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Geology of the Palisades
Washington
Palisades Organization
Miller
Licensed Geologist #109

Introductory
Spokane,
Prepared for
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State of Washington
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The cliffs of Spokane's Palisades face east over the city in this view from Rimrock Drive. Summits of Mica Peak crest to the east. Other vistas from the Palisades include Mount Spokane and the valleys of Spokane River and its tributaries.

Location and Access
This study was to the west of Spokane and to the east of Airway Heights. Indian Canyon was near the south end of the study area. The study included public land in parts of sections 15, 22, and 23, T. 25 N., R. 42 E.

Access roads to the study area include Rimrock Drive, Basalt Road, Bonnie Drive, Elliot Drive, Indian Canyon Drive, and Greenwood Road. Historic Cooper Way Trail and Baker Trail are additional access in section 15. Burlington Northern Santa Fe Railway parallels the east side of the study area, and Grove Road lies outside the west side of the study area.

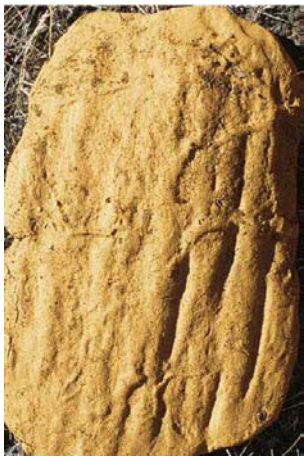
The Basalt
The Palisades are steep basalt cliffs that are locally vertical to overhanging. The basalt rock layers that form the cliffs are part of the wide Columbia River Plateau. Earlier reports, such as those by Pardee and Bryan (1926), Weissenborn (1955), and Griggs and Swanson (1976) describe these basalt rocks.

The basalt rocks of the rimrock are typically massive, uniform, and fine grained. Freshly broken basalt was gray, and the weathered basalt was observed to be generally gray, brown or yellow, occasionally tinted green and orange by moss and lichens. Small, rounded, bubble-like voids, **vesicles**, were seen to be locally conspicuous in the basalt layers.

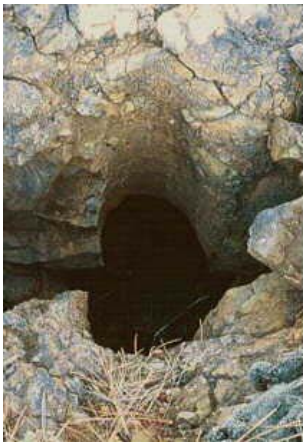
Some larger voids, measured in inches and referred to as **vugs**, were noted to have rounded tops and flat or domed floors. Voids like these are ordinary features in volcanic rocks.

Pillow basalt crops out at the Palisades study area in addition to the massive variety of basalt along the rimrock. The bulbous, oblong pillows were seen in bluffs along Indian Canyon below the falls and along the east side of the study area. Some of the

individual **basalt pillows** were several feet across. The pillows had a typical, thick, rough skin of black, basaltic glass. Cross sections of some of the pillows displayed fan-like fracture patterns, and some of the pillows were hollow. Silt, sand, and chips of basaltic glass filled spaces between some pillow masses. Clay and yellow to brown, iron-bearing minerals formed around the pillows and in their matrix. The basalt pillows stood out in relief. These pillow basalt accumulations merged into more massive basalt. Basalt pillows are common throughout the Columbia River Plateau where the molten basalt lava had flowed into a watery environment.



An upright, flattened tubular hole was seen in the old pillow basalt at the Palisades. The hole was interpreted to have been an impression of **a tree trunk or limb** in the once-molten lava. The impression, exposed by a vertical fissure, was about nine inches across. **Lengthwise patterns** on the wall of the cylinder were about a foot long, an inch across, and a quarter of an inch in relief. A rind of glassy basalt several inches thick surrounded the impression. Yellow-brown, iron-containing minerals formed and colored this rind and the surrounding basalt. Also, thin patches of clear, glassy silica coated the pillow basalt around the cylinder. Casts of trees, or tree molds, are locally common in the basalt rocks of the Columbia River Plateau. At left is a clay cast of the interior of the hole.



Sediments and Sedimentary Rocks

Ancient lakes, rivers and glacial-age floods hosted emplacement of relatively large volumes of sediments and sedimentary rocks at and near the Palisades according to earlier reports. Prominent topographic benches of sediments and sedimentary rocks are visible to the east along Spokane River and its tributaries. Similar accumulations of sand, gravel, silt, and shale lie in benches and slopes below the rimrock of the Palisades and along Indian Canyon. (Pardee, 1910; Pardee and Bryan, 1926; Bretz, 1959; Molenaar, 1988 p. 8-15, figures 5-10).

Sandy sediments were well exposed at the locality called the sandpit and along the grade of Greenwood Road on the north side of Indian Canyon. Sparse pebbles, cobbles, and boulders of angular to well-rounded granitic, quartzite, schist, and basalt rocks were noted in sand at the sandpit. Shale was seen along the floor of the sandpit. Alluvium containing granitic boulders was noted west of Elliot Drive along a lower bench beneath the rimrock.

Erratic Stones: Ancient, glacial-age lakes and spectacular, scouring floods that influenced geology in the Spokane area long ago are described in reports by Pardee (1910), Bretz (1959), Molenaar (1988, p. 10-15 and figures 7-10), and Crosby and Carson (1999). There was evidence related to reports of glacial-age floods topping the bluffs at the Palisades in the **isolated, non-basaltic stones** that lay sparsely scattered about the basaltic rimrock flats.

It was well known that glaciers and their streams could pick up, move, and emplace isolated

boulders and stones like those at the Palisades (Crosby and Carson, 1999, p. 4-6). Some of these displaced stones at the Palisades were several feet across. A few quartzite stones and many granitic stones were noted. These stones were far away from similar bedrock outcrops. The stones were far from modern-day streams that might have carried and emplaced them, and many were far from roads. Most of the naturally displaced stones were observed to have been deeply weathered. Several of the stones had split, and flakes of rock had spalled off and lay around some stones.

Whereas some of the natural, displaced boulders were rounded, as though by abrasion along stream courses, other stones were angular, as if plucked from bedrock or broken during movement. Additionally, there were angular holes several feet across in flat-lying slabs of basalt west of the rimrock where chunks of basalt had been plucked out. The naturally displaced, isolated stones and indications of plucking from bedrock are pertinent to interpretations of the glacial-age history of the Palisades.

Mima mounds of silty sand were seen on the forested basalt flats west of the rimrock. Earlier reports, such as those of Tallyn (1981) and Berg (1989), describe similar mounds and review ideas about their origins. These mounds were typically tens of feet across and several feet high. Distinctive vegetation grew on many of the mounds. Low circles and arcs of basalt-rock chunks surrounded some of these mounds in a type of **patterned ground**. The basalt rocks in the patterns were notably free of vegetation, soil, and silt and sand. Sandy soil, mounds, and patterned ground such as these are common and widespread throughout eastern Washington.

Summary

Layers of ancient, fine-grained basaltic rock of the Columbia River Plateau accumulated at the Palisades. Some of this basalt showed vesicles, vugs, glass, and pillow structures. The basalt lava had spread into watery localities and engulfed vegetation. Secondary clay and minerals containing silica and iron formed. Weathering, erosional sculpting, and accumulation of sediments, sedimentary rocks, and isolated, displaced stones has taken place here. Earthy mounds and patterned ground developed at the Palisades.

Additional Information

More information pertinent to the geology of the Palisades was found by scanning the Internet for keywords such as "Columbia River Basalt", "Latah Formation", "glacial floods", "pillow basalt", "lava tree molds", "patterned ground", "Mima mounds, "digital geologic map of Spokane County", "U.S. Geological Survey", "Washington State Division of Geology and Earth Resources", and "University of Washington Burke Museum." Many authors had described the region surrounding the Palisades and inferred the history and relations of the geologic features.

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