Geomorphic Response of the Henrys Fork River to Pleistocene Volcanism, Mesa Falls Recreation Area, Caribou-Targhee National Forest, Idaho

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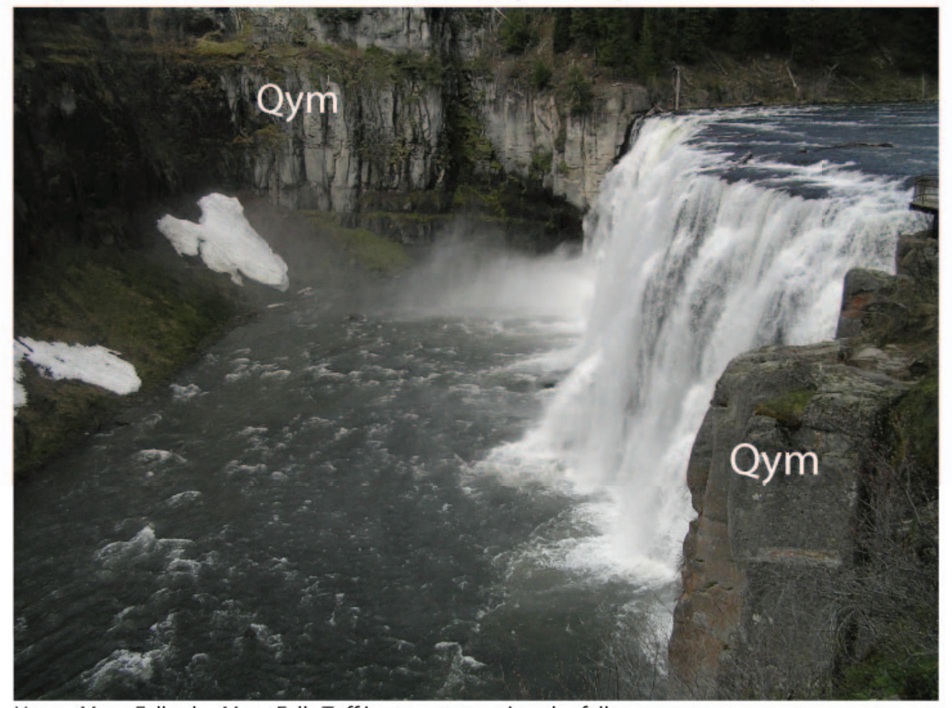
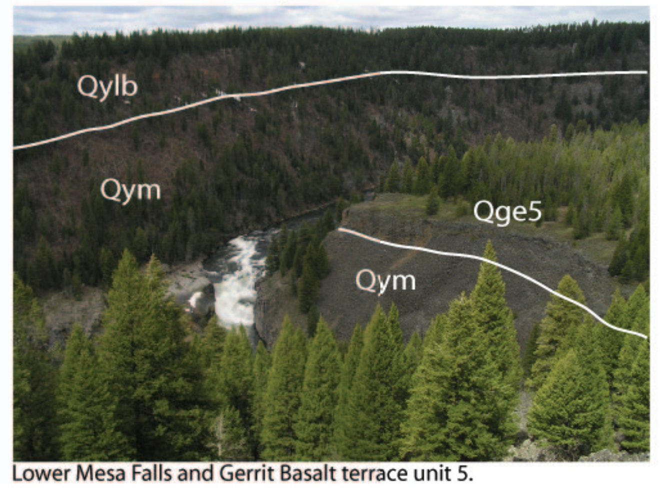
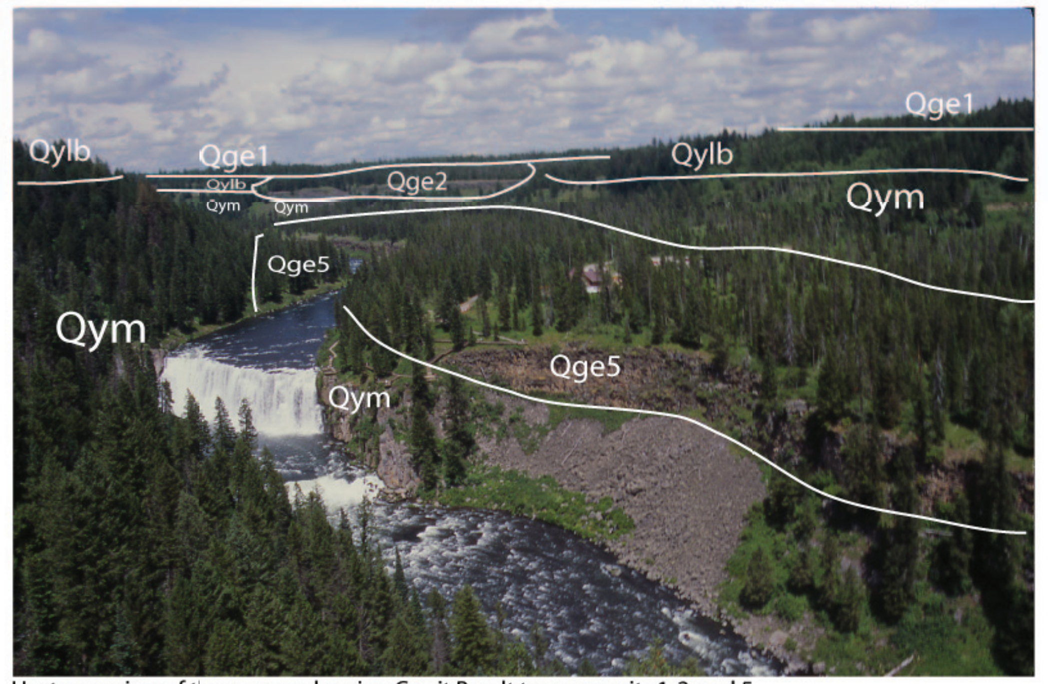
ABSTRACT:
The Mesa Falls Recreation Area, located approximately 16 kilometers northeast of Ashton, Idaho, consists of Pleistocene volcanic units, including the Mesa Falls and Lava Creek Tuffs of the Yellowstone Group and the Gerrit Basalt. On occasion, the channel eroded by the Henrys Fork River has been partially to completely filled by basalt flows, producing multigenerational terraces as the Henrys Fork entrenched along the margins of the flows. Differences in erodibility of the tuffs and basalt seems to be the primary control on the present course of the Henrys Fork River and will likely continue to influence future migration. An inverted valley is developing as the Henrys Fork River erodes through the rhyolitic tuff at the edge of the basalt flows. Mapping and correlation of remnant basalt terraces helps to better understand the geomorphic response of river systems to concurrent volcanic activity.



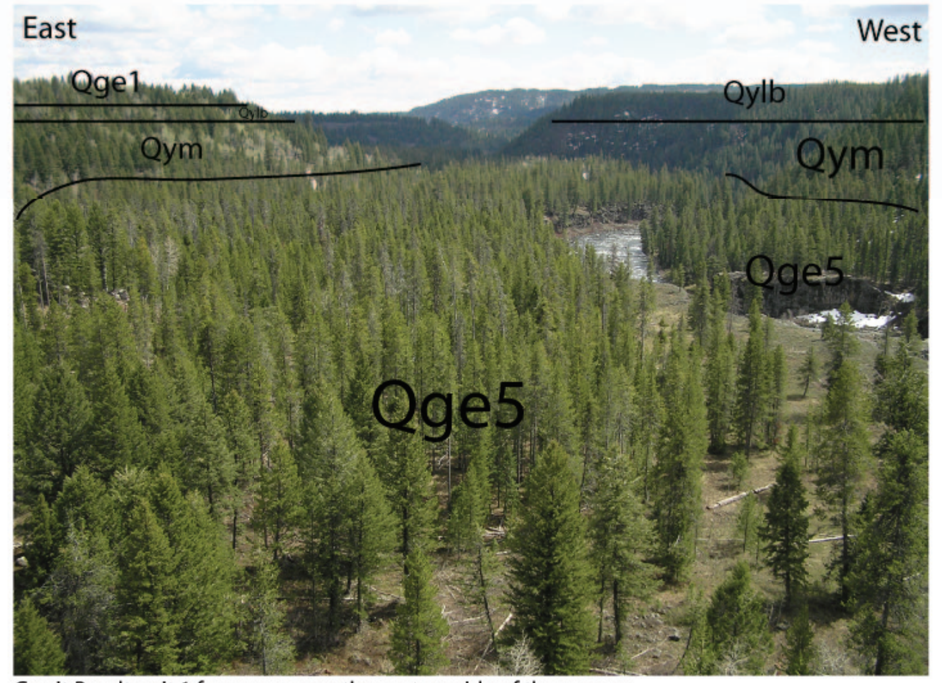
Upper Mesa Falls; the Mesa Falls Tuff is now supporting the falls.



Lower Mesa Falls and Gerrit Basalt terrace unit 5.

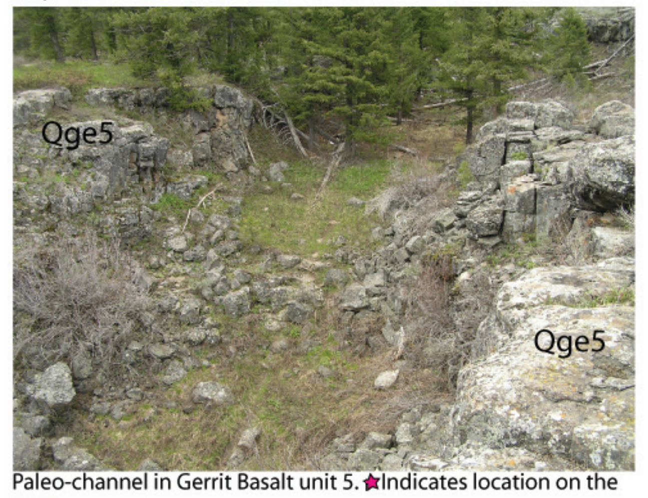


Upstream view of the canyon showing Gerrit Basalt terraces units 1, 2, and 5.

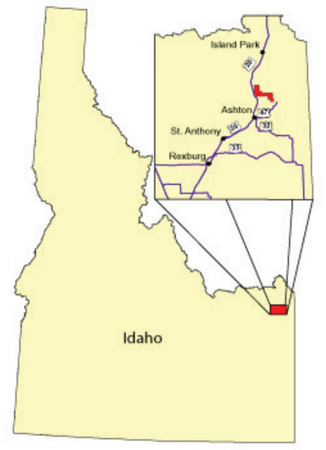


Gerrit Basalt unit 1 forms a cap on the eastern side of the canyon. Gerrit Basalt unit 5 was deposited later and forms a broad terrace on the bottom of the canyon.

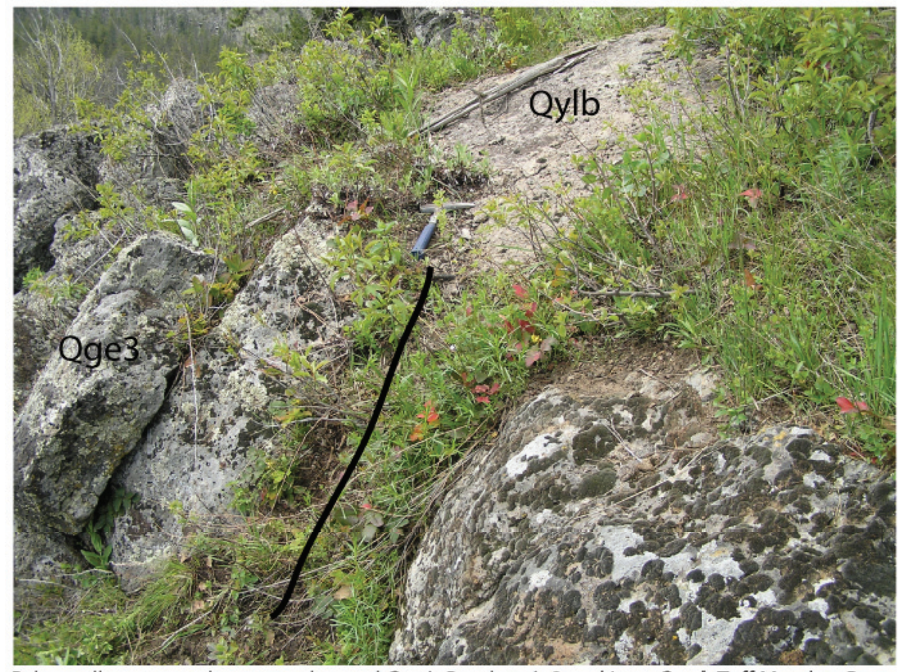
Pot hole erosion on top of Gerrit Basalt unit 5 represents a time when the Henrys Fork had been dammed and was aproximately 6 meters above the current elevation. ☆Indicates location on the map. (hammer for scale)



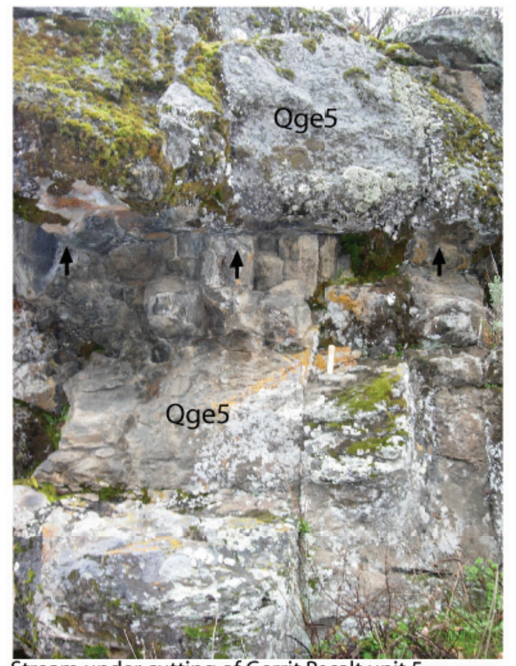
Paleo-channel in Gerrit Basalt unit 5. ☆Indicates location on the map.



Inverted valley shown by the contact between Gerrit Basalt unit 5 and Mesa Falls Tuff, located at Upper Mesa Falls.



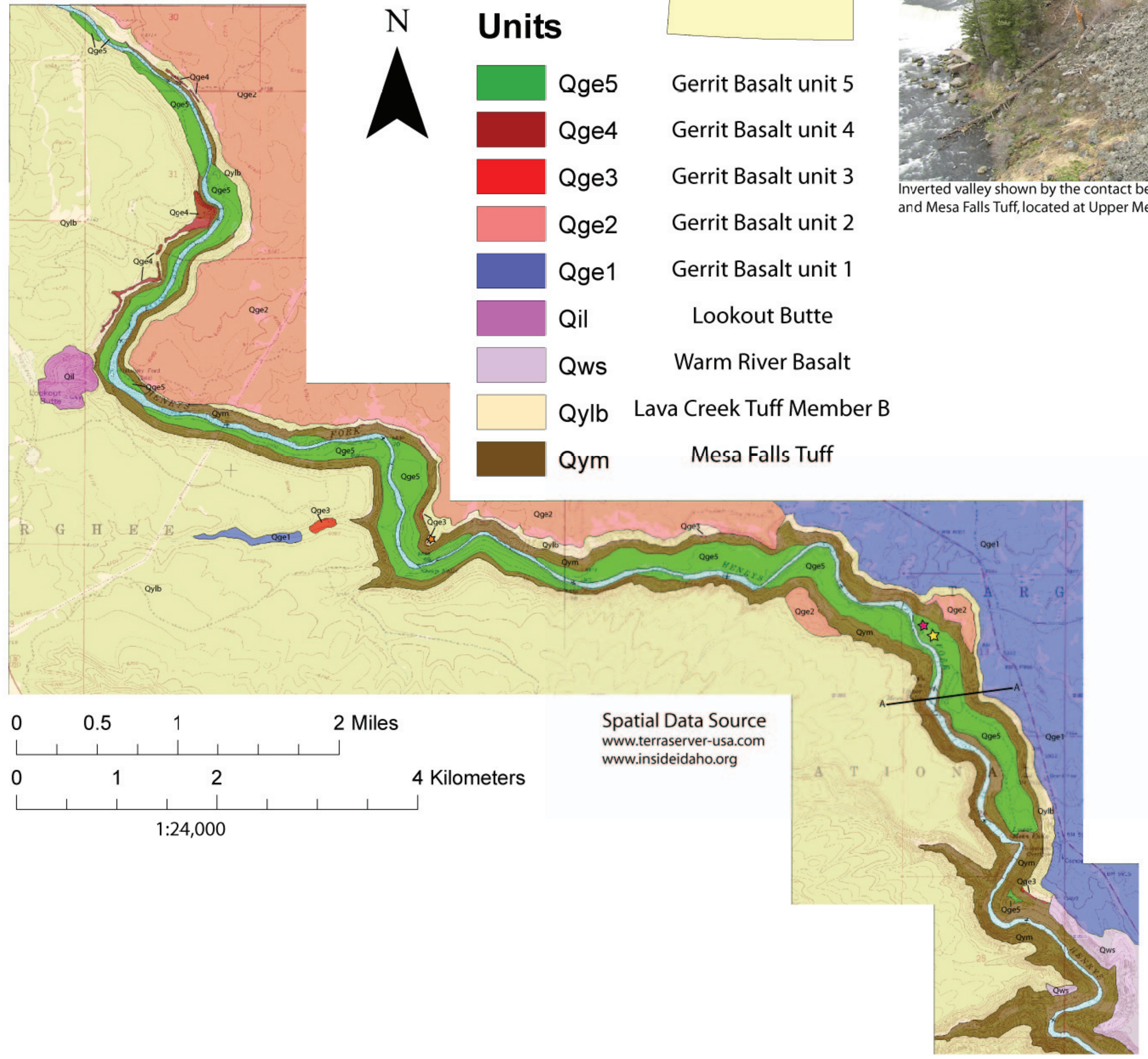
Paleo-valley contact between elevated Gerrit Basalt unit 3 and Lava Creek Tuff Member B. ☆ Indicates location on the map. (rock hammer for scale)



Stream under cutting of Gerrit Basalt unit 5 indicates past elevation of the Henrys Fork. ☆Indicates location on the map. (hammer for scale)

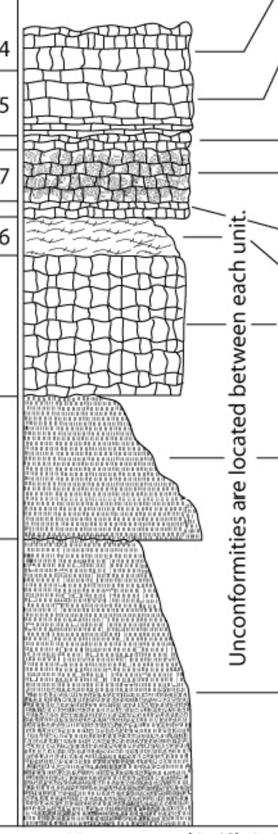
Fluting on top of Gerrit Basalt unit 5 indicates past elevation of the Henrys Fork. ☆ Indicates location on the map.

Geologic Map of the Study Area



General Stratigraphic Column

Series	Age	Formation		Thickness in Feet	Thickness in meters	Description
Pleistocene	~ 200 ka**	Gerrit Basalt	unit 5	0-90	0-27.4	Diktytaxitic, porphyritic, non-vesicular to vesicular basalt. Phenocryst content is 1 to 3%, and is predominantly olivine.
			unit 4	0-100	0-30.5	Dark gray to black, viscous, non-vesicular to vesicular to scoriacious, porphyritic basalt. Phenocryst content is 1% and is composed of plagioclase and olivine. Basal part of the unit is platy and grades upward into flowbanding and columnar jointing. Flow behavior mimics that of a rhyolite lava.
			unit 3	0-20	0-6.1	Diktytaxitic, non-vesicular to vesicular basalt.
			unit 2	0-140	0-42.7	Diktytaxitic, porphyritic, non-vesicular to vesicular basalt. Phenocryst content is 15-20% and is composed of 10%, long, slender plagioclase and 5% olivine.
			unit 1	0-20	0-6.1	Diktytaxitic, porphyritic, non-vesicular to vesicular basalt. Phenocryst content is 1% and is composed of olivine.
	?	Lookout Butte		0-120	0-36.6	Rhyolite lava dome. Age relation to the other units is unclear.
	?	Warm River Basalt		0-300	0-91.4	Diktytaxitic, porphyritic, non-vesicular to vesicular basalt. Phenocryst content is 4 to 7% and is composed of 5% olivine and 2% plagioclase. Age relation to the other units is unclear.
	600 ka*	Lava Creek Tuff	Member B	50-200	15.2-61	Pink to gray to purple, welded to densely-welded, crystal poor, devitrified, rhyolitic ash flow tuff. Basal part of the unit is spherulitic.
	1.3 Ma*	Mesa Falls Tuff		0-300	0-91.4	Gray to tan, densely-welded to very densely-welded, crystal rich, devitrified, rhyolitic ash flow tuff. Phenocryst content is 50 to 80% and is composed of large sanadine and quartz. The very densely-welded basal region weathers into large, rounded, cliff-forming outcrops.



All thicknesses are approximated and only represent exposed thickness within the study area

*Ages reported in (Christiansen and Blank, 1972).
**This age represents one of the younger Gerrit Basalt units and was reported in (Christiansen, 2001).

CONCLUSION:

Five distinct episodes of basalt damming have partially to completely filled paleo-topographic lows. Absolute ages of individual Gerrit Basalt units are unavailable; however, the elevation of flow contacts, superposition, and juxtaposition provide relative chronologic relationships. The wide-spread and thin nature of Gerrit Basalt unit 1 indicate that it entered a broad, glacially-carved valley. Gerrit Basalt units 2-5 were emplaced at progressively deeper levels as the Henrys Fork incised its valley. Repeated incision and filling events have left basalt terraces that represent inverted valley floors along the walls of the canyon with older flows being located topographically above younger flows. Basalt damming has forced a westward migration of the Henrys Fork River. The Mesa Falls are now being supported by the densely-welded, crystal-rich basal part of the Mesa Falls Tuff, which is highly resistant to erosion and is slowing further incision by the river.

ACKNOWLEDGMENTS:
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Christiansen, R.L., Embree, G.F., 1987, Island Park, Idaho; transition from rhyolites of the Yellowstone Plateau to basalts of the Snake River Plain, Geological Society of America Centennial Field Guide, Rocky Mountain Section
Embree, G.F., Hoggan, R.D., 1999, Secondary deformation within the Huckleberry Ridge Tuff and subadjacent Pliocene units near the Teton Dam: road log to the regional geology of the eatern margin of the Snake River Plain, Idaho, *in* Hughes, S.S., Thackray, G.D., eds., Guidebook to the Geology of Eastern Idaho .
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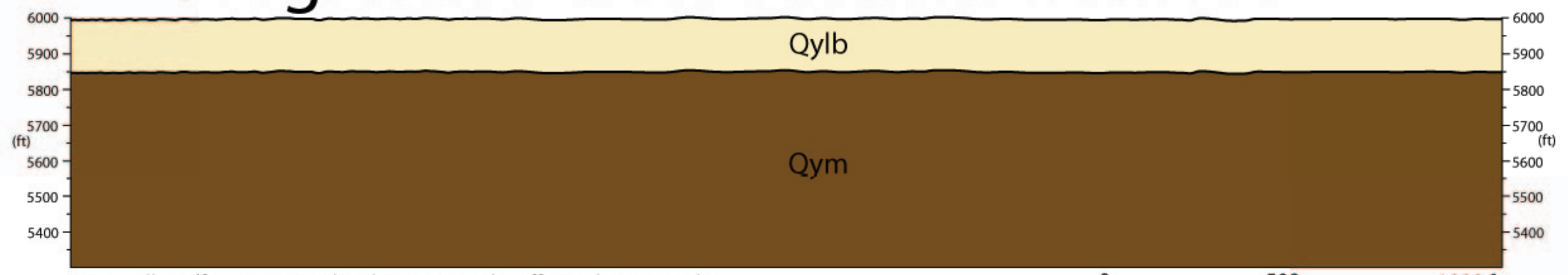
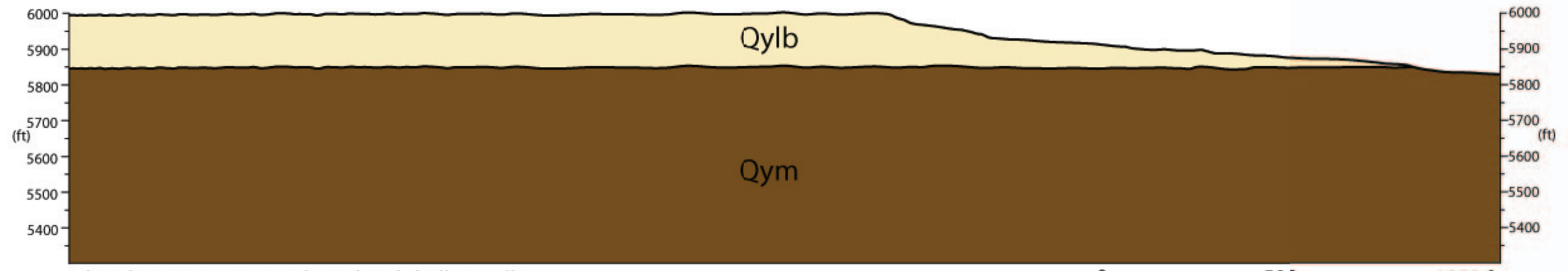
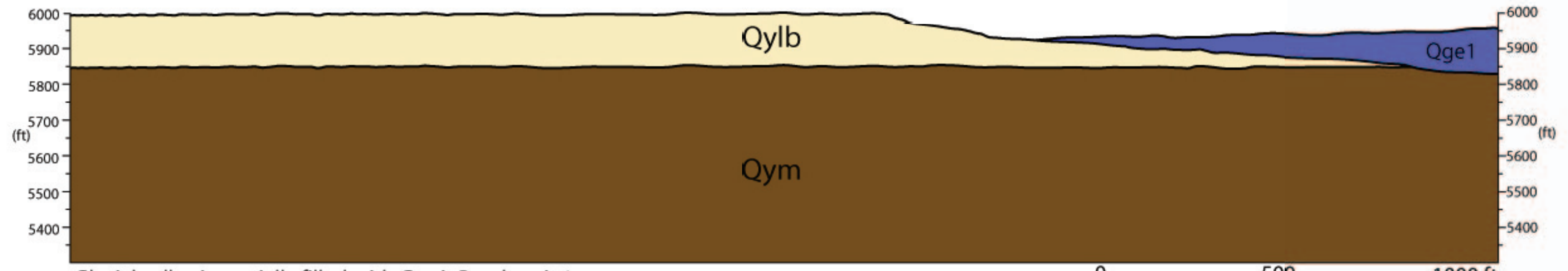
Progressive Cross Sections from A to A'



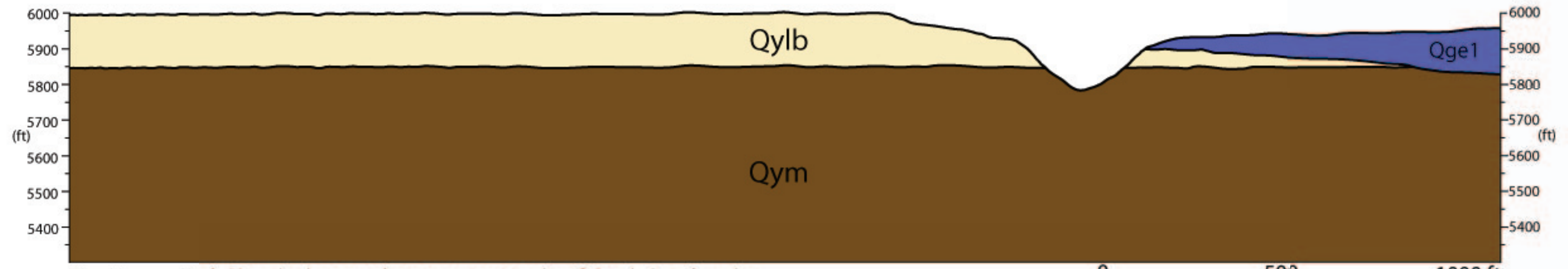
Mesa Falls Tuff (1.3 Ma) overlain by Lava Creek Tuff Member B (600 ka).



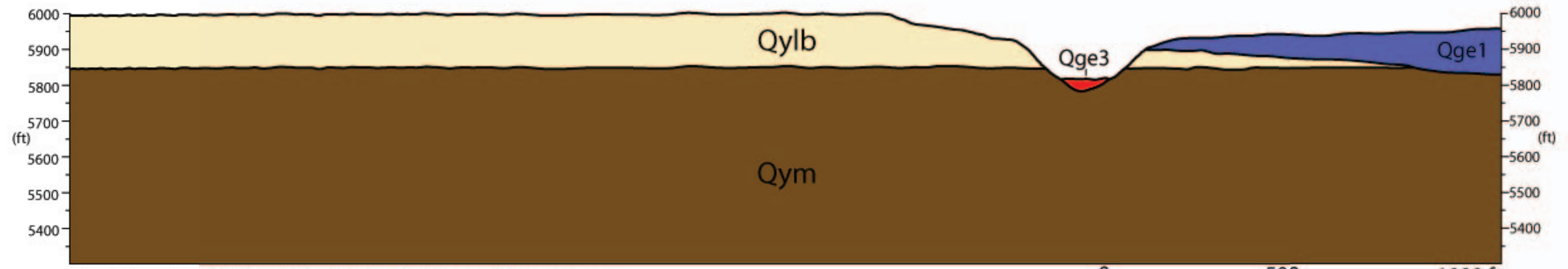
Glacial incision creates a broad and shallow valley.



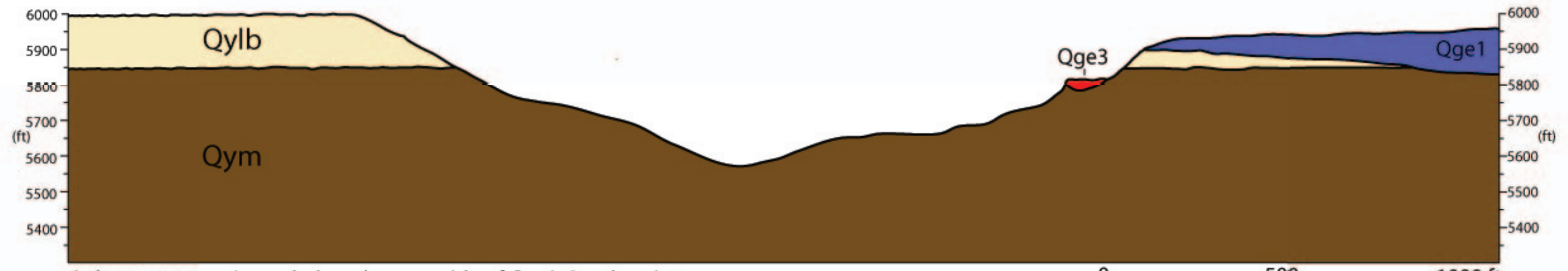
Glacial valley is partially filled with Gerrit Basalt unit 1.



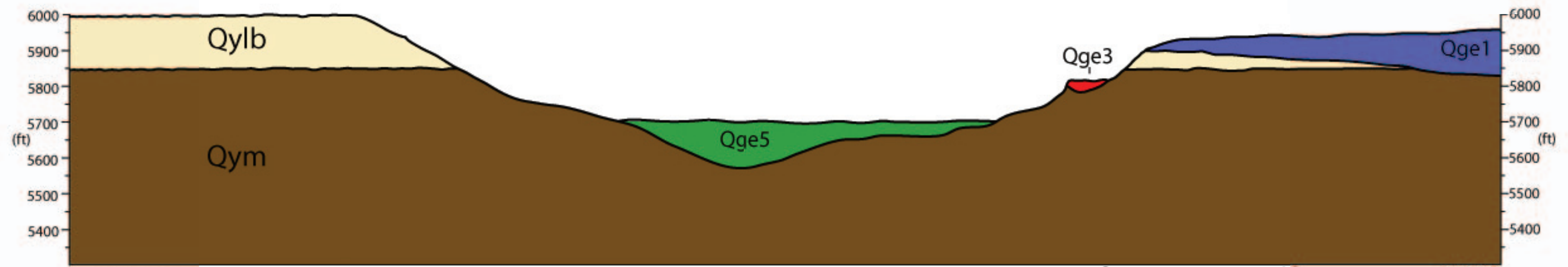
The Henrys Fork River incises on the western margin of Gerrit Basalt unit 1.



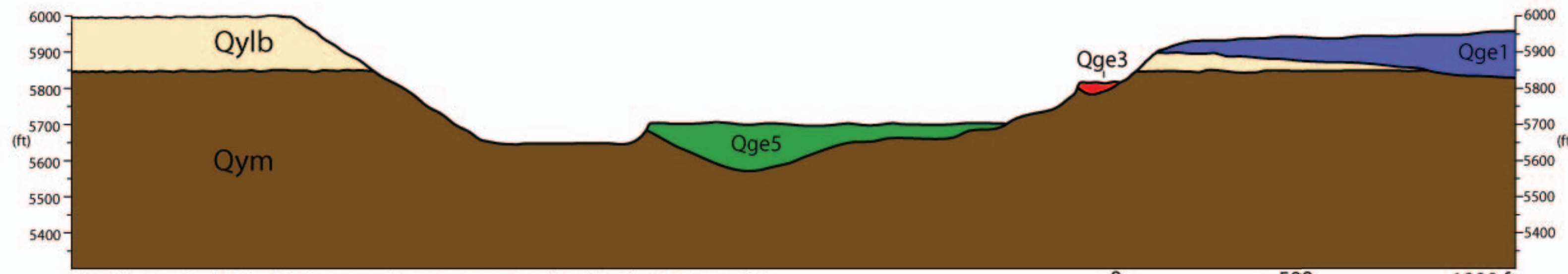
Gerrit Basalt unit 3 partially fills the bottom of the canyon.



A deeper canyon is eroded on the west side of Gerrit Basalt unit 3.



Gerrit Basalt unit 5 partially fills the bottom of the canyon.



The Henrys Fork River incises on the western margin of Gerrit Basalt unit 5.