HUI PŌHAKU 'O HAWAI'I
Rock & Mineral Society of Hawai'i, Inc.

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METEORITES

BY DEAN SAKABE

The term meteor comes from the Greek *meteoron*, meaning phenomenon in the sky. It is used to describe the streak of light produced as matter from the solar system falls into Earth's atmosphere. This creates a temporary incandescence resulting from atmospheric friction. The light show typically occurs at heights of 50 to 70 miles above Earth's surface.

Meteorite is also used loosely with the word *meteoroid*. Here, it is referring to the particle itself without its relation to the phenomena it produces when entering the Earth's atmosphere. A meteoroid is matter revolving around the sun or any object in interplanetary space that is too small to be called an asteroid or a comet. There are even smaller particles, which are called micrometeoroids or cosmic dust grains, which include any interstellar material that should happen to enter our solar system. All this said it comes down to a meteorite is a meteoroid that reaches the surface of the Earth without being completely vaporized.

Meteorites are sort of difficult to classify, however there are three very broad groupings: *Stony* (92.8%), *Stony Iron* (1.5%), *and Iron* (5.7%). Of the Stony meteorites, the most common are classified as *Chondrites* (85.7%).

These are stony meteorites, of which radioactive dating has placed them at 4.55 billion years old. These are considered pristine samples of early solar system matter. Although in most cases their properties have been modified by thermal metamorphism and/or icy alteration. Some have suggested that the different properties found in various Chondrites suggest the location in which they were formed. Enstatite Chondrites contain the most refractory elements (metals) and are believed to have formed in the inner solar system. Whereas ordinary chondrites, which is the most common type contain both volatile and oxidized elements. These are thought to have formed in the inner asteroid belt. Carbonaceous chondrites, which have the highest proportions of volatile elements and consequently are the most oxidized, are thought to have originated from even greater solar distances.

MEETING
Wednesday
May 25
6:15-8:00 pm
Makiki District Park Administration Building

NEXT MONTH
June 22
Anything Petrified

LAPIDARY
Every Thursday
6:30-8:30pm
Second-floor Arts and Crafts Bldg
Makiki District Park

MEMBERSHIP DUE COSTS 2010

Single: $10.00
Family: $15.00

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Diablo Canyon Meteorite (Meteor Crater, AZ)

Silicated Meteorite (Campo Del Cielo, Argentina)

The other majority Stony meteorite type is called Achondrites. has been geologically processed are Achondrites, Achondrites are considered differentiated or reprocessed matter. They are formed by the melting and recrystallization of or within the meteorite parent bodies. This results in Achondrites having distinct textures and mineralogies, which are indicative of igneous processes.

Stony Iron Meteroites are very interesting. One classification is the Pallasites, which are meteorites composed of olivine enclosed in metal.

Iron meteorites are classified into thirteen major groups and consist primarily of iron-nickel alloys with minor amounts of carbon, sulfur, and phosphorus. These meteorites formed when molten metal segregated from less dense silicate material and cooled, thereby showing another type of melting behavior within meteorite parent bodies. Thus, meteorites contain evidence of changes that occurred on the parent bodies from which they were removed or broken off, presumably by impacts.

Aside from the classification of the Meteorites, the most common classification is basically where there the meteorite came to settle or in some unique cases, where the meteorite originated from.

The Gibeon Meteorite was first reported by Capt. J.E. Alexander in 1838. He heard of masses of native iron up to two feet square on the east side of the Great Fish River. While he did not see the masses himself, he was able to obtain samples for analysis. In the years following, Europeans established large cattle ranches in the area and recovered many more large meteorites. A 232 kg mass was recovered in 1857. Many masses between 100 and 500 kg were recovered in the years shortly after 1900, Scientist have speculated that the Gibeon consisted primarily of large masses and lacked the smaller pieces like those found at Canyon Diablo, Odessa, and Sikhote-Alin.

Achondrite Meteorites have been discovered at Norton County, Kansas. It is a basaltic composition and was probably formed when the asteroid melted about 4.5 billion years ago. ,he asteroid broke up some time later and this small piece of the asteroid was captured by Earth's gravity

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Gibeon Meteorite (Great Namaqualand, Namibia)

(Mesosiderite Meteorite (Dong Ujimqin Qi, Mongolia
Rock Museum, Central Point, Oregon

Pallasite Meteorite (Brenham, Kansas)

and fell to the ground.

Martian meteorites belong to an extremely rare group of meteorites known as the Shergottite, Nakhlite, and Chassigny (SNC) group. SNC meteorites are from the planet mars, and are actually pieces of the crustal mantle of the planet Mars that were blown into orbit by an enormous meteorite impact hitting the red planet hundreds of millions of year ago. This Martian planetary material spent eons in outer space before it entered the earth's atmosphere as a meteorite.

Martian meteorites are amongst the rarest of the rare meteorites. This meteorite, a basalt lava rock nearly indistinguishable from many Earth rocks. Originally weighing nearly 8 kilograms (17.6 pounds), it was collected in 1979 in the Elephant Moraine area of Antarctica.

Lunar meteorites, or lunaites, are meteorites from the Moon. In other words, they were ejected from the Moon by the impact of an asteroidal meteoroid or possibly a comet. And landed on the Earth. Chemical compositions, isotope ratios, mineralology, and textures of the lunar meteorites are all similar to those of samples collected on the Moon during the Apollo missions. All of this taken together, these various characteristics are different from those of any type of terrestrial rock or other type of meteorite. For example, all of those meteorites that are classified as *feldspathic breccias* are rich in the mineral *anorthite*, which is a plagioclase feldspar, and a calcium aluminum silicate, Consequently, these meteorites all have high concentrations of aluminum and calcium. Because of some unique aspects about how the Moon formed, the lunar highlands are composed predominantly of

anorthite. Anorthite is much less common on asteroids and, to the best of our knowledge, on the surface of any other planet or planetary satellite.

Vesta Meteorite is assumed to be a sample of the crust of the asteroid Vesta, which is only the third solar system object beyond Earth where scientists have a laboratory sample (the other extraterrestrial samples are from Mars and the Moon). The meteorite is unique because it is made almost entirely of the mineral pyroxene, common in lava flows. The meteorite's mineral grain structure also indicates it was once molten, and its oxygen isotopes are unlike oxygen isotopes found for all other rocks of the Earth and Moon. The meteorite's chemical identity points to the asteroid Vesta because it has the same unique spectral signature of the mineral pyroxene.

Chondrite meteorite fell in 1970 in Cherokee County, Oklahoma. It is subclassed as an olivine -bronzite chondrite. This meteorite is of a type named chondrite and is thought to have formed at the same time as the planets in the solar nebula, about 4.55 billion years ago.

The iron meteorite, is a type of meteorite, which gets its name because it is mostly made of iron and nickel. A large meteorite found at Victoria Land, Antartica was probably a small piece from the core of a large asteroid that broke apart. In a melted asteroid, the melted rocky material and the melted metal do not mix. The two liquids are like oil and water and stay separate. Metal is much denser than the rocky liquid, so metal sinks to the center of the asteroid and forms a core. This liquid metal consisted largely of iron and nickel, which cooled very slowly over a period of millions of years, resulting in the formation of a crystalline alloy structure visible as the *Widmanstätten Pattern* in iron, and some stony-iron, meteorites that have been sectioned and acid etched.

Canyon Diablo Meteorites, about 25,000 years ago a building-sized iron meteorite crashed into the desert between the towns of Flagstaff and Winslow in northern Arizona. The size and inertia of the meteorite resulted in a massive explosion which excavated a crater almost 600 feet deep and 4,000 feet in diameter. Research conducted by the seminal meteorite scientist H.H. Nininger revealed that a large part of the original mass vaporized upon impact, while hundreds of tons of fragments fell around the crater within a radius of several miles. The site is erroneously named Meteor Crater (craters are formed by meteorites, not meteors) and is generally regarded as the best preserved impact site on earth. Iron meteorites are still occasionally found around the crater, but the surrounding land is privately owned and, unfortunately, meteorite collecting is prohibited. The meteorite takes its name from a steep-sided canyon situated west of the crater.
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(8) Coconut Geode, Mesteno Ranch, Chihuahua State

The 15-ton Willamette iron Meteorite is considered by many to be the most beautiful and spectacular meteorite in the world. It was discovered in 1902 on land owned by the Oregon Iron and Steel Company near the village of Willamettte. The finder, Mr. Ellis Hughes, together with his fifteen year-old son discretely moved the huge iron almost a mile, onto his own land, using an ingenious hand made wooden cart. Hughes was later successfully sued by the steel company, with ownership of the meteorite being awarded to them. In 1906 the meteorite was purchased, reportedly for $20,600, and donated to the American Museum of Natural History in New York. It was displayed in the Hayden Planetarium for many years, and can today be viewed in the Rose Center for Earth and Space. Controversy has continued to follow the Willamette. The Confederated Tribes of the Grand Ronde Community of Oregon sued the American Museum of Natural History for the return of the Willamette, claiming it once belonged to the Clackamas tribe, and is a relic of historic and religious significance. In the year 2000, an agreement was reached stipulating that the Grande Ronde Community could "re-establish its relationship with the meteorite with an annual ceremonial visit."

The Sikhote-Alin Meteorite was found In the winter of 1947, the largest documented meteorite event took place near the Sikhote-Alin mountains in eastern Siberia. Thousands of fragments fell among snow-covered trees, and formed an extraordinary crater field comprised of 99 separate impact structures. There are two distinct types of Sikhote-Alin meteorites: individuals which flew through the atmosphere on their own, often acquiring regmaglypts and orientation; and angular shrapnel fragments which exploded as a result of atmospheric pressure. Sikhote-Alin individuals typically melted into unusual sculptural shapes in flight, are among the most attractive iron meteorites, and are much coveted by collectors.

The Widmanstätten Pattern in Iron Meteorites. In early 1800s, a British geologist remembered only as "G" or possibly "William" Thomson discovered a remarkable pattern while treating a meteorite with a solution of nitric acid. Thomson was attempting to remove oxidized material from a specimen of the Krasnojarsk Pallasite. After applying the acid, Thomson noticed a lattice-like pattern emerging from the matrix. The same effect was also noted by Count Alois von Beckh Widmanstätten in 1808, and is today best known as the Widmanstätten Pattern, but is sometimes also referred to as the Thomson Structure. The intricate pattern is the result of extremely slow cooling of molten asteroid cores. The interlocking bands are a mixture of the iron-nickel alloys taenite and kamacite. Nickel is slightly more resistant to acid than is iron so the mineral taenite doesn't etch as fast as kamacite, thus permitting the inducement of the Widmanstätten Pattern. Coarseness is an indication of the length of time the crystal growing process was allowed to run within the body of the asteroid. Growth of both mineral plates occurs so long as the temperature remains above 400°C and below 900°C. Generally this process is measured in declines of tens of degrees C per million years. Since Widmanstätten Patterns cannot form in earthbound rocks, the presence of this structure is proof of meteoric origin.

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DOOR PRIZES

Please note that we have instituted door prize drawings at our monthly meetings. Because of Hawaii's gambling laws, these drawings cannot be conducted in the common "raffle" format where tickets are sold. Rather, each *paid* member attending the meeting will receive a drawing ticket upon request. A voluntary donation of $1.00 is requested and encouraged. Drawings will be conducted at the end of the meeting with available prizes awarded in random order. You must be present to win. Please remember: if you win a prize, please bring one to the next meeting. This helps to keep our drawings going. Thank you.

WE HAVE A FACEBOOK PAGE! LET'S GO LIKE IT!

HTTP://WWW.FACEBOOK.COM/PAGES/ROCK-AND-MINERAL-SOCIETY-OF-HAWAII/103902329673700?V=WALL&REF=SGM

MAHALO TO MARKUS FOR ESTABLISHING OUR *ROCK FACE*!

MAKE YOUR OWN GEODE

What You'll Need:

- Water
- borax*
- clean egg shells halves
- egg carton
- waxed paper

Steps:

1. Create a super-saturated solution of borax and water — fill a jar with boiling water then add borax one tablespoon at a time until no more will dissolve. This will be about three tablespoons per cup of boiling water.
2. Place small pieces of waxed paper in the egg carton sections.
3. Set the clean egg shell halves in the carton on top of the waxed paper.
4. Pour a small amount of the super-saturated borax solution into the egg shell halves.
5. In a few days, or less, crystals will form inside the shell.

*You can use other solids to make super-saturated solutions with. Such as : table salt, rock salt, sugar, baking soda, and Epsom salts. Each of these will create a different looking crystal and will require a different ratio of water to solid, and will require a different number of days to form.

PARKING AT MAKIKI PARK

Parking along Keeamoku St. starts at 5:30
After that, good luck because it drops off really fast!

Rock & Mineral Society of Hawai`i, Inc.

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The Rock & Mineral Society meets on the 4th Wednesday of each month (except for adjusted dates in November and December) at the Makiki District Park, 7:00 - 9:00 pm. Enter from Keeaumoku Street. Parking is free but limited.

The Newsletter is published monthly, some days prior to the meetings and is distributed in electronic format by email (Adobe Acrobat PDF file attachment). Printed copies are "snail" mailed to those who do not have email. The electronic format usually contains full-color images; the print version may be limited to B&W due to reproduction costs.

Any newsletter comments are appreciated, and can be sent to elise.thomasson@gmail.com

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