Flying Shingle, February, 2008: Dear Editor: Texada Goop-Let it weather, 36(3), p.3

[Note: the assertion that the goop is mainly "limestone" turned out later to be not entirely accurate. It contains a curious mix of limestone and carbonate minerals, mainly calcite, but also marble, dolomite, magnesite, and siderite. What was thought to be limestone chips turned out on closer inspection to be igneous rock fragments (granodiorite type) coated in carbonate. The figure for the total quantity of limestone/carbonate in the mix given in this article is therefore much too high. Practically all of the article remains valid nevertheless because limestone on Texada is the ultimate source of the carbonate, and it is the combination of carbonate and clay that causes most of the trouble.]

Dear editor

These are exciting times for geologists who study Gabriola's roads. Not only are there faults in the blacktop to study, but now a whole new field of enquiry has been opened up. I refer of course to the geochemistry of the roads—to the discovery of Texada Goop.

Now, I don't live on an unpaved road, so I have no overwhelming reason to get too upset about the mess it makes. But if I did, I would, and then I think there's a good chance that during the day I would have to reach in my pocket for a pill. An antacid pill—a Rolaid, a Tum, or something like that, to settle my stomach. And what's ironic about that of course is that Texada Goop comprises mostly calcium carbonate, with maybe a little magnesium carbonate thrown in, which is exactly what antacid tablets are. Calcium carbonate is actually good for us. It makes bones and useful parts like that. The sea is saturated with it, which is why we have things with calcium carbonate shells like clams and oysters. It's also why the sea is alkaline rather than acidic. If it were acidic, the calcium carbonate would dissolve and the shellfish would all be naked. So what is it with the limestone, which is mainly calcium carbonate with a little magnesium, that, when labelled "Texada Goop", it causes so much trouble? Chipped limestone is after all widely used on driveways, and most yards that carry sand and gravel have some for sale.

When Randy Young first pointed it out to me plastered (good word, as you'll see) on a car in the ferry line-up last summer, the answer was obvious. It is because the limestone is mixed with clay (not sand, which is different both physically and chemically), and there is some delightful evidence on Gabriola that limestone, or in this case the chemically-identical mineral calcite, mixed with clay forms a kind of hydraulic cement, which is a cement that swells as it sets instead of shrinks, thereby filling cracks that might cause leaks. A similar chemical is calcium sulphate, better known as "Plaster of Paris". Hydraulic cement seals in moisture, including salty water if that's on the road too, and it might be that this property of the goop causes the reported corrosion problems and maybe even the health ones too if it traps bacteria, because limestone by itself is neither corrosive nor toxic.

Clay and limestone rarely go together in the natural world because limestone is the fossilized remains of seashells. There's seldom any clay along with it, because in calm tropical waters, there is no mud, which is what clay is when it's in the water. The Texada limestone formation is geologically a part of Vancouver Island (Wrangellia) and it overlays what was once a shallow submarine lava plateau----the very same plateau that was brought here from south of the equator and shoved up against North America to form, among other mountains, Mount Benson. The limestone is about 200-million years old (late-Triassic).

To see for yourself a natural form of hydraulic cement, go down to the beach below the Community Cemetery. There you'll find everywhere, calcite nodules that have eroded from the shale cliff. They're brownish in colour and quite heavy because they contain iron and manganese. Break one open and you won't see much beyond a greyish featureless interior, made of clay, calcite, sulphides, and silt. Not very exciting, but look on the outside and you will often see a fascinating snapshot of life at the bottom of a stagnant sea, seventy-million years ago. Worm trails and borrows are beautifully preserved on the surface of the nodules. The nodules themselves were formed from the bodies of the giant clams that once lived here. These particular clams were buried in submarine landslides at the estuary of a great river. There they died, attracting all sorts of wormy scavengers, and as the organic material decayed, it formed calcium carbonate, which, because it was mixed with mud, swelled as it lithified forming a plaster cast of the walls of the giant clams' graves.

Now fast forward from last summer to a few days ago. Very confident that I knew what the goop was, I set out to measure the acidity (the pH) of the water in a few pothole puddles. It's very easy to demonstrate that a rock is limestone or calcite. You add a little vinegar to it (or hydrochloric acid if you're a geologist) and it fizzes as carbon dioxide is released from the carbonate by the acid.

In the natural world, calcium carbonate in water is dissolved by the carbon dioxide from the atmosphere, but as the carbonate dissolves it neutralizes the acid arriving at a happy balance point with a pH of about 8.2 (neutral de-mineralized water has a pH of 7.0). I stuck my meter in a puddle and watched the reading climb. 7.1, 7.4, 7.8, 8.2 ... ah! hah!, but wait .... 8.4, 8.7, 9.1. It finally stopped at 9.2. That's not dangerously alkaline, egg whites have the same pH, but it is higher than expected. So what gives? My confidence shaken a bit, I scooped up some of the goop (no, not enough to make another pothole) and collected some of the surface water, but enough to look at under the microscope and run some chemical tests.

After washing away the clay (the grains of clay are too small to analyze with a regular light microscope) and drying, I sorted the gravel mix that was left. A few of the grains were exciting for someone who rarely leaves Gabriola these days---magnetite, ilvaite, along with obsidian and epidote and patches of rutile on quartz. By I digress, these minerals are harmless and my scoop contained very few of them. In summary, about 72% of the mix was limestone and crystalline calcite, and the rest was equal proportions of fine-grained volcanic rocks including greenish basalt that probably contains olivine (I'm not very good at green rocks) and coarse-grained quartz-rich intrusive rocks with lots of pink potassium feldspar. All quite ordinary in the larger scheme of things. These are not minerals that are going to leap up and shred your tires; chipped carbonate rocks are in fact softer than your average river gravel, even though the chips are not so well rounded.

After a sleepless night or two, the solution to the pH problem occurred to me. At a high pH, the form of dissolved calcite changes from bicarbonate to carbonate, and sodium carbonate (washing soda) is very soluble and quite alkaline. If someone has been putting salt (sodium chloride) on the road, the pH will go up because some of that sodium ends up as carbonate. I put calcite in a glass of water, measured the pH, and then added a pinch of salt. Low and behold, a pH of 7.8 before adding the salt, became 8.7 after adding it. Salting goopy roads evidently makes it even more alkaline. [the "salt" it was later discovered is actually calcium and magnesium chlorides, used for dust control. Sodium chloride for de-icing is not used on unpaved roads, though some may run off driveways.]

Goop in drinking water? Clay by itself is harmless—though I believe it's a laxative--talk to Tracy or Will at the Pharmacy—and clay adsorbs heavy metals. In our rural setting, and with bedrock devoid of heavy metals other than harmless iron and manganese, I'd guess that the clay isn't harbouring high concentrations of anything nasty; however, if goop from the road surface is reaching your well, it's possible other stuff is too. You can flocculate clay using alum, which your dinner guests and well pump might appreciate, but again, you might want to talk to Tracy or Will about the healthiness of doing that. Personally, I believe (something real scientists don't do) it's safer to drink cloudy Gabriola water than drinking off-island water that's been soaking in plastic for weeks.

What is the clay? Give me some dollars and I'll find out. Meanwhile, I'll just say, it's white when filtered, forms translucent crystals, and is very sticky. Given that there is little feldspar in the mix, and even less biotite or amphibole, my guess is that the clay does not come from weathering, but is instead bentonite. That's volcanic ash to you. It makes sense that now and again in the environment where the seashells developed, there would be a volcanic eruption near-by from time to time resulting in thin layers of mudrock or shale in the limestone.

What to do about it? Well, if all my speculation is right—and I'm very willing to have the holes in my theory exposed—the simple solution is to weather the stuff before it's used. Like good firewood, it has to be seasoned. A year in the rain will wash away the volcanic ash and what's left will be common or garden fill like you see everywhere. A simple solution, and quite cheap.

Sincerely
