Context:
Geology, Gulf Islands, sandstone, cavernous weathering

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Doe, N.A., The Malaspina Galleries, *SHALE* 9, 2d ed., pp.53–56, August 2004.

Errors and omissions:
This is the unpublished 2nd edition which mentions that the fractures are not vertical.

References:

Doe, N.A., What makes holes in sandstone, *SHALE* 9, 2d ed., pp.12–40, August 2004.

Doe, N.A., The geometry of honeycomb weathering of sandstone, *SHALE* 26, pp.31–60, November 2011.

Doe, N.A., Australia's Wave Rock and Gabriola's Galiano Gallery—salt weathering *SILT* 5, 2012.

Doe, N.A., Salt-weathering of upper Nanaimo Group sandstone, *SHALE* 23, pp.35–56, March 2010.

Doe, N.A., Holes in sandstone at great heights, *SHALE* 22, pp.32–33, January 2010.

Doe, N.A., Windy New Mexico, *SHALE* 22, p.33, January 2010.

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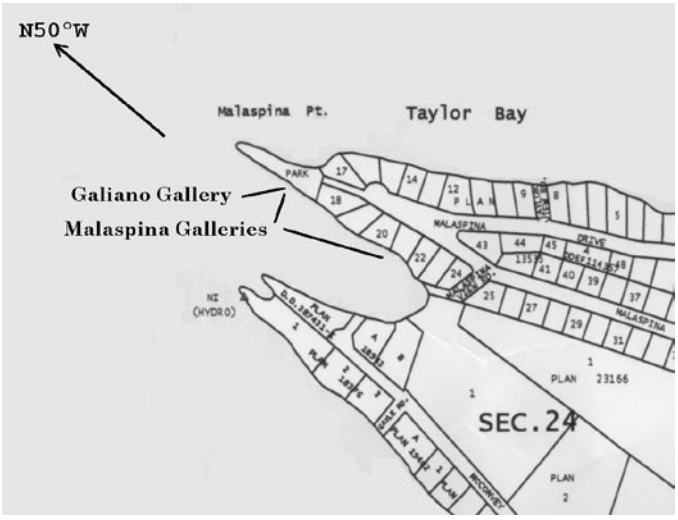
The Malaspina Galleries

by Nick Doe

The Malaspina Galleries, the largest of which is officially known as the *Galiano Gallery*, are Gabriola's most famous honeycomb holes, but misconceptions, both geological and historical, about them abound.



Adapted from RDN GABRIOLA ISLAND legal base map

For example, they are *not* in the Gabriola Sands Provincial Park (they're in a Regional District Community Park); they *weren't* used by 18th-century Spanish explorers to cache goods (they were explorers, not swashbuckling buccaneers); they were *not* sketched by either Commander Galiano or Admiral Malaspina (Malaspina was never anywhere near the place, and if Galiano did see them, he says not a word about them in his diaries); a drawing of them by José Cardero in 1792 was *not* found in a trunk in an attic in Madrid (Cardero's original has been lost; the engraving most people are familiar with is by Bartolomé Maura and is based on a painting by the Malaspina expedition's Italian artist, Fernando Brambila. Neither Maura or Brambila ever visited British Columbia); the galleries, interesting though they are, are *far* from being unique (you can see a similar formation directly across the water from the parking lot at the ferry terminal on Gabriola); the galleries were *not* formed by the wind and the waves (if they had been, there would be barnacles all over the back wall; surf everywhere in winter; and you'd hardly be able to stand up in them because of the wind); they were *not* carved by frost (if they had been, they would be far more common on the north side of islands); they are *not* made of limestone (they are a sandstone formation, unusual in the Gulf Islands only in as much as they are bigger and more accessible than most); and they were *not* formed eons ago (weathering and erosion is on-going as is made perfectly obvious by the gradual disappearance of the graffiti on the backwall). What is true is that they were used by the Snunéymux[w] for cave burials, but these were shamelessly vandalized by early settlers.[1]

While we're at it, we may as well deal with those little honeycomb holes too. One admittedly attractive idea is that "rock bees do it", presumably at night when nobody is looking.[2] An interesting variant of this theory, worth a couple of points, is that the holes are the burrows of ancient molluscs, only now being revealed to the outside

[1] Lillian Gustafson & Gordon Elliot (ed.), *Memories of the Chemainus Valley*, p.56, Chemainus Valley Historical Society, 1978.

[2] *WaveLength*, June/July 2001.

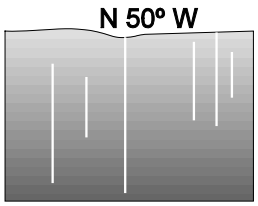
world by the erosion of the rock.[3] Trouble is, there are hardly any fossils at all in the sandstone, yet alone the remains of legions of molluscs. Perhaps, they all left home, *Mary-Celeste* style, in a great hurry—or maybe they were immortal molluscs.

Another theory is that the holes were formed by escaping gases when the rock was molten. Although a good thought, unfortunately, sandstone just wouldn't be sandstone if it'd ever been hot enough to melt. It's sedimentary rock, not igneous; it's never been anywhere near a volcano.

Anyway, enough! I'm just glad I don't live in Newfoundland or Ireland or I'd be here all night. I think the straight-up, conventional, middle-of-the-road, "old-age", possibly-boring-but-I think-true explanation for the galleries goes something like this.

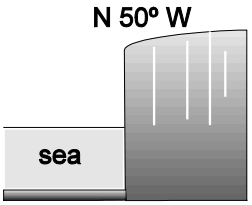
The galleries are formed from late-Cretaceous rocks, about 70–65 million years old, and consist mainly of massive (unbedded) sandstone, but with some thin layers of mudrock (lithified silt and clay).

After deposition of sediment ceased, but more than 40 million years ago, the rocks were folded and fractured, as were all of the rocks that make up the east coast of Vancouver Island. The main fractures (there are many minor ones) are *longitudinal fold fractures* and they run N 50º W parallel to the central axis of a ∪-fold (syncline) in Gabriola's bedrock. I'll draw them vertically though they are in fact slightly inclined. Such fractures form remarkable "tramlines" on the beaches, creating the



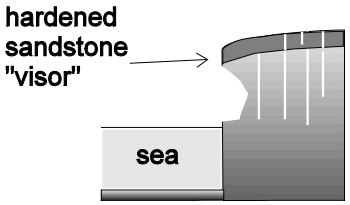
impression that there has been an earthquake here recently. You can see them at the galleries if you walk out to the end of Malaspina Point, or look on the beach on the Taylor Bay side of the point.

Sometime, most likely in the last million years, a glacier removed a large "sliver" of this fractured sandstone. This created the bay between McConvey Road and Malaspina Drive in which the Malaspina Galleries are found today. The "bay"



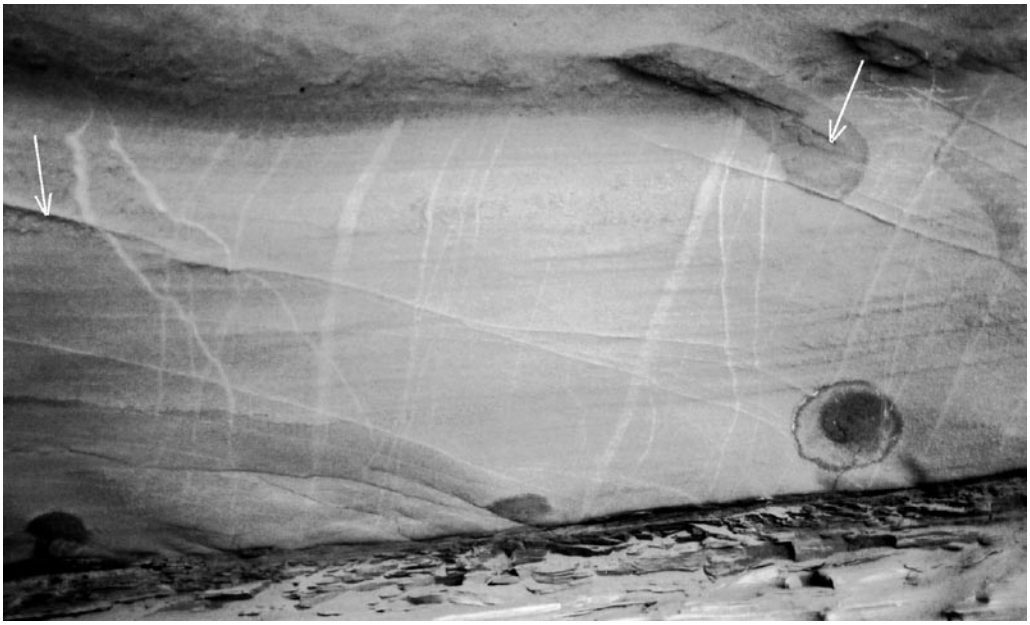
actually extends a fair distance inland in the form of a wide gully, filled with clay and glacial debris—now the home of alder groves and secret gardens.

After the glaciers retreated, minerals in the sandstone (mostly *biotite*) were weathered by oxygen and water to form a "case hardened" layer on the surface. The "case-hardening" is produced by iron oxides (known as *limonite*, which can include *hematite*, *ferrihydrite*, *goethite*, etc.) that

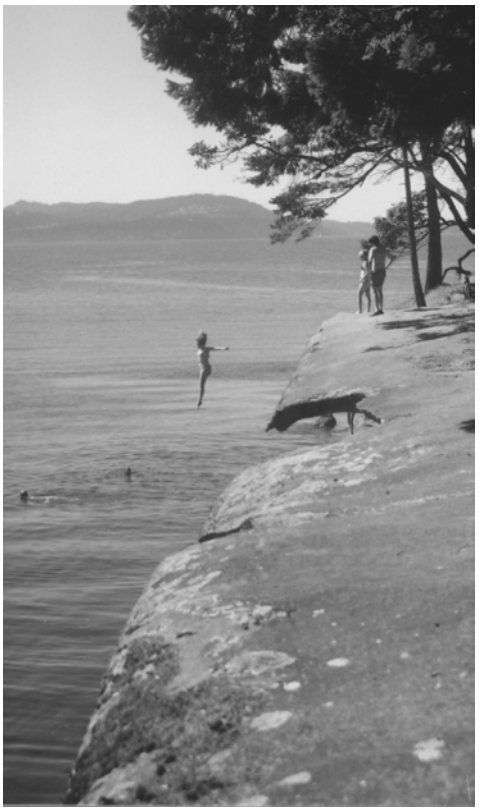


cement the grains more firmly than in the original sandstone. The thickness of the layer was determined by how far rainwater could seep into the rock driven by surface tension. Sandstone acts rather like a sponge because of the gaps between the grains, which is why it is much slower to dry out in the sun than granite.

[3] Stephen Gehlbach's suggestion. This is not as wild an idea as it sounds. Piddocks bore lots of holes in shale, and they must have had a hand in forming False Narrows because, below tide level, they are abundant. John W. Evans, *The role of* Penitella penita *as eroders along the Pacific Coast of North America*, Ecology 49, 1, pp.156–159, Winter 1968.

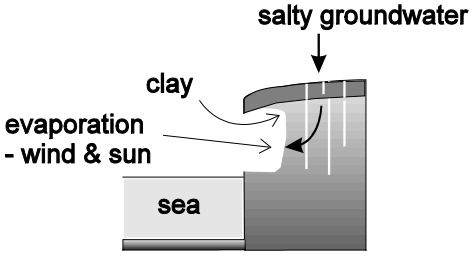


Above: the backwall of a gallery in Descanso Bay. The part shown measures roughly 3 × 6 feet and the picture has been processed to make the white "veinlets" more visible than they actually are. The veinlets are partially "healed" fractures in the sandstone. The white coating of the grains in the veinlets appears to be *calcite* and *zeolite*. Note the "thick-lip" weathering (*arrow* upper left edge, and a thicker example, *arrow* top, middle right). This is a sure sign of the presence of water in the fractures, and not necessarily in the distant past as claimed by some observers.



Above: Inland of the Galiano Gallery, seen here on the far left, are a series of smaller galleries (caves). These were used by the Snunéymux^{w} as an ossuary, but possibly only for people killed in battle or by disease. They were ξ<é' ξ<ε, a word often translated as "sacred", but also meaning "something forbidden", "a source of danger or power", or "something out of the ordinary".

Left: the main gallery's "visor". The near vertical alignment of the outer edges of the roof and the floor of the gallery below make the roof a popular diving board.



Erosion of the sandstone underneath the visor is due to salty groundwater (rockwater) seeping out through minor fractures from the vertical fractures in the sandstone, and leaving salt deposits on the backwall. The salt de-cements the sandstone by "attacking" the clay minerals in the matrix that hold the unweathered sandstone together. Although nobody is exactly sure (at least I'm not), the "attack" is most likely the result of pressure exerted by the expansion of salt crystals that form as the water evaporates.

The loosened grains of sand drop away, leaving behind the clay. You can see it on the inside roof of the galleries. Horizontal transmission of rockwater to the erosion surface is aided by the thin beds of mudrock in the sandstone. These are relatively impervious, and so tend to prevent the water just running away to below sea-level through the fractured sandstone.[4]

The floor of the galleries, which is sandstone, is protected from this type of salt erosion by being regularly washed by the sea. The honeycomb holes in the floor are probably due to a combination of wetting by wave splashes at high tides (which in the Strait of Georgia occur mainly at night in summer), and drying out in the sun during the day (when summer tides are low).

In places, the roof of the gallery droops down, almost as if it had melted. This is a small portion of the original outer surface of the cliff face.

Graffiti on the backwall was originally painted on. Initially, the paint protects the surface from de-cementation, but once the graffiti is standing proud of the surrounding sandstone, rockwater no longer moves to the graffiti surface and so it remains relatively uneroded, even after the paint has gone.[5] The erosion rate of the backwall is somewhere between 0.5–3 mm per year, which, given that it is now over five metres deep in places, implies an age of a few thousand years.

Eventually of course, the roof of the Galiano Gallery will collapse; however, the building of houses on top of the galleries inland from the main gallery has changed the natural flow and composition of the rockwater, and hence the erosion rate, but to what effect is uncertain. Another factor is that, as can be seen in the main gallery, some of the faces of the internal vertical fractures have acquired a "case hardened" layer just like the roof, presumably because they are such good groundwater conduits. This could conceivably slow down the erosion. Or, on the other hand, it could create new erosion patterns for future Gabriolans to make up new and wonderful stories about. ◊

[4] Sandstone on Gabriola is always fractured and is made relatively permeable by such fractures. The vertical passage of groundwater is slowed when either mud (clay) clogs the fractures; the fractures terminate in a dead end; or the sandstone overlays a bed of mudrock. This is, of course, why putting a septic field in sandstone immediately above an unconfined aquifer is not a terribly good idea.

[5] Digby Jones recalls that before the war, the names of tugboats—*Goblin* was one—used to be painted on the rocks at their tie-up points on Tugboat Island in Silva Bay. Because the names were regularly re-painted, they grew very proud of the erosion surface. Some stood out as much as 4 inches (100 mm) he estimates, and years later, after the tugboats had gone, there were narrow ridges standing out even higher, although by then, they were unreadable.