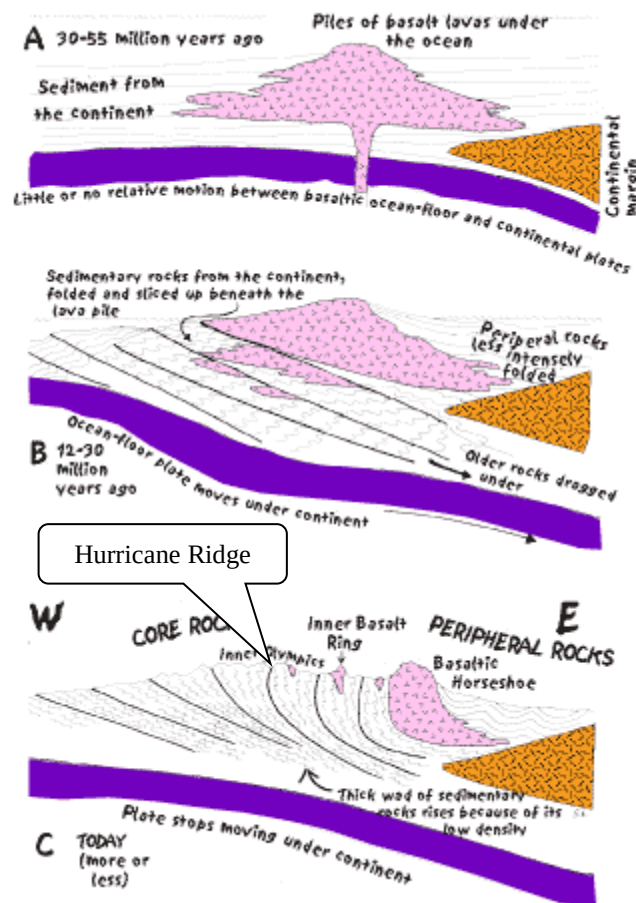


Hydrogeology and Potential Well Construction at Hurricane Ridge

The bedrock formations underlying the entire area in the vicinity of the Hurricane Ridge Visitors Center are part of the “Needles-Gray Wolf Lithic Assemblage” as defined by Tabor et.al. (1972). The assemblage started out as alternating layers of ocean sediments; sand, clay, silt, and mud. As the Earth’s crustal plates collided, the oceanic plate was forced under the North American Plate and some of the oceanic sediments were scraped off the oceanic plate, turned vertically, and stacked against the leading edge of the North American Plate. In the process of this “bulldozing”, the sediments were metamorphosed to sandstone and shale. In the Hurricane Ridge area, these sediments are nearly vertical and the contacts between the sandstone and shale layers form numerous small fracture zones.

The following diagrams illustrate the geologic processes that formed the bedrock formations at Hurricane Ridge.



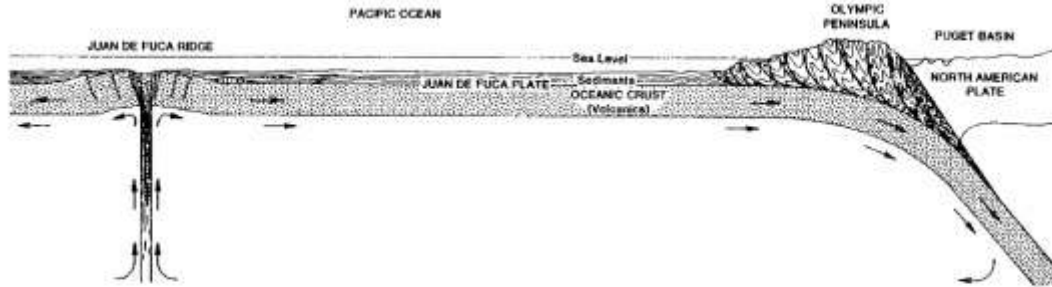


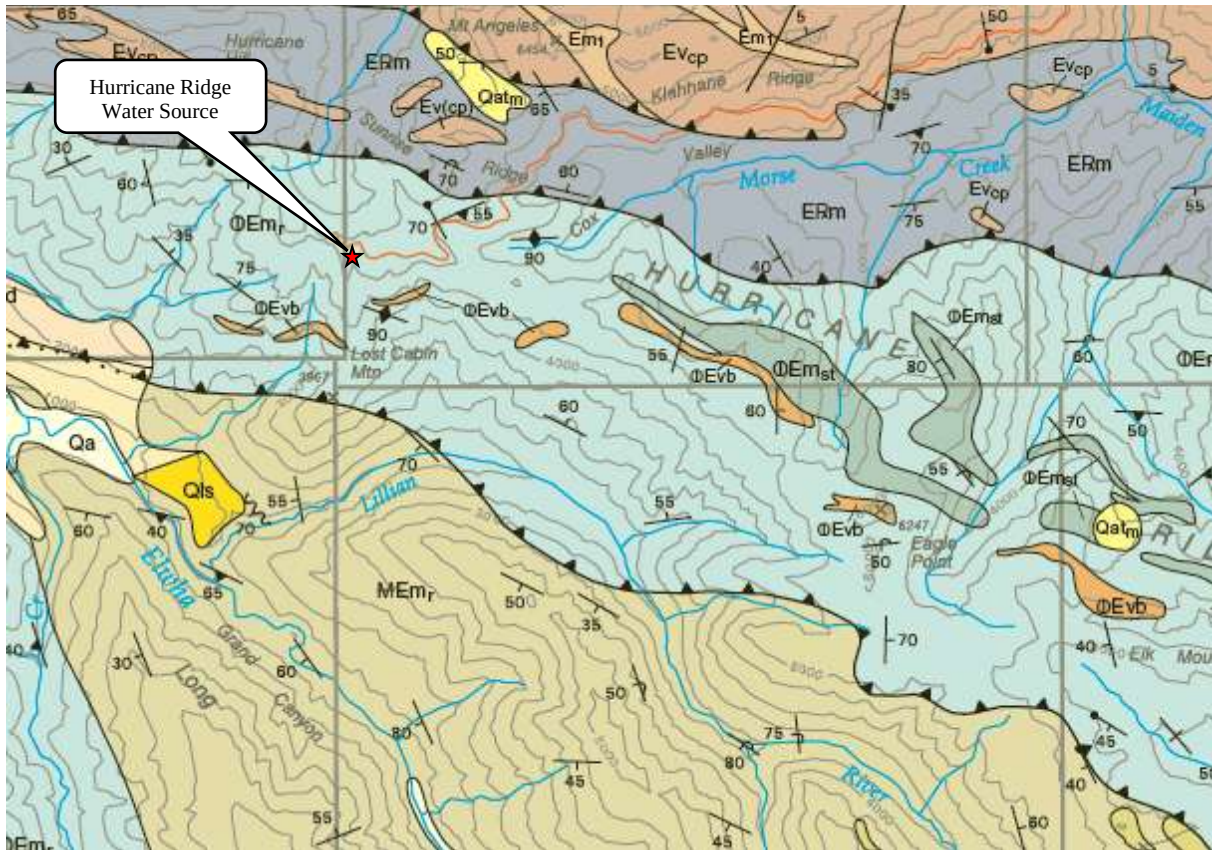
Figure 28.4 How plate convergence may have produced the complex structures of the Olympic Peninsula. Oceanic crust, bearing marine sediments, moved eastward for millions of years from the Juan de Fuca ridge, a Pacific spreading center. When heavier oceanic crust met less dense continental crust of the North American plate, the oceanic plate was subducted. Some sedimentary material was dragged down on the oceanic plate; some was scraped off and piled up against the North American plate, enlarging the continent by accretion. From Rau 1980, *Washington coastal geology between the Hoh and Quillayute Rivers*, Bulletin 72, State of Washington Department of Natural Resources.

The following picture shows the fractured bedrock typically found in the Hurricane Ridge area (Chronic, 1986). The bedrock formations in this area have been tilted to near vertical so that the fractures between the sedimentary layers are near vertical. These fractures may provide a pathway for infiltration of rain and snowmelt. There may be enough fracturing in the rock to provide groundwater for a low-yield well.



Thin shale and sandstone layers, tilted 90 degrees, are visible on Hurricane Ridge along the trail to Hurricane Hill. Individual layers are 1 to 10 centimeters (0.5 to 4 inches) thick.

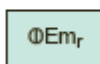
The most recent geologic mapping by Gertsel and Lingley (2003) shows that the entirety of the Hurricane Ridge area is underlain by the “Needles-Gray Wolf Lithic Assemblage”. This assemblage is a series of alternating thin layers of sandstone and shale. To construct a well in any other geologic formation would require moving several miles from the visitors’ center.



Geologic Map of the Mount Olympus 1:100,000 Quadrangle, Washington

by Wendy J. Gerstel and William S. Lingley, Jr.

2003



Rocks mapped with this symbol by Gertsel and Lingley (2003) belong to the “Needles-Gray Wolf Lithic Assemblage” as mapped by Tabor et al., (1972). In the Hurricane Ridge area this formation is characterized by thin, laminated beds of sandstone, siltstone, slate, and shale.

Potential drilling sites on Hurricane Ridge are limited by access and wilderness area boundaries. I suggest trying a location near the existing water collection system. There appears to be some type of geologic structure that concentrates groundwater in this area to sustain surface flow at a high elevation on the ridge throughout the year. A well in this area might tap into this same groundwater source/geologic structure. There is an existing access road in this area and it should be fairly easy to connect with the existing water system.

If a test well is constructed on Hurricane Ridge, it should be constructed with an air-rotary or cable-tool rig. A mud-rotary operation should not be used as it would be much messier and more difficult to determine whether the well was capable of producing small volumes of water. It would also be very difficult to remove all of the drilling mud and properly develop what I would expect to be a low-yielding well. By low-yield, I mean less than 5-10 gpm.

If a well is attempted, it should probably be limited to about 300 feet deep. The fractures are likely to be squeezed shut by the weight of overlying rock at greater depths.



Potential location for a test well on Hurricane Ridge

References

Chronic, Halka, 1986, *Pages of Stone, Geology of Western National Parks and Monuments, Vol. 2 Sierra Nevada, Cascades, and Pacific Coast*, published by The Mountaineers, Seattle, WA, pp. 108-120

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Harris, Ann G., Esther Tuttle, and Sherwood D. Tuttle, 1997, *Geology of National Parks*, 5th ed., Kendall/Hunt Publishing Co., pp. 357-377

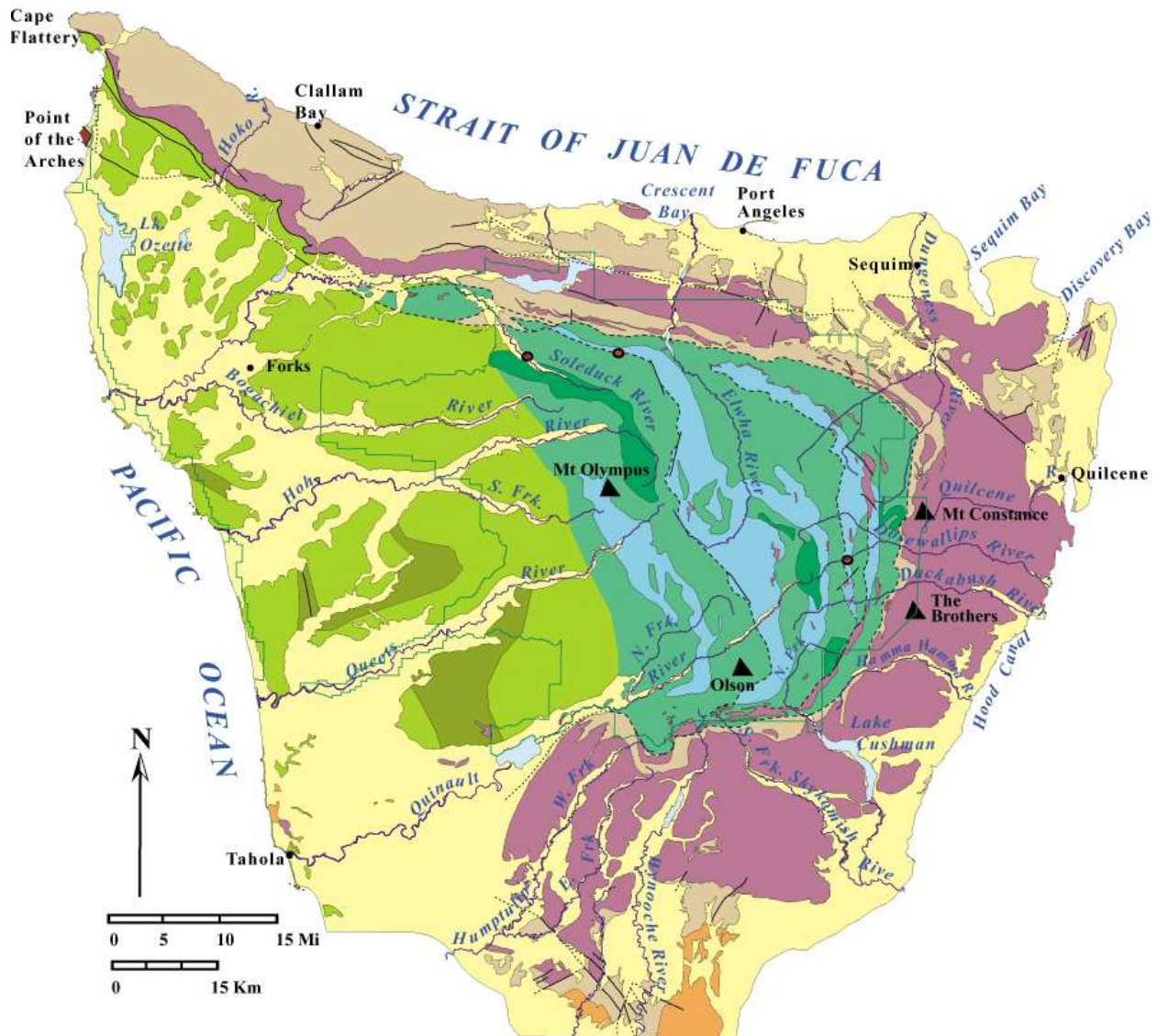
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Tabor, R.W., R.S. Yeats, and M.L. Sorensen, 1972, *Geologic Map of the Mount Angeles, Quadrangle, Clallam and Jefferson Counties*, Washington, USGS Geologic Quadrangle Map GQ-958, 1 sheet.

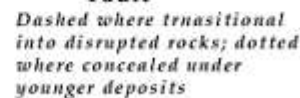
Walters, Kenneth L., 1970, *Water Supplies for Selected Sites in Olympic National Park, Washington*, USGS Open File Report (not numbered), 72 pp.

<http://wrgis.wr.usgs.gov/parks/olym/index.html>

The following web site contains a nice explanation of the geology of Olympic National Park, including a simplified geologic map. <http://wrgis.wr.usgs.gov/parks/olym/index.html>



SIMPLIFIED GEOLOGIC MAP OF OLYMPIC PENINSULA





WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

Construction/Decommission ("X" in circle)

- ☒ Construction
☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number

PROPOSED USE: ☐ Domestic ☐ Industrial ☒ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other	
TYPE OF WORK: Owner's number of well (if more than one) ☒ New well ☐ Reconditioned Method: ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jamed	
DIMENSIONS: Diameter of well 8 inches, drilled 205 ft. Depth of completed well 185 ft.	
CONSTRUCTION DETAILS Casing ☒ Welded 8" Diam. from +1 ft. to 52 ft. Installed: ☒ Liner installed 6" Diam. from -5 ft. to 185 ft. ☐ Threaded " Diam. From ft. to ft.	
Perforations: ☐ Yes ☒ No Type of perforator used _____ SIZE of perfs in. by in. and no. of perfs from ft. to ft.	
Screens: ☒ Yes ☐ No ☐ K-Pac Location _____ Manufacturer's Name CERTALOCK Type PVC Model No. _____ Diam. 6 Slot size .020 from 145 ft. to 185 ft. Diam. Slot size from ft. to ft.	
Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____ Materials placed from ft. to ft.	
Surface Seal: ☒ Yes ☐ No To what depth? 52 ft. Material used in seal BENTONITE Did any strata contain unusable water? ☐ Yes ☒ No Type of water? _____ Depth of strata _____ Method of sealing strata off _____	
PUMP: Manufacturer's Name GOULDS Type: 45J H.P. 10	
WATER LEVELS: Land-surface elevation above mean sea level ft. Static level 30 ft. below top of well Date 10/12/2007 Artesian pressure lbs. per square inch Date _____ Artesian water is controlled by _____ (cap, valve, etc.)	
WELL TESTS: Drawdown is amount water level is lowered below static level Was a pump test made? ☒ Yes ☐ No If yes, by whom? AQUA PUMPS Yield: 58 gal./min. with 46 ft. drawdown after 48 hrs. Yield: gal./min. with ft. drawdown after hrs. Yield: gal./min. with ft. drawdown after hrs.	
Recovery data (time taken as zero when pump turned on; water level measured with well top to water level) Time Water Level Time Water Level Time Water Level 9 AM 46'11" 9:01 45' 9:02 42' 9:03 40'9" 9:04 40'3" 9:05 40' 12PM 36'5"	
Date of test 10/14/2007 Bailer Test gal./min. with ft. drawdown after hrs. Airstest 75 gal./min. with stem set at 80 ft. for 4 hrs. Artesian flow g.p.m. Date _____ Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No	

CURRENT

Notice of Intent No. FEDERAL

Unique Ecology Well ID Tag No. ALJ113

Water Right Permit No. PENDING

Property Owner Name OLYMPIC NATIONAL PARK

Well Street Address HURRICANE RIDGE

City PORT ANGELES County CLALLAM

Location 1/4-1/4 1/4 Sec 30 Twn 29 R 6W EWN ☐ Check
(s, t, r Still REQUIRED) WWM ☒ One

Lat/Long Lat Deg N9758.234 Lat Min/Sec

Long Deg W12330.4 Long Min/Sec

Tax Parcel No. (Required) FEDERAL

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
TOP SOIL	0	1
BROWN HARD SHALE	1	43
BROWN MEDIUM HARD SHALE	43	46
BROWN HARD SHALE	46	54
GREY HARD SHALE	54	56
BROWN HARD SHALE	56	60
GREY HARD SHALE	60	62
BROWN HARD SHALE	62	66
GREY HARD SHALE	66	81
BROWN HARD SHALE W/LESIONS OF SANDSTONE AND QUARTZ. W/B	81	199
BROWN HARD SHALE	199	205

RECEIVED

OCT 24 2007

DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Start Date 9-27-07 Completed Date 10/10/07

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) RICHARD DEBYER

Driller/Engineer/Trainee Signature

Driller or trainee License No. 2252

IF TRAINEE: Driller's License No. _____

Driller's Signature: _____

Drilling Company AQUA PUMPS & WELL DRILLING

Address 242 ALPINE VIEW LANE

City, State, Zip PORT ANGELES WA 98362

Contractor's

Registration No. AQUAPO66LM Date 10/14/2007

Olympic National Park
Hurricane Ridge Well

