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Arctic Asteroid!

A 200 metric ton rock from space streaked across the skies of western Canada on January 18, 2000.

June 1, 2000 -- On January 18, 2000, residents of Western Canada were surprised when a fireball as bright as the Sun streaked across the morning sky. Exploding with an estimated yield of 5-10 thousand tons of TNT, the brilliant meteor attracted the attention of defense satellites, seismic monitoring stations, and just about anyone who happened to be standing outdoors within 700-800 km of the dazzling meteor's path.

"People described it as coming over the mountains, over their heads, and then disappearing over the horizon," says Dr. Peter Brown of the University of Western Ontario. "It was very long-lasting and unusual. We estimate that this object was about 7 meters across and 200 to 250 metric tons. This wasn't your average meteoroid -- it was basically a C-class asteroid detonating in the atmosphere over the Arctic!"

Above: Duane Hilton's rendition of a brilliant fireball streaking above a snowy Canadian landscape.

The first fragments of the object were discovered in January by a local resident near the spot where the meteorite hit.

"He was driving his truck across a frozen lake [Tagish Lake] when he noticed some black rock on the snow-covered ice," recounted Brown during a recent presentation at the NASA/Marshall Space Flight Center. "Fortunately, we had been in contact with him beforehand [because he lived near the expected fall-zone] so he knew how to collect the samples. He placed them in clean plastic bags and kept them continuously frozen -- they've never been touched by human hands. He found several dozen pieces after looking for 90 minutes."

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"The fragments have been positively identified as carbonaceous chondrites," says Brown. "This is very important. Carbonaceous chondrites are the most pristine, organically-rich meteorites known. The ones that we find soon after a fall are even better than Antarctic meteorites, which have been sitting out for a long, long time -- in some cases 10,000 years or more. This is the first time a meteorite has fallen in a cold arctic area and been quickly recovered."

Above: This sequence of pictures was captured by Ewald Lemke (Atlin Realty, Atlin, British Columbia) on January 18, 2000. It shows the expanding smoke train of the Yukon meteor over a 14-minute period. The first frame shows a smoky red vapor trail just 1 minute and 30 seconds after the initial flash.

In April, 2000, Brown and a team of scientists returned to the icy lake to look for more fragments that might have been uncovered as the snow began to melt with the coming of

Spring.

"We were out on the lake on April 20 when we came across a hole in the snow with dark material at the bottom. It looked like wolf droppings but it was actually a carbonaceous chondrite! We spent days harvesting and came out with over 400 fragments. The biggest single piece was 200-300 grams; the total mass collected was 5 - 10 kilograms. The only reason that we were able to recover these things is that they were frozen on ice. Water turns these carbonaceous chondrites into mush -- it looks like a black organic sludge when you add water."

meteorite -- a rock from space that hit the ground because it did not burn up entirely in the atmosphere (see also meteor and meteoroid).

C-class asteroid --these comprise about 75% of all objects in the asteroid belt. They are extremely dark and have chemical compositions similar to the Sun, minus hydrogen and helium (see also S-type and M-type asteroids).

carbonaceous chondrite -- a dark, crumbly carbon-rich meteorite, similar in appearance to a charcoal briquette.

Even though the fireball streaked across the sky in a fiery-looking blaze, the fragments were probably ice-cold when they hit the ground, said Brown.

"The outer layers were hot [due to friction with the atmosphere], but carbonaceous chondrites are very porous and don't conduct heat very well," he explained. The inside of the object was still frozen by the icy cold of space when the pieces reached the ground.

These are the only freshly fallen meteorite fragments ever recovered and transferred to a laboratory *without thawing*. Keeping the fragments continuously frozen minimized the potential loss of organic materials and other volatile compounds in the fragments.

"This is the first carbonaceous chondrite found just after landfall since the Murchison meteorite in 1969. This will be the first time ever that we can use modern techniques to study one of these. People are going to want to look for fullerenes and amino acids. This meteorite was 6% carbon, by weight; other carbonaceous chondrites are only 2%. It's very rich in carbon compounds."

Right: Samples of three carbonaceous chondrite meteorites. Left: Allende meteorite fell on Mexico in 1969. Center: Sealed in a nitrogen bag, a sample of the Yukon meteorite that exploded over western Canada earlier this year. Right: Murchison meteorite sample, which fell to Earth in Australia in 1969. [more information from the NASA/Johnson Space Flight Center]

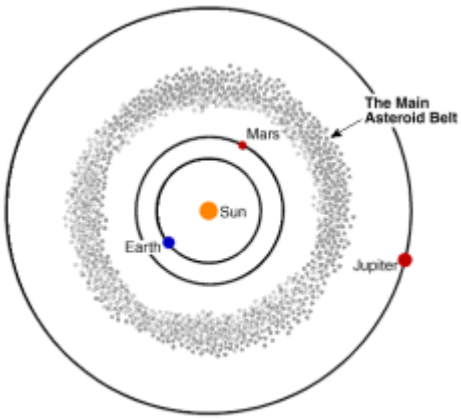
Carbonaceous chondrites, which comprise only about 2 percent of meteorites known to have fallen to Earth, are typically difficult to recover because they easily break down during entry into Earth's atmosphere and during weathering on the ground.

"They are rare because they are so very fragile," continued Brown. "You need an incoming meteorite that's huge -- something that can afford to lose hundreds of metric tons as it blazes through the atmosphere and still deposit many kilograms on the ground."

The fragments -- lumps of crumbly rock with scorched, pitted surfaces -- resembled partly used charcoal briquettes: black, porous, fairly light -- about the same density as lightweight

pumice.

Brown and colleagues are trying to compute an accurate orbit for the meteorite to discover where it came from.



"The data we have now indicates the object followed a low-inclination orbit coming from the asteroid belt," says Brown. "Its incoming velocity was 15-16 km/s -- if we can pinpoint the velocity with a precision a few hundred m/s, we might be able to tell which asteroid family this object came from. So far we know that the object has a typically asteroidal orbit, though it is remotely possible that it might be related to short-period comets."

Although the Yukon meteor was spectacular, Brown notes that it didn't add much to the amount of extraterrestrial material that falls to Earth every day.

"Daily the Earth is bombarded by 80 to 100 metric tons of microscopic space dust (in the form of 10-5 gm particles)," said Brown. "Thus, the Yukon meteorite was only 2 or 3 days worth of space dust."

Editor's note: The Nomenclature Committee of the Meteoritical Society has officially designated the name Tagish Lake Meteorite for the Yukon fall specimens.