Expedition to Antarctica 2011

Dear South Pole Expedition Member,

As your Expedition Scientist, I am both pleased and excited to be joining you on our wonderful Expedition to Antarctica, January 1-11, 2011. We are about to take a journey into the interior of an amazing continent!

We have a wonderful opportunity to do some very useful science in “the land way down under”. We will field test an improved method for locating meteorites both on and under the surface of the ice, and survey ice fields for meteorites and carefully record our findings. If our methodology proves to be viable under Antarctic conditions, then future search expeditions will be able to locate many previously missed Antarctic meteorites.

I will provide you with a more detailed briefing when we meet at Punta Arenas, Chile. In the mean time, you are encouraged to review the following background information:

1. “-oids” and related astronomical terms
2. Our Antarctic Micrometeorite Survey
3. Ideas for leisure time
4. About your Expedition Scientist

Best regards,

Landon Curt Noll

TravelQuest Expedition Scientist

P.S. Be sure to bring some GPS units for us to test at the South Pole and to include in our group GPS photo! Bringing sextants and compasses with you are also welcome.

“-oids” and related astronomical terms

What are micrometeoroids, meteoroids, and asteroids?

All of those “-oids” can get a bit confusing. Below is a handy size chart to tell what is what.

A solid natural object moving in interplanetary space is called a micrometeoroid, meteoroid, or asteroid depending on its diameter:

Name	Diameter
Micrometeoroid	100 μm (1/250th inch) and smaller
Meteoroid	between 100 μm (1/250th inch) and 10 m (33 ft)
Asteroid	10 m (33 ft) and larger

This photograph of the Asteroid (253) Mathilde was taken by the space probe NEAR on 27 June 1997 from a distance of 2400 km (1491 miles). It is lit up from above right by the sun. The part of the Asteroid visible in the picture has an expansion of 59 by 47 km (36 by 29 miles).

We will be talking about these a lot on our expedition; here is a handy table to keep some of the terms straight:

Suffix	Name	What they do
-oids	Micrometeoroids, Meteoroids, and Asteroids	Drift through space
-ors	Meteors	Passing through the atmosphere
-ites	Meteorites	At rest on the surface

Most of the objects our Earth encounters in its orbit around the Sun are micrometeoroids. Astronomers estimate that about 12,750,000 metric tons (14,300,000 tons) rain down on our planet each year! However, with a mass less than 1 gram (1/28th oz) these 25,500,000,000,000 yearly visitors go mostly undetected.

Astronomers estimate that between 37,000 and 87,000 meteoroids with a mass over 10 grams (1/3 oz) reach the Earth each year, adding 2,900 to 7,300 kg (6,400 to 16,100 lbs) to the Earth's mass on an annual basis. Most range in size from a marble to a basketball. Only about one large meteoroid in the range of 5 to 10 m (16 to 33 ft) reaches Earth each year.

This is an artist's impression of when a very large Asteroid impacts the Earth. Astronomers estimate in the past 600 million years, Asteroids or Comets with a diameter of at least 5 km (3 miles) have stuck the Earth 60 times.

Fortunately, for those of us on Earth, asteroid encounters are rare. While an asteroid hits the Earth about once every 14 years, most of these are on the smaller end of the scale: 10 to 20 m (33 to 66 ft). Asteroids 100 m (330 ft) strike the Earth about once every 6,800 years while 1 km (0.62 mile) asteroids strike at a rate of about once every 340,000 years.

What is a meteor?

A meteor is a natural object from outer space that has entered our atmosphere.

Most of us have seen meteors: those lovely brief streaks across the night sky that are commonly known as "shooting stars". Those streaks are not stars, but meteoroids.

A bright meteor from the 2009 Leonid Meteor Shower photographed by Navicore on 2009 November 2009.

Most meteors are small natural objects from outer space that vary from sand grain size to the size of a pebble. Although a head-on collision speed of 71 km/s (158,800 mph) is possible, most meteors hit our outer atmosphere at speeds of up to 42 km/s (93,500 mph)! At these great speeds, air friction starting at altitudes of about 65 to 120 km (45 to 75 miles) becomes intense enough to cause the meteor to begin to glow. As they descend, these meteors encounter denser air, heating rapidly until they disintegrate at an altitude of about 50 to 95 km (30 to 60 miles).

Half of the meteors occur during the daytime where nearly all are lost in the glare of daylight. Many nighttime meteors occur over very remote places where there are few, if any, people to see them. For people who live in a city or town, all but the very brightest meteors are lost in the glare of city lights.

Meteors may occur in showers when the Earth moves through the path of debris left behind by a passing comet. Most other meteors come from the debris left over from asteroid collisions long ago.

What is a meteorite?

A meteorite is a meteor that impacts the ground without being destroyed.

This meteorite (409 gram) was discovered in Saudi Arabia by Meteorite Recon in April 2008.

Most meteors break up into many fragments as they descend into our atmosphere. They often break up and scatter debris over a wide area. Only a very few meteors are large enough to create large impact craters. Most strike the surface at terminal velocity creating only a small pit.

Most meteor strikes go unnoticed. On average, Scientists recover fragments from about 5 to 6 meteor cluster strikes each year. Astronomers estimate that about 500 meteor clusters strike the surface of the Earth each year.

As of February 2010, only 1,086 strikes have been witnessed and well documented, ever. On the other hand, there are over 38,660 well-documented impact finds.

Large meteors can strike the ground having lost little of their speed due to air friction. These large strikes form hypervelocity impact craters.

A public domain photograph of the 1.19 km (0.74 mile) wide Barringer Crater in Arizona.

The Barringer Crater, a 1.19 km (0.74 mile) diameter crater in Arizona is an excellent example of a hypervelocity impact crater. Most hypervelocity impacts come from iron meteoroids. The object that formed the Arizona impact crater some 50,000 years ago came from a 300,000 metric ton (330,000 ton) Nickel-Iron asteroid that was about 50 m (164 ft) in diameter. Astronomers estimate that about half of that asteroid was vaporized before it hit the ground.

Most moderate sized stony or icy meteors do not form impact craters. When they hit our lower atmosphere, most of these stony or icy meteors fragment and vaporize as an explosion high in the air. Even if they do not impact the ground, the destruction high in the atmosphere can cause considerable devastation on the ground. One famous event occurred near Tunguska Siberia in 1908 where a stony meteor of about 10 m (33 ft) in diameter exploded at an altitude of 6 to 10 km (4 to 6 miles) with a force equivalent to 20 kilotons of TNT.

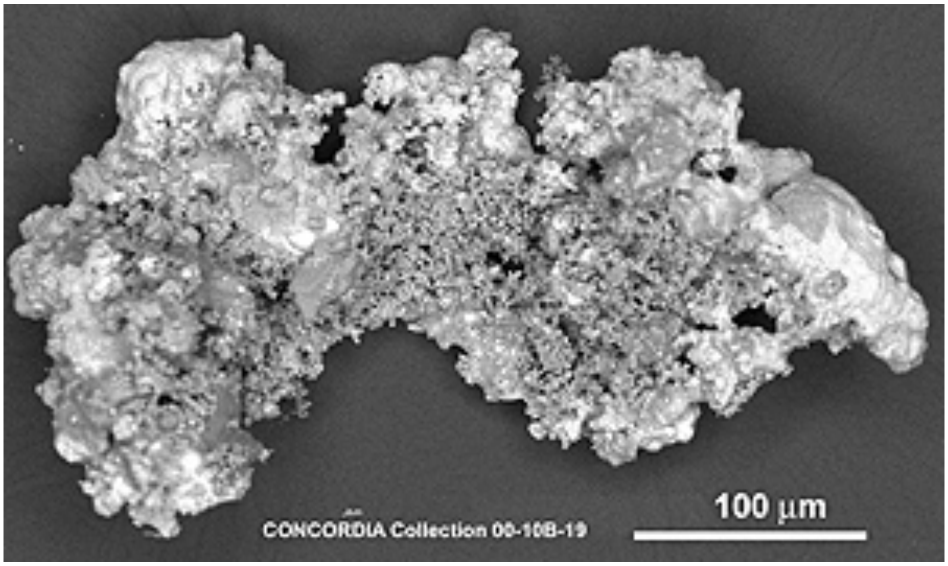
A photograph from Kulk’s 1927 expedition showing devastation of the forest 19 years after a stony meteor of about 10 m (33 ft) in diameter exploded at an altitude of 6 to 10 km (4 to 6 miles).

The force of that explosion leveled over 2,150 square km (830 square miles) of forest near Tunguska.

The vast majority of meteorites range in size from a marble to a basketball. They are associated with very small dents or small craters. Most of the impressions left at these impact sites are quickly eroded away leaving behind little evidence of the impact other than the meteorites themselves.

What is a micrometeorite?

A micrometeorite is a very small natural object from outer space that is resting on the surface of a planet. They are smaller than 100 μm (smaller than 1/250th inch) in diameter.



A micrometeorite, shown under high magnification, discovered in the Antarctic ice near Dome C by Prof. Claus Hammer (NBI Copenhagen-DK), in 1997.

Our Antarctic Micrometeorite Survey

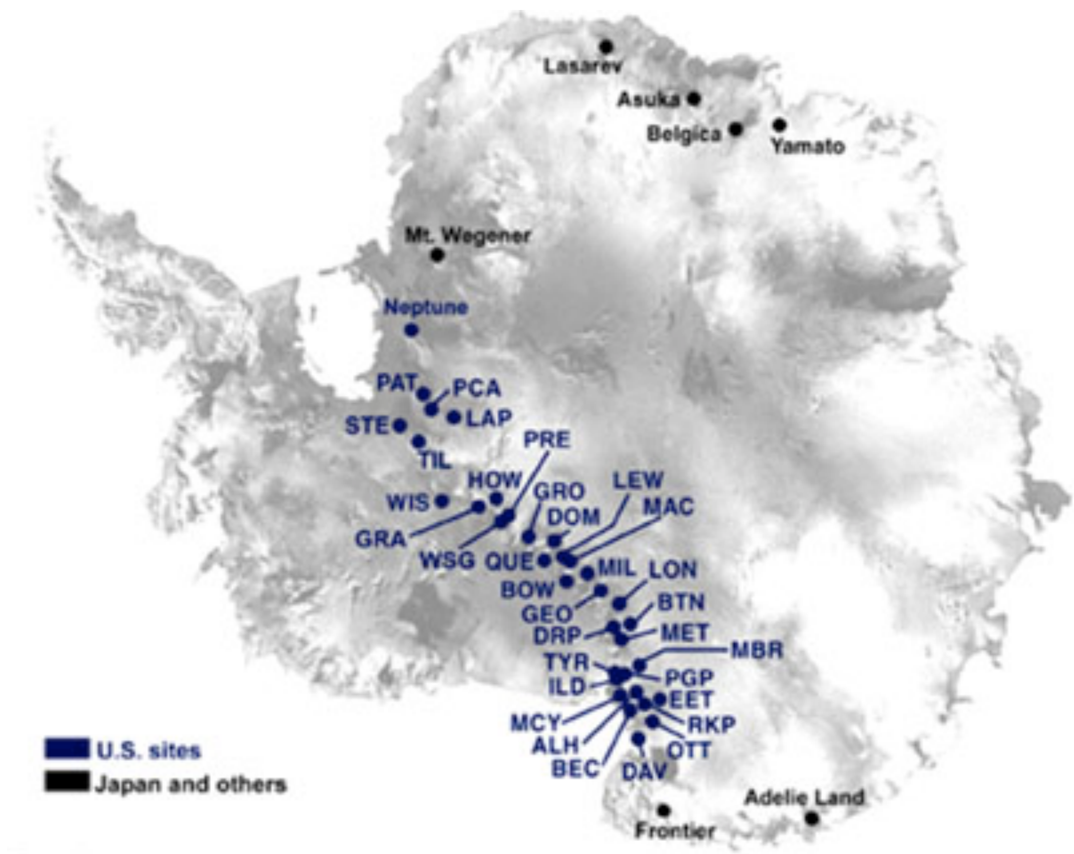
Please note that the participation in this survey, while encouraged, is voluntary.

What is so special about meteorites and micrometeorites?

Meteorites and micrometeorites provide Astronomers with hands-on experience with stuff that makes our solar system. Finding a meteorite that came from an asteroid or planet surface is the next best thing to being there.

Why search for meteorites and micrometeorites in Antarctica?

A meteorite that falls in the Antarctic ice stands out and is reasonably undisturbed by natural processes. In contrast to most meteorites elsewhere on Earth, Antarctic meteorites are easier to spot by people. These meteorites suffer less from earth-bound contamination than their counterparts on dry land or under water do.



A map of meteorite finds in Antarctica. This image was provided courtesy of Rick Fienberg.

Why will we look for, but not collect meteorites?

The scientific purpose of our expedition is to conduct a meteorite survey and to field test the equipment, **NOT** to collect samples!

The Antarctic Treaty System (ATS), a set of treaties signed by some 47 countries, protects natural resources south of 60° S latitude. Observing these regulations preserves the ability for scientists to conduct research in this fragile environment. In return for permission to access these protected areas, we have agreed to only locate, but not remove, any meteorites we find.

How will we avoid contaminating meteorites?

We must avoid contaminating meteorites. Therefore, we must neither touch nor breathe on any meteorites we find. This will preserve the scientific value of what we discover.

These scientists are approaching, but not touching, a large meteorite found on top of the Antarctic ice. This image is provided courtesy of Rick Fienberg.

How will we conduct the meteorite survey?

We will perform a visual search above the ice and employ magnetometers to detect metals in meteorites below the surface of the ice. In the event of a discovery, we will follow a detailed procedure to safely record our findings. We will thoroughly brief you on this process when we meet at Punta Arenas, Chile. You will also have an opportunity to practice this process before we reach our search fields.

Ideas for leisure time

Not more than a few decades ago, extremely courageous explorers risked their lives to be where we will go. While you are in Antarctica, take time to appreciate the natural wonders of this extraordinary place. In addition to just being there, you are encouraged to watch, listen to, and photograph your surroundings.

You will travel to one of the most special places on the planet. So, you might think about conducting some interesting experiments of your own. The following are some suggestions for activities that you might think about and plan for:

- Bring a GPS to the South Pole and see how it performs. Did the manufacturer of your GPS consider the case where all of longitude lines meet in one place?

- Locate important directions from the South Pole. Identify the International Date Line and the Prime Meridian. Determine which direction points to your home. Determine the direction of the North and South Magnetic poles by compass. Etc.

- Take a group GPS photo at the South Pole. Photograph the South Pole surrounded by potentially confused GPS units held by members of the group.

- Measure your latitude, the 19th century way. Using a sextant that you have brought with you, determine your latitude.

- You are visiting a very cold place. How do substances behave at these extreme temperatures? For example, how long does a cup of hot water remain liquid when tossed into the cold air?

- You will be in the land of the midnight sun. What is the path of the sun in the sky throughout the day? Using a binocular (and perhaps some filters and other sky-object locating aides) you have brought with you, see if you can spot any celestial object other than the sun.

What else is possible? We encourage you to be creative!

You are welcome to suggest other ideas, or to ask questions about any of the above ideas by posting them to the TravelQuest Antarctica forum at:

http://www.tq-international.com/phpBB3/viewforum.php?f=43

or by sending them via email to:

travel@travelquesttours.com

or by calling TravelQuest at:

+1 (928) 445-7754
+1 (800) 830-1198 (for US and Canada)

About your Expedition Scientist

Landon Curt Noll in the Sahara desert near Al ‘Aziziyah, Libya where the highest record air temperature of 57.7° C (135.9° F) was recorded.

Landon is wearing an Antarctica T-Shirt from a prior expedition that went near Vostok, a place where the lowest recorded air temperature -89.2° C (-128.6° F) was recorded.

The first complete sentence I spoke as a child of age 2 was: “How far is the Sun?” Since that age, I have remained fascinated with the Universe in which we live. In fact, I can truly say our Universe is one of my favorites!

Today as an astronomer, having just celebrated my semi-centennial, I still hold on to that wonder I discovered as a young child. Owing to the great size of the Universe, I chose to focus my area of study on our solar system with particular emphasis on inner solar system: the zone in which we ride our wonderful planet Earth, and that is bookended by the Sun and Jupiter.

My research has included a search for Vulcanoid asteroids (asteroids that are believed to orbit very close to the Sun). I have been fortunate to conduct a number of search experiments during total solar eclipses, many of those led by TravelQuest International.

At age 18, I became the youngest person to break the record for the discovery of the largest known prime. I have had the honor to hold or co-hold eight world records related to primes and related mathematical values. I have been credited as the co-inventor (with

John Horton Conway) of a system for naming numbers of any size (see http://www.isthe.com/number for details).

I graduated from Linfield College with a BA in Math/Physics. I am a member of the American Mathematical Society and an associate of the American Astronomical Society.

To supplement my Astronomy income, I work for Cisco Systems. My agreement with Cisco allows me to view any total solar eclipse, planetary transit or supernova that is bright enough to become visible to the unaided eye. Through similar agreements with other employers, I have been fortunate to view many eclipses, observe the transits of Mercury and Venus, and observe supernova 1987a only a few hours after discovery. You might say that I am a Cryptographer and Number Theorist by day, and an Astronomer by night.

For other details about me see:

> http://www.isthe.com/astro
> http://www.isthe.com/bio
> http://en.wikipedia.org/wiki/Landon_Curt_Noll

In case you are curious about answer to my age 2 question: “How far is the Sun”? 34 years later, using data I collected while on a TravelQuest Transit of Venus 2004 expedition, and combined with other observations as far away as Madagascar, I calculated the mean distance from the Earth to the Sun to be:

149 593 222 km, plus or minus 4648 km

(92 952 919 miles, plus or minus 2888 miles)