[music]

0:00:04.7 Sarah Crespi: This is the Science Podcast for March 17th 2023. I'm Sarah Crespi. First up this week, an active volcano on Venus. Staff writer Paul Voosen joins us to discuss finding a fresh lava flow in 30-year-old data. Next up, a commentary on a concerning increase in early onset colon cancer, researcher Kimmie Ng is here to talk about how these early colon cancers, those diagnosed before age 50, are different from late onset colon cancers. And we also talk about what needs to be learned about diet, environment and genetics to better understand this condition. Now, we have Paul Voosen, he's a staff writer for our news team, we're gonna talk about volcanoes on Venus. Hi, Paul.

0:00:51.5 Paul Voosen: Hello.

0:00:52.8 SC: This is a cool finding for two reasons at minimum. First of all, the way they found out this information, and of course volcanoes always cool. There's no mission at Venus right now, and as far as I can tell, telescopes can't see the surface. Why are we just hearing about volcanic activity now in 2023 when it's been a long time since anybody's visited.

0:01:17.0 PV: Some telescopes can see the surface.

0:01:19.4 SC: Really?

0:01:20.2 PV: Radio telescopes like the Arecibo could, but very, very coarsely so very difficult to detect changes over time, but yeah. This is data from the Magellan mission that NASA sent to Venus. It departed Earth in the '80s, got there in the late '80s and then mapped the planet with radar for a couple of years before going kaput, but hidden in this data that used to be only accessible compressed on CD-ROMs was a sign of volcanic activity that people just didn't see before.

0:02:00.7 SC: So like 30 years ago, Magellan took several passes over the planet. In the data we have a very limited time series that takes sketchy before and after photos of certain points on the surface. What made researchers decide to look at these images at this point?

0:02:19.0 PV: A researcher told me it's really tedious to do this. Back in the days of Magellan, people were paid to try and search through this, but they're doing this with '90s era technology and it was just impossible for an individual to kind of flip back and forth, but we have these new missions coming up to Venus, including two NASA missions, and so one of the people work on it, Robert Herrick, he goes by Robbie thought, we're hoping with this much better radar to detect volcanic activity that we didn't see before, why not just go look through all of that all data again and just manually flip between these three cycles of images and see if anything looks different.

0:03:00.3 SC: Right. The Magellan mission went around the surface three times, but not everything was photographed or imaged three times, but they found pairs or triplets and said, "Well, are we seeing any differences between the first time the image was taken and the second time image was taken?" But even that even sounds complicated, but it's actually more complicated because the spacecraft wasn't always circling exactly the same path.

0:03:25.5 PV: Yeah, that's right. It was on this near polar orbit, so it was inclined just a few degrees. That meant when it was going down over the south pole, you need to be looking to the right to see it 'cause to the left is just like space. Hello, space. And for the second pass, the first pass was like their biggest mapping, the second pass they look the other way, the third pass only got 20% of the plan, those back left looking. When you have these two bigger passes, you're trying to look at things from the exact opposite angle, and there are not a lot of things in life that look exactly the same from one side versus the other, so to seeing the change is even harder.

0:04:06.3 SC: These images are not taken from the same angle, and they're taking about eight months apart, how are they able to see a change?

0:04:13.8 PV: The guy behind this, Robbie, he was aided by a large number of Zoom calls during the pandemic, where he was just doing the systematic search flipping back and forth. And he was just able to see a circular vent, so a circle, very simple shape only about two kilometers wide. And you looked in the other image and it kind of had deformed more an oval, four kilometers wide. Even then you might be like, "Oh, it just because of the change in angle or whatever," but a circle is such a simple thing that you can model what it should look like, knowing the kind of angle of the other one, and it just looks drastically different than what they actually saw, so that's kind of a pretty clear indicator. And this is in the area with Venus's tallest volcanoes kind of that... We knew there were volcanoes there, but just if they were doing anything or not or if there are 500 million years old. And so he targeted his search. After all of this, he had only searched 1.5% of the planet surface.

0:05:18.0 SC: Well, some people out there can help out if you wanna go to download this data.

0:05:23.4 PV: He's not gonna do it more, so it's wide open.

0:05:26.6 SC: He targeted places where there were volcanoes and this place where they saw a change was a volcano, is it surprising that they're active at this point?

0:05:34.4 PV: It's surprising, and it's not surprising. For some researchers, it's been surprising that they haven't seen it or they were just convinced that with better data, they will see it. There are reasons to think Venus should have volcanic activity, it's the same size as Earth. It probably didn't lose its heat a lot faster, same place in the solar system, roughly. And then there have been hints, especially in the past little over a decade of things that point out at possible volcanic activity like changes in sulfur in the atmosphere or anomalous little hot spots seen by a European orbiter that visited a decade ago, but nothing was really kind of not clear with your own eyes and could be poo-pooed away.

0:06:21.7 SC: Does it change anything about the kinds of research people wanna do at Venus or what people will be looking for in the future missions?

0:06:29.3 PV: They'll certainly be coming back to this spot where they are fairly certain they'll see fresh gorgeous lavas when researcher put it to me. And then once you have infer things about that

lava, you can study things about older lava, and that's also a gateway to the interior, the planet. It just helps when people are thinking, are there tectonics of some kind not plate tectonics, but the thing like pack ice or around these possible hot spots. It just helps further support the notion that this type of stuff is probably going, not all of it is necessarily going on, but that there's activity. Just that you're able to see this big change in eight months span. There aren't a lot of volcanoes like that making big changes like that in an eight month span on earth. Right? So this is an indicator that the activity level could be somewhat similar to earth, hard to say with just one, but just gives a big indication that Venus is alive.

0:07:30.4 SC: Yeah, and so that means the surface is changing, it might be different than the last visit in other places as well. Are they gonna be using the same kind of imagery techniques in upcoming missions that are going out in what? The 2030s?

0:07:43.1 PV: Yeah. They should be arriving in early 2030s I believe. They'll be using a much more advanced radar, so stuff that's probably what's happening during the Magellan, just invisible with the kind of resolution of the radar will be plain to see. And then one of the missions will also be sending a radar kind of a probe that will plunge through the atmosphere and get down to the surface where it'll then crap out shortly because Venus destroys all things.

0:08:12.3 SC: I was gonna say. I was gonna say is it gonna just fizzle out as soon as it gets close to the surface?

0:08:17.5 PV: Yeah. It's gonna collect a very dear data, and people are working on high temperature electronics for the Venus surface, and we had a feature on that five years ago, but it's not there yet.

0:08:28.7 SC: That's great. Are there other archives like this where the data has been sitting around on CD-ROMs or even older types of recordings and now they're being placed in repositories that people can access and investigate?

0:08:42.0 PV: It's been there, it's not like it just appeared. It's been available. It's just no one was being paid to do this or had proposed to do this. And I don't know if anyone would have funded them to do this if they had proposed to do it, this was done on Robbie's free time, the researcher, they are always kind of especially with... This is a technique that would be hard to train for machine learning...

0:09:02.1 SC: Interesting.

0:09:03.6 PV: For various reasons, Robbie thinks, but there's all sorts of data lurking out there that could be exploited.

0:09:10.9 SC: Okay, thank you so much, Paul.

0:09:13.3 PV: Thank you.

0:09:14.5 SC: Paul Voosen is a staff writer for Science. You can find a link to the story we discussed and the related paper at science.org/podcast. Stay tuned. Up next, Kimmie Ng and I discuss increase in early onset colon cancer.

[music]

0:09:38.6 SC: There has been concerning rise in early onset colon cancer cases here in the US and in some other very rich countries. Kimmie Ng and colleagues wrote a commentary piece this week at Science about how this early onset colon cancer is different from what is seen with late onset and more about what we need to learn on diet, environment and genetics to better understand and treat this early onset colon cancer. Hi, Kimmie.

0:10:03.3 Kimmie Ng: How are you? Thank you for having me.

0:10:07.3 SC: Thank you so much for coming. One thing I wanna get out of the way first is, how are we defining early onset colon cancer?

0:10:14.6 KN: Early onset colon cancer is defined as a colon or rectal cancer diagnosis that occurs at an age younger than 50. And that is predominantly because historically, the screening age where people at average risk, the colorectal cancer starts at age 50.

0:10:32.2 SC: Is there any chance that it's because people are just opting into being screened or trying to get more information about their bodies and we're just seeing an increase in screening at these younger ages?

0:10:41.3 KN: That is a great question, and that is something that has been looked into. And unfortunately, that is actually not the explanation for the rise in colorectal cancer cases in young people. If it were purely a screening effect, you would expect that most of the cases diagnosed in young people would be of early stage because the ones detected by screening are generally the ones that are caught before symptoms start or when they're earlier stages, but in fact, what we're seeing is the opposite. The cancers that are being diagnosed in people under age 50 are for the most part of advanced stage disease.

0:11:15.5 SC: Are there any other differences between what we see in people who have this early onset versus late onset?

0:11:22.2 KN: There are several differences that are pretty noticeable. One is that most of the cancer is diagnosed in people under the age of 50 tend to occur on the left side of the colon or in the rectum. This is distinct from cases that occur in older individuals. We also see that many of them are more poorly differentiated than those that are being diagnosed in older people. And again, the advanced stage at diagnosis is one of the largest distinct differences that we see between younger patients and older patients.

0:11:54.2 SC: This left right difference, is that relate to the way the colon functions? What are some possible suggestions from what that might be going on?

0:12:03.4 KN: We actually don't know right now why it is that left-sided cancers and rectal cancers are the majority of young onset colorectal cancer cases. We do know that the right side of the colon and on the left side of the colon are extremely different. They have distinct embryological origins, they have different functions, and we also know that the gut microbiota differ according to the location in the colon.

0:12:28.6 SC: That's so interesting.

0:12:29.1 KN: Yeah. We also know that somatic mutations are also different between the different sides of the colon, including responses to treatment and prognosis. And so we still need to do a lot of work to better understand why it is that the left side of cancers in particular are rising.

0:12:46.7 SC: Now, you said something about a difference in differentiation between the left and right-sided cancers, can you talk a little bit more about what that means in terms of cancer.

0:12:55.8 KN: Poorly differentiated cancers are traditionally more aggressive in behavior, and unfortunately, many studies do report that those types of cancers are being seen more commonly in young patients as opposed to older patients.

0:13:11.5 SC: We should put this in the context that overall, colon cancer incidents and death is decreasing for example, in the US, but even with that going on, we're still seeing an increase in these cancers in young people.

0:13:23.4 KN: Yes. And I really think it's the successes of screaming programs and improved treatments over time that have led to declines in incidence of mortality in individuals who are older and who are being screened for colorectal cancer, but even those improvements are starting to slow down a bit. Largely because of this opposing rise in colorectal cancer in young people.

0:13:46.4 SC: Do we know anything about the causes of these cancers being different?

0:13:50.3 KN: Colorectal cancer is probably the one cancer that is most strongly linked to diet and lifestyle, and we do know that several diet and lifestyle factors that are known to be associated with a higher risk of colorectal cancer no matter what age you are do seem to be rising over the past few decades that seem to have parallel the rise in young onset colorectal cancer, with the one factor that has been most looked at being obesity. Certainly obesity rates have been rising, and we do find in some prospective cohort studies that we've done, that people who do report higher rates of obesity do seem to have a higher risk of developing colon cancer at an age under 50.

0:14:31.6 SC: What about environmental risk? Each cohort, each generation is exposed to different things in their home and the environment and the food that they eat, is there some understanding of how that might be playing in here?

0:14:44.9 KN: Absolutely, the effect of the rise in young onset colorectal cancer very much follows what we call a birth cohort effect. It is something that is affecting generation by generation, where

the people born in 1990 have significantly higher rate of developing colorectal cancer compared to individuals born in 1950.

0:15:05.0 KN: And we do think it's environmental exposures. What exactly? We don't know. Again, we've looked at obesity, we've also looked at sedentary behavior, higher consumption of sugar, sweet and beverages, lower vitamin D levels, and they all do seem to be associated with a higher risk, but I don't think that that is all that explains what happening.

0:15:26.8 SC: All these things are rising at the same time, it's gonna be hard to pick it out. What kinds of studies do you think would help better understand the causality here?

0:15:36.7 KN: Yes. Colorectal cancer is an extremely complex disease with many interrelated factors that are likely interacting with each other and contributing together towards this phenomenon that we are seeing. And so what I do think we need are large prospective cohorts that have comprehensive collection of not just survival and treatment and clinical pathologic data, but also validated diet and lifestyle information, information on early life exposures. Because we do think that many of these environmental exposures are probably acting over a long period of time to then subsequently influence the risk of developing this disease in young adulthood.

0:16:17.5 KN: We also need comprehensive collection of biospecimens. We need tumor samples, we need blood samples, we need stool samples to look at the microbiome, because we do think that many of these environmental exposures that may be contributing to this rise in young onset colorectal cancer may perhaps be affecting our microbiome for our immune systems that may be leading to this rise in cancers in younger people. Comprehensive collection of biospecimens with integrated clinical and diet lifestyle data are really necessary to help us figure out what the causes of this are.

0:16:55.9 SC: What about treatment for this? Is the early onset cancer responsive to the same treatments as the late onset?

0:17:04.3 KN: Currently, I don't think we know enough about what the biology is that's different about younger one colorectal cancer compared to older onset to lead to any differences in treatment. We have found some preliminary differences in somatic genomic alterations between younger or patients and older patients, but many of those go away when you adjust for the sightedness of the primary tumor. Right now, younger patients are treated similarly to older patients, but what we do know is that even though younger patients have better performance status at baseline, so better health overall, and they have fewer side effects to treatment and receive more treatment, their survival is not correspondingly longer or better than an older onset patients.

0:17:49.6 SC: And that's even if you control for when it was caught, when it was detected in the phase of the disease?

0:17:54.2 KN: Correct, yes. When you look at stage four patients, specifically in that group, younger patients despite getting more treatment, do not seem to be doing better than older patients.

0:18:04.8 SC: Can you give us some quantities here? How common is it for someone under 50 right now to get early onset colon cancer?

0:18:12.4 KN: It is important to note that the vast majority of colorectal cancers are still happening in older individuals, and the strongest risk is still occurring in people who are older, but in the latest statistics from the American Cancer Society, about 13% of all colorectal cancers will now be diagnosed in people under the age of 50, and about 7% of all colorectal cancer deaths will occur in young people. And this is significantly higher than statistics from a couple of decades ago.

0:18:44.5 SC: And what's the incident? Do you know?

0:18:46.7 KN: It's about almost 20,000 new cases of colorectal cancer in people under the age of 50 are expected for 2023, and almost 30,800 deaths will be occurring in young people.

0:19:00.8 SC: And we are talking about the US here, where else has this been seen to be on the rise?

0:19:04.1 KN: We are seeing extremely similar trends in western countries and those who have national screening programs where people who are being screened over the age of 50, the incidents and mortality of colorectal cancer is steadily declining much like the US. But in people under the age of 50, there has been a steady rise in young onset colorectal cancer. And actually this is being seen around the globe, even in countries that are of lower socio-economic status, who are now seeing westernization of lifestyles, we are now also starting to see a rise in young onset colorectal cancer in those countries.

0:19:40.6 SC: In addition to figuring out what's happening, what the causes are, how to treat it, is there also a possibility of moving screening to a younger age?

0:19:48.1 KN: Yes, we do think that earlier age of screening will significantly help to prevent young onset colorectal cancer as well as detect cancers earlier in young people. And actually in the United States, the United States Preventive Services Task Force recently did lower their recommendations from age 50 down to 45. This will have a significant impact because about 40% of all young onset colorectal cancers do happen in that age range, but this is not helping the 20-year-olds and 30-year-olds that we are increasingly seeing in clinic with colorectal cancer. Further work needs to be done to understand the underlying biology and risk factors so we can identify them for earlier screening.

0:20:32.2 SC: Alright, thank you so much, Kimmie.

0:20:34.6 KN: Thank you so much for having me.

0:20:36.9 SC: Kimmie Ng is the director of the Young Onset Colorectal Cancer Center at the Dana-Farber Cancer Institute, and an associate professor of medicine at Harvard Medical School. You can find a link to the commentary piece that we discussed at science.org/podcast.

And that concludes this edition of the Science Podcast. If you have any comments or suggestions, write to us at sciencepodcast@aaas.org. You can listen to this show on the Science website, science.org/podcast or search for Science Magazine on any podcasting app. This show was edited by me, Sarah Crespi and Kevin McClain with production help from Prodigy. Jeffrey Cook, composed the music. On behalf of Science and its publisher, AAAS, thanks for joining us.