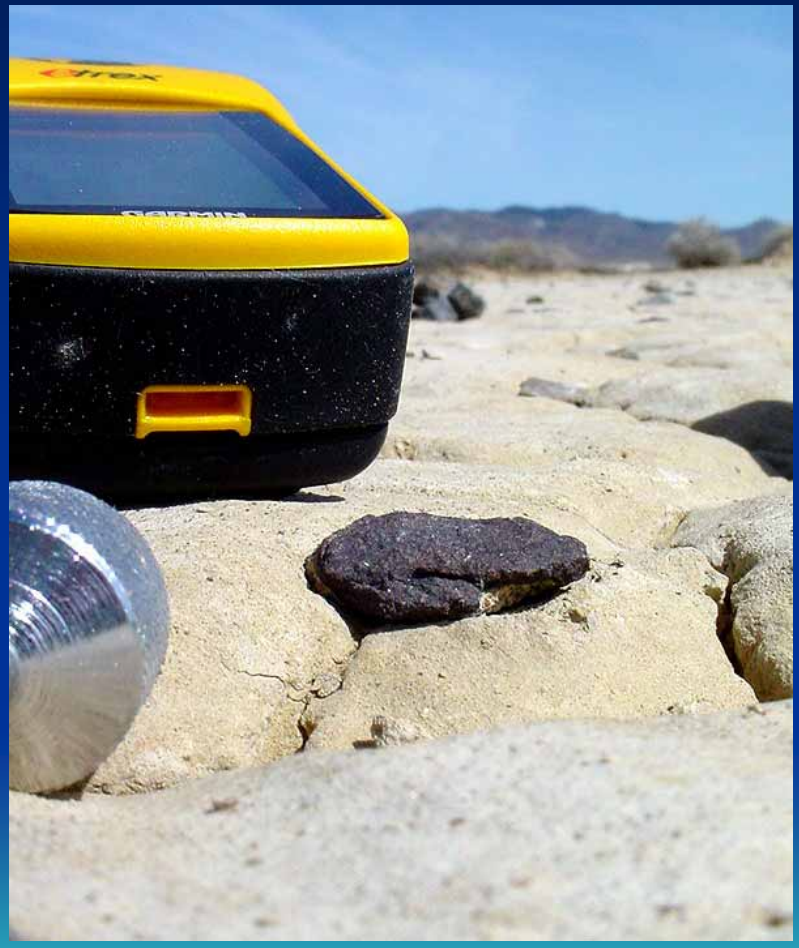
Deserts are the first and easiest choice for meteorite hunting. Antarctica is next but it is cost prohibitive for most meteorite hunters.

Desert meteorite find



Close-up of a Nevada desert meteorite find

Another Nevada desert find



North West Africa is a prime meteorite hunting region

Mars rock, 35.782 g Shergottite meteorite, 100% complete individual

NWA Martian, assorted unclassified & NWA Lunar

Antarctic meteorite hunting

Success in Antarctica

Of the ~17000 meteorite stones found by ANSMET in Antarctica (1976-2007), 1 in about 900 stones is lunar (19 stones representing 11 meteorites; for Mars, it's 9 stones representing 8 meteorites).

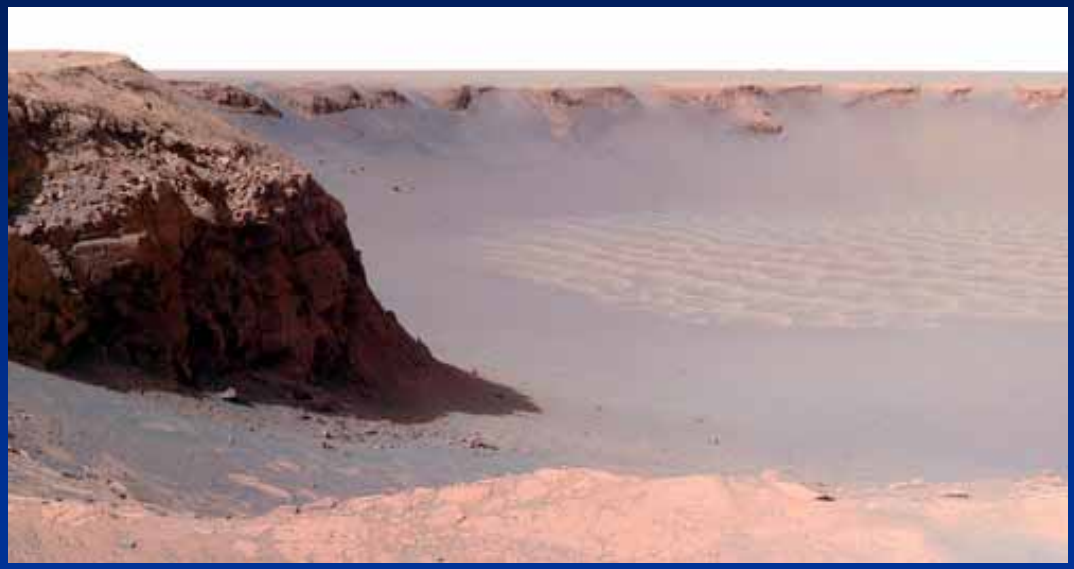
Success in Antarctica

Metal detectors in farm fields

Desert meteorite hunting with metal detectors

World’s largest oriented pallasite

Mars is great for meteorite hunting



Looking over the rim of Victoria crater on Mars courtesy of the Opportunity rover. NASA announced recently that stony meteorites were found near the 1/2 mile diameter crater.

Meteorite on Mars

One of Opportunity's latest meteorite finds near Victoria Crater on the Red Planet.

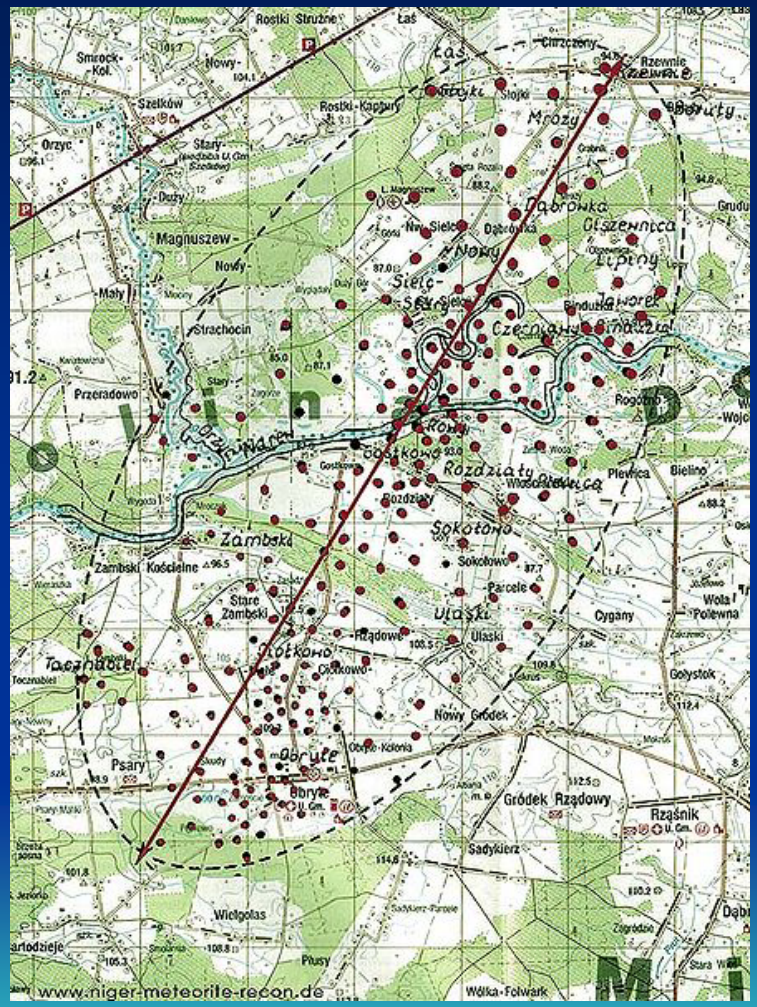
Hunt in known strewnfields

The term strewnfield indicates the area where meteorites from a single fall are dispersed.

There are two strewnfield formation mechanisms:

- Mid-air fragmentation: When a large meteoroid enters the atmosphere it often fragments into many pieces due to thermal shock before touching the ground. This mid-air explosion causes the dispersion of the material over a large oval-shaped area. The orientation of this oval is determined by the flight path of the meteoroid. When multiple-explosions occur, the material can be found in several overlapping ovals.
- Impact fragmentation: When there is almost no mid-air fragmentation the fragmentation can occur upon impact. In this case the strewnfield shape can be different, usually circular. (e.g. Canyon Diablo at Meteor Crater)

Strewnfield map



Hunt in areas known to have rocks which have fallen from the sky!

What are meteorites worth?

Meteorite prices range from as little as US$0.10 per gram for common unclassified chondrites to as high as US$40,000 per gram for the rarest of Martian and Lunar meteorites. Fine pallasite polished slices with nice transparent olivine fetches up to US$20/gram, and etched octahedrites showing good Widmanstätten patterns about US$2/gram.

Meteorwrongs

There are many examples of rocks which resemble meteorites in many ways, yet their origin is terrestrial as opposed to extraterrestrial.

If you begin to collect meteorites, get well educated first and only buy from reliable meteorite dealers – caveat emptor!

Tektites and Australites

- Tektites or Australites (when they are found in Australia) are not meteorites (they never independently orbited the sun) and they are not from the Moon. A tektite was formed from Earth material during the impact of a meteoroid or comet.
- Tektites and Australites are the most common and well known “meteorwrongs”.

Tektites and Australites

The dung test

Step on anything black.

If it crumbles, it is dung.

If it does not crumble, it is possibly a tektite or meteorite

Moldavite

Moldavite is an olive-green or dull greenish vitreous substance possibly formed by a meteorite impact. It is one kind of tektite named for the town of Moldauthein in Bohemia (the Czech Republic).

Nodules of moldavite presented curious pitting and wrinkles on the surface, which could not be due to the action of water or wind, but resembled the characteristic markings on many meteorites. Another “meteorwrong”.

Moldavite

Carved Moldavite in Jewelry

Libyan desert glass

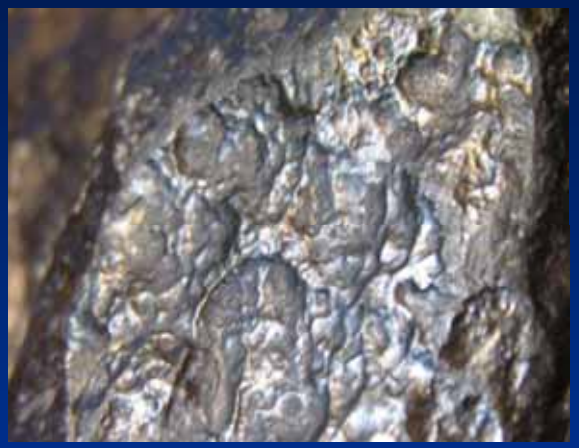
The origin of the glass is a controversial issue for the scientific community, with many evolving theories. Meteoric origins for the glass were long suspected, but recent research linked the glass to impact mechanics, such as vaporized quartz and meteoric metals, and to an impact crater. Another “meteorwrong”.

Libyan desert glass

My Meteorwrongs

These seemingly “oriented” rocks with apparent “flow lines” and a “fusion crust” like surface attracted a magnet, had metal and translucent olivine inclusions visible after slicing. A European PhD geologist initially misidentified them as meteorite. After further analysis by university meteorite experts, we were both proved wrong. A classic example of “Meteorwrongs”.

My Meteorwrongs



< Meteorwrong >

< Meteorite >

What can you do with meteorites?

Besides collecting and scientific study, the most common modern use of meteorites is in jewelry and watch faces.

You can also eat them!

Devil protection

Early Russian villagers believed they would be protected from the Devil by grinding up and ingesting meteorite powder.

A modern day example is the elusive “Meteorite Elixor”…

“Meteorite Elixir”

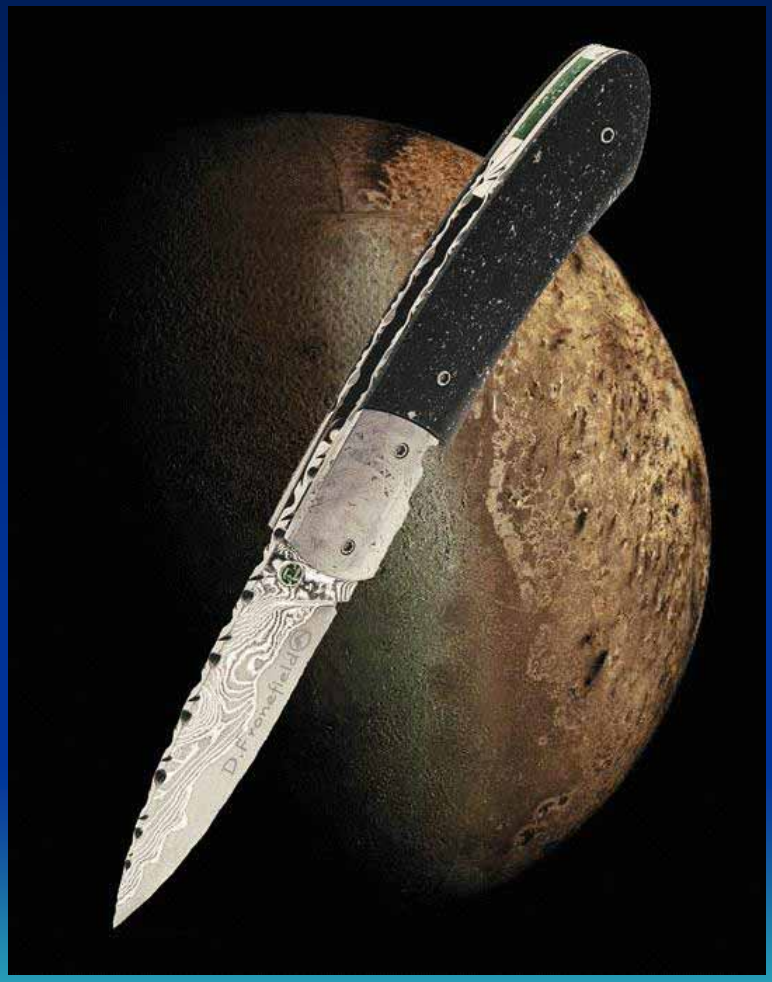
Black magic meteorites

- Meteorites have been used in amulets from Russia to Tibet to Thailand. Tibetan Buddhism respects meteorites as Namchak, or “sky metal”, and in Thailand, one who is fortunate enough to acquire and wear a “dow dtoke” (meteorite) will be protected from gunshot wounds since it is believed the meteorite will prevent bullets from exiting gun barrels.

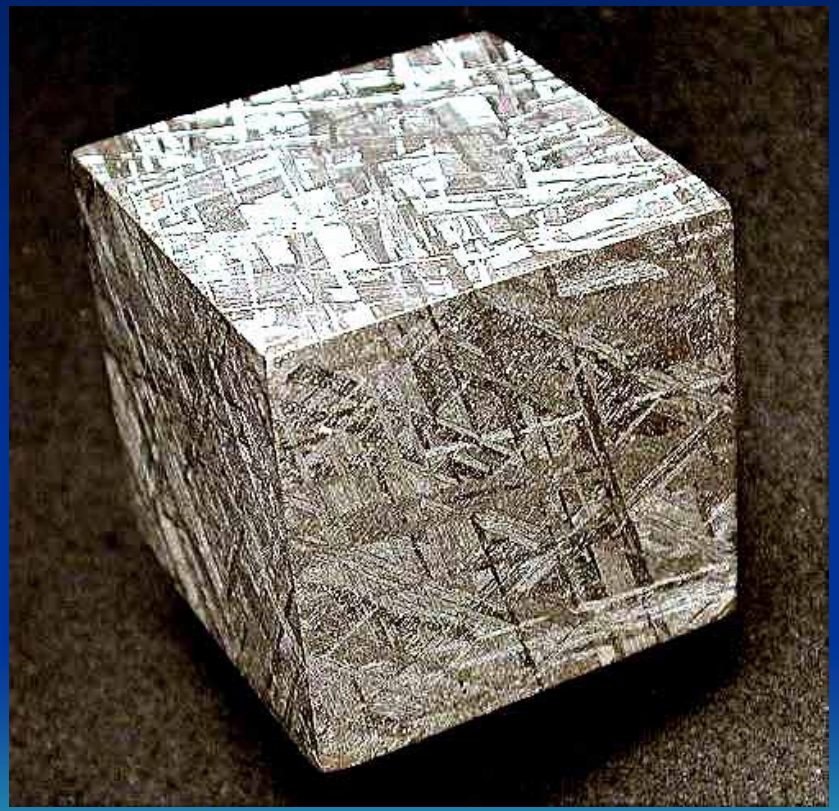
- The historic Thai name for this type of amulet material is “Lek Lai”. Tradition tells us to take a gun and shoot at the area where you suspect the presence of Lek Lai - no bullet will issue forth no matter how many times you try!

Buddhist amulet carved from meteorite

You can make modern fancy tools…



You can make spheres & cubes…



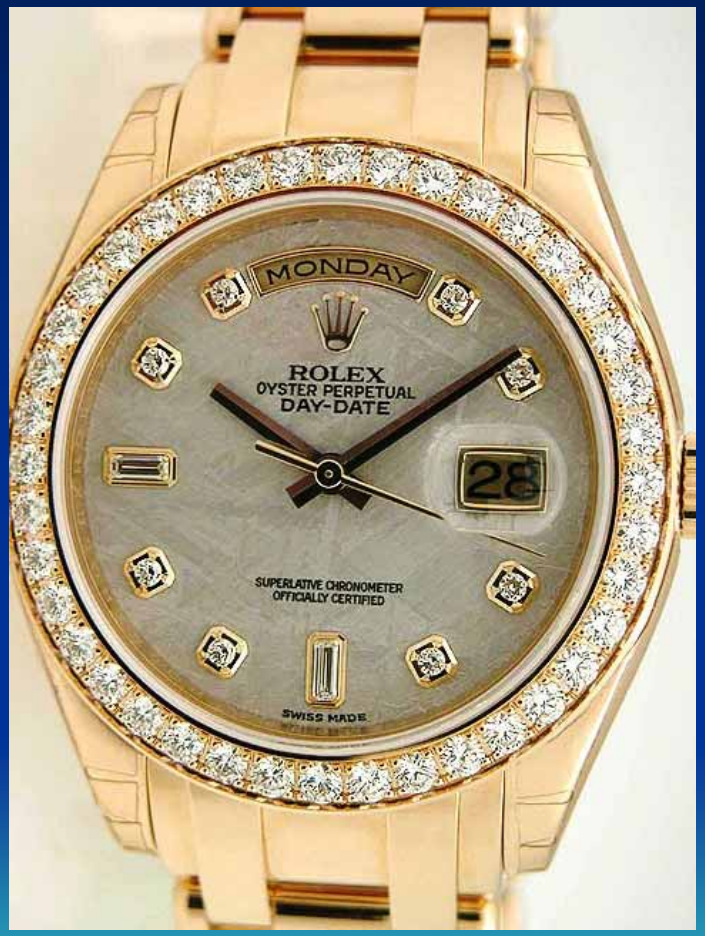
Rings & things…





Rings & things…

The Ultimate!



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