GEOLOGIC MAP OF THE LITTLEROCK 7.5-MINUTE QUADRANGLE, THURSTON COUNTY, WASHINGTON

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Abstract—No. 387-2 (297674):

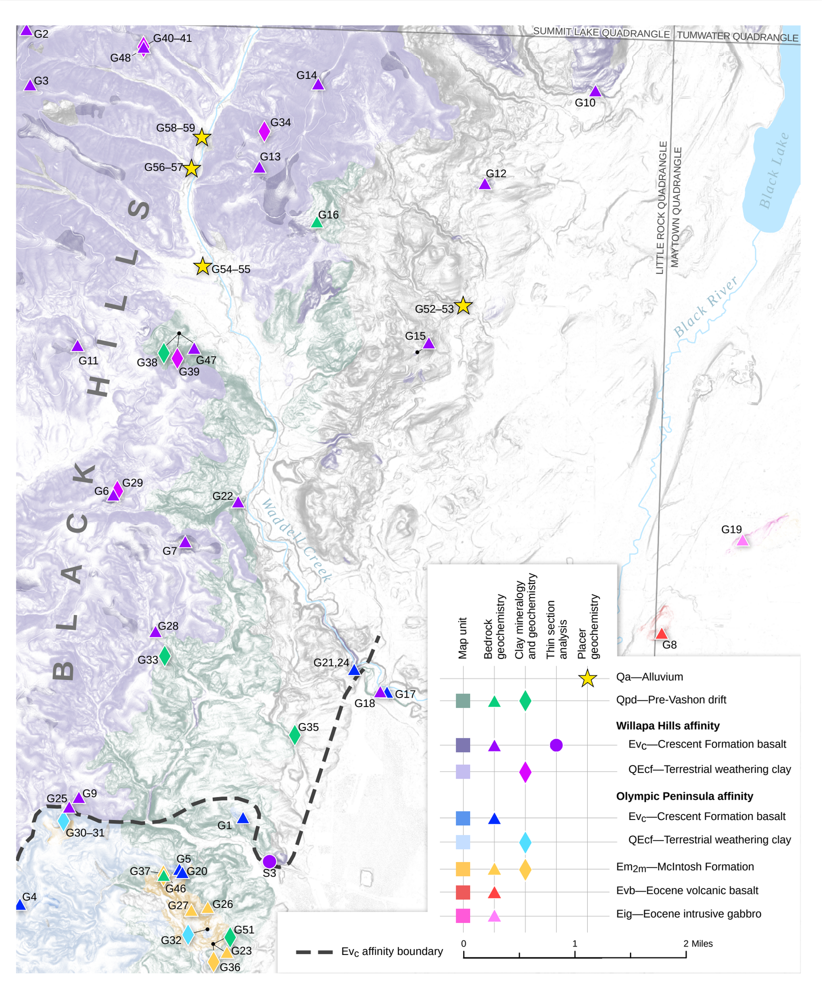
We present a new 1:24,000 scale geologic map of the Littlerock 7.5-minute quadrangle, which straddles the eastern Black Hills and southern Puget Lowland southwest of Olympia and was previously mapped at smaller scales. More detailed geologic mapping is needed for informed land management; forestry, agriculture, recreation, ecologically sensitive areas, and development increasingly compete for natural resources. We support the new map with field work, lidar, subsurface exploration data, aeromagnetic data, geophysical explorations, geochemistry, and new $^{40}Ar/^{39}Ar$, detrital zircon U/Pb, luminescence and radiocarbon dates.

New bedrock geochemistry confirms that the Black Hills are cored by Crescent Formation basalt. North of Mima Creek the geochemical signature is similar to Willapa Hills Crescent Fm. South of the creek it is more similar to Olympic Mtns. Crescent Fm. Geochemistry and a new 46.0 Ma $^{40}Ar/^{39}Ar$ date suggest that basalt east of the Black Hills is chemically distinct and younger than Crescent Formation but older than nearby intrusive rocks, though all are likely from the same mantle source.

A new 47.4 Ma U/Pb zircon date from tuff in McIntosh Fm. marine sedimentary rocks that overlie Crescent Fm. basalt in the southern Black Hills constrains the transition from Siletzia volcanism and accretion to marine sedimentation.

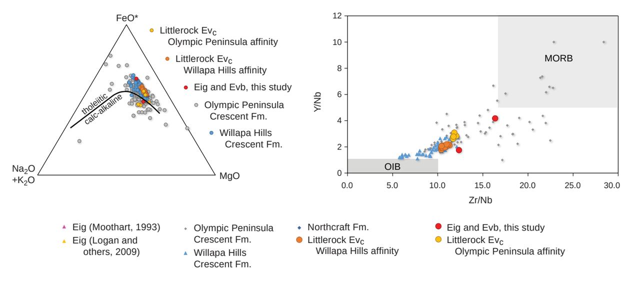
We mapped glacial deposits from the Vashon stade and at least one prior glaciation that was slightly more extensive; these glaciations created ice dammed lakes in the Waddell Creek valley. New OSL and IRSL dates on fluvial sediments suggest that Possession (MIS4) meltwater drained south via the Black River Valley, although Possession ice never came close to the map area.

Geochemistry and clay mineral identification by XRD of thick, deeply weathered, clay-rich soils in the Black Hills suggest that most of the Black Hills are unglaciated and have been subaerially weathered since before the Quaternary. Onlapping of Eocene to Miocene marine sediments indicates that the hills have been a topographic high since the Eocene and may never have been buried. Isolated shear exposures and geophysical data suggest a northwest striking, southwest down fault beneath Mima Prairie. This fault may extend structures previously mapped farther southeast, but it has not offset the Vashon outwash terraces.

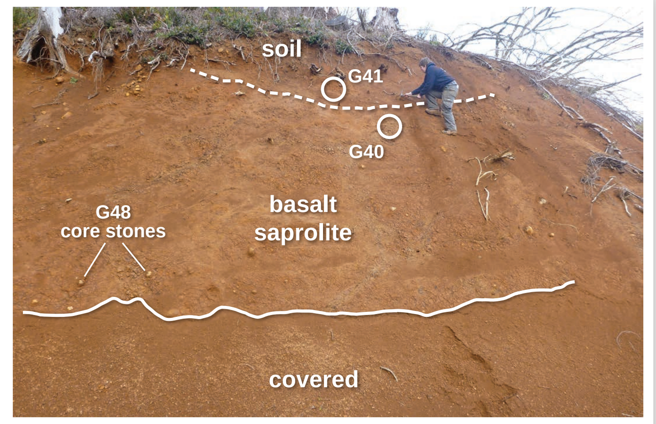


Simplified geologic map showing geochemistry sample locations, geologic units, and analysis type.

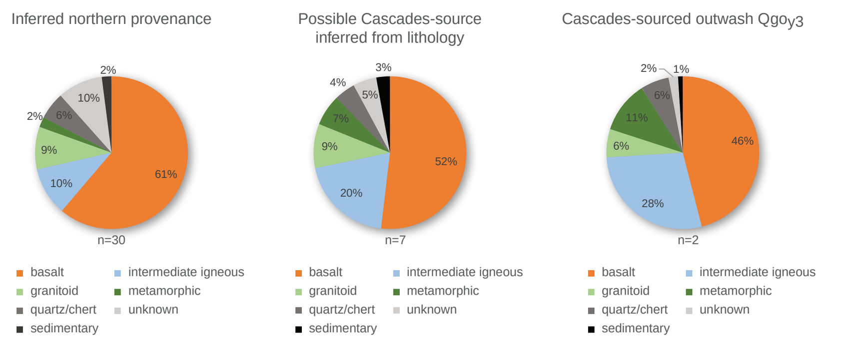
Cross-sectional view of a Mima mound (clast count sites C2 and C3).



Major and trace element geochemistry results for Littlerock samples.



Roadcut with clay at geochemistry sampling sites.

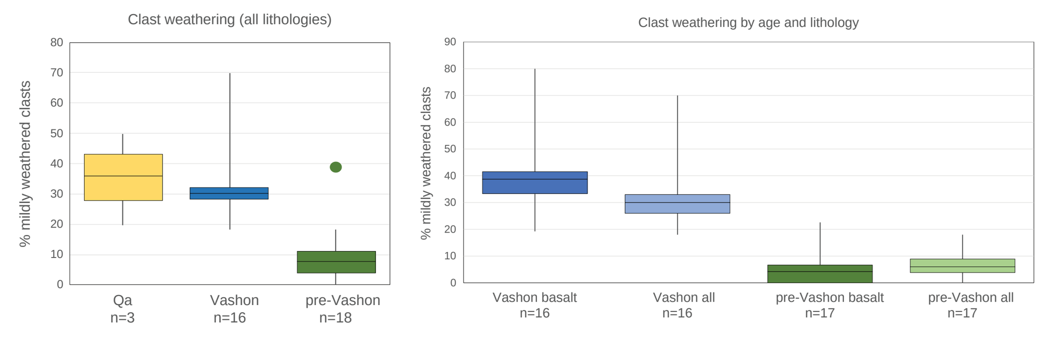


Pie charts showing clast lithologies from unlithified deposits.

[wt%] No Data where blank — Sampled material	tuffaceous siltstone	basalt soil	basalt soil	basalt soil	basalt saprolite	basalt soil	basalt saprolite	basalt saprolite	drift (basalt and andesite rich)	drift	drift	drift	claystone	claystone
Geologic unit	Em(2m)	QEcf*	QEcf	QEcf	QEcf	QEcf	QEcf	QEcf	Qpd	Qpd	Qpd	Qpd	Em(2m)	Em(2m)
Site ID	G30	G31	G34	G29	G32	G41	G42	G39	G38	G51	G33	G35	G36	G37
Quartz	43	38	5	18	Trace	Trace		Trace	10	40	29	32	6	1
Plagioclase feldspar (albite)	21	9	Trace					Trace	3	7	11	9	10	
K-feldspar (orthoclase)	3	5					2	Trace	1	4	2	4	7	20
K-feldspar (sanidine)	2													
Amphibole	4			1					2	1				
Chlorite	15	24		3					4	8				
Muscovite/illite	6	9		2									7	
Halloysite			71	44	80	69	57	73	63	36	37	36		
Kaolinite					3						6			
Smectite (nontronite)													65	75
Smectite (montmorillonite)											2	6		
Gibbsite	4	10		6					Trace	1				
Goethite		5	22	20	15	19	26	20	12	2	12	13	1	
Hematite	2			2		1	4	1	1	1				
Magnetite			Trace	2	2	7	7	2	3					
Ilmenite			2	2		4	4	4	1		1	Trace		
Zeolite (heulandite)													3	
Apatite													1	
Anatase														4

XRD results (clay mineral percent).

Range of clast weathering for unit Qa and Vashon and pre-Vashon glacial deposits.



Clast weathering in units Qpo_1 (site C11) and Qpo_2 (sites C42 and C51).