# Geology with Schmitty Thompson
# Ologies Podcast
# September 14, 2022

Oh hey, it's the string on the spine of a string pea; what am I doing here and why am I stronger than navy rope? Alie Ward, and finally, finally, you can stop looking to see if we have a Geology episode because it's here. Rocks... Rocks! What are they? Where do they come from? And how do you become a person who suddenly has context for everything surrounding you so that you appreciate it? You talk to a geologist.

So, this ologist is beloved in the science community and I was introduced to them via Sarah McAnulty of the Teuthology, squid episodes. Sarah runs Skype a Scientist and this ologist helps write Geology Corner trivia for Skype a Scientist Trivia Nights. And while I'm here, it is Squidtember so enjoy the encore of the squid episode if you haven't heard it, there's a link in the show notes.

But this ologist, this geologist is on their way to a PhD in geology via a postgrad research fellowship at Harvard University, as a visiting student from Oregon State, having studied paleoclimate and glacial geology, with an undergrad degree in geology and mathematics at Northland College, which is in Ashland, Wisconsin – hello, Wisconsin – on the south shore of Lake Superior. They're already listed as an author on published papers such as, "A Global Database of Marine Isotope Stage 5a and 5c Marine Terraces and Paleoshoreline Indicators." And you'll know exactly what all of those words mean in a second. Just kidding, no you won't. You'll know why a rock is heavy though! And that's what we're here for.

Okay, before we get into it, thank you to everyone on Patreon who supports the show, you can join for as little as $0.25 an episode and that lets you submit questions for the ologists ahead of time. Thank you, patrons. Thanks to everyone who tweets and TikToks about the show and to everyone rating, and leaving reviews, and subscribing, which helps the show so much. I read every single one, and to prove it, here is a steamy freshy from UpWayTooEarly, who left the review:

> *The information about the natural world is fascinating and the unabashed enthusiasm of the guests is a real treat.*

Thank you, UpWayTooEarly for that and everyone who left reviews this week, I read them all.

Okay, geology, *geo* the earth, the study of the earth. So, consider this like a 101 course of, what is this big rock that we live on made of, and how can we appreciate gravel, hard rocks, soft rocks, stone skipping, edible stones, how large is a small boulder, how old are diamonds, where do geodes come from, why are different rocks different colors, why you should stare at your countertop, what are the best rock puns, why road trips can take forever, and just wonder at the natural world, with Part 1 of this 2 parter, with your new favorite geologist, Schmitty Thompson.

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**Schmitty:** My name is Schmitty Thompson, and I use they/them pronouns.

**Alie:** And you are a geologist!

**Schmitty:** I am a geologist. I am currently a geologist in training so hopefully going to be a Dr. Geologist soon.

**Alie:** If you're studying it, you are an ologist. So, you *are* a geologist.

**Schmitty:** I am a geologist, yes.

**Alie:** Okay. I've wanted to do this episode for so, so long because rocks are something that I do not understand a thing about. I want you to know that I know nothing about rocks, and you know so much. [*Schmitty laughs*] So, I guess let's start with, since ologists are people who study things, how long have you been a geologist? Because you've liked rocks for, I'm going to guess, more than one minute.

**Schmitty:** Yes, I have liked rocks for a very long time. I do remember, I met my first geologist when I was going into 8th grade. I went on a canoe trip for a few days in the middle of nowhere in Minnesota and the trip leader had just graduated with her undergraduate degree in geology. She was telling us about what she was studying, and she was showing us all these rocks and I remember we were packing up our food to go on our trip and I just looked over at her [*heavenly music*] and I said, "I'm going to be a geologist someday." So, it's been a meandering path ever since then.

**Aside:** So, it's been a real rocky road, in that it's been full of beautiful wonders really, because rocks are cool.

**Alie:** What was it about rocks that you thought, "I'll dedicate my life to that ology."?

**Schmitty:** That's a really good question. It's just... they're so beautiful and they're so interesting because you know... When you're walking in a grocery store parking lot – this is the example I always use – you can look down at the rocks in the weird medians there and if you know how to talk to those and you can read their stories, even seemingly the most mundane rocks ever, have the most amazing stories. You can go into the middle of nowhere on a long canoe trip or backpacking trips and you can see these beautiful, magnificent outcrops, mountains, and rivers, and everything. You can go drive down the side of the highway and I'm sure many people have been driving and seen a beautiful roadcut. Roadcuts are great. If you see someone stopped on the side of the road, there's a good chance they're a geologist looking at the roadcuts.

They're so beautiful, and getting to learn about the history of our planet and understanding just how beautiful and dynamic the Earth is… Our planet has been around for 4.5 billion years and that's an unimaginably long stretch of time and so much interesting stuff has happened since then.

**Aside:** Just by the by, an outcrop is any visible, exposed bedrock, or a like naturally occurring geologic goodness where you're like, "Woah, what's that?" And a roadcut is when they cut a road and, kind of like a piece of cake, you can just drool over the layers, and when you do...

**Schmitty:** Even if you can't look at the outcrop and say, "I know exactly what's going on here," you're getting to sit there and think about, what's the story here? How did these rocks get where they are today? Were they born deep into the earth? Were they born on a beach? Did a dinosaur walk on this rock? Just, the stories that they can tell are amazing and I think there's also something there that I don't know if I can explain, I just love rocks.

**Aside:** I love this kind of love.

**Alie:** Let's define a rock, number one. What's the difference between a boulder, a pebble, a rock, a geological formation? At what point is something sand and at what point is something a rock?

**Schmitty:** Yeah, what is a rock? That's a really good question. So, a rock is sort of a broad definition for material that has come out of the earth that is made of minerals. So, that's a really common question, what's the difference between a rock and a mineral? Minerals are essentially like the ingredients that make up a rock, so a mineral is a chemical compound that has a crystal structure and formed, for the most part, under natural circumstances. For example, a mineral that a lot of people have heard of is quartz. Quartz is a really beautiful mineral, it's really common, and rocks are going to be made up of... Sometimes you have a rock made up of just one mineral, like if you have a big chunk of rock salt. Salt, its mineral name is halite. And then a lot of other rocks, for the most part, are made out of combinations of different minerals.

So, for example, if you've ever gone to someone's house or a nice bar and you see that they have a granite countertop, granite is a rock that forms deep under the earth. The minerals, the ingredients, or the components that make it up, are for example quartz, you have quartz in granite. You also can get a mineral called feldspar, which is this beautiful little pink mineral that has lots of shiny surfaces; it's made up of a mineral called mica, which has two forms, biotite and muscovite, which are these beautiful flakey rocks you can form. So, minerals are like the ingredients that make up rocks and rocks are just materials that come out of the earth. So, for example, a rock that you pick up, again just off the ground, is just going to be just as much of a rock as a cliff you see in a hilltop.

Now, words like silt, or sand, or pebble, or boulder can be technical terms to talk about how big the rock is. So, if we're talking about the size of a rock, we can split it into categories. We have the tiniest sizes of earth materials, but if we're thinking about the size of rocks, you can think all the way up to a boulder, which is a technical term. So, rocks above a certain size are boulders.

**Aside:** Okay, I looked this up and it's a very technical term. A boulder has to be greater than 25.6 centimeters or 10.1 inches in diameter. That is the threshold of when a rock becomes a boulder. So, in common usage though, some people define a boulder as one that's too big for one person to move. That's how people classify it. But one time, my dad moved a giant, person-sized boulder out of the road so that other cars wouldn't hit it, and at the time, he was 70 years old and on chemo. So, I think that metric of who can move what is pretty subjective; there are many non-boulders I probably could not move. But yes, a boulder can be gigantic, but at its smallest, the smallest boulder is a little under a foot in diameter. So, what's smaller than a boulder?

**Schmitty:** You can go down a step to a cobble, which is just maybe the size of a softball or a football. And then you can get down to a pebble, which is just kind of like what you expect a pebble in a fish tank to be. And then you have sand, and there's all sorts of different sizes of sand. And then you get down to silt, and then you get down to the tiniest particles, which are clay.

**Alie:** Wait, clay is a type of rock? What?

**Schmitty:** Yeah, that's the hard thing. When you get down to sand, and silt, and clay, they're all earth materials, so they're all involved in the way that stuff moves through the earth system. Clay is really fun because clay particles are so tiny that you have to look with a microscope to look at the individual clay particles.

**Alie:** [*hushed voice*] Nooo. And they just stick together with water? Is that how we mold clay?

**Schmitty:** That's how we mold clay. Actually, this is a really fun tip if you want to look like a geologist in front of your friends; if you're at a riverbank or you have some really fine silty, clay-ey material. If you want to figure whether you're holding silt or clay, what you do is you take a little bit of that really fine powdery stuff and if you're being really casual you can spit in your hand, [*Alie laughs*] or if you're being fancy, you can take some water from a water bottle and mix it with a little bit of dusty material and then try to paint with it. See if it leaves a streak across your palm; if it doesn't leave a streak, that means it's silt, which means that it's made out of slightly larger particles. And if it does leave a streak, that means it's clay.

**Alie:** Augh, I never knew that. I never knew that clay was a bunch of little rocks. That's so thrilling.

What about different types of rocks? You know how when you are an absolute newbie and... there have been several times I've picked up a rock and been like, "This is probably a meteorite," and it absolutely has not been. But things between sedimentary and igneous... I know that there are 4th graders that know a lot more about this than me but what are the types of rock and some of their hallmarks, would you say? For a total rock newbie who appreciates rocks.

**Schmitty:** Total rock newbie. You are excited, that is great, that is all you need to start learning about rocks is excitement. [*Alie squeals then laughs*] The three main types of rocks that we have are igneous rocks, sedimentary rocks, and metamorphic rocks. Which kind of rock they are is all dependent on how they formed.

Igneous rocks formed as lava or magma cooled and so you can break igneous rocks into two categories. You have the Class Is, which are volcanic igneous rocks, and so these are rocks that when you have, for example Mount St. Helens or any of our other volcanoes, when you have a volcano erupting, you're getting lava and ash and all this really hot molten rock, lava being erupted out of the volcano. When that lava cools, it forms an igneous rock. Actually, these igneous rocks coming out of volcanoes are one of the most common types of rock we have on the planet because if you go down all the way to the ocean floor, underneath all of our oceans are just these huge plates of an igneous rock called basalt.

**Alie:** Ooh! And there's big giant plates, would they each be one huge boulder?

**Schmitty:** That's a really good question and I think that's something that you need to go to a coffee shop [*Alie laughs*] on a Sunday morning and debate amongst yourselves. So yeah, volcanic igneous rocks form when a volcano, or some kind of lava moving up from the middle of the earth onto the surface of the earth, cools.

You can also get what's called a plutonic igneous rock. And so essentially, if you go deep, deep under the surface of the earth, you have all of this really hot, squishy rock moving around in what's called the mantle. The mantle is this really large layer between the center of the earth and the crust that's on the outside. So, when a blob of the mantle gets really hot and starts to move around, you can get these blobs of magma. So, when you have really hot molten rock, the difference between it being called lava or magma, is lava is when it's on the surface of the earth, it's come out from the inside of the earth, and magma is when it's still on the inside of the earth.

So, sometimes you get these blobs of magma that slowly move up through the crust. Sometimes they'll erupt and become a volcano, and sometimes, they don't quite make it to the surface, they just sit under the surface of the earth, and for, like, hundreds of thousands of millions of years they cool, and as they are cooling, all of that liquid rock has time to grow really large crystals.

So again, you can go find a granite countertop and you can just put your hand on it and look at all those crystals, because granite is a plutonic igneous rock. So, any granite countertop that you're going to be looking at, you can look at it and think about the fact that that formed deep, deep under the surface of the earth and cooled over hundreds of thousands to millions of years to form these big, beautiful crystals.

**Aside:** So, igneous rock comes in two main flavors. There's extrusive, AKA volcanic, and that is a fountain of lava. Or intrusive, or plutonic, and that is an underground cooling blob that cools more slowly, which may be what your counters are made of. But your floor is definitely made of lava. [*"The floor is molten lava." "The floor is lava."*]

**Alie:** You know what always gets me is in home renovation when people are like, "I'm *over* my quartz countertops", or "I'm over my granite countertops." And then they just demo them and then they get a new rock countertop. I'm always like, "Do we have enough rock for that?!"

**Schmitty:** [*chuckles*] Yeah, that's a good question. There are some kinds of rock that we do have a lot of, but I do think it's a waste to get rid of any good stone countertop. You went through the effort to get that out of the earth, why would you demo it? Though one of my undergraduate professors, when he was showing us different kinds of igneous rocks, he had a little board with different countertop samples on it, [*Alie gasps*] really nice clean-cut samples of these rocks. Countertops are a great way to see some cool rocks because people like to take... you know, really hard durable rocks can be good for countertops so you can see lots of fun rocks there.

**Aside:** Okay, so to recap, rocks can be made of different minerals and minerals can be made of straight-up elements or chemical compounds. But a mineral is, according to the US Geological Survey, something with an orderly internal structure in a crystal form. Minerals you may know are quartz, feldspar, mica, olivine, and calcite, and amphibole... which, when I read it, it looks like *amphibolé,* which sounds like some kind of Italian frog man superhero.

But to recap, a rock is a lump of minerals; sometimes just one mineral, sometimes a bunch of them. Also, not to confuse you, but a lot of quartz countertops aren't naturally occurring slabs. Most of them are about 90 to 95% ground-up quartz or silicon dioxide, with about 10% of it being resin binders. Did you know that? I didn't. So now, when you're sitting at your countertop... you won't *take it for granite*, unless it's marble, which is not igneous. But first, sedimentary, my dear Watson.

**Schmitty:** When you're talking about igneous and sedimentary, you can kind of go in a cycle because rocks and earth material on the planet is always cycling. Nothing is ever still or sedentary on the planet. So, when you get rocks that start to break down, for example, if you have a granite cliff, things like rain moving on it and wind blowing on it, and just the weight of the rock face pulling it down is going to start to break up that granite into smaller particles. And so, as rocks weather, they start to fall apart and you get the individual crystals in it, for example, the quartz crystals in granite, they fall apart, and they become loose sediment.

And so, sediment is just any material that's a loose scattering of smaller grains of rock that have weathered out of something else. [*"I'm totally falling apart."*] And so, you can go to the beach, and you can pick up your really pretty sand, that probably started as an igneous rock somewhere deep underneath the earth. And so, as you get sediment like clay, and silt, and sand moving around the surface of the earth, it's in our oceans, in our rivers, it's sand dunes in the desert. Eventually, some of that stuff stays still for a long time or it gets buried, and over time as water is moving through it and as it's compressing together, loose sediment like sand, silt, or clay is going to harden in a fun process called lithifying and it's going to become a new kind of rock. So, that sedimentary rock is a rock that formed out of sediments that have been weathered out of other rocks.

Sandstone is a really great sedimentary rock, and then you can also get sedimentary rocks that form out of lots of shells in the ocean. If you're in the ocean, you can have big shells, you can have microscopic shells. When those shells settle to the bottom of the ocean, they will also squeeze together and form a rock called limestone. So, sedimentary rocks are just what happens when loose earth material on the surface of the earth or the oceans compacts together.

**Alie:** So, is it kind of like if you were baking biscuits and there are a bunch of leftover pieces, and you made another biscuit out of that biscuit?

**Schmitty:** Exactly. Yeah, that's a great way to put it. It's material recycling through the earth system.

**Alie:** What is cooking it though? I know that if I reform that biscuit and I put it in the oven, I've got a new biscuit. But that lithifying, what's hardening it into a whole other rock?

**Schmitty:** Yeah, so that's going to be sometimes you have just pressure over time is going to meld those grains together. And then oftentimes, rocks, again look at your granite countertop or a nice marble countertop, sometimes you look at a rock and you're like, "There's no way water can get in that." But especially in sedimentary rocks, where you have lots of loose spaces between the grains, you can get water moving through it and that's going to deposit little bits of, essentially cement, in between them. So, that's going to hold that together.

**Alie:** Oh! I don't even know what cement is, but I understand it's different from concrete and I'm like, "I need to do a whole Masonology episode." Yeah, what is cement?

**Schmitty:** So, in this case, cement is just... One of the ways minerals can exist is you can have little bits of the components of minerals dissolved in water. And so sometimes as the water is moving through loose sediment, that's going to deposit little, tiny bits of the mineral in between the loose pieces of sediment and that's going to weld them together. So, it's kind of like glue, it's gluing the rock together.

**Alie:** And then what about metamorphic?

**Schmitty:** Yes, metamorphic rock. This is where the fun stuff comes in. A lot of rocks, whether they formed deep underneath the earth in a volcano, or on the surface of the earth, they can get buried again and they can get pushed into the earth's crust. So, what happens sometimes is when you get a rock that formed either from a volcano or from loose sediment...

**Aside:** I.e., take an igneous or a sedimentary rock, which you now know what those are, congrats.

**Schmitty:** If it gets put under really intense heat and pressure, then everything in there will get kind of squishy and stuff. It won't melt all the way, because if you melt the rock all the way, then it becomes an igneous rock again, but if it just gets really… if things get loose in there, then minerals can start to rearrange themselves into a new rock.

One example of a metamorphic rock is... I talked about limestone. So, limestone forms the bottom of the ocean when tiny shells gather up in layers over time and stick together. If limestone gets buried deep underneath the surface of the earth, all of those little grains of calcium carbonate that make up the shells are going to kind of meld together and become more solid, and that's what forms marble. If you've ever, again seen a marble countertop, or like a marble statue in a really fancy building, that started off its life as shells or some kind of marine creature in the ocean, and then got buried and metamorphosed, and everything got squishy and rearranged itself and someone made it into your countertop.

**Aside:** So, some extrusive volcanic igneous rocks are basalt, pumice, and obsidian. And then remember, intrusive or plutonic rocks, quite literally, chill beneath the Earth's surface, and thus they cool more slowly, which tends to let crystals form. Granite, and diorite, and pegmatite are intrusive igneous rocks.

Also, did you know that you shouldn't throw rocks in a fire? Especially wet ones. Rocks can straight up absorb water and then explode at your face, which is not the relaxing firepit atmosphere that you were going for. So, don't make a firepit with sandstone, or river rocks, or pumice because they can sponge up water. And then harder rocks like granite, marble, and slate, plus lava rocks are a better bet, but you should ask a firepit person or the internet first and don't sue me.

But some sedimentary rocks are sandstone, shale, limestone. Even coal is a sedimentary rock, which I didn't know. It's an organic sedimentary rock because it's made of old dead plants! Coal is rock? Chalk is a rock! Chalk is a rock?? Yes. A sedimentary one, made up of old shells. So, this pod is just chock-a-block with cocktail party facts.

Metamorphic rocks, once again, they get stronger under pressure or high temperatures, but not high enough so that they melt to magma, they just kind of get molded and folded. And some metamorphic rocks are phyllite, schist, quartzite; marble is a metamorphic rock. But marbles, those are not rocks, those are glass. And glass is cooled, heated sand, and silica and some other stuff. And it's not a mineral or a rock because glass doesn't have a crystalline structure.

But I learned this on accident this week so now you have to learn it. One time, marbles were embedded in highways and road signs for reflectivity, and they were called cataphotes when they were used that way. It was invented by a guy named Percy Shaw in 1937 who thought that marbles were pretty shiny in headlights, like a cat's eye. And marbles in road signs were like, "Okay, these are pretty good," until World War II, and then marbles in road signs, or cataphote, took off because back then military vehicle headlights had shutters on them like eyelids to cloak them from being visible from above. And in World War II, since the entire world was a battlefield, shuttered headlights were standard in a lot of cars, meaning that reflector marbles on road signs were discreet and helpful, so they were everywhere. And when I learned that I lost my marbles, which is an idiom first coined in 1886 in a newspaper article which read, "He has roamed the block all morning, like a boy who has lost his marbles."

Also, it was while researching this aside that I realized that this episode needed to be a two-parter because, I'm sorry, there's just a lot of cool shit to learn about rocks and rock-adjacent things. But all that glimmers is not glass.

**Alie:** What about things like diamonds, and sapphires, and rubies, and quartz crystals, those are igneous or those are metamorphic?

**Schmitty:** A lot of them can be both. The situation in which big, typically-gemstone crystals grow is when you have either magma cooling over really long periods of time that lets those crystals grow. For example, if you are thinking about a tourmaline crystal, I've been to outcrops where you can see big, beautiful tourmaline crystals that have grown in granites that have cooled over a really long period of time that allows those big crystals to grow. And then a lot of other gemstones form in metamorphic rocks where essentially, you can get the right ingredients there, and if you put them under heat and pressure, it'll have time for those ingredients to come together and grow into these new gemstones. So, most gemstones, for the most part, are going to be either coming out of an igneous or a metamorphic rock.

**Alie:** When we're looking at rocks, say in the yard, or gravel in the driveway, or scattered around... This is maybe not a smart question, but is there a garden variety that we see probably more than anything? Like if we see a bug in our house, like a 90% chance it's a housefly or something. Are there types of rock that it's like, you probably see this all the time and don't realize what it is?

**Schmitty:** Yeah! I would say, there's a kind of rock called basalt, there's a lot of it around. It's formed in a lot of different conditions; it's an igneous rock so it forms when lava comes out of the earth and cools really fast, so it's usually gray and really fine-grained. And basalt is what makes up the tectonic plates at the bottom of the ocean. So, this basalt forms at what's called mid-ocean ridges, where in the center of a lot of these tectonic plates at the bottom of the ocean, they're kind of split in half and they're spreading apart where magma is coming up underneath them in a plume and you just get this long, skinny, sort of volcano, splitting the plate. And the plate is moving out slowly from that center line where that basalt is being produced. So, there's a lot of basalt out there, so you can take a look around at a lot of gravel pits and if you see a fine-grained, sometimes really smooth rock, that's probably basalt. It is very common, which is not to say that it's not beautiful in its own way. But that's probably a good garden variety.

**Alie:** What about colors of rock? Because I texted you before this to tell you that I sometimes will pick at gravel in a driveway and then I'll arrange it in a beautiful ombre color, and for some reason I find it very soothing.

**Aside:** I mean, it's the cheapest and most low-stakes hobby a person can have. When Jarrett and I were staying at my sister's helping out with my dad, I'd sometimes go outside for a minute, I'd just grab a few rocks and then arrange them in color order, and then sigh and just toss them back and return to the house. I even started drilling holes in a few with a Dremel to make driveway rock necklaces.

But I just found out researching this that there are naturally occurring rocks that have a hole straight through them, maybe from a mollusk track as they formed, and those are called hag rocks. To drill a hole in a rock and to say it's a natural hag rock is to invite a curse on you. But I promise, I just wanted to put a few driveway rocks on a string. It was a time, it was a hard time, it was a good time. It was a time. Anyway...

**Alie:** Why are some rocks white, some are yellowish, some are gray, some are brown? What's going on in there?

**Schmitty:** Yeah, so you can trace that all back to the chemistry and the physical structure of the rocks. So, again, all rocks are going to be made out of minerals, and then all those minerals are just based on various combinations of chemical elements, arranged in different structures. So, sometimes a rock's color will be based on just the plain structure of the mineral in it. And then sometimes with the minerals you'll get little, teeny, tiny trace elements, so just a little bit of dye into the crystal structure. So, that's going to give it its color. So, a lot of rock color is going to be based on its chemistry.

Though a fun thing I learned a while back is that if you're looking at a rock like a granite and you see little kind of clearish, gray crystals, a lot of the times, those are going to be quartz crystals. And the reason they look gray is not because they're colored that; it's because a lot of the times, quartz will form clear and the reason in a rock it looks dark-colored or gray, is because there's no light in there. [*"Oh, it's so dark in here."*] So, it's clear looking into a lightless interior of a rock.

**Aside:** So, for people who collect crystals or rocks, your purple amethysts have some iron in them to give it that lavender color. Rose quartz has traces of titanium, or manganese, or iron. And smokey quartz gets that tinted window look via some natural irradiation affecting the aluminum in it. Milk quartz, that's just quartz with some liquid or gas trapped inside, which can be really helpful for people with bowel issues... just kidding. I think it's just fun to think of milk quartz doing little farts. Your citrine in nature has colloidal ferric hydroxide impurities, but if you have an ombre, amber crystal that was sold to you as citrine, it's more than likely it's an amethyst baked at 900 degrees, which turns the purple parts golden yellow at the tips. But hey, if it's a citrine in your heart and mind, then you can think of it as a citrine all you want.

As far as crystals having powers, if it makes you happy then it makes you happy. I said this in the Gemology episode but, our brains are just a jiggly mess of nerves, and wires, and memories, and shit we don't fully understand, and one of those things is the placebo effect. So, if you think a stone is going to destress you, it might destress you. From a behavioral standpoint, if a gem or a rock reminds you to take actionable steps toward, like, keeping your heart open for love, or being kinder to yourself, or managing your money more wisely, then that stone is working by way of reminding you to change your behaviors, which affect your life.

But the placebo effect is not medicine and there are people, sadly, literally banking on your fears and your hopes, and those people are sometimes doing a lot of dangerous mining, using child labor in some countries, which is never good vibes, people. My point is that some rocks get all the attention, they're sold for a lot of money, but really, all rocks are special, like dogs.

**Alie:** What about, as somebody who probably has to haul around rock samples and things like that, why are they heavy?

**Schmitty:** Yeah, why are they heavy? So, that's all about just the density of the minerals. When a mineral or a rock is forming, how many atoms can it pack in there? So, a lot of them, because they're in these really rigid crystal structures, they can pack in a lot of elements that are pretty heavy. So again, a lot of the rocks that form, for example, the plates at the bottom of the ocean are really heavy in things like magnesium and iron. It's all going to come back to the crystal structure of the rock and its chemistry. So, there's a lot of stuff packed in there.

**Alie:** I'm so rude. I just realized that we're however many minutes in and I didn't even ask about your job or your work. I was just like, "What the fuck is a rock?" [*laughs*]

**Schmitty:** That's fine!

**Alie:** Your work deals with ice age rocks, right? How many rock samples do you have to collect? How big are the samples? What are you analyzing? What's happening?

**Schmitty:** Yeah, so that's actually a really interesting thing. I love talking about rocks but the work I do for my research, actually, I don't look at rocks that much. [*Alie squeals*] [*"I'm so sorry."*] Because I feel like that's one of the things about geology, it's a really broad field and it's not just about studying rocks; it's about studying the systems of our planet. And so, it's a really interdisciplinary field so the kind of work that I do is I actually, I sit at my laptop all day [*Alie laughs*] because there's a lot of geology that actually involves a lot of mathematics.

So, when it comes to trying to figure out or simulate how a volcano erupts, or how an ice sheet moves around, or how the ocean responds to various things moving around on it, a lot of the times we really understand the math behind it. So, what we can do is, I can write some code and tell my computer program, "Hey, do this math and figure out," for example in my research, if we took an ice sheet and we grew it all the way from Canada down toward Oregon, what's going to happen to the ocean, what's going to happen to the land surface if I grew the ice sheet closer and closer to where I am in Oregon?

**Aside:** So, their thesis involves working on problems of sea level during glacial cycles, and another paper they've been an author on is titled, "3D Mantle Viscosity Structure in Glacial Isostatic Adjustment Models Resolves Discrepancies in Marine Isotope Stage (Mis) 5a and 5c Global Mean Sea Level Predictions"... In case you were wondering.

**Schmitty:** So, there's a lot of geology that just doesn't involve going out into the field and looking at rocks. Like I said, a lot of the work that I do involves computer programs and math, and then there's also a lot of really amazing geology, really important geology going on that involves a lot of chemistry. So, there's going to be a lot of people who are taking rock samples that have been collected, and they're going into labs, and they're breaking them down into their component parts and doing a lot of chemistry on them to look at what exactly are these rocks made out of? What stories are in this rock chemistry that can tell us about how long ago did it form? What conditions did it form in?

And so, I find that's a big misconception about geology is it's just a lot of people in tan hats in a field, [*Alie laughs*] collecting rocks. But it's really this beautifully big, varied field. There's all sorts of ways to approach it.

**Alie:** Do movies or TV ever get geology really wrong? Has there ever been a pop culture rock that you're really a fan of or one that incenses you? Feel free to vent here.

**Schmitty:** Absolutely. So, I'll tell you my favorite and least favorite geology in movies. [*Alie laughs*] One thing that a lot of movies get wrong is volcanoes. Volcanoes are really beautiful because a lot of them can be these massive, explosive, very dramatic eruptions. But oftentimes in movies, when they're showing a volcano erupting, it'll be the kind of volcanic eruption that's really explosive to have a lot of ash and steam coming out of it, a lot of really harmful gasses. And oftentimes when these big explosive volcanoes erupt, for example like Mount St. Helens, the really dangerous thing about them is going to be when all of that hot ash, that's literally boiling, rushes down the mountain. The technical term for that is a pyroclastic flow. Oftentimes in movies you get these really dramatic scenes where there's all these people in cars trying to drive away or trying to run on their feet away from this ash flow. And these ash flows go really fast, they go tens of miles per hour fast.

**Aside:** I looked this up and yes, pyroclastic flows haul ass. Average speed, 60 miles an hour, or 100 kilometers an hour, going up to 400 miles an hour of pyroclastic flow. That's 700 kilometers an hour, if you're not an American.

**Schmitty:** The example I use is the second *Jurassic World* movie when Chris Pratt is outrunning a pyroclastic flow on this island. He should not have survived that, [*Alie laughs*] I can't watch that movie. You can't outrun a pyroclastic flow on foot. [*human screaming and animal squeaks and screeches over dramatic music*] And so, that's always something you can think about when you see a volcano in a movie is like, okay, what are the hazards they are portraying in this movie from this volcano and how well does that line up with what's dangerous?

**Aside:** Chris Pratt would have to run a 1-minute mile, for several miles, to escape even the slowest, most sluggish pyroclastic flow. And I watched the YouTube of this movie clip and the comment section... Mm, it's delicious. It's like a cocktail party of both jocks and nerds, each in respective corners having conversations. Some are like, "Bitchin' explosion." And some are like, "I feel like Owen would have grabbed onto one of the running dinos for a ride. They're faster than him, thus more likely to outpace that pyroclastic flow. Plus, it would have looked cool seeing him charge downhill on a stego or an ankylosaur," which is a good point.

Now, when it comes to scientists and fiction, can a movie ever pass the realism vibe check?

**Schmitty:** The movie that I will say I think got a lot of the geology right is a Norwegian movie called *The Wave* that tells a really interesting story about... In areas that have had a lot of glaciers in them, you can sometimes get this valley called a fjord. And so, a fjord is where you had a glacier carve away this super tall, deep valley from a continent, and it fills with water. *The Wave* tells a story of a small town in a fjord that had really unstable rocks on these huge cliffs next to it. And sometimes, if you can get a really loose pile of rock attached to a cliff face, if that falls into this valley, into the water that's covering the bottom, it can cause a huge wave [*people screaming and various sounds of destruction and chaos.*] that moves through the fjord and just destroys anything in its path. I think if anyone wants to get a good idea of what natural hazards can look like and what natural hazards geology can look like, I recommend the Norwegian movie, *The Wave.*

**Alie:** What about the myth or maybe just something that is overlooked, if you are out on a hike and you see a pretty rock and you go, "Ah! So lovely." Can you put that in your pocket or are you degrading that environment? How much rock collecting is too much rock collecting?

**Schmitty:** That's a good question. I think the important thing with that is... The important thing is that you're asking yourself that question [*Alie laughs*] because a lot of the circumstances are going to depend. So, before you go anywhere and if you're thinking, "Man, I'd really like to collect some rocks," you can look up whose land it is. Is it private land? Is it public land?

Sometimes if it's private land, for example, I know there are some places here in Oregon where private landowners have allowed rock collecting on their land, sometimes for a small fee. And if it's public land, like the Bureau of Land Management, or the National Parks Service, or State Parks, will have a rock collecting policy on their website. If you go into certain public lands, you can collect regular rocks and you can collect invertebrate fossils, but you might not be allowed to collect vertebrate fossils. For example, if you're going on a hike and you're interested in collecting some rocks, I would recommend looking up the regulations on rock collecting because oftentimes, different land management agencies will have guidelines for you.

**Aside:** PS, I tried this. And yes, if you google a state park or BLM, the Bureau of Land Management, plus your state, you can usually find a PDF with guidelines for rock hounding, like no more than 25 pounds a day and 250 pounds of rock a year. Which is a shitload more rocks than I was expecting. I was talking like, "Oh, this pebble is kind of greenish, maybe I'll keep it in my pocket like a traysure because I'm sad." But no matter what the limits are, Schmitty says...

**Schmitty:** I think in terms of the ethics of it and in terms of your personal relationship, in terms of what rock you're collecting, you can think, "If I'm taking this rock away, am I removing something that other people would get to enjoy?" For example, when I was in the Wind River Canyon many years ago and there was this beautiful granite cliff face with these huge tourmaline crystals. That is something that we would never take away because if we took those tourmaline crystals away then other people passing by on the road, other people stopping for fun, other geologists wouldn't get to enjoy them. [*"Good point."*] So, I think when you're taking a rock, you can ask yourself, "Am I removing something that future generations won't get to enjoy if I take it?"

Also, you can ask yourself, "Why am I taking it?" For example, if you're picking up a rock and saying, "I can bring this back to a community group," or "I can bring this back to my classroom to help teach people about the earth," that can be a really great reason to take a rock out of the field. For example, I have some rocks I brought with me today. I took them off roadcuts and I bring them with me; that way I can teach people about rocks.

So, I think the important thing when you're collecting a rock is beware of the regulations around you and just make sure you check in with yourself like, "Why am I picking this up? And if I take this rock out of the environment, am I going to be removing something from the community of rock lovers in the area?"

**Aside:** And this is morbid but I'm just going to say... If you do rockhound, as a verb, maybe have a plan for your collection when you die. I'm sorry! I'm sorry to bring it up but do you want your rocks scattered back to where you got them? Do you want them donated to a place that could use them for education? Maybe your friends have a gem and mineral rummage sale/funeral because think of how many rockhounders die, and all these pretty rocks just get dumped into a landfill by people who don't appreciate them. And I'm sorry that's depressing, but something has to happen to all the stuff that we own one day. Some of it is billions of years old that we took home to look at for a decade, and then they get buried in a pit of diapers and rotting banana peels because people don't understand how cool they are. Okay, let's change the subject.

**Alie:** What about licking rocks? Can you talk to me about licking rocks? I didn't know that licking rocks or fossils was even a thing until very recently. Who licks what for why?

**Schmitty:** I'm a big fan of licking rocks. I've licked a lot of rocks in my lifetime and there's definitely some valuable information you can get. [*Alie laughs*] So, one of the classic rocks that everyone has licked at some point is salt. Table salt is formed of the mineral halite. So, if you're in the field and you're in an area where you know halite salt forms and you're like, "Wow, this is a really cool rock, I wonder if it's halite," you can lick it. I think that's a fine way to do it. [*Alie laughs*] A lot of times if you're taking a geology class and you have samples going around, sometimes they might encourage you like, "Hey, if you think this is halite, this is going to be the best way to for sure determine it, is you lick it."

There are other rocks that, if you lick it, will have a distinct taste. So, halite, table salt is made out of sodium chloride and there's another mineral called sylvite, which is potassium chloride. If you lick sylvite, it's going to taste like bitter salts. So sometimes, the taste of a rock can be a really diagnostic tool.

**Aside:** So, out in the wild, sylvite can be an orangey, goldish, chunky rock, kind of like a pink Himalayan salt lamp but with a rusty ochre hue. And did you know that you can buy tiny potassium chloride, or sylvite rocks, in the supermarket? You can. They come in a shaker, it's called Morton Salt Substitute and it is sodium free, it's just made with potassium chloride. And a quarter of a teaspoon of it has 150% of the potassium of a banana, that's 610mgs baby, I just looked it up. It's also easier to pack on hiking trips and it can help balance your water retention if you get bloated from eating too much ramen. But check with a doctor first because I'm not one and too much potassium can be a problem for people with certain medical conditions like cardiac issues. But yeah, it tastes just like a dash of zingy salt, I've had it.

**Schmitty:** I also know there are some other geologists, if you're someone who studies sediment a lot, I do know people who will lick or chew a little bit of sediment because that's one way to get an idea of about how big the grains are. For example, if you lick silt, which is going to feel kind of like mud, versus sand, that's one way to tell how big the grains are.

When it comes to licking fossils, fossilized bone, it's not necessarily going to have a distinct taste but oftentimes, if you're licking the right part of a fossilized bone, that interior, airy structure of the bone can be preserved, and so if you touch it to your tongue, it's going to stick. [*Alie squirms*] So, that can be a really good way to tell whether or not you're licking bone. So, I think licking can be a very important diagnostic tool. [*Alie laughs*] Though there are rocks that you definitely do not want to lick. So, at least try and have some kind of an idea of what you're licking before you lick it. [*"That's good advice."*]

**Alie:** What don't you want to lick? Are there uranium rocks out there? Are there radium rocks?

**Schmitty:** Yeah. There's one rock called galena and galena has two elements in it: lead and sulfur. So, probably don't want to lick that much lead.

**Alie:** Or the sulfur. Sounds like a big poisonous fart, pretty much.

**Schmitty:** Yes, the chemical formula is PbS. I knew someone in college who the way they memorized the formula for galena was, "PBS, it's not for kids."

**Alie:** [*laughs*] What about the roundness of rocks? I guess… because I've been sitting in a driveway for several months sorting rocks. I'm like, "Some are round, some are jagged." Is that the age of the rock, where it hasn't been worn away, or is that the density of the rock?

**Schmitty:** Yeah, that's a really good question. So, that's going to tell you about the history of the rock. Part of how round the rock is going to be reflective of how resistant is it? So, a piece of quartz, that's going to be more resistant because it's really durable, really hard rock so it's going to take a lot of effort to try and round that off. Whereas talc, there's the mineral talc, that's going to be really soft, and it doesn't take a lot of work to round it off. So, how round a rock is, in part reflects the chemistry and the structure of the rock, how resistant is it?

For the most part, how round a rock is, is going to tell you about the history of it. So usually, when an igneous or a metamorphic rock is fresh formed, those are going to be really big, angular crystals. Once rocks break apart and their component parts start to move through the rivers and the oceans and they're getting carried around by glaciers, that's going to start to wear away the edges of the rock. And so, oftentimes if you see, for example, if you go to a river and you pick up a really smooth, beautiful river stone, that tells you that that stone has been carried around through water for a long time because all the other particles that are being carried around in that river in the water is working to smooth out the edges.

**Aside:** Okay, I squeezed down a very deep, dark rabbit hole, crevasse googling stone skipping. But what you need to know is that those perfect, silver dollar, smooth, flat stones for skipping rocks have been lapped upon by waters for so, so, so many years. And competitive stone skippers like to find patches of rounded shale flakes or even better, slate discs for stone skipping. Shale, sidenote, is a sedimentary rock that turns into the metamorphic rock, slate.

And yes, I did say competitive stone skippers, which I learned about from a 2009 CBS piece titled, "Stone Skipping Professionals." [*"I couldn't believe what I was seeing, a stone that skipped, and just kept on skipping, and skipping, 51 times." Laughs. "Oh my gosh."*] Which led me down the warren to the 2016 documentary, *Skips Stones for Fudge*, which details this rivalry between the two top athletes in the sport, there is Russ "Rock Bottom" Byars and Kurt "Mountain Man" Steiner.

Now, Russ chucks things into the water, but Kurt reads physics papers about stone skipping and searches for hours on the shore for the perfect rock. And Kurt, science-minded, was the record holder and then in one competition, he let Russ use one of his rocks and Russ got 51 skips on one stone, broke Kurt's record, devastating him. Russ held the world record for 6 years, until he was beaten by a man who skipped a rock on a lake surface 88 times. That man... was Kurt, who reclaimed his title. And then Russ passed away in 2017 and Kurt remains the title holder.

Now, if you wish to unseat him, prepare to dedicate your life to the sport, which is not lucrative, and maybe start by reading the 2002 *American Journal of Physics* paper, "The Physics of Stone Skipping," which taught the world that around a 20-degree angle to the water, plus a really high spin rate to stabilize the stone give the highest number of bounces on the water. And then, as it slows down toward the end and the skips become more frequent, like beep-beep-beep-beep-beep, that's called a pitty-pat, and stone skipping competitions use high-speed video analyses to confirm the number of skips.

If you have no idea what this whole aside is about, I apologize for that because regional vocabularies may vary. But skipping stones on a surface of water is also called skimming, stone skiffing, ducks and drakes, it's called lobster cutting, *Mizu Kiri*, or water cutting, some people call it throwing a sandwich, or letting the frogs out. So, let he who cast the first skipping stone though, prepare by reading some physics papers. You too can overthink next time you're on a lakeshore trying to meditate to the sound of lapping waves.

**Schmitty:** One of my favorite things to do ever, I actually really like sand. I think sand is really beautiful and something I recommend everybody do is... I know actually if you have a loupe or a hand lens, hand lenses are really, really useful for geology. So, you can get a magnifying glass, or a macro camera, or hand lens and go to any beach, you can pick up sand and look at it under a lens. I was literally looking at sand, [*laughs*] I was at the beach this morning, I was looking at a bunch of sand today, thinking about its history. You can get an idea about how long sand has been hanging around the environment by how round it is because if you're looking at sand grains and they're really rough and angular, that means they came out of their parent rocks pretty recently. But if you look at sand grains that are kind of clear and they're really round, that means those grains have been hanging around the surface of the Earth for millions, if not hundreds of millions of years.

**Alie:** And you are living outside of Portland, right?

**Schmitty:** I'm in Corvallis, I'm an hour from the beach, but I'm there all the time.

**Alie:** Well, you know what, when you live in LA, like, I live in Los Angeles and I'm like an hour and a half from the beach because everything, getting to Santa Monica, it's a nightmare. Don't recommend it. [*"Well, we are two hours from the beach... four in traffic."*]

**Aside:** And Schmitty was born in Utah, which has beautiful sedimentary rocks that have been shaped by water over eons. But they say, they did a lot of their growing up in Minnesota which is full of old rocks that escaped ice sheets. We're going to get to more of that in a second but first, a quick break because each week we donate to a cause of the ologist's choosing.

This week, Schmitty is tossing cash to Skype a Scientist, which has a database of thousands of scientists and helps them connect with classrooms, and families, libraries, scout troops, and more, all over the globe giving students the opportunity to get to know a real scientist and get the answers to their questions straight from the source.

Skype A Scientist was founded by Dr. Sarah McAnulty, a squid scientist and your Teuthology episode friend. And September happens to be Squidtember so you can celebrate by donating to Skype a Scientist or you can buy some cool new squid stickers that Sarah just launched with a Philadelphia-based artist. They are very cool, I ordered several of them to give as gifts; Sarah hand ships them out herself. There are links to those squid stickers in the show notes, along with a link to Skype a Scientist. That donation was made possible by sponsors of the show.

[*Ad Break*]

Next week, Schmitty answers so many pressing Patreon questions about geodes, and crystals, favorite rocks, best rock puns, petrified wood, ice, and more. But this week, let's get back to their favorite geology.

**Schmitty:** The rocks that were really formative for me were the rocks of the Northwoods of Minnesota and Wisconsin and I spent a lot of time on Lake Superior. Lake Superior is very near and dear to my heart. And so, when you get up to sort of the upper Midwest, you get to a part of the continent called the Canadian Shield. So, a lot of continents have what's called a craton, which is continental material that was formed deep underneath the surface of the earth, and it's been floating around the surface of the earth for billions of years. And so, that's very hard, resistant rock.

So, the areas that I spent a lot of time in the summers canoeing when I was a kid, and then the area around where I went to college was just these old, beautiful rocks that have been around for hundreds of millions, if not billions of years, so they carry a lot of history. So, for one of my college classes, we were driving along the side of a country highway and we just pulled off on the side and stepped out, and we looked at this tiny little roadcut where you're able to put your hand on the rock and say, "That rock is 2 billion years old. That rock is older than bones!"

**Aside:** Ahhhh! What? I didn't know any of this. But animals with skeletons didn't exist until about 550 million years ago. And paleontologists now think that the chemistry in the oceans changed, and fish could grab and store more calcium and phosphorus in these things called osteocytes. And then they think the original purpose of these bone cells were to act as batteries for long journeys. So, you might be driving past outcrops and roadcuts of rocks, older than bones! [*hushed voice*] Older than bones.

**Alie:** Are you a bit of a slow poke when it comes to road trips? Do you have to factor in double the amount of time to go on a road trip?

**Schmitty:** Yes, I do love stopping on road trips. [*Alie laughs*] The thing with me that you really have to factor in triple, if not quadruple time, is hiking. Hiking or walking on a beach, I'm always stopping. Just on the beach yesterday, we're at this beautiful Pacific beach, huge ocean stretching off before us, and just this little 20-foot-tall sandy cliff. There was me, looking at the cliff. I was ignoring the ocean behind me.

So, I really have to factor in a lot of time when I'm hiking because if there's a boulder on the side of the road or an exposed cliff face, even if I can't look at it and immediately understand like, "Oh, this is what happened," it's really fun to sit there and interact with it, feel, "What's this rock made of? Are there any fossils in this rock?" Trying to piece together, just standing there moving your hands around, thinking about how did this get to where it is today? Because you know, every now and then I'll be in a parking lot and be like, "Wait, I just gotta look at that rock." [*Alie laughs*]

**Alie:** What about rock tumblers? Do you have a rock tumbler?

**Schmitty:** I don't have a rock tumbler but some people I love very much are really into rock tumbling. I think tumbled rocks are really, really cool. I personally, all the rocks that I have, I prefer to not tumble them because a lot of the times the natural structure of a rock can tell you a lot about it. I think if you're collecting well-sourced rocks, I think tumbling can be a great thing to do. There's a lot of really cool textures that you can only see through rock tumbling. So, I think that's a great activity as long as you have something soundproof to put it.

**Alie:** I bet it's very loud.

**Aside:** A rock tumbler, quick aside, is a hollow drum, it looks kind of like a coffee can, that you put in raw rocks, some water, and some polishing grit, which is usually silicon carbide, which is a 9 to 9.5 in the hardness scale, compared to a 10 of a diamond, pretty hard. The rocks churn in that and the water for a few weeks, and they come out smoothed and shiny. But it's not easy on the ears. [*loud rumble*]

And fun fact, not that fun, but because of ethical issues sourcing diamonds, a lot of people these days are choosing a stone called moissanite for engagement rings. Moissanite is a type of silicon carbide, it's really pretty, it's really hard. Silicon carbide is also used in rocket engines and as semiconductors in LED lights, and for bulletproof vests. So, it's a stone so tough it provides safety in love and war, I suppose.

**Alie:** What about myths? What is a piece of flimflam that you need to bust about rocks?

**Schmitty:** Oh gosh. Not necessarily a rock piece of flimflam, but something that's very personal to me for my research, is this is a very large piece of flimflam, but anthropogenic climate change is real. [*Alie laughs*] I just can't not take this opportunity to say that. But part of my research, for the rocks that I study, I use a lot of math and I use computer models, and I also use all of these ancient shorelines around North America to study how our climate has changed in the past.

And that's one myth I really want to bust is that a lot of people will say, "Climate has changed in the past, temperatures have fluctuated. We've warmed and we've cooled in the past, so that means our warming today is not a problem." If you look and compare, the amount and rate of warming that's happened naturally in the Earth's history, a lot of the stuff that's really natural is very slow and gradual and it'll take thousands of years to warm up a couple of degrees. And so, what we're seeing today is absolutely not natural. And we have had some times in Earth's history where the climate has changed really rapidly and that's always been a bad thing, that's never been good.

**Alie:** That makes plenty of sense.

**Schmitty:** I can't not take this opportunity to talk about climate change.

**Alie:** I wonder, speaking of Sunday morning coffee and philosophy, there must be people who are like, "Welp, we grew here and we're destroying it and that's all part of nature." You know what I mean?

**Schmitty:** Yeah, I think they're right, humans are natural, we're part of our environment and we grow out of our environment. But in terms of our impact on our environment, one really important thing to think about is our responsibility to the planet around us. We are part of all of these communities: community of people, community of animals, community of plants, we're in community with the rocks around us. And we have a responsibility to take care of the planet and, decidedly, the carbon emissions that we're putting into the atmosphere are not taking care of the planet. So, we have a responsibility to ourselves, to the world around us, and to our children, to the people that are going to be here ahead of us to take care of our planet because we live here.

You're not going to never vacuum your house, [*Alie laughs*] you're not going to never dust, you better do your dishes, and so we need to be responsible citizens of this Earth and we have... We take care of other humans, and we need to take care of the planet we're living on.

**Alie:** That's a beautiful way to look at it. I love the idea of people who proudly, like, roll in coal, like, proudly filthy. No one would be like, "Look at how dirty my toilet is." [*laughs*]

**Schmitty:** Yeah exactly, it's a weird comparison.

**Alie:** It's a weird flex.

**Aside:** And for more on this, see the frequently cited 2010 paper, "Climate change, human rights, and moral thresholds." If you ask yourself, would I stab a million strangers? And the answer is "No," then all of us joining forces to combat global warming trends is within our scope of morality.

Now, are we smart enough to save ourselves as a species? Well, I dug around looking at the Drake equation which calculates how many trillions of planets might be sustaining millions of intelligent civilizations, and found that Frank Drake just passed away last week, September 2, 2022. So, we have a little less intelligent life on this planet.

But then there's the Fermi paradox, which is the great question of, if there are so many potential aliens, [*echo effect*] *where is everybody*? And one hypothesis is called the Great Filter which basically says, once a civilization gets too advanced, it meets a barrier of some sort which makes its detectability very rare. Essentially, our big brains snuff ourselves out.

And we did a whole episode, the Astrobiology episode touches on this, but there's also an article on NASA's astrobiology page, casually titled, "Do Intelligent Civilizations Across the Galaxies Self-Destruct? For Better and Worse, We're the Test Case." And it's about this Great Filter idea and it mentions the work of David Grinspoon, a planetary scientist and the former Astrobiology Chair and the Library of Congress, who sees humans as, "The planet's most powerful and consequential force of nature." But marveling at our surroundings and appreciating them may be the key to saving it all.

**Schmitty:** That's one of the beautiful things, I think, about studying geology is when you can pick up this rock and be like, "Well, this rock is 2 billion years old, I'm 25 years old." Learning to think on that timescale and really understanding just how, in terms of the history of our planet, how small we are, it can be at times deeply eerie, but for the most part very reassuring to feel like we are a small step in a *long* story that's been ongoing for 4.5 billion years.

**Alie:** I'm sure that that gives you so much perspective about just, in terms of like the cut bangs, text your crush... this thing has been around for billions of years, we've got maybe 70, 80, you know, might as well just do your thing but... Can I ask you questions from listeners?

**Schmitty:** Absolutely, please do.

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So, ask rock people hard questions and then go stare at the driveway because the world is a tough but a glimmering place, like a rock. And Schmitty Thompson is not on social media because they are smarter than me, but they will be back next week for Part 2, answering your rock questions. Their bio is in the show notes, and if you attend Skype a Scientist After Hours Trivia for adults on Thursdays at 8 PM Eastern, you will see them there a lot. Link on my website for that plus so much else that we talked about at AlieWard.com/Ologies/Geology.

I'm @AlieWard on Instagram and Twitter, *Ologies* is on both @Ologies. *Smologies* are shortened, G-rated episodes, suitable for kids and all ages, those are up at AlieWard.com/Smologies, linked in the show notes. OlogiesMerch.com has hats, and totes, and sweatshirts, all kinds of goodness. Thank you, Susan Hale, for managing that and so much more. Noel Dilworth does our scheduling. Erin Talbert admins the *Ologies* Podcast Facebook group, with assists from Boni Dutch and Shannon

Feltus of the comedy podcast, *You Are That*. Emily White of The Wordary makes professional transcripts, Caleb Patton bleeps episodes, and those are up for free on our website at AlieWard.com/Ologies/Extras. Zeke Rodrigues Thomas and Mercedes Maitland of Mindjam Media edit *Smologies*. Kelly R. Dwyer helps with the website; she can design yours and her link is in the show notes. Nick Thorburn made the theme music. And the lead editor is the mystical man, Jarrett Sleeper, of Mindjam Media as well.

If you stay long enough you will hear a secret and this week's is that Gremmie got a molar extracted yesterday and without me even having to ask, the vet gave it to me in a small glass tube and I was so thrilled. It's in three chunks with these long roots. Do I make earrings? Do I make a necklace? Do I fabricate some kind of magic dog wand that manifests cheese? I don't know. But her tooth is like a Pegasus feather to me and I will forever treasure it. Okay, go stare at a rock. Berbye.

*Transcribed by Aveline Malek at TheWordary.com*

**Links to things we discussed:**

Donations went to Mindat.org and Skype a Scientist

Schmitty's bio

Schmitty's published papers:

A Global Database of Marine Isotope Stage 5a and 5c Marine Terraces and Paleoshoreline Indicators

3D MANTLE VISCOSITY STRUCTURE IN GLACIAL ISOSTATIC ADJUSTMENT MODELS RESOLVES DISCREPANCIES IN MARINE ISOTOPE STAGE (MIS) 5A AND 5C GLOBAL MEAN SEA LEVEL PREDICTIONS

Skype a Scientist After Hours Trivia for Adults

Squid Stickers!

USGS explains metamorphic rocks

Cat-eye marble road sign

More history on cataphotes

Losing one's marbles

Some marble history

The Volcano Eruption in 4K HDR | Jurassic World: Fallen Kingdom

Trailer for The Wave

You can watch The Wave (but with ads) via YouTube

Bocquet, L. (2003). The physics of stone skipping. American Journal of Physics, 71(2), 150–155.

2016 Stone-skipping documentary "Skips Stone for Fudge"

2004 paper in Nature, "Secrets of successful stone-skipping"

Swift Stone Skippers Could in Theory Skip 100s of Skips

Bone metabolism and evolutionary origin of osteocytes: Novel application of FIB-SEM tomography

More on YaraHaridy: Sassy Palaeontologist

This guy tumbles a lot of rocks!

The work of philosopher Simon Caney

Climate change, human rights, and moral thresholds

Ultimate disintegration products of the radioactive elements; Part II, Disintegration products of uranium

Biographical Memoir Of Bertram Borden Boltwood 1870-1927

Mother Jones: An Updated Lead-Crime Roundup for 2018

Large boulder the size of a small boulder tweet

Indeed a large boulder sized small oopsie

MinDat.org

Cummingtonite

Silicon carbide aka Moissanite

Petrified wood vs. fossilized bone

Dark crystals: the brutal reality behind a booming wellness craze

Morton Salt Substitute

The Great Filter

Do Intelligent Civilizations Across the Galaxies Self-Destruct? For Better and Worse, We're the Test Case

Glass is a mineral!

Top-Down and Bottom-Up Mechanisms in Mind-Body Medicine: Development of an Integrative Framework for Psychophysiological Research

2009 Stone Skipping Professionals piece on CBS

Mining in Madagascar

Crate and Barrel Petrified wood cheese board

Glacier ice: a mineral?

Ice and minerals, cont.

Prospecting geodes

Rainbow Forest

More photos of the Petrified Forest National Park in Arizona

Rhyolite spherulites aka THUNDER EGGS

Geode vs Thunderegg

"No progress in diversity in 40 years"

Barriers to fieldwork in undergraduate geoscience degrees

Protecting BIPOC scholars in the field