

Bill Bonnicksen
927 East Seventh Street
Moscow, Idaho 83843
(208) 882-9062, billb@uidaho.edu

Education

B.S., University of Idaho, 1960, Geological Engineering
Graduate studies in geology, New Mexico Institute of Mining and Technology, 1960-62
Ph.D., University of Minnesota, 1968, Geology

Professional Experience

2005-2011: Adjunct Professor of Geology, Washington State University
1976-2003: Research Geologist, Idaho Geological Survey (retired in 2003)
1976-2003: Adjunct Professor of Geology, University of Idaho
1996-1998: Instructor, Mount Holyoke College (Spring semesters)
1969-1976: Assistant Professor, Cornell University
1963-1966 & 1969-1976: Research Geologist, Minnesota Geological Survey (part-time)
1962-1967: Graduate Student, Instructor, Research Associate, Teaching Fellow, University of Minnesota
1960-1962: Graduate Student, Cartographic Draftsman, New Mexico Institute of Mining & Technology

Selected Publications and Geologic Maps Related to Volcanic Geology and to Idaho

(Note: this list is compiled through 2008 & does not include later papers nor papers on other subjects)

Bonnicksen, Bill, W.P. Leeman, N. Honjo, W.C. McIntosh, and M.M. Godchaux, 2008, Miocene silicic volcanism in southwestern Idaho: geochronology, geochemistry, and evolution of the central Snake River Plain. *Bulletin of Volcanology* 70: 315-342.

Branney, M.J., B. Bonnicksen, G.D.M. Andrews, B. Ellis, T.L. Barry, and M. McCurry, 2008, Snake River (SR)-type volcanism at the Yellowstone hotspot track: distinctive products from unusual, high-temperature silicic super-eruptions. *Bulletin of Volcanology* 70: 293-314.

Bonnicksen, Bill, and M.M. Godchaux, 2006, Geologic map of the Murphy 30x60 minute quadrangle, Ada, Canyon, Elmore & Owyhee Counties, Idaho. *Idaho Geol. Survey, Digital Web Map* 80, 1:100,000.

Andrews, G.D.M., M.J. Branney, B. Bonnicksen, and M. McCurry, 2008, Rhyolitic ignimbrites in the Rogerson Graben, southern Snake River Plain volcanic province: volcanic stratigraphy, eruption history and basin evolution. *Bulletin of Volcanology* 70: 269-292.

Boroughs, Scott, J. Wolff, B. Bonnicksen, M. Godchaux, and P. Larson, 2005, Large-volume, low-delta- oxygen-18 rhyolites of the central Snake River Plain, Idaho, USA. *Geology*: 33, 821-824.

Bonnicksen, Bill, Michael McCurry, and M.M. Godchaux, 2004, Miocene Snake River Plain rhyolites of the Owyhee Front, Owyhee County, Idaho. *K.M. Haller and S.H. Wood, eds., Geological Field Trips in Southern Idaho, Eastern Oregon, and Northern Nevada: Department of Geosciences, Boise State University*, 154-173.

Aranda-Gomez, J.J., M.M. Godchaux, G.J. Aguirre-Diaz, Bill Bonnicksen, & J. Martinez-Reyes, 2003, Three superimposed volcanic arcs in the southern cordillera--from the early Cretaceous to the Miocene, Guanajuato, Mexico. *Geologic transects across Cordilleran Mexico, Field trip guidebook for 99th annual meeting, Cordilleran Section, Geol. Soc. Am.: UNAM, Instituto de Geol. Publ. Especial* 1, 123-168.

Bonnichsen, Bill, and M.M. Godchaux, 2002, Late Miocene, Pliocene, and Pleistocene geology of southwestern Idaho with emphasis on basalts in the Bruneau-Jarbridge, Twin Falls, and western Snake River Plain regions. *Bill Bonnichsen, C.M. White, and Michael McCurry, editors, Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province: Idaho Geological Survey Bulletin* 30: 233-312.

Godchaux, M.M., and Bill Bonnichsen, 2002, Syneruptive magma-water and post-eruptive lava-water interactions in the western Snake River Plain, Idaho, during the past 12 million years. *Bill Bonnichsen, C.M. White, and Michael McCurry, editors, Tectonic and Magmatic Evolution of the Snake River Volcanic Province: Idaho Geological Survey Bulletin* 30, 387-434.

White, Craig M., W.K. Hart, Bill Bonnichsen, and Debra Matthews, 2002, Geochemical and Sr-isotope variations in western Snake river Plain basalts, Idaho. *Bill Bonnichsen, C.M. White, and Michael McCurry, editors, Tectonic and Magmatic Evolution of the Snake River Volcanic Province: Idaho Geological Survey Bulletin* 30, 329-342.

Bonnichsen, Bill, and M.M. Godchaux, 2000, Geologic map of the Melba quadrangle, Canyon and Ada Counties, Idaho. *Idaho Geological Survey Digital Web Map* 79, 1:24,000.

Bonnichsen, Bill, and M.M. Godchaux, 1998, Geologic map of the Walters Butte quadrangle, Ada, Canyon, and Owyhee Counties, Idaho. *Idaho Geological Survey Map* GM-21, 1:24,000.

Jenks, M.D., Bill Bonnichsen, and M.M. Godchaux, 1998, Geologic map of the Grand View-Bruneau area, Owyhee County, Idaho. *Idaho Geological Survey Technical Report* T-98-1, 1:100,000.

Bonnichsen, Bill, and M.M. Godchaux, 1995-97, Geologic maps of the Buhl, Clover, Filer, Twin Falls, and portions of the Balanced Rock, Jerome, and Niagara Springs quadrangles, Twin Falls and Jerome Counties, Idaho. *Unpublished contract reports, USGS STATEMAP program*, 1:24,000.

McCurry, Michael, Bill Bonnichsen, Craig White, M.M. Godchaux, and S.S. Hughes, 1997, Bimodal basalt-rhyolite magmatism in the central and western Snake River Plain, Idaho and Oregon. *P.K. Link and B.J. Kowallis, eds., Proterozoic to Recent Stratigraphy, Tectonics, and Volcanology, Utah, Nevada, southern Idaho, and central Mexico: Brigham Young Univ. Geol. Studies*, v. 42, part 1, 381-422.

Othberg, K.L., Bill Bonnichsen, C.C. Swisher, and M.M. Godchaux, 1995, Geochronology and geochemistry of Peistocene basalts of the western Snake River Plain and Smith Prairie, Idaho. *Isochron/West*, no. 62, 1-14.

Bonnichsen, Bill, and M.D. Jenks, 1995, Geologic maps of the Cowan Reservoir, Grassy Hills, and Triguero Lakes quadrangles, Owyhee Co., Idaho. *Id. Geol. Survey Tech. Rpts. T-95, 1, 2 & 3*, 1:24,000.

Bonnichsen, Bill, and M.M. Godchaux, 1994, Geologic maps of the Dorsey Butte & Jackass Butte quadrangles, Ada, Elmore, and Owyhee Co. Idaho. *Unpub. USGS COGEOMAP reports*, 1:24,000.

Jenks, M.D., Bill Bonnichsen, and M.M. Godchaux, 1993, Geologic maps of the Grand View-Bruneau area, Owyhee County, Idaho. *Idaho Geological Survey Tech. Rpt. T-93-2, 21 p. & 19 maps*, 1:24,000.

Jenks, M.D., Bill Bonnichsen, and M.M. Godchaux, 1991-93, Geologic maps of Initial Point and Sinker Butte quadrangles, Ada and Owyhee Counties, Idaho. *Unpub. USGS COGEOMAP reports*, 1:24,000.

Godchaux, M.M., Bill Bonnichsen, and M.D. Jenks, 1992, Types of phreatomagmatic volcanoes in the western Snake River Plain, Idaho. *Journal of Volcanology and Geothermal Research*, 52, 1-25.

Honjo, Norio, Bill Bonnichsen, W.P. Leeman, and J.C. Stormer, Jr., 1992, Mineralogy and geothermometry of high-temperature rhyolites from the central and western Snake River Plain. *Bull. Volc.* 54, 220-237.

Bonnichsen, Bill, John Bernt, M.D. Jenks, and D.F. Kauffman, 1990, Geologic maps of the Sheep Creek West, Jarbidge River, Bruneau River, Little Jacks Creek, Big Jacks Creek, and Duncan Creek Wilderness Study Areas, Owyhee County, Idaho. *USGS Maps MF-2126, 2127, 2128 & 2142, 1:50,000.*

Jenks, M.D., and Bill Bonnichsen, 1990, Geologic map of the Wild Horse Butte quadrangle, Ada and Owyhee Counties, Idaho. *Idaho Geological Survey Tech. Rpt. 90-8, 9 p., 1:24,000.*

Bonnichsen, Bill, Robert L. Christiansen, Lisa A. Morgan, Falma J. Moye, William R. Hackett, William P. Leeman, Norio Honjo, Margaret D. Jenks, and Martha M. Godchaux, 1989, Excursion 4A: Silicic volcanic rocks in the Snake River Plain--Yellowstone Plateau province. C.E. Chapin and Jiri Zidek editors, *Field Excursions to Volcanic Terranes in the Western United States, Volume II: Cascades and Intermountain West: New Mexico Bureau of Mines and Mineral Resources Memoir 47: 135-137.*

Jenks, M.D., and Bill Bonnichsen, 1989, Subaqueous basalt eruptions into Pliocene Lake Idaho, Snake River Plain, Idaho. V.E. Chamberlain, R.M. Breckenridge, and Bill Bonnichsen, eds., *Guidebook to the Geology of Northern and Western Idaho and Surrounding Area: Idaho Geological Survey Bulletin 28, 17-34.*

Bonnichsen, Bill, W.P. Leeman, M.D. Jenks, and Norio Honjo, 1988, Geologic field trip guide to the central and western Snake River Plain, Idaho, emphasizing the silicic volcanic rocks. P.K. Link and W.R. Hackett, eds., *Guidebook to the Geology of Central and Southern Idaho: Idaho Geological Survey Bulletin 27, 247-281.*

Bonnichsen, Bill, and D.F. Kauffman, 1987, Physical feature of rhyolite lava flows in the Snake River Plain volcanic province, southwestern Idaho. J.H. Fink, editor, *Emplacement of Silicic Domes and Lava Flows: Geological Society of America Special Paper 212, 119-145.*

Bonnichsen, Bill, 1982, Rhyolitic lava flows in the Bruneau-Jarbidge eruptive center, southwestern Idaho. Bill Bonnichsen and R.M. Breckenridge, editors, *Cenozoic Geology of Idaho: Idaho Bureau of Mines and Geology Bulletin 26: 283-320.*

Bonnichsen, Bill, and G.P. Citron, 1982, The Cougar Point Tuff, southwestern Idaho and vicinity. Bill Bonnichsen and R.M. Breckenridge, editors, *Cenozoic Geology of Idaho: Idaho Bureau of Mines and Geology Bulletin 26: 255-281.*

Additional Information

(1) Professional Societies:

Senior Fellow, Geological Society of America

Fellow, Society of Economic Geologists

(2) Areas of Expertise:

Volcanology, Geologic Mapping, Economic Geology, Igneous and Metamorphic Petrology, and the Geology of Idaho and of the Snake River Plain

(3) Principal Investigator and Supervisor:

Phosphate resource evaluation, SE Idaho, for USGS & BLM, 1979-83

Geologic mapping, Wilderness Study Areas, SW Idaho, for USGS, 1985-86
Geologic mapping, Grand View-Bruneau area, for US Fish/Wildlife & IDWR, 1989-92
Geologic mapping, Birds of Prey Natural Area, SW Idaho for USGS COGEOMAP program, 1986-89
Geologic Mapping, various areas, SW & N Idaho, for USGS STATEMAP program, 1990-2002

(4) Editor:

Cenozoic Geology of Idaho, 1982: Idaho Bur. Mines & Geol. Bull. 26, 42 articles, 725 p.
Guidebook, Geology of N. & W. Idaho & Vic, 1989: Idaho Geol. Survey Bull. 28, 9 articles, 156 p.
Tectonic & Magmatic Evolution of the Snake River Plain Volcanic Province, 2002: Idaho Geol. Survey Bull. 30, 18 articles, 482 p.

(5) Field Trips & Meetings Organized:

GSA Penrose Conference, Magmatic Sulfides and Mafic Plutons, 1975
Numerous Friends of Rhyolite & other informal field trips in Snake River Plain, 1977-2005
Five GSA & IAVCEI formal field trips in Snake River Plain and other localities, 1987-2004

(6) Advisory Activities:

National Science Foundation-sponsored and Leicester University (U.K.)-sponsored studies of Snake River Plain volcanism for W.P. Leeman, J.A. Wolff, J.W. Shervais, and M.J. Branney.
Geologic studies of volcanism in the Guanajuato region, Mexico, for J.J. Aranda-Gomez and G.J. Aguirre-Diaz.

(7) Major TV contributions:

Helped develop and appeared in the 1-hour TV program: "Idaho Geology; A Convergence of Wonders" in the Idaho Public Television's Outdoor Idaho series, 2012.

Current Geology Project

A study entitled: "Evolution of Salmon Falls Creek Canyon and its Tectonic Implications, Southern Idaho and Northern Nevada"; an abstract of this study appears in: Geological Society of America 2014 Abstracts with Program, Rocky Mountain/Cordilleran Section, vol. 46, no. 5, p. 94.

[Bonnichsen CV2015.docx]

THE GEOLOGIC SITUATION NEAR BERGER, IDAHO

by

Bill Bonnichsen, Ph.D.

THE GEOLOGIC SITUATION NEAR BERGER, IDAHO

The relatively thin basalt zone beneath the Berger area serves as the principal aquifer. It lies above accumulations of rhyolite and fine-grained sediments that do not readily transmit water. Consequently, the aquifer in the Berger area is considerably less robust than many assume.

Introduction

One of the most important factors for understanding groundwater availability for any locality is the character of the geologic units that contain the water and control its underground flow. In order to better understand the subsurface geologic nature of the area surrounding the test well near the mutual corners of sections 7, 8, 17, and 18 in T. 11 S., R. 16 E., at 2 miles west and 0.5 mile north of Berger, the following information is presented. The bedrock units that need to be considered are the basalt, rhyolite, and sediments that underlie that area as well as throughout the region around this part of the central Snake River Plain. Also, to get a more specific and quantitative idea of what actually is present beneath Berger and the test well, several well driller's logs archived in the Idaho Department of Water Resources web site were examined and the results are discussed below.

Basalt

In the area near Berger, Idaho, and north past the test well near 3300N 2200E (Twin Falls Co. grid) all the way to Snake River canyon, the near-surface geologic unit is a sequence of Pliocene age basalt flows known as the basalt of Sucker Flat, which were erupted from a group of basalt shield volcanoes that constitute the Hollister volcano alignment zone, a nearly 12-mile-long zone extending SE to NW just west of Hollister and Berger (Bonnichsen and Godchaux 2002). The Sucker Flat basalt lies beneath a mantle of topsoil, caliche and basalt fragments seldom exceeding a thickness of 15 ft. The main source of the Sucker Flat basalt is believed to be the northwest-trending elongate shield volcano, Berger Butte. Other shield volcanoes in the Hollister volcano alignment zone that likely contributed basalt flows to the Sucker Flat basalt unit include Holly Hill, Checking Station Hill, and Hills 4534, 4535, 4613, 4645, and 5155. Radiometric ages of the Sucker Flat basalt include a K-Ar date of about 4.6 million years from a sample obtained near Hollister (Armstrong, 1975) and an Ar-Ar date of about 2.91 million years from a sample obtained from the east flank of Berger Butte (Othberg and others, 2012).

The basalt flows in the Berger area are similar to basalt flows throughout the central Snake River Plain region, many of which can readily be examined in the walls of the canyons of the Snake River and of Salmon Falls Creek, all within a short distance of the Berger area. The basalt flows beneath the Berger area are believed to contain many porous and permeable zones of primary cavities within, and especially at the tops, of individual flows, and abundant cracks and open fissures that cut through parts of the flows. Also, interlayered with the some of the basalt flows are extremely porous zones of cinders and scoria. Altogether, the sequence of basalt flows in the

Berger area is a good aquifer, permitting groundwater to flow through it at a reasonably fast rate.

Rhyolite

Lying beneath the basalt flows in the Berger area, and generally throughout the entire central Snake River Plain region, is the type of volcanic rock known as rhyolite. The rhyolite exposed nearest to the Berger area, at about 9 miles distance in the northwestern part of the Cassia Mountains (South Hills) is the Tuff of McMullan Creek, which is a densely-welded series of rhyolitic tuff layers aggregating as much thickness as almost 400 ft., and which is the upper part of a sequence of welded rhyolitic tuff units exposed throughout the Cassia Mountains with a maximum thickness greater than 1300 ft. (Williams and others, 1991). It is believed that the rhyolite unit beneath the basalt in the Berger area is part of the McMullan Creek welded tuff. This unit has a K-Ar date of about 8.5 million years. It probably was erupted explosively from a buried caldera located generally north or northwest of the Cassia Mountains, and which now is hidden beneath the later basalt flows that cover that part of the central Snake River Plain.

Sediments

Three general types of sedimentary material are to be expected beneath the Berger area. First are minor amounts of sedimentary material between some basalt flows, as commonly can be seen in canyon walls around south-central Idaho. Most of this material is fine-grained clay and silt and represents ancient soil layers that accumulated during time intervals between outpourings of basalt, as the wind blew material across the landscape. Such old soil layers usually are less than 10 feet thick.

Beneath the basalt in the region north and west of the Berger area are lake beds of the Glens Ferry Formation (Malde and Powers, 1972; Wood and Clemens, 2002; Othberg and others, 2012) that were deposited in a large, long-lasting lake known as Lake Idaho that occupied the western Snake River Plain basin and parts of the central Snake River Plain area during much of the late Miocene and Pliocene time periods. Much of the material that was deposited in this lake is fine-grained silt and clay, accompanied by variable quantities of rhyolitic ash that fell from the atmosphere during major rhyolite eruptions. The southeastern margin of this ancient lake has never been clearly delineated because it is buried beneath younger basalt flows, but various lines of evidence suggest that it goes through the area a mile or two north of Berger. Near the lake margin there may be minor amounts of sand and gravel that were deposited along streams or rivers that flowed into the ancient lake and which now are buried beneath or interlayered with the basalt.

Finally, interbedded with the layers of densely-welded tuff in the rhyolite zone beneath the basalt flows are layers of volcanic ash and minor quantities of soil, sand and gravel that were deposited during the time intervals between the rhyolite eruptions. In the subsurface environment such ash deposits, as well as the lower and upper glassy parts of the welded tuff layers, over time commonly become

degraded to clay minerals by their interaction with somewhat heated groundwater, leading to impervious layers consisting partially to completely of clay.

Structure and Buried Topography

Prior to emplacement of the basalt flows that underlie the Berger area the landscape likely was somewhat irregular, with hills and valleys giving topographic relief of perhaps a few hundred feet. Reasons to believe this are seen in the variation of the elevation of rhyolite occurrences around the central Snake River Plain region, as well as at depth where rhyolite was intersected in water wells that have been drilled. Part of the variation is the result of erosion of certain parts of the rhyolite landscape by streams during the 4 million or so years prior to burial by the basalt flows, and part of the variation is the result of faulting and tilting of the welded tuff layers after they were deposited. A sense of the amount of faulting can be seen in the Cassia Mountains where many normal faults of small to modest displacement are shown on the geologic map (Williams and others, 1991) and by faults that displace the top of the rhyolite in the lower part of Salmon Falls Creek canyon a few miles west and northwest of the Berger area. These pre-basalt topographic and structural variations indicate that the elevation of the bottom of the basalt zone in the Berger area may vary locally by several hundred feet.

Water Well Information

Twenty-seven water-well driller's logs archived in the IDWR website for the area surrounding the test well were examined to gain a better idea of the subsurface geologic characteristics of the area surrounding the test well. The well logs examined are those within about 3.5 miles of the test well and that were drilled to at least 500 feet deep, with the deepest having been drilled to 975 feet. The logs examined describe wells in sections 1 and 2, T. 11 S., R. 15 E. and in sections 6, 9, 16, 17, 19, 20, 21, 22, 27, 28, 29, and 30, T.11 S., R. 16 E. Of these 27 wells, 10 stopped in basalt and the other 17 were drilled into rhyolite or sediments beneath the basalt. The driller's logs which were examined commonly refer to the rock drilled through as lava; this is a broad term that could refer to either basalt or rhyolite, so an "educated evaluation" was made in many instances to estimate the depth at which the drilling reached the bottom of the basalt. In other instances, however, the driller's log are more specific and use the terms basalt and rhyolite, permitting a more reliable estimate of the depth at which the drill hole went out of the basalt into the underlying rhyolite or sediments. It was found that the depth at which the bottom of the basalt zone was reached ranges from approximately 240 to 710 feet which, when taking the variations in surface elevation of the wells into account, converts into an elevation range for the bottom of the basalt of 3440 to 4110 feet above sea level. Most of these wells intersect the bottom of the basalt zone between elevations of 3650 and 4050 feet above sea level, with higher elevations being more prevalent farther south and lower elevations being prevalent to the north.

Geologic Influence on Groundwater Availability

The basalt that occurs for the first few hundred feet beneath the surface in the Berger area is considered to be a good aquifer because of the various fractures and

cavities it contains, as well as the interlayered cinder and scoria layers. Undoubtedly, this basalt zone contributes most of the groundwater pumped from the area. The underlying zones of rhyolite and clay and other fine-grained sediments, however, are not good aquifer materials because they contain much less open space as cavities and fractures than the basalt and because these are not materials that would permit water to flow through them at a rate anywhere near approaching that of basalt. It is only the rare lenses of gravel and sand that occur within the zones beneath the basalt that might act as good aquifers. Consequently, even though the zone of rhyolite and sediments beneath the basalt would contain water, recovery of very much water from this zone at much of a sustained rate simply would deplete the water supply there so that water derived from wells drilled to such depths would be coming mainly from the higher-level basalt zone. Thus, in effect, the bottom of the basalt zone represents the bottom of the aquifer from which sustained water volumes can be obtained.

Examination of the well logs in the Berger area indicate that the depth at which water stood (static water level), which would approximate the top of the water table when any particular well was drilled, varied from 210 to 540 feet below the surface. This is equivalent to elevations between 3770 and 4320 feet for the water table at those times for the various wells. And actually, the static water level for nearly all of the wells fell within the range of 3800 and 4000 feet above sea level. By taking the vertical distance between the static water level and the bottom of the basalt zone an estimate can be made for the thickness of the basalt aquifer that might produce substantial amounts of water for each of the wells. The results are that for nearly all of the wells that were examined the thickness of the productive water zone is relatively thin; it typically ranges between 100 and 250 feet.

Two of the main implications of these observations are that: (1) the amount of water that can be obtained from the basalt aquifer with sustained pumping likely is more limited than many have assumed because the water-bearing zone is not really very thick, and (2) drilling to depths below the water-bearing basalt zone is not likely to yield much additional water being available because the dense rhyolite and nearly impervious clays-rich sediments there cannot transmit water very rapidly. These observations mean that prolonged pumping at a high rate of the groundwater from the basalt aquifer in the region of the test well likely will draw down the water table for a considerable distance around, resulting in water loss for other wells in the surrounding area.

GEOLOGIC SITUATION IN THE JACKPOT, NEVADA, AREA

Three miles south of Jackpot, NV, at the north end of a volcanic rock and sediment-filled basin, Delaplain Valley, Salmon Falls Creek and Shoshone Creek join and enter Salmon Falls Creek canyon at an elevation of approximately 5100 feet. The stream flows through this canyon to the upper end of Salmon Falls Creek Reservoir. The location of this stream confluence is about ten miles south of a drainage divide in the

Rogerson graben (the valley through which Salmon Falls Creek flows located between the Browns Bench escarpment to the west and the hills to the east) that separates south-flowing streams from north-flowing streams. Within the Rogerson graben the drainage divide is at an elevation above 5300 feet, and to the sides of the valley it is at much higher elevations. In the Rogerson graben this divide can be traced as an irregular course from west to east on the U.S.G.S. Meteor 7.5-minute quadrangle topographic map through sections 6 and 5 of T. 16 S., R. 15 E. and sections 33, 28, 34, 35, and 36 of T. 15 S., R. 15 E. Farther east, this divide separates the drainage basin of Shoshone Creek and its little tributary Mule Creek from the small streams and other watercourses that flow off the northwest flank of the Cassia Mountains into the Salmon Tract region.

The region around Jackpot and the southern part of the Rogerson graben is underlain by a thick succession of rhyolitic welded tuff units ranging in age from about 12 to 7.5 million years old (Andrews and others, 2008; Bonnicksen and others, 2008). These rhyolitic units are well exposed on the escarpment west of the Rogerson graben, so there really is no mystery as to what lies beneath the valley where Salmon Falls Creek Reservoir is located. In the southern part of the Rogerson graben there is no succession of basalt flows overlying the rhyolite, nor are there layers of sand, gravel or other materials that would readily transmit water. Thus, there does not appear to be any sort of subterranean rock sequence through which groundwater readily could flow out of the basin south of Jackpot and into the Salmon Tract area to the north. It seems clear that essentially all of the water that escapes from Delaplain Valley flows out through Salmon Falls Creek canyon and into Salmon Falls Creek Reservoir, and does not leave the valley as groundwater flowing northward. Consequently, there is absolutely no reason to believe that water from the Mule Creek drainage, or from elsewhere in the larger Shoshone Creek drainage basin, would travel underground northward to become part of the groundwater system in the Berger area.

References Cited

Andrews, GDM, MJ Branney, B Bonnicksen, and M McCurry, 2008, Rhyolitic ignimbrites in the Rogerson Graben, southern Snake River Plain volcanic province: volcanic stratigraphy, eruption history and basin evolution; *Bulletin of Volcanology* v. 70, p. 269-291.

Armstrong, RL, WP Leeman, and HE Malde, 1975, K-Ar dating, Quaternary and Neogene volcanic rocks of the Snake River Plain, Idaho; *American Journal of Science*, v. 275, p. 225-251.

Bonnicksen, B and MM Godchaux, 2002, Late Miocene, Pliocene, and Pleistocene geology of southwestern Idaho with emphasis on basalts in the Bruneau-Jarbridge, Twin Falls, and western Snake River Plain regions; *in* B Bonnicksen, CM White, and M McCurry, eds., *Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province*; Idaho Geological Survey Bulletin 30, p. 233-312.

Bonnichsen B, WP Leeman, N Honjo, WC McIntosh, and MM Godchaux, 2008, Miocene silicic volcanism in southwestern Idaho: geochronology, geochemistry, and evolution of the central Snake River Plain; *Bulletin of Volcanology*, v. 70, p. 315-342.

Malde, HE, and HA Powers, 1972, Geologic map of the Glenns Ferry-Hagerman area, west-central Snake River Plain, Idaho; U. S. Geological Survey Misc. Geol. Inv. Map I-696, 1:48,000.

Othberg, KO, JD Kauffman, VS Gillerman, and DL Garwood, 2012, Geologic map of the Twin Falls 30 x 60 minute quadrangle, Idaho; Idaho Geological Survey Map 49, 1:100,000.

Williams, PL, HR Covington, and JW Mytton, 1991, Geologic map of the Stricker 2 quadrangle, Twin Falls and Cassia Counties, Idaho; U. S. Geologic Survey Misc. Inv. Series Map I-2146, 1:48,000.

Wood, SH, and DM Clemens, 2002, Geologic and tectonic history of the western Snake River Plain, Idaho and Oregon; *in* B Bonnichsen, CM White, and M McCurry eds., *Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province*; Idaho Geological Survey Bulletin 30, p. 69-103.

Submitted 11 Feb 2015

Bill Bonnichsen

Bill Bonnichsen, Ph.D.
927 East Seventh Street, Moscow, Idaho 83843

Senior Research Geologist (retired), Idaho Geological Survey, University of Idaho