Video Transcript - Exploring the Solar System with Antarctic Meteorites

Maggy Benson:	Wow! [00:00:30] Hi, everyone. Thanks for joining us here on Smithsonian Science How? We have a really great show today about meteorites and to talk about them with us is geologist from the Smithsonian's National Museum of Natural History, Dr. Cari Corrigan. Cari, thank you so much for being here.
Cari Corrigan:	Thank you. Thanks for having me.
Maggy Benson:	So Cari, you're a geologist here who studies meteorites. Can you tell us what that means?
Cari Corrigan:	Yes, geologists are people who study rocks. And meteorites are rocks, but more specifically, they are rocks that come [00:01:00] from outer space and they pass through the earth's atmosphere and landed on the earth.
Maggy Benson:	And where from outer space are these meteorites coming from?
Cari Corrigan:	So more than 95 percent of them come from the asteroid belt but we actually do have a few that also come from Mars and the moon.
Maggy Benson:	So you brought a collection here for us to take a look at today. Can you tell us a little bit about what we're seeing?
Cari Corrigan:	Yep. You can see, I brought a number of different things and they all look a little bit different. That's because they're all different types. But here are some examples of the kinds that we have the [00:01:30] most of, 95 percent of the meteorites that we have are these. And you can see, they look a little bit different from each other but they also look different on the inside than they do on the outside.
Maggy Benson:	Yeah, it's pretty dark. Actually, looking at all of the different examples that you brought, they all have this dark surface on them. Now before you tell us what that dark surface is, I think we should ask our viewers, what do you say?
Cari Corrigan:	Yeah, that sounds great.
Maggy Benson:	Viewers, here's an opportunity to participate in a live poll with us. Tell us what you think by responding in the window that appears to the right of your video screen.
Maggy Benson:	[00:02:00] The surface of the meteorite is dark because, our collections managers polished it, Earth's atmosphere polished it, it was cut with a sharp tool, or it is coated with a different rock type. Remember that this is the same place that you can pose questions for Dr. Cari Corrigan to answer during our live

show. And we have a special guest, fellow meteoriticist from the Natural History Museum, Dr. Tim McCoy, also answering your questions in the chat today.

Maggy Benson: Cari, [00:02:30] we can see the results coming in in real time and 82 percent of our viewers think that the Earth's atmosphere polished these meteorites. What do you say?

Cari Corrigan: I'd say that they are pretty much right. So most of the people guessed the right answer. So actually the fusion crust is what this is called on the outside of [00:03:00] these meteorites and it actually forms as the meteorites coming from space, traveling really, really, quickly and it passes through the earth's atmosphere and is going so hot and rubbing up against the atmosphere so fast and so hard that it actually melts the outside. And then it hits the ground and cools off.

Maggy Benson: Very cool. So what's causing these meteorites to actually enter into earth's atmosphere in the first place with that much speed?

Cari Corrigan: Out in the asteroid belt, where most of these are from, the asteroids [00:03:30] are actually crashing into each other and some of these get launched off as meteorites (they have to hit each other pretty hard). And as they're traveling through space, since space is a vacuum, there's nothing for them to rub up against to slow down. So they basically hit the Earth's atmosphere and that's the first thing they've encountered to slow them down. So they're traveling really quickly on their way in.

Maggy Benson: So once they land on earth and you find them as a scientist, can you look inside these meteorites to find clues about that impact that they had [00:04:00] out in outer space?

Cari Corrigan: Yeah, there are a number of different ways we can tell about the impacts and that's actually what we're trying to do. My research revolves around actually trying to understand the collisional history of the whole solar system. And some of these actually have been hitting each other so hard that tiny little diamonds, which take a lot of pressure to form, have actually formed. So this is a ureilite and it's one of a number of couple different meteorite types that have diamonds. This is a picture of it under a microscope.

Maggy Benson: It's beautiful.

Cari Corrigan: Yeah, they're beautiful.

Maggy Benson: So do [00:04:30] all meteorites have diamonds?

Cari Corrigan: No, a few types do but mostly the really primitive ones, but not all of them do, no.

Maggy Benson: And so, do you have an example here of a different meteorite that has some kind of evidence of a collision that isn't a diamond?

Cari Corrigan: I do. I brought a great example of another type of clue that we use to understand how rocks have collided together and this one here has a melt clast, this white clast in the rock, is actually a piece of an asteroid that has been hit so [00:05:00] hard that it melted all the way. It may be a part of the same asteroid that this came from, or it may have been one that came in from somewhere else.

Maggy Benson: Is that what we're seeing now?

Cari Corrigan: Yep, these are (those melted grains) underneath a scanning electron microscope; so you're actually looking really, really closely at those melted grains.

Maggy Benson: So are you studying this area of melted meteorite to be able to understand these bigger questions about the solar system that you just mentioned?

Cari Corrigan: We are. So, these are from the asteroids that I've looked at. This is part of the asteroid belt. But, you can actually look [00:05:30] at pieces of the moon for example, and the moon has a record of impact that's really, really- you know, it's been happening forever. There's a picture of an impact here, and you can see as the impact crater is forming, the red, melted part, it actually splashes out and you end up with these melt clasts all over the surface of either the moon or the asteroid that you're looking at.

Cari Corrigan: So the Earth we know, and if you're looking at this through time, we know the solar system formed about four and a half billion years [00:06:00] ago, and the moon actually formed from a really large impact into Earth, just after that, actually. Not too long after. So we want to know what happened after that, even from then until now.

Maggy Benson: So is there any way to tell actually, how old that impact, the one that you were showing us is?

Cari Corrigan: There is. We can actually use isotopes to try to date that and we do that with moon rocks, too. We think that on the moon there is a big cluster of melted material that is 3.9 billion years [00:06:30] old, but not really very much material older than that, so we know there must've been some really big event that happened at 3.9 billion years. People call it either the Late Heavy Bombardment or the Lunar Cataclysm. But, you can see lots of things impacted the moon at that time.

Cari Corrigan: And we're also trying to understand if that happened in the asteroid belt.

Maggy Benson: So you said that that's evident in the moon?

Cari Corrigan: Yeah.

Maggy Benson: Why wouldn't it be evident on Earth, because if there was a big event, would Earth be getting bombarded at the same time?

Cari Corrigan: It [00:07:00] would, actually. It should be the same. The material that's coming in should be hitting both. On Earth, however, we have water, we have volcanoes, and we have plate tectonics, all these things that are actually erasing the clues to the Earth's past that are on the surface.

Maggy Benson: So what kind of clues do you have on the Moon?

Cari Corrigan: Well, you can look at the Moon and look at the surface and see those really big, you know, craters. If you look at the moon, yup, you can see it's got those big, dark basins and each one of those is actually an impact basin from when something [00:07:30] hit the surface of the moon.

Cari Corrigan: And then we can look at the rocks, for example, the lunar meteorites, or the rocks that the Apollo astronauts brought back and understand and study the melted pieces in there to try to understand how they formed and when they formed.

Maggy Benson: This is all very cool. I mean, to do all this kind of work, you have to identify where these meteorites are coming from in the first place.

Cari Corrigan: Right.

Maggy Benson: And you showed me a little bit about how you do that in your lab, here at the Smithsonian.

Cari Corrigan: Yes.

Maggy Benson: It was very fascinating, let's show our viewers.

Cari Corrigan: OK.

Maggy Benson: Cari, [00:08:00] we're somewhere very special. It happens to be the place where you work. Where are we?

Cari Corrigan: We're in the meteorite vault in the Department of Mineral Sciences at the Natural History Museum, and you can see that behind us is where we store our meteorites. These are special cabinets that actually keep the humidity level, or the water level low in the air that they're in, to keep those meteorites from rusting.

Maggy Benson: So, how many meteorites are here, in the meteorite vault?

Cari Corrigan: We have about 5,000 in this room.

Maggy Benson: Wow! That's amazing.

Maggy Benson: Do you know where all of the meteorites come from?

Cari Corrigan: Yep, so that's one of our jobs [00:08:30] to figure out where these meteorites came from, out in outer space.

Cari Corrigan: We can look at this one, for example, you can see it's got fusion crust on the outside and that's what forms when it comes through the Earth's atmosphere.

Maggy Benson: It's really heavy.

Cari Corrigan: That's a clue as to how we know where this came from. It's full of all that shiny nickel and metal, which is really heavy. So we know that this came from an asteroid.

Cari Corrigan: This one we've sliced open, you can see that we just took one of our cutting saws and sliced it right open like a slice of bread. Just look at the inside, and that [00:09:00] is where we can see most of our information.

Cari Corrigan: We have another one over here. So this one looks very different, this has been sliced open, also. The fusion crust on this one is a completely different color. You want to hold that one.

Maggy Benson: And it's pretty bumpy and it looks like there's a lot of different rocks or something inside of it.

Cari Corrigan: Yep, so that one is actually from the moon.

Maggy Benson: Wow! Really?

Cari Corrigan: Yep. You can see right away that the two of these are very different by looking at them. That's because the moon's surface has been hit by so many asteroids and meteorites through time, that it's just been [00:09:30] churned up and churned up. So each rock, you know, the new rocks that they make, are made up of lots of little pieces of other rocks.

Maggy Benson: So how can you tell for sure that this is a moon rock?

Cari Corrigan: We would make another slice of it, this time a much thinner slice, and we would glue that down to a glass slide and then we'll polish that to the width of a human hair, and then we can look at it in the microscope so we can pass enough light through it to be able to identify what the minerals are inside.

Cari Corrigan: Different types have different minerals in them.

Maggy Benson: Can we look at that now?

Cari Corrigan: Yeah, let's do it.

Maggy Benson: [00:10:00] Awesome.

Cari Corrigan: Okay, so I've put the thin slice of the rock here, on the stage of this petrographic microscope, which is the kind of microscope we use actually, to use to look at rocks and try to understand the minerals in them. Have a look.

Maggy Benson: Wow. I didn't think it would be that colorful.

Cari Corrigan: Yeah, it's beautiful. So we've used a special kind of light called 'polarized light' and that actually brings out the colors in the minerals and that can teach us about their composition and what minerals they are and that actually helps us figure out what kind of rock [00:10:30] it is.

Cari Corrigan: So if we have a look again, we can actually learn even more when we turn the stage.

Maggy Benson: Wow. It's like the colors are changing or flashing.

Cari Corrigan: Yeah, it's like a kaleidoscope almost. So, we can actually learn more about the minerals when we do that, than just when we hold it still.

Maggy Benson: So it's really not just a pretty picture, you're getting important information out of this.

Cari Corrigan: Yeah, exactly.

Maggy Benson: Cari, that was super cool. I actually got to hold a piece of the moon. It was amazing and then I got to see how colorful [00:11:00] it was underneath that microscope.

Maggy Benson: Do all meteorites look like that underneath the scope? Yeah, and you can actually see it on the screen, here.

Cari Corrigan: This is piece of the moon. The lunar meteorite that Maggy held, and you can see up close that it's actually made up of lots of different pieces of other types of rocks.

Maggy Benson: Very cool. It was surprising to see all those colors underneath that microscope.

Cari Corrigan: Right.

Maggy Benson: So that is how you actually identify a lot of these different minerals and meteorites and their origins.

Cari Corrigan: Yes.

Maggy Benson: Do [00:11:30] you have any other examples to share with us today?

Cari Corrigan: Of things underneath a microscope? Yes, we do. So we have a picture of a chondrite, so the meteorites I showed you first, those are ordinary chondrites. So if you look, this is one underneath a microscope. You can see all those brown, circular things in there are the chondrules, that make up a chondrite and those are, basically, in the same way that they were four and a half billion years ago when they formed.

Maggy Benson: Wow!

Cari Corrigan: But then we have another one, where this meteorite has probably been melted so you can see that instead [00:12:00] of having all those individual little minerals, these minerals are all kind of smashed together and they've regrown in that space.

Maggy Benson: I wouldn't mind looking at meteorites under a microscope and identifying them as a job.

Cari Corrigan: It's a lot of fun and you can tell them apart pretty quickly.

Maggy Benson: It's really beautiful. Let's learn a little bit more about your work.

Cari Corrigan: OK.

Maggy Benson: You worked specifically on the Antarctic Meteorite Collection-

Cari Corrigan: Right.

Maggy Benson: And you have actually been to Antarctica to collect meteorites.

Cari Corrigan: I have.

Maggy Benson: I was wondering before I talked to you, why you would ever go to Antarctica, and some of our viewers might be wondering the same thing.

Cari Corrigan: Yep.

Maggy Benson: So let's ask them [00:12:30] what they might think, why you would go there in the first place.

Cari Corrigan: Sure.

Maggy Benson: Viewers here's the opportunity to participate in another live poll.

Maggy Benson: Tell us, Antarctica is a good place to search for meteorites because it's cold, mountainous, windy or close to outer space. Take a moment to think about it and put your answer in the window that appears to the right of the video.

Maggy Benson: [00:13:00] The results are still coming in and there's kind of a smattering across all responses, but most people think it's because it's cold.

Cari Corrigan: And they would be right, but, actually, it turns out that it's because it is cold, because it's mountainous, and because it's windy. And while it has the highest elevation of any of the continents overall, that probably doesn't help because meteorites actually fall all over the Earth, equally.

Cari Corrigan: But the cold is the main reason. If you can see on the graphic on the screen, the meteorites fall onto the ice and then they get buried and then they travel with the [00:13:30] ice and they get stuck up against the mountain range, called the Trans-Antarctic Mountains that run the whole length of Antarctica. And then, there's such a dry, strong wind that that actually, sort of, degrading the ice on the surface and the meteorites get left just sitting there on the surface, waiting for us to come pick them up.

Maggy Benson: And just like this. Is that you with a meteorite?

Cari Corrigan: It is me with a meteorite and that was probably the biggest meteorite we found that season that I went.

Maggy Benson: Do you pick your field sites based on where those mountain ranges are?

Cari Corrigan: Yes, [00:14:00] we do. We know that Antarctica is basically a dome shape, and the ice flows downhill, so we know where it's going to get stuck when it hits up against those mountains and we can go look for places, they're called Blue Ice Regions, and those are where the ice tends to be really stuck. You can see on this map, the place the La Pas and the Gallopine Hills, those are two of the places that I visited. And those are right along that mountain range. And this is another place I visited called Meteorite Hills and actually, each of these red and blue dots is a meteorite that was found in [00:14:30] one of two seasons of people that went to search for meteorites there. So that's a well over 1,000 meteorites.

Maggy Benson: Over 1,000 meteorites?

Cari Corrigan: Yeah, just in that one place.

Maggy Benson: You can visit this same location year after year and continually find new specimens?

Cari Corrigan: Right, yeah. Usually we'll go back maybe a few years in between because the snow blows around and things get uncovered that we may have missed before.

Maggy Benson: That's very interesting.

Maggy Benson: What is it like to actually go to Antarctica, to look for meteorites? I know that you sleep in tents, in sleeping bags on the ice.

Cari Corrigan: Yeah, we do [00:15:00] and it's a really long trip and it's cold, just like everybody would suspect. But it's really exciting because some places you go, you're the first person to have ever been there and you're the first to see a piece of space.

Maggy Benson: And it's beautiful.

Cari Corrigan: And it's beautiful. This is a place that we camped, you can see the image there. That's our practice tent camping and we practice how to use all of that equipment and it's right next to the southern most active volcano on Earth called Mount Erebus, which is cool.

Cari Corrigan: And then they take you out into the field, you [00:15:30] use the snow mobiles to search on this bare ice, like this, or you may walk around in glacial moraines, where there are a lot of terrestrial rocks that you're actually trying to find the meteorites that are sitting in between all of those rocks.

Maggy Benson: What a fascinating trip that must be.

Cari Corrigan: It is, yeah. It's a little bit lonely but it's an amazing experience.

Maggy Benson: Amara [00:15:48] has a really great question that comes in by video about- that really plays well into this conversation about Antarctica.

Cari Corrigan: OK, perfect.

Maggy Benson: Let's have a look.

Cari Corrigan: Yeah.

Amara: Hi, I'm Amara and I was wondering if keeping a meteorite [00:16:00] in the cold helps preserve it.

Cari Corrigan: It absolutely does. So if you think about exposing a rock, any old rock, to water or if you put your bike outside, right? What happens to your bike if you put it out and leave it out there in the rain, it rusts. So keeping rocks in Antarctica, basically where that water is frozen, it can't interact with the rocks there, where it could here, for example.

Cari Corrigan: So, keeping them cold and keeping them from rusting is one of the great reasons to keep them there.

Maggy Benson: So meteorites can get rusty?

Cari Corrigan: They can. Actually, they're made [00:16:30] out of iron. They have a lot of iron metal in there and if you look at the one that's showing the screen right now, you can see there's some rusty places here and this one has a lot of rust in it. Just in these little pockets where it's starting to form. But this one, that just came back, the larger one behind, just came back from Antarctica maybe two years ago, and it's got a nice clean surface without much rust on it at all.

Maggy Benson: Cari, there's a video segment that shows how you keep these meteorites safe from rusting [00:17:00] here at the Smithsonian. Let's show our viewers.

Cari Corrigan: OK.

Cari Corrigan: I'm Cari Corrigan

Linda Welzenbach: I'm Linda Welzenbach and we are in the gowning area that precedes the clean room.

Linda Welzenbach: Cari and I are sitting in the Antarctic meteorite storage facility in Suitland, Maryland. [00:17:30] This facility houses all the Antarctic meteorites that are collected in the US/Antarctic Meteorite Program.

Cari Corrigan: We have about 15,000 Antarctic meteorites.

Linda Welzenbach: This facility is clean room, which is why we're dressed so strangely and it is meant to essentially element contaminates that may interact with a meteorite.

Cari Corrigan: This is one of our dry nitrogen storage cabinets, and you can see they have these funny gloves that stick out and they stick out because there is pressurized nitrogen gas inside of here.

Cari Corrigan: And this is what we use to store our meteorites. And the reason [00:18:00] that they're in dry nitrogen is so that they don't get exposed to moisture and also they're in these cabinets so they aren't contaminated by anything.

Cari Corrigan: Keeping things like this and the meteorites that we have in this kind of storage, actually preserves them for that when the instrumentation gets better and better, 30, 40, 50, 100 years from now, we can make even more detailed measurements than we can now. But that the meteorites will still be fresh as they were when they came off the ice.

Linda Welzenbach: In the last 30 years, [00:18:30] we've collected more new types of meteorites, including finding meteorites on the moon and Mars, then we have in the last 500 years.

Maggy Benson: Cari, it's really interesting that you keep those meteorites fresh and I understand that you keep them fresh all the way from their trip to Antarctica, all the way here, to the Smithsonian. How do you do that?

Cari Corrigan: Basically, once we pick up a meteorite, we never touch it with our hands if we can help it. We put it in a bag and we wrap it in a bag and then we put it into cold storage, so that it stays frozen, basically [00:19:00] just stays outside in a box in Antarctica, because it's not going to melt. Then it goes on a freezer ship, and a freezer truck until it gets to the lab where it's then thawed out.

Cari Corrigan: We're doing that to keep (away) the different organic materials, and keep it from rusting, so keep all of that stuff from getting exposed to the atmosphere and warming up.

Maggy Benson: What kind of things in the meteorites are you actually trying to preserve, for future study?

Cari Corrigan: That's a really good question. Some of the stuff we may not even know yet. Like, recently people [00:19:30] have found amino acids in meteorites. So we're keeping our organics off of the rocks for one thing but, we're also looking at, for example, I brought a rock here from Mars. This is Martian meteorite called Allan Hills 84001 and it's a four billion year old piece of igneous rock.

Maggy Benson: Four billion?

Cari Corrigan: Yeah, four billion. Only four.

Maggy Benson: Wow, it's really old.

Cari Corrigan: It's a really old rock from Mars, but it contains in it, carbonate minerals and carbonate minerals require water to form. [00:20:00] So this is our hand sample evidence that there actually has been water on Mars. This would've formed before, you know, all of the collision history on the moon, for example. The carbonates we think are actually younger than that, but the rock itself is four billion years old.

Maggy Benson: You know this rock is special because it comes in its very own case.

Cari Corrigan: Yes.

Maggy Benson: But you said that it's igneous.

Cari Corrigan: Yes.

Maggy Benson: And that it contains evidence of liquid water.

Cari Corrigan: Right.

Maggy Benson: And sitting here on Earth, we have igneous rocks, [00:20:30] we have liquid water.

Cari Corrigan: Right.

Maggy Benson: Does that mean that early Mars could've been a lot like Earth?

Cari Corrigan: Yeah, so these are some of the clues. This is our rock clue, right? The one that we can actually hold in our hand. But we also have spacecraft that are up there taking pictures of the surface of Mars and we're using clues like the gullies you can see here, and other layering in places that look like water created those features.

Cari Corrigan: We can use all of that evidence together and looking just at the surface of Mars, you can see the lowlands. There may [00:21:00] have been areas that were filled with water. It was probably a much warmer, much wetter place in the past.

Maggy Benson: How do you know definitively, for sure that this rock came from Mars in the first place?

Cari Corrigan: That's another really good question. For a long time we had these rocks, and until we actually sent spacecraft to these planets, to Mars, to other planets we did not know that any of the meteorites that we had come from anywhere else for sure. So the Viking Landers went to Mars in the 1970s and they measured the composition of the atmosphere [00:21:30] and then later in the '80s we have another type of igneous rock from Mars, but this one's only about half a billion years old. So 150 million to 500 million years old.

Cari Corrigan: But there are melt pockets, so we're talking about melted rocks again. And there are pockets in there that are melted that actually trap, when they melt and then cool really quickly, they trap the atmosphere that is around them. Some scientists were able to measure the composition of that trapped atmosphere [00:22:00] and compare it to the measurements that the Viking Landers made of the atmosphere, and it's a one to one match. You can see the melt pockets in this rock from the picture that's showing.

Maggy Benson: That's really fascinating and, I mean, this rock is relatively young in comparison to that other one that you showed us, Allan Hills.

Cari Corrigan: Yes. Much younger, so that tells us there were actually volcanoes that were active on Mars, recently.

Maggy Benson: That's pretty interesting.

Cari Corrigan: Yeah.

Maggy Benson: So do you have any other meteorites from Mars to be [00:22:30] able to help you, kind of piece together the story?

Cari Corrigan: We do. I brought one more. So this actually fits, sort of, in the history in between. This is called Nakhla and it's one of a group of meteorites called Nakhlites, because this was the first one of its type. These are only a billion years old. Older than the shergottites, that's this other one that we used to figure out they were from Mars. But much, much young than Allan Hills 84001 at four billion years.

Cari Corrigan: Nakhlites are beautiful underneath the microscope, which is part of the reason why I like to study them.

Maggy Benson: They really are.

Cari Corrigan: Yeah, these are more thin-sectioned microscope [00:23:00] images that are showing. This one is a billion years old, but we know it's igneous also. Except instead of being a lava flow, it would've formed from probably deeper below the surface. So we can look at other types of igneous rocks on the surface of Mars.

Maggy Benson: So all of these different meteorites, especially the Mars ones, are helping you really piece together the history of Mars. But even the solar system origins.

Cari Corrigan: Right, because every one of these had to have come off Mars during an impact, right? We know this formed [00:23:30] deep, but it had to have somehow gotten off Mars. So either it was a really big impact that knocked it off, or it was exposed to lots of different impacts.

Maggy Benson: Yeah.

Cari Corrigan: As you can see in this picture, there's a picture of this deeper rock maybe. It could've been at the bottom of that packet of rocks.

Maggy Benson: Very cool.

Cari Corrigan: Yeah.

Maggy Benson: Cari thank you so much for sharing a little bit about your work on meteorites here at the Smithsonian.

Cari Corrigan: Yeah, you're welcome.

Maggy Benson: We have a lot of student questions.

Cari Corrigan: Great.

Maggy Benson: Let's try to get to as many as we can.

Cari Corrigan: OK, sure.

Maggy Benson: The first one comes from Draco. What do the minerals tell us about the meteorites?

Cari Corrigan: So the minerals within the meteorites. [00:24:00] A lot of times we can look at individual minerals and figure out the temperatures for example, or the pressures when these were formed. Individual minerals form at specific temperatures, so it can tell us some of the conditions when they formed. Plus it can tell us the composition of what was around. So we can today, these are made up of iron, magnesium and silicon. Or these are made up of calcium, and aluminum, sodium and silicon, for example.

Maggy Benson: This one is from Mrs. West's class, what is the biggest meteorite [00:24:30] on file?

Cari Corrigan: That's a very good question. The largest meteorite that we have on Earth is called Hoba. And it's so big that it's still sitting in the hole it made when it fell in Namibia, which is in Southern Africa.

Maggy Benson: We have an audio question this time.

Cari Corrigan: OK.

Maggy Benson: Coming in by videos, let's have a look.

Cari Corrigan: Sure.

Crystal: Hi, my name is Crystal and I just wanted to know if you found anything recently in the slices of the meteorite that you are studying.

Cari Corrigan: That's [00:25:00] a great question, Crystal and since most of my research is about impact then, the answer is yes, we have. We have been slicing meteorites open and you can see, here's one of them. That's just slicing it up like a loaf of bread with a saw, and they're actually if you look at the next image, we have circled some of the things we think might be impact melts that we're looking for in one of these slabs.

Cari Corrigan: And then we would take those and make the microscope sections of them. So this is sort of the next place we would start.

Maggy Benson: So [00:25:30] you make new discoveries all the time.

Cari Corrigan: We do. Yeah, it's fun.

Maggy Benson: This one comes from Magnus.

Cari Corrigan: OK.

Maggy Benson: Did all of the meteorites form within the solar system?

Cari Corrigan: As far as we know, all of the meteorites that we have formed in our solar system. There may be pieces, like I was saying, we have some pre-solar grains in some of the meteorites that may have formed outside of our solar system, but for the most part we think that they have all come from inside our solar system.

Maggy Benson: KLO Middle School asks, what is the biggest diamond found in a meteorite?

Cari Corrigan: All right, okay. Wow, that is a good question. [00:26:00] they are not very big, so it is not something that you would break open the meteorite and say, "Let's make a ring out of this", for example. They are tiny, tiny little things, like microns or maybe, maybe up to a millimeter across. Not big.

Maggy Benson: Alexandra asks, are there minerals in meteorites that are not found on Earth?

Cari Corrigan: There are a few, yes. We've found- and not that many, not as many as you'd expect because all of the elements are the same [00:26:30] but the conditions are different. So the conditions in space are a little bit different enough, that there are some minerals that do form on the asteroids that we don't have. A lot of times, once you bring those minerals onto the Earth's surface and expose them to Earth-like conditions, the minerals will actually transform into a different mineral that's stable on our conditions.

Maggy Benson: KLO Middle wants to know, how long you've been doing this type of work?

Cari Corrigan: That's another really good question. I've worked here at the museum for about [00:27:00] eight years. Before that I was actually a post-doc here, so total of about 10 years. I started studying meteorites when I was an undergraduate, purely by accident, actually.

Maggy Benson: Did you ever think that you were going to be a geologist? Let alone, study meteorites?

Cari Corrigan: Probably not when I was in middle school, for example. I barely even knew what a meteorite was at that point and I certainly didn't know you could have a job where you studied them or worked in a museum taking care of them.

Maggy Benson: Or went to Antarctica to collect them.

Cari Corrigan: Never, no. And to be fair, that's part of what drew me in to studying meteorites [00:27:30] is actually, wanting to. Then I ended up with an internship at Johnson Space Center where I was an intern and I studied the meteorites and met a lot of people including my PhD advisor and my boss, at that time.

Maggy Benson: Now, do you take interns?

Cari Corrigan: I do. I've had probably eight or nine interns since I started working here. It's a really fun way that I learn new things, while also teaching other people things.

Maggy Benson: Very cool.

Maggy Benson: Cari thank you so much for helping us understand a little bit more about meteorites and your work here at the Smithsonian.

Cari Corrigan: Yeah, thank you so much [00:28:00] for having me. It's been so fun.

Maggy Benson: Can you tell our viewers where they can learn a little bit more, if they're interested in getting involved in this kind of thing?

Cari Corrigan: Yep, so you can start with the Division of Meteorites and the Mineral Sciences Department here at the museum where we have a website. NASA has some fantastic information about meteorites on their website and you can get involved by just going to your local geology club, many of those have kids clubs and you can get involved in that way.

Maggy Benson: Thank you so much.

Cari Corrigan: Yes, thank you.

Maggy Benson: And thank you viewers for tuning in today and asking such great questions.

Maggy Benson: This is it for our show [00:28:30] today, but if you want to see this program again, you can check it out at qrius.si.edu where there are also some cool links and teaching resources.

Maggy Benson: That's it for this season of Science How? but we'll be back next school year. Have a great summer.