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Errors:
The article suggests that green colouration might be due to *olivine*. While true, it is perhaps more common for basalt on Gabriola to contain the mineral *chlorite*, which is also green, as a result of weathering.

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This is Version 4.9, the final version.

So, what colour is basalt?—stones on Gabriola Island's beaches

When you crack open a *basalt* pebble or cobble, what you usually see is a dark-grey, featureless, fine-grained rock; however, some stones may be dark greenish-grey, dark bluish-grey, or even olive green inside. Be careful by the way, *basalt* is hard and heavy, so hitting it can be dangerous.

The components are tiny crystals, mostly of *pyroxene*, which is black, sometimes with a faint greenish tinge, together with crystals of calcium-rich feldspar (*plagioclase–anorthite*), which is white or colourless. The greener stones probably contain crystals of *olivine*.

Some *basalt* looks glassy on the surface, even when dry. This is because it is the result of an underwater eruption and the skin of the pillow lava was cooled extremely rapidly.

Gabriola Island has no volcanic bedrock or intrusions, so all the *basalt* stones and boulders you see on the beach were brought here by glaciers, most likely from Vancouver Island (Karmutsen Formation). Even though *basal*t is much harder than sedimentary rocks, you can sometimes see grooves and scratches on the stones that were likely created while it was being transported by a glacier.

Many of the *basalt* pebbles have acquired a thin weathering rind that can have one of several different colours. The most easily recognized are jet-black, particularly when wet. Because of the fine grain, they look very polished and attractive. Other colours however are common and effectively disguise the colour of the interior. The rind on *olivine-basalt* can be either lighter or darker than the interior, and more distinctly green, but this is not always so.

Presumably the reds, browns, oranges, and purples are the result of weathering of the *pyroxene* to release iron oxides. The whites occasionally have a *calcite* crust, but most show no reaction at all to acid. Some whitish rinds are quite hard, but others have a chalky texture. A comment on this was generously offered by Andrew Alden who runs his own geology website. He remarks:

In thin sections [of the rind] you'll see remnants of the primary minerals and a lot of mostly phyllosilicates—micas, clays, ..etc....plus whatever the minor sulfide and oxide minerals turn into, which would be small portions of sulfates and the iron minerals *goethite* and *hematite*. You'll see some void space. The main primary mineral in the rind is *plagioclase*, which is the most weathering-resistant species in the average basalt.

Not all mixed colours are due to weathering. They may have been formed much closer to the time the rock was formed by successive lava flows, mixing within the magma, or intrusion of *basalt* into older rocks, but if the rind completely encases a pebble, weathering is of course the most likely cause. Another possibility on Gabriola Island however is, because there are often middens at the tops of beaches, the particular stone you are looking at may once have been in a fire. Fires tend to turn local rocks red because of the production of *hematite* from the darker coloured iron oxides. Yet another possibility on Gabriola is that a surface colour is a stain, possibly resulting from prolonged immersion in mineral-rich groundwater. Some of the reds, like the one shown above, closely resemble the colour of the skins of those beautifully rounded *quartzite* cobbles you see in the conglomerate bedrock.

For anyone doubting that the rocks shown in the pictures are all *basalt*, all I can say is you might be right; however, all have a hardness of 6 or 6+, are fine-grained, had no phenocrysts when cracked open (although lots on the beach do), did not fracture conchoidally, and are not clastic.

Perhaps the safest answer when asked while walking the beach "what kind of rock is this?" is simply to say, after some deliberation of course, " it's volcanic". On Gabriola though, you have to be careful not to confuse *basalt* that has an orange rind with the calcareous nodules found in shale on Whalebone beach and at False Narrows. These look similar, but they react vigorously to acid, are softer, break more easily, have a smooth flint or chert like texture inside, and commonly have trace fossil on their surface. These aren't *basalt*, they're calcite-rich nodules, fossil remnants, usually of late-Cretaceous inoceramids.

References: S.J. Gordon & R.I. Dorn, *Rind weathering*, entry in A. Gould (ed.), *Encyclopedia of Geomorphology*, 2, pp.853–855, Routledge Ltd., 2004.

Andrew Alden's basalt site: http://geology.about.com/od/more_igrocks/ig/basalt/index.01.htm