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Seneca Lake Pure Waters Association: For our latest deep dive, tonight we're going to be looking at the Seneca Drums. It is a mystery that has been emanating from Seneca Lake for hundreds, if not thousands of years, and is relatively unique.

Seneca Lake Pure Waters Association: to, the geology of Seneca Lake as well.

Seneca Lake Pure Waters Association: And we have Professor Jed Sparks from Cornell here to talk about the theories behind it, and the processes that could potentially fuel

Seneca Lake Pure Waters Association: this incredibly, strange, and mysterious, phenomenon. So, Jed, if you wouldn't mind taking over, thank you very much.

Jed Sparks: Thanks a lot, Ben. Thanks to all of you for taking some time out of your day to listen to me.

Jed Sparks: I'm going to be talking about the Seneca Drums, both from kind of the legends and, you know, reporting and the history, and then some of the science of what we think it is, and some of the things that we're doing to better understand it. I'm, of course, not doing this alone.

Jed Sparks: I'm working with some other folks,

Jed Sparks: all the way on the left, the guy with the rope in his hand is Ben Uveges. He's my postdoc at,

Jed Sparks: Cornell, and then the other two people are Aaron Hassiter and Jim Morin, and they are SUNY ESF, and all of us together have been, doing this, and interesting, it's all... it's not driven by...

Jed Sparks: you know, huge amounts of money being given to us or anything like that. We're mostly doing it just because we think it's super, super cool, like I think most of you probably do. I'm not originally from the Finger Lakes, but I've been here for 25 years, and when you get here, it's kind of... it's one of those things you hear about, the Seneca Drums, you know.

Jed Sparks: staff at Cornell will talk about hearing it as a kid. It's... it's just this very cool, community-level kind of thing.

Jed Sparks: If you go back in time, the first mentions of, booming noises from Seneca Lake are actually from the Haudenosaunee, so the Seneca peoples. And the legend is that there was a warrior who trespassed on, sacred hunting grounds, and for his punishment, this loud, booming sound is... is holding him on those hunting grounds for all eternity.

Jed Sparks: If you come up to, sort of, the Civil War period, or the Revolutionary War period, in... I found this great book, Ghosts of the Revolutionary War, and one of those ghost stories is that the drum in Seneca Lake is the drum of a revolutionary soldier trying to... to find his regiment.

Jed Sparks: It really gains national popularity when James Fenny Moore Cooper writes a short story in 1850 called The Lake Drum, and he describes this deep, hollow, distant, and imposing explosion that resembles artillery blasts, yet defy conventional scientific explanation.

Jed Sparks: If you go out, it's one of those interesting things where, if you guys are local, it's one of those things that kind of everybody's heard, but you hardly find anyone who's seen it. Liam Kennedy from the New York Times did find someone who saw it, and his name was Jim Mead, and he talked about leaning over the side of his boat and seeing something in the water about a few feet away, it was a big bubble.

Jed Sparks: And when it...

Jed Sparks: came up through the surface, it shot from the... and it made this low, booming sound that he found to be unbelievably loud. So there are...

Jed Sparks: Anecdotal people who have reported stuff.

Jed Sparks: If you go way back in time, there are great stories in local newspapers, and this is the Buffalo Times, which I don't think even exists anymore, but in 1903, William Prosser reported to the paper that he was lighting his pipe

Jed Sparks: And there was a flash and a deafening roar, and it blew him and his boat through the air onto the shore.

Jed Sparks: So, pretty impressive.

Jed Sparks: If we take a big global view, lots of gases come out of lakes all over the world, so it... the part about a gas coming out of a lake isn't anything new or surprising, but one that makes a big loud sound is.

Jed Sparks: The reason that that happens is way deep in a lake, down in the sediments, in the muck at the bottom of the lake, there are chemical reactions that can happen that

Jed Sparks: form a gas. This example that I have up here right here is basically the formation of methane, or natural gas, and that will happen deep in the lake sediments, and then that gas will either diffuse, or it can... if you look over here on the left side, this crazy word, ebullition, what that means is there's a bubble that forms down in these sediments, and it all comes out at once, and it comes out as a bubble.

Jed Sparks: And you could see that if you're ever walking through a wetland or a swamp or anything, you see some bubbles coming up, you're wondering what it is. It's... it can be methane, it can be sulfur dioxide, but they're these gases that are coming out as a bubble.

Jed Sparks: Interestingly, It's... this is a great quote from 1934.

Jed Sparks: the direction of the guns or the drums is always vague, it's like the foot of a rainbow, they're always somewhere else. And when the observer moves the locality from which they seem to come, it disappears. And this is in the Geneva Times in 1934, so it's very much something that people hear, but they rarely see.

Jed Sparks: the first thing that got us interested in Seneca Lake was Middlebury College did a study of what's called bathymetry, and bathymetry is you use equipment, and you send sonar down to the bottom of a lake, and you map what its bottom looks like.

Jed Sparks: And this figure is the result of that bathymetry, and this is the southern end of Seneca Lake, this whole region.

Jed Sparks: And it's covered with pockmarks. It kind of resembles the surface of the moon when you look at it, so it's like there's been impacts, or there's been eruptions, or something has happened there. And that really got us thinking about, well.

Jed Sparks: maybe these are the source of the Seneca Drums, that these are the bubble places, where the bubbles came out and where they erupted and went to the surface.

Jed Sparks: Things like gases coming out pretty explosively, you can find them around the world. This is from the Baltic Sea.

Jed Sparks: And they basically used echo sonar to look at the bottom of the Baltic Sea, and you see this big plume that comes out, and this is methane.

Jed Sparks: And it's continuously leaking methane into the Baltic Sea. So one possibility is that Seneca Lake does something similar.

Jed Sparks: So, basically, there's the possibility that down in this mud, in the lake, they're forming methane, which is natural gas, and then it bursts as a one large gas bubble.

Jed Sparks: Bill Arnsbrock, proposed this in 1971. He didn't do any measurements, but he thought this could be a possibility, and he thought there were two different ways it could happen.

Jed Sparks: One would be that the microbes way down in the sediment produce this bubble, then it sits there, and then eventually it bursts through the surface and comes

up. The other one that he talked about was that the location and the geology of Seneca Lake is it does intersect with shale layers that contain natural gas.

Jed Sparks: And so another possibility is, this is an ancient bit of...

Jed Sparks: drawing from an old textbook, but this is Seneca Lake.

Jed Sparks: And then these are all the different shale layers that come down, and the Hamilton and the Marcellus intersect the bottom of Seneca Lake.

Jed Sparks: So, the other possibility is it isn't being produced here, it's actually leaking from the Marcellus. So, the Marcellus Shale can leak natural gas into these lower layers, it sits in these muck layers for a while, and then it eventually erupts.

Jed Sparks: So what we set out to do was to look at some of these pockmarks.

Jed Sparks: And we... there's a lot of them, and we ended up selecting 14 pockmarks. And in those pockmarks, we measured the methane concentration inside the pockmark and outside the pockmark. So, if there's methane continuously leaking from this, we'd expect the ones on the inside to be higher.

Jed Sparks: Okay?

Jed Sparks: And so, we did this, 3 inside, 3 outside, and 14 pockmarks.

Jed Sparks: We did this with what's called a Niskin bottle, so this is Erin, and she's holding the Niskin bottle right here, and it's a pretty clever device. These endpoints come out, and you have it in the firing position, and it holds it with a big elastic band.

Jed Sparks: And you lower it down with the rope, follow it with sonar, get it right where you want it, a meter off the bottom, and then you run a messenger, which is a large lead weight, down the rope, and it goes and it hits the trigger, and it releases this rubber band, and it closes, so it's collecting water from that depth, exactly where you want it to be.

Jed Sparks: And then you have to pull it back up. This is a... this is kind of a low-tech operation, so here's where you torture the postdoc in your lab to pull up

Jed Sparks: 600 feet of line to retrieve this, Niskin bottle, and then we sample the water from within that Niskin bottle. This is Aaron pulling it up.

Jed Sparks: And you can have a nice little video of how much fun they had pulling miles and miles of rope, up through the boat.

Jed Sparks: And then you basically take that water, and you put it into a vial so that you can equilibrate the gas that's in that water with the gas that's in the air that you add to the water.

Jed Sparks: And then my job was to do the equilibration. I'm in the worst shape and the oldest of everyone, so I got to sit there and shake all of the samples until they were equilibrated.

Jed Sparks: And then we take these back to either SUNY ESF or Cornell, and we measure them on a couple different instruments, and we get two pieces of information. One is the concentration of the methane, which lets you know is it higher or lower inside of these pockmarks.

Jed Sparks: And then the second measurement is what's called a stable isotope ratio, and that's a chemical measurement that's unique to different sources of things, like methane.

Jed Sparks: So, in other words, we could tell the difference between a methane molecule that was produced in the sediments versus a methane molecule that was produced a long time ago in the Marcellus Shale and is leaking out.

Jed Sparks: This is the first piece of data that we got, so to orient you to what you're looking at, is on the bottom are the 14 pockmarks that we looked at, and on the y-axis here is the methane concentration.

Jed Sparks: the kind of... Orangey bar is what is the concentration outside, and the blue bar is what's inside.

Jed Sparks: And basically what this is showing you is there's no real difference inside and outside. So at the time we were making a measurement, there's no... you don't detect any higher level of methane inside. So it doesn't look like there's a continuous source of methane.

Jed Sparks: Secondly, the reason we were interested in that isotope number is because of this figure, and that's because this fossil fuel number right here,

Jed Sparks: is what we call lighter. It tends to be a more negative isotope ratio, and it's indicative of something that's coming from fossil fuel. And the other one is coming from... here, it's labeled as wetlands.

Jed Sparks: Now, what's unfortunate for us is we tend to fall right in the middle.

Jed Sparks: So these are all those 14 different measurements that we made, and it all... the mean of all these is about a negative 50, which means it's perfectly in between the

Jed Sparks: What could be produced by methanogenesis in the sediments versus methane being leaked from the shale.

Jed Sparks: All that's to say is our initial attempts is what we figured out is what it's not. So, the, Seneca Drums are not a continuous leaking source of methane to the lake.

Jed Sparks: So what that means is that it's not a continuous sort of process. So it's got to be some kind of ephemeral pressure builds up, forms a bubble, and then there's a pop.

Jed Sparks: From the bottom of the lake, which then propagates that bubble up through the water column and erupts from the surface.

Jed Sparks: Unfortunately for us.

Jed Sparks: it's really difficult to make that kind of measurement, because you don't know when it's going to happen, or what can you measure, and I'll get to what we're doing, to try and solve that in the next slide.

Jed Sparks: So, by just pure luck.

Jed Sparks: This is a map of not Seneca Lake, but Cayuga Lake.

Jed Sparks: The Cornell campus is right down here on the southern end, and this red star right here is if any of you have heard of the Kubo. The Kubo is a large drilling site that Cornell is doing to test whether or not they can heat the campus with geothermal heat.

Jed Sparks: Now, one of the concerns with this was, well, is it going to have any effects on the stability of the ground? Because it's a very deep hole. And all of these white triangles

Jed Sparks: Our seismic equipment that measures... these are the things you use to measure earthquakes, except they're very, very sensitive to small events.

Jed Sparks: And these are the local magnitudes, these are all really, really small magnitude events, and these are the cumulative events. And what was surprising to these people was that you didn't have any

Jed Sparks: seismic events around the Kubo Hole, but you had a ton inside of Cayuga Lake.

Jed Sparks: At first, they look, this red line's right here, this is the salt mine, if you're familiar with it in Cayo Lake, and some salt mining activity could result in these, but you have all of this in the southern part of the lake, in exactly the same sort of position that's in Seneca.

Jed Sparks: that has these seismic events. And so these people called me and said, hey, we've been unable to explain why we have these small seismic events in Southern Cayuga Lake. Do you think it could be

Jed Sparks: the same phenomenon in Seneca Lake.

Jed Sparks: And so what we've done now is, in collaboration with a guy named Jeff Avers, he's in geology at Cornell, we've now installed each of these squares as a seismic instrument around the south end of,

Jed Sparks: Seneca Lake. And so these are monitoring, you know, you can... you pick up quarry blasts, you pick up other things in the region, and we're trying to narrow in on, are we listening to the drums when... when they go off?

Jed Sparks: One thing we need to kind of do is figure out

Jed Sparks: How do we know what a drum event would look like?

Jed Sparks: And that's gonna come down to this third bullet point right here, is our next phase, which we're gonna do in the next month, is we're gonna take air cannons to the bottom of Seneca Lake.

Jed Sparks: and release a bubble of air ourselves. And at the same time, we'll be able to watch the seismic instrumentation and look what... what would a bubble that erupts from the bottom of the lake sound like?

Jed Sparks: If it erupts and then goes all the way to surface and, makes a booming sound.

Jed Sparks: In addition, other things we're doing is continuing seismic monitoring in Seneca Lake, and then on the more chemistry side, we're going to take sediment cores from the bottom of the lake and

Jed Sparks: When things like methanogenesis happen, when methane is made, it leaves behind chemical clues that it has been made. So we'll be able to look at that.

Jed Sparks: And then we're trying to expand this to Cayuga Lake. I took a quick look at all the bathymetry studies I could find for the Finger Lakes, and in this region, where it kind of intersects with the Marcellus and Hamilton Shale, there tend to be pockmarks. They don't tend to be as many as are in Seneca Lake, but I've seen them on the bottom of Skinny Atlas, and I've seen them on the bottom of other lakes, and we'd really love to see if

Jed Sparks: Is this true for Cayuga Lake as well? Is it common all across the Finger Lakes or not?

Jed Sparks: So that's all I have, and I'd be...

Jed Sparks: Really excited, A, to hear if you yourself have heard the Seneca Drums, or if you have any questions about anything we've talked about.

Seneca Lake Pure Waters Association: I'm gonna start off with a few, and if anyone else has any questions, I would encourage you to put them into the chat.

Seneca Lake Pure Waters Association: So, I was surprised by the no methane, the no continuous methane. Is that a recent finding, and what does that mean for theories behind what is actually causing this?

Jed Sparks: So you can probably have two different ways that methane could come from a sediment, and one would be like the Baltic Sea. You just have continuous production, and it's like this big column of methane coming up all the time.

Jed Sparks: The other would be that you have stratified sediment layers, and you have the methanogenesis producing this methane, and the gas is just being stored in that sediment. It's building up, it's building up, it's building up, and then it finally has enough energy to break through the surface, and it's just one event that it then booms and then goes. The second kind of mechanism is what happens in a swamp.

Jed Sparks: You know, when you're walking through the swamp, and you see those bubbles coming up, that's what's happening on a microscale, and here it'd be happening as a macro scale. But what it means is if it is that...

Jed Sparks: Building of a bubble, and then an eruption of the bubble, is you have to be there.

Jed Sparks: at that exact moment that that bubble's erupting in order to see that methane, because if not, it's gonna... it's basically just gonna dissipate throughout the volume of the lake really rapidly. So that's what we think is probably going on.

Seneca Lake Pure Waters Association: Got you. Is this... because you were saying that this might not be inherently unique to the Finger Lakes, but might this be unique to the Finger Lakes itself compared to other lakes in the world? Is there something unique about the geology here that is potentially behind this? Because I know that there are other lakes that have...

Seneca Lake Pure Waters Association: Toxic gases or methane, like, too much methane coming up, but it's a continuous bubbling that is just... it's not this giant gas bubble that is so loud that people have described it as shaking their house, you know?

Jed Sparks: Right, so the lakes that get the big press, which are, like, most of them are in Africa, and what happens in a lake is the temperature dynamics are such that the

water separates by temperature, so the bottom water won't mix with the top water until the top water reaches a certain temperature.

Jed Sparks: So, like, they call them the killer lakes of Africa. What happens is carbon monoxide grows... builds up in the bottom, and then they'll turn over, so they start to mix all that CO, and you see the pictures of people, and cattle and all these things in Central Africa being killed by this... this kind of thing.

Jed Sparks: Our finger legs don't do that. They don't stratify and they don't turn over.

Jed Sparks: So it doesn't have that kind of dynamic. There are probably plenty of lakes where you just kind of have a little bit of methane being produced all the time, and it just diffuses, and there's never a big bubble.

Jed Sparks: And then probably what the Finger Lakes are is this case of it builds up bubbles and sediments. It's interesting to me that where the pockmarks are is where the bottom sediments of Seneca intersect the Marcellus Shale. So the Marcellus Shale is going up. Once you get up north into Syracuse, it's nearly at the surface. Down at the southern end of Seneca, it's basically right intersecting with the bottom of the

Jed Sparks: LA.

Jed Sparks: So that gives you the option of, well, it's not being produced right there, it's just leaking out of the shale and coming into the sediments, and then as soon as there's a big enough bubble, it's a massive eruption. These pockmarks on the bottom are impressive. I mean, they're 10 meters across.

Jed Sparks: They aren't little itty-bitty guys, they're... something very large erupted from... from there somewhere in the past.

Jed Sparks: There are other things. I'm not a super expert on the bathymetry and formation of the bottom of lakes, but there are other mechanisms that could create pockmarks. So, you know, you don't know absolutely for sure that it's a gas eruption, but it certainly looks like it.

Jed Sparks: I wouldn't say that Finger Likes are totally alone. There's other...

Jed Sparks: There's a group of lakes in Italy that the local population call the Thunder Lakes, which every once in a while, there's this kind of crazy booming sound that happens. There's one in Asia, in China, which they call the God's Lake, which sort of has the same... so there's kind of a recurring theme of these very small group of special lakes that do this one big bubble eruption into a booming sound.

Jed Sparks: But no one, to my knowledge anyway, no one has tracked down the exact mechanism of what's causing it.

Seneca Lake Pure Waters Association: Got you. Please go into more detail on this gas cannon thing. When is this happening, and where exactly, and...

Seneca Lake Pure Waters Association: Why?

Jed Sparks: So, basically, when you get seismic information, it's like you'll get all these events. Well...

Jed Sparks: I don't know, this one could be someone did an explosive blast in a quarry somewhere in the region, you pick it up.

Jed Sparks: You know, another one could be localized construction, you know, if someone's pounding a giant piling in or something, you're picking that up. So what you'd really like is to know what exactly... how would a seismometer exactly record a bubble

Jed Sparks: of the size that we think it would be erupting from the top of Seneca Lake. So how do you do that?

Jed Sparks: Well, people who do, mapping and stuff.

Jed Sparks: they like to make loud sounds underwater, because then they can record when that sound bounces back. And a guy named Trish...

Jed Sparks: Scholes, who is at Syracuse. It's this great story of this... this investigation keeps expanding and expanding because of people like you advertise it, or, you know, it's written up in the New York Times, and then people go, hey, I want to get involved. So this guy called us, he said, this is what I do. We release big bubbles of water to do mapping, and I've got these air cannons, and I'm like, that sounds awesome, let's do that.

Jed Sparks: And so we're trying to put it together. It's like most things, it's trying to get a boat, you know, and all the different things you need to do, but the idea would be is we'd fill it with the volume of what we think it is, we'd lower it down to a meter above the surface, release it.

Jed Sparks: and then look on the seismic array, what did that look like? And then you can use things like machine learning.

Jed Sparks: we won't call it AI, but you can ask an AI to... I want you to look for that exact sound profile of the... that a gas bubble would make. So... but, you know, just saying the word gas cannon just sounds fun, so I want to do it.

Seneca Lake Pure Waters Association: Yes, a question from the chat,

Seneca Lake Pure Waters Association: Where are these limited to, these events limited to? Because, is... there have been reports of, being heard further north than just the south end of the lake.

Jed Sparks: Yeah, if you go anecdotally, almost anyone who is within earshot of Seneca in its totality has heard the drums, and so...

Jed Sparks: But the pockmarks... so they've done the bathymetry for the northern part of the lake, and there are no pockmarks there, that doesn't necessarily mean

Jed Sparks: you couldn't have, you know, an eruption of a bubble. Perhaps the sediment's different, and it's just collapsing back in, and it doesn't leave that footprint or signature. It could be that you could be way up north, and you could be hearing things that happen in the south.

Jed Sparks: You know, to me, it's amazing, because there's a lot of eyes on Seneca Lake, right? I mean, it's not like it has... it's not like a great lake where it has vast areas where things could happen, you know, you sit there and you can see, so there should be more sightings of the eruption of the bubble, to my mind, and you don't have that many.

Jed Sparks: Which leads me to believe either the eruption at the surface isn't that easy to see, and it's more audible than it is visual. That's one possibility. The other possibility is, you know, we're just...

Jed Sparks: we're just all creatures of imagination, and we're making all kinds of things into Seneca Drums. That's a possibility. But that's always a possibility. So anecdotal evidence is always... it's always a bit iffy, because

Jed Sparks: You can go to any bar in the Finger Lakes, and one person in there will definitely heard the Seneca Drums. All of my staff at Cornell, they're all local and from the region, and they've all heard it.

Jed Sparks: Especially when they were children. This seems to be more hearing from when, you know, 70s and 80s and 90s compared to today.

Seneca Lake Pure Waters Association: Anecdotally, there have been reports that it has been slowing down.

Jed Sparks: Yeah, no one has done any science toward that. The ideas that have been put forward by several people are both the natural gas extraction, like the fields in Tyrone and that region, that

Jed Sparks: Decreased the amount that was leaking into the lake.

Jed Sparks: The other one is that various forms of either physical salt mining or the saline mining that goes on in Seneca, that has resulted in extra, you know, valves and directions for the methane to go. But it's pretty common. If you talk to people, they'll always say, oh, there was a...

Jed Sparks: I think it was the Watkins Glen newspaper. There was some time period in 1964 when there were so many booms, it made front-page news in Watkins Glen. You know, it was like, there were, like, a hundred different reportings in, like, one summer. So...

Seneca Lake Pure Waters Association: Yeah, so there might be, like, peaks and valleys of how this is going, more or less, and we don't totally understand what's causing it, so we don't understand why that would be the case.

Jed Sparks: Yeah, and we've obviously manipulated the Marcellus, even if we're not doing it in New York. You know, it's... in Pennsylvania and Ohio, we're now fracking that whole substrate. It's hard to know how much effect that would have on the whole formation.

Seneca Lake Pure Waters Association: Hmm.

Jed Sparks: gases that are in there. So, I would not be surprised that the frequency of the drums have gone down.

Seneca Lake Pure Waters Association: Got you. So we've talked about how this unique geology could potentially be leading to this situation. Does it also lead to a unique chemistry of the lake itself?

Jed Sparks: It could, it depends what all...

Jed Sparks: The methane itself wouldn't change the chemistry, but other stuff.

Seneca Lake Pure Waters Association: Okay.

Jed Sparks: come out, mostly salt. The other thing that's down there are these,

Jed Sparks: briny areas, they're... they're encapsulated things that have a whole bunch of salt in them, and they're from Precambrian. And that could also... so you could also... we've tested for that. We've looked, those... those measurements aren't done yet, but in about 2 or 3 months, we... we...

Jed Sparks: put down sensors into the pockmarks last May.

Jed Sparks: And their battery life will be done in about November. And we'll pull them up, and they'll have a continuous record of salinity, of all of the different cations and

anions that are in the lake, and if they're abnormally high or low around these pockmarks because of some kind of leakage. So we'll know more about that.

Seneca Lake Pure Waters Association: Gotcha. Personally speaking, I've heard of a geological process when, glaciers recede that very slowly the ground kind of rebounds up, because it no longer has that pressure on top of it, and as we know, geology...

Seneca Lake Pure Waters Association: for us, a long period of time for geology is an incredibly short period of time. Is it possible that the area is still responding to the absence of the glaciers from 10,000 years ago?

Jed Sparks: I am definitely not an expert in that kind of geology, but,

Jed Sparks: I think the rebound is pretty much done.

Seneca Lake Pure Waters Association: Okay.

Jed Sparks: Like, that's, the energy is, you know, the energy forces that are at work are so big that it... it's not fast, but for geology, it's fast, because you're moving that massive amount of weight.

Jed Sparks: But it was... it is the glaciers had a lot of effect on, you know, the tilt of the Marcellus and all of the different things. People think of the... these different things being flat underground, and they're really not. You know, if you go up north of Syracuse, the Marcellus Shale is basically at the surface.

Jed Sparks: Right, and it's at 7,000 feet by the time you get to Ohio, so it's very... it's very sloped all the way across its,

Jed Sparks: Entire... and across its entirety, for sure.

Seneca Lake Pure Waters Association: Got you. What can you tell us about your latest research into this? Any interesting results that, you can share with us?

Jed Sparks: So...

Jed Sparks: it's only word of mouth, but the ABERS group that has the seismic information out there, they say, wow, it's got the same seismic stuff... more seismic stuff happening in the lake than outside the lake, which is weird. You know, if you put it anywhere, you should be

Jed Sparks: picking up construction sites and explosions and other sorts of things, and they're all centered in the bottom of Seneca, just like they're centered in the bottom of Cayuga. So there's something seismically going on in the southern end of both lakes. I would love it to be this bubble eruption sort of thing. We haven't narrowed it down to that. The air gun would help with that. We'd love to

Jed Sparks: get... what does a diagnostic bubble look like, and then compare it to these seismic events.

Jed Sparks: A lot of people say, well, it's the salt mines, which is a reasonable kind of thing to say, but they're not centered on the salt mines, they're far south. Well, in Cayuga, you know, it's a physical mine that goes underneath, and all of the seismic stuff is to the south of that.

Jed Sparks: So it... and they... it's proprietary, but the salt companies do their own seismic measurements, and...

Jed Sparks: According to them, at least what they've released publicly, that they don't have any seismic effect in their mining activity.

Seneca Lake Pure Waters Association: Gotcha.

Seneca Lake Pure Waters Association: Last chance for questions, and oh, we have someone saying thank you. They really appreciate, the research that you're doing and the presentation as well. Is there anything that you haven't touched on tonight that you would like to, discuss as well?

Jed Sparks: No, just... and there's... when there's interesting things that are important to a community, you know, engage your local universities. We love this stuff. You know, so, there can be great... much better connections. If there's something you're interested in that you think is strange.

Jed Sparks: give a professor at one of these universities a call, and we're likely to be interested. That's why we do what we do.

Seneca Lake Pure Waters Association: Thank you so much. We really appreciate you having this evening. And, to everyone who was here, we appreciate that you were here as well, and I hope that I get to see you guys at the Summer Soiree next week, and our virtual auction is open right now as well.

Seneca Lake Pure Waters Association: And, we will continue going forward with this series next month. We will be looking at invasive macrophytes. So, we look forward to seeing you there as well, and Jed, once again, thank you so much for this talk. This was great.

Seneca Lake Pure Waters Association: And, we really appreciate you having you on, and when you find out more about this, let us know, and we'll have you back on.

Jed Sparks: I'll be back.

Seneca Lake Pure Waters Association: Thank you, appreciate it.

Seneca Lake Pure Waters Association: Bye, everyone!