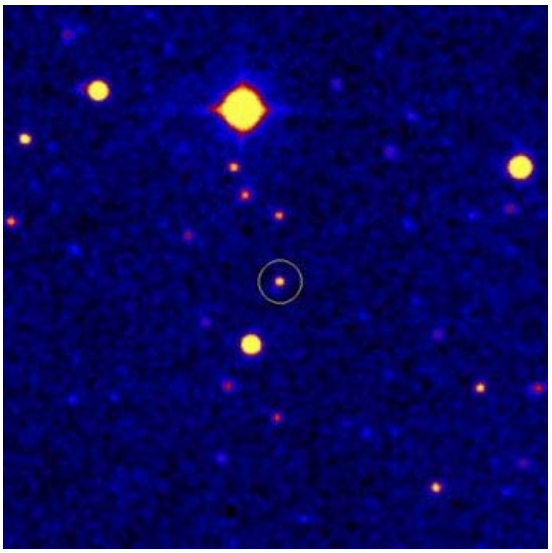
Oddball Quasar and Salt Water Inside Meteorite

August 29, 1999

Oddball Quasar

Cambridge, England Last week Cambridge scientists said they were puzzled by mysterious, dark bands in the sky just before and after the August 11th eclipse. But Dan Green, Director of Harvard's Smithsonian Astrophysical Observatory, told me that the horizontal bands have been seen before in other total solar eclipses and are thought to be atmospheric distortions.

This week I also talked with Astronomer George Djorgovski (jor-GOV-ski) at the California Institute of Technology in Pasadena, about a mysterious star his team photographed during their Large Digital Sky Survey. The astronomers noticed an oddly colored star in the constellation Serpens, the Snake.



Photograph by Astronomer S. George Djorgovski © 1999,
California Institute of Technology, Carina Software and Large Digital Sky Survey.

When the unusual star's spectrum was profiled on a graph, it did not match any known astronomical body. Last week, the mystery was solved at the Keck Observatory in Hawaii. Their new infrared spectroscope equipment confirmed the object is definitely an oddball quasar about 8 billion years old.. A quasar is the most luminous object we know in the universe. A single quasar can shine a thousand times brighter than our *entire* galaxy. Scientists aren't sure, but think the enormous luminosity is produced when matter is dragged into black holes at the centers of quasars.

Salt Water Inside Meteorite

Houston, Texas As of current data, the universe is estimated to be between 12 and 14 billion years old. We're living on a watery planet that's about 4 1/2 billion years old. - A geologist from the Univ. of California-Berkeley has spent years looking for evidence of water in meteorites. Last week, Dr. Michael Zolensky at NASA's Johnson Space Center near Houston, Texas, announced the discovery of salt water inside a small meteorite that landed in west Texas a year ago on March 22, 1998. Several boys were playing basketball when the meteorite landed on their court. The boys reported it to the police who called NASA and the next day the space rock was delivered to a "clean room" at the Johnson Space Center near Houston.

Photograph of actual meteorite at NASA
Johnson Space Center, Houston, Texas, 1998.

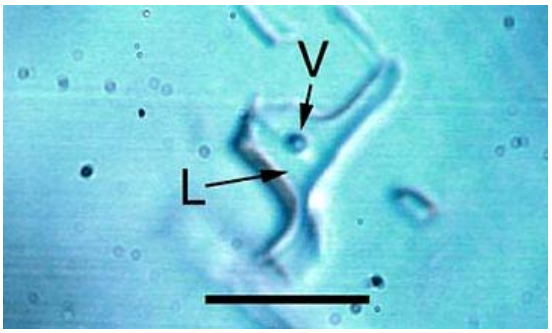
The significance of salt water inside the meteorite excites Dr. Zolensky because it implies a lot of water was present at the beginning of our solar system's creation and might be in other solar systems as well.

Interview:

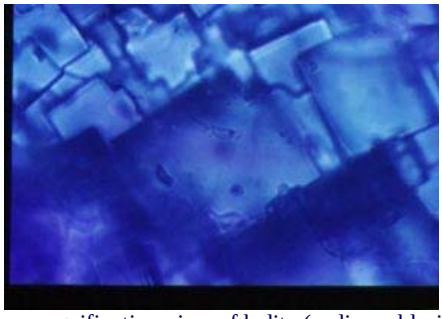
Michael Zolensky, Ph.D., Geologist, NASA Johnson Space Center, Houston, Texas: "This is the first time we've had liquid water samples from off the earth to study in the lab. And they're sitting inside these little bubbles of water are sitting inside of halite crystals that's table salt or sodium chloride - which as far as we know, is also the first example of that. Although there have been reports of sodium chloride microscopic grains in some previous meteorites that no one believed in the past because it seemed so incredible. But if we go back now and look, maybe they were true.

YOU'VE GOT A METEORITE THAT HAS BOTH TABLE SALT IN IT AND WATER BUBBLES.
Yeah. All we need now is pepper and we're all set to go!

THE WATER HOW IS IT THAT THE WATER ITSELF IS CAPTURED IN BUBBLES INSIDE THE SALT?
If you have salty water evaporating and it leaves behind salt crystals that's just what happens. Salt crystals, or any other kind of crystal grown from a fluid if they grow fast enough will actually kind of overrun and trap samples of the solutions from which they are forming. And those are left behind in the crystal as it grows. And those are called fluid inclusions.



Microscopic close-up of a 15 micron diameter inclusion in meteorite
that contains water (L) and a vapor bubble (V) shown with arrows.
NASA Johnson Space Center, Houston, Texas, 1999.


Microscopic low magnification view of halite (sodium chloride salt crystal)
with one small 15 micron diameter inclusion in the center of photograph, in focus.
NASA Johnson Space Center, Houston, Texas, 1999.

In addition, the halite sodium chloride's mineral name is halite was this beautiful purple-blue color which only happens if halite has seen a lot of radiation. And this has happened to this halite because there is some radioactive potassium inside the halite a very tiny amount that over the billions of years since it formed, has given it this beautiful color. And so, if in fact the halite had come from the earth or had somehow been contaminated, it wouldn't be purple like that. It would be transparent and colorless just like table salt is. So, the fact it's purple proves it's not from the earth.

THAT IT IS EXTRATERRESTRIAL.
Oh, yeah. Although we've seen evidence of water in other meteorites in the past, we never actually found any samples of the water itself to study. And that's critical because we want to learn where water came from in the early solar system whether it was born in the solar system itself or created in interstellar space or from some other solar system and how it got into the solar system and how it got moved around from place to place? How it got to the earth, in fact, and made the oceans how did that happen?

THIS IS LITERALLY EXTRATERRESTRIAL WATER INSIDE OF A METEORITE?
That's right. And what we're doing now is opening these little bubbles one at a time and analyzing the droplets of water to determine what their composition is and try to figure out where it came from.

IN THE NEWSPAPER HERE IN PHILADELPHIA, IT REFERRED TO IT AS BRINE BEING A SALTY WATER - AND IT IMMEDIATELY BROUGHT TO MY MIND AN OCEAN.
Yeah, that's the thing. On the earth, you see sodium chloride usually forming when you have seas that evaporate - salty seas. And unless there is some other origin that we don't know about yet that is more likely, what this implies is that there was a lot of water present on some of these early solar system bodies. And these are early because we are able to date the mineral, the halite, and John Bogard and others at the NASA Johnson Space Center are doing that. And the dates they are getting for the meteorite and the sodium chloride which contains

the water are about 4.5 to 4.6 billion years ago. And that's right at the very dawn of the solar system. So, this is very, very ancient water.

FROM YOUR SPECULATION ABOUT WHETHER OR NOT THIS WOULD BE ORIGINATING FROM SOMETHING LIKE A COMET OR FROM, LET'S SAY, ONE OF THE LUNAR BODIES SURROUNDING A PLANET LIKE JUPITER OR SATURN - COULD THIS BE FROM ONE OF THOSE MOON BODIES?
Probably not from one of those bodies themselves. But possibly from an identical type body which might still be out as a comet or asteroid today. Many of those bodies in the outer solar system there is a lot of ice around today. But early in our solar system's history, this ice would have been melted if these asteroids out there had heated up some how. And there is plenty of evidence from meteorites that this indeed happened. There was some internal heat source that caused a lot of these asteroids to kind of heat up briefly and cook for awhile stew, so to speak. The rocks sometimes got very, very hot indeed.

WHAT WOULD DO THAT IN AN ASTEROID?
We think it was from an element that was very radioactive. It would have been created and then been so radioactive that it decayed entirely away. And when you look for evidence of elements like that, there are actually a couple of possibilities: one is Aluminum 26 which decays to Magnesium 26. And there is evidence in meteorites that this happened that early in the history of the solar system, there was this very hot element, Aluminum 26, which was incorporated into small objects and building up toward the progenitors of planets and decayed so rapidly that it heated the rock up all around them. And that would have been enough to melt some ice that was there and promote water to be present and to move around and to react to the rocks.

BUT WHY WOULD IT BE SALTY?
Well, that's the big problem. See, to be salty, the water has to react to a whole lot of rock in order to remove enough chlorine and sodium to be salty. What that means to have brine seems to imply that there was a lot of water around reacting with a lot of rock for a fair amount of time. It wouldn't have been just a brief instance of some water created and drying out immediately. It would have to have been water around for awhile, kind of stewing for awhile to dissolve the constituents of brine out of the rocks. And that could have happened.

COULD THIS HAVE HAPPENED ON MARS AND COULD THIS BE A METEORITE FROM MARS?
No, it's not from Mars because rocks from Mars are totally different in terms of mineralogy and the rock. So, this is definitely rock, not from a planet, but from some little planet-want-to-be, a little object that never quite got into a planet and never evolved beyond just heating up a little bit.

WOULD EUROPA BE A LIKELY CANDIDATE SINCE IT'S SUPPOSED TO HAVE A LOT OF WATER?
It might be an analog a place where this same thing could have happened and been preserved until the present. In fact, there is some data from radar sensing Europa that the sub-surface ocean is a brine also. And so it can be totally analogous to the situation with the meteorite.

COULD THIS ACTUALLY BE A METEORITE FROM EUROPA?
Uh, I don't know. It could be from anywhere in the outer solar system. I think it's unlikely, but I can't say that it isn't. We just don't know. There are millions of asteroids and there are many moons and we have only a few thousand meteorites. And we don't know where almost any of them are from.

WHAT IS THE NEXT STEP IN THIS STUDY OF THIS BRINE AND THESE BUBBLES? YOU'VE OPENED UP SOME. HAVE YOU FOUND OUT ANYTHING MORE THAN WHAT HAS BEEN REPORTED SO FAR?
The next step is basically to begin to open up these little bubbles one at a time and look at the composition of the water. And to also look at the isotopic composition of the water. And that data will basically tell us where the water

came from. That's the next step. It's very hard to do because the biggest of these bubbles is only about 15 micrometers across. That's much smaller than a human hair in diameter. So, it's very hard to do that work. But we're doing that now along with our collaborators.

Also in the meantime, we've also found this in a second meteorite which fell last year in Morocco. Very similar circumstance. Fell in a very dry country and very quickly got shipped back to the lab and there was the same thing inside: halites with water inside.

WAS IT THAT SAME PURPLE-BLUE?
It was more a midnight blue color, a very lovely blue color. Not quite as purple as the first one.

SUGGESTING IT HAD BEEN EXPOSED TO RADIATION?
Oh, yeah, again. We haven't proceeded very far with analysis, but it looks like the same thing. So, my guess is that this is going to turn out to be fairly common. It's just that if you don't get to the meteorite quickly or if you mistreat it by cutting it with water or washing it off, you're going to destroy all the evidence inside.

HAVE YOU BEEN ABLE TO DETERMINE ANY ISOTOPES FROM OPENING UP THESE BUBBLES SO FAR TO EVEN GIVE A SPECULATIVE GUESS ON THE ORIGIN?
No, because the technique for doing that probably doesn't exist yet. There's one lab in Cambridge in England where they are working on a new instrument that can probably do this and they will probably be on line and ready to go sometime in this year. So, at that time, we'll give them a sample and they'll have a look at it.

ANY POSSIBILITY THAT THERE'S ANY KIND OF A MICROBE IN THESE WATER BUBBLES?
I hope not.

MEANING?
I don't think so.

WHAT DO YOU MEAN, 'I HOPE NOT?'
That would mean these are dangerous rocks. But we've had them around long enough and no one has gotten sick or anything. But also, you can look right through the inclusions in the microscope and you can see if there were things swimming in there, you'd see them. And we don't see those. Also, the analysis techniques we use to look to verify there is water in the inclusions involves shining a laser light through the inclusions and looking at the light coming out the other side looking at the spectra. And that spectra would also tell us if there were organics in the water. And there really isn't as far as we can determine. So, there is really no evidence for much organics in the water at all, much less any kind of microbe or anything.

But you know, these meteorites I think have been falling on the earth for the entire history of the earth. If there were microbes in these meteorites, then they've been here longer than we've been here. So, they aren't anything really new.

THIS COMBINATION OF SALT AND WATER BUBBLES INSIDE A METEORITE THIS IS TRULY A FIRST IN ASTRONOMY SO FAR IN THIS CIVILIZATION?
That's right.

IF THIS HAPPENED AT THE BEGINNING OF THIS SOLAR SYSTEM, THEN THE LIKELIHOOD WOULD BE THAT A WATERY SITUATION WAS IN OTHER SOLAR SYSTEMS.
That's right.

THAT MEANS POSSIBLY MORE CHANCES FOR LIFE OUT THERE.
That's right. I hope so. It would be nice to have some friends out there somewhere."

Websites:

http://astro.caltech.edu/~george/dposs/

Credits