Contribution to the Treasure Valley Hydrologic Project - 1997

STRUCTURE CONTOUR MAP OF THE BASE OF QUATERNARY BASALT

Murphy and west part of Mountain Home Map Sheets, Idaho

By
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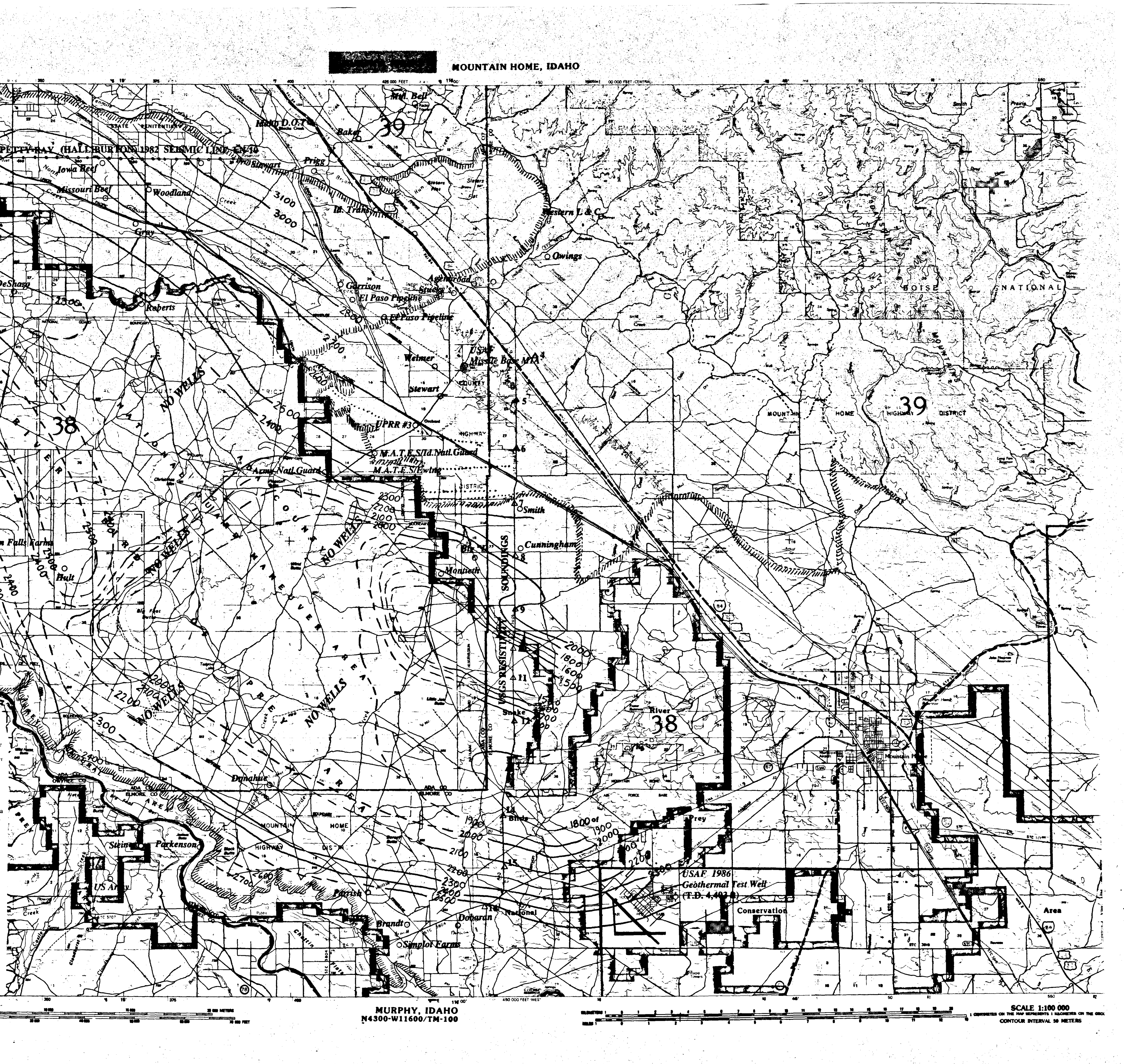
Scale = 1:100,000
Contour Interval = 100 feet
Contours are dashed where uncertain for lack of control wells
Elevations in feet with respect to sea level

UPRR #3 ○ = deep water well used for control
Δ 15 = vertical electrical-resistivity-sounding point **(unpublished data of R.J. Bisdorf (USGS), 1983 referenced by Whitehead (1992)**
= mapped geologic contact of the basalt field



Introduction

An extensive field of Quaternary aged basalt lies southeast of the Boise River Valley, across the western Snake River Plain, which is here named the Mountain Home-Kuna lava field. Ages obtained on these basalts are mostly younger than 2 million years (Malde, 1991, p. 265; Othberg and others, 1995b, p. 23). The greatest volume of basalt erupted from a crudely aligned group of shield volcanoes that trend obliquely about N70°W across the western plain from Mountain Home to the Kuna-Melba area (Wood, 1989). Fissures and faults that cut shield volcanoes are aligned with the main linear array of vents oriented about N 70°W. Thus the lava field has the character of a *volcanic rift zone* as discussed in Kuntz and others (1992, p. 241) about 95 km long. Two vents off of the main group, on the northeast margin of the plain erupted about 1 million years ago. Lavas from Slater's Butte, a vent on the NE margin of the plain flowed west, and merged with the Mountain Home-Kuna lava field, while the lavas from the Fivemile vent, also on the NE margin flowed into north and were confined by the Boise River Valley (Othberg and others, 1995b).

Only outcrop basalts of the lava field have been dated, and the oldest of these are basalts along the Snake River near Grandview. These are the basalt of Wild Horse Butte, an unnamed basalt, and the basalt of Jackass Butte dated at 1.92 ± O.16, 2.06 ± 0.24, and 2.18 ± 0.18 Ma, respectively (Malde, 1991). Wood and Anderson (1981) identify a buried basalt field in the subsurface south of Lake Lowell, suggesting that this locus of activity began earlier than the Quaternary.

A number of events have effected the distribution of these lavas, but the alignment of shields and vents is the main controlling feature of a constructed lava terrain up to elevation 3600 feet. The locus of vents trending obliquely across the plain has constructed a highland of about 3000 foot elevation, and has forced the Snake River into a course along the south side of the plain. The modern Snake River cuts breaks through the lava field in Swan Falls gorge, creating spectacular sections of the eruptive vents and sediments of lava-dammed lakes in the walls of the canyon (Malde, 1987). Lavas and sediments of lava-dammed lakes were named the Bruneau Formation by H.E. Malde in the course of his mapping along the canyon over the past three decades (Malde, 1991).

Much of the lava erupted onto the plain after the Lake Idaho basin was sediment filled and river systems reached the outlet. However some lava apparently erupted into Pliocene Lake Idaho, prior to drainage. For example the subsurface lava field by Lake Lowell (Wood and Anderson, 1981) and the basalt of Jackass Butte. At the 2700-foot elevation level on Jackass Butte the basalt appears conformable with palagonite tuffs which are conformable with Glenns Ferry Formation lake beds at that locality (Malde, 1987, p. 31).

Studies have recognized "water-affected" basalts thought to have erupted into Lake Idaho (Jenks and Bonnichsen, 1989; Godchaux and others, 1992), but clear stratigraphic relationships have not been published, and it cannot be discerned whether the older of these erupted into lava-dammed lakes (Bruneau Formation) or into Lake Idaho (Glenns Ferry Formation).

Over most of the field lava erupted onto a land surface that was at elevation 2400 to 2500 feet. In its central part, the lava field built up to elevations above 3000 feet, and the largest shield, Big Foot Butte is 3535 feet in elevation. On the basis of Schlumberger-array electrical-resistivity soundings, Whitehead (1992) shows Quaternary basalt down to

elevation 1300 feet, and a thickness of about 1500 feet near Little Joe Butte. Water wells in this area drilled in basalt to the bottom of hole at elevation 1880 feet. Therefore in the vicinity of the large shields in the central part of the lava field the contact between the basalt and fluvial-lacustrine sediment is at a much lower elevation. The reason for this low elevation contact is not known. Possibly the vent area is downfaulted, or perhaps the contact is of dike injected sediment near the vents. The deep and thick basalt appears to be in a zone about 10 km wide over the main vent area as interpreted from a north-south resistivity profile.

The thickest pile of Quaternary lava, extending from Fraser Reservoir near Mountain Home west to about Big Foot Butte coincides with the areally large NW-SE aligned positive gravity anomaly of the western plain (Bankey and others, 1985). Although the Quaternary lava surely contributes to the gravity anomaly, the breadth of the anomaly indicates much of the anomalous mass is at a greater depth. A very thick deeper basalt was drilled at the Mountain Home Air Force base well. Lewis and Stone (1988) show a basalt beneath the lacustrine section from depth 1,886 to total depth of 4,403 feet (corresponding to elevation −1381 feet {i.e. below sea level}), and the combined effect of the Quaternary basalt and the deeper Tertiary basalt produces a positive anomaly greater than +30 milligals

Infilled channels and incised paleocanyons in the western plain: Malde (1991, p. 266) called the upper lavas of the basalt field, "basalt of the Snake River Group" based upon their freshness and generally well preserved surface morphology. The distinction has to do with Malde's identification of several paleocanyons of the Snake River that were filled and diverted by lava eruptions. However, the lava eruptions persisted into the late Quaternary, and the distinction between basalts of the Bruneau Formation and basalts of the Snake River Group is not broadly useful.

An ancestral channel of the Snake River trends northwestward in the subsurface from Swan Falls to the vicinity of Melba and Bowmont, originally identified by Malde (1987) and called the "Canyon 3 Stage". Malde (1991) states that the floor of this "third canyon" is at 2150-ft (655 m) elevation based on well data in the Melba area, and he believed the canyon went through to the Boise River drainage. It seems unlikely that the canyon was deeper than about 2300 feet: I have been unable to locate the well cited by Malde. In the Swan Falls area the canyon is filled with basalt aged 1.4 to 1.8 Ma, the lowest exposures being about 2350-ft elevation (Malde, 1987, p. 38). Just below Swan Falls, the present river elevation is 2290 feet. North of Lake Lowell, in the vicinity of Nampa and U.S. Highway 30, Wood (1981, unpublished mapping) water wells drilled basalt for 100 feet down to elevation 2330 feet. At Caldwell the basalt crops out at elevation 2370 feet. Wood and Anderson (1981) called these northern basalts the "basalt of Indian Creek" because a subsurface strip of basalt is mapped along the alignment of the present day Indian Creek. Thus there is evidence of incision of the older lake deposits and intracanyon basalt down to 2350-foot elevation, but not down to 2150-ft elevation as suggested by Malde (1991).

Elevations of the base of gravels within the upper fluvial deposits of the western Snake River Plain are important to understanding evolution of these Quaternary-aged deposits, and the history of incision of the lake deposits. The elevation range 2300 – 2400 appears to be the deepest level of incision in the lower reaches of the plain. Cobb Rapids by Weiser is 2080 feet, and is the lowest believable level of incision of the plain.

Data used for structure contours

Most of the data on the base of basalt is from driller's logs; however there are 4 townships with no wells in southeastern Ada County, coinciding generally with the higher elevation part of the lava field. The deepest well is the Montieth well in the vicinity of Cinder Cone Butte where the base of base of basalt is below 1900 feet elevation. Other nearby wells are completed in the underlying sediments below the base of the basalt at about 2200 feet elevation. In that area, along the Ada County – Elmore County line is a line of deep resistivity soundings obtained from the files of the U. S. Geological Survey – a much reduced version of which was published by Whitehead (1992). I have examined the data, and interpreted depth of the basalt along that line as the base of the high resistivity section (>150 ohm meters), below which the resistivity drops to less than 100 ohm meters more characteristic of the sedimentary section. There is a zone of high resistivity extending down to elevation about 1500 feet, that lies between the Montieth well and Little Joe Butte, a zone about 3 miles wide. It could be a zone of intrusive dikes or sills, for it is not likely that the depositional surface was ever that deep during the Quaternary.

On the north side of the field near Orchard, the basalt is intercalated with alluvial fan sediment shed from the mountains to the north. No basalt occurs in the subsurface north of Interstate 84, and only one layer occurs in the ;USAF Missile Base well drilled down to 2050 elevation. That basalt occurs between 3010 and 3090 feet elevation.

The basalt of Slaters Butte erupted north of the main field and flowed west and merged with the field. Basalt is 326 feet thick in the section 34 El Paso Pipeline well, and could be entirely Slaters Butte flows, or overlap upon older flows of the main field.

On the west end of field is a broad area where the base of the basalt is between 2500 and 2600 foot elevation. The basalt flowed around Madden Butte and ridges of the Ten Mile Gravel to the north near Nampa. I did not produce a map of the base of the basalt for the part that extends into the Boise 1:100,000 map sheet, for most of it is about 2500, with the exception of infilled channels discussed earlier in the vicinity of Nampa. These have been previously mapped (Wood, 1980, unpublished mapping), but detailed 1:24,000 sheets were not included in Wood and Anderson (1981). They can, however be made available if requested.

Intracanyon basalt flows mantle two of the terrace surfaces in the Boise River Valley. The Fivemile b*asalt erupted from a vent on the Tenmile surface and spilled over onto the Fivemile surface, which was an active floodplain at the time (Othberg, 1994, p. 34). The Fivemile basalt thickness exceeds 150 feet in the Micron Technology Facility area (Squires and others, 1992, p. 98). Othberg and others (1995b) report a whole-rock K-Ar age of 0.974 ± 0.130 years for the Fivemile basalt. The Gowen basalt is only about 30 feet thick (Wood and others, 1987). The Gowen basalt probably erupted in the Smith Parry area and flowed down the south fork of the Boise River and spread on the active floodplain of the Gowen surface. Othberg and others(1995b) report a whole-rock K-Ar age of 0.57∠ + 0.210 years.

Boundary of the lava field has been compiled from geologic mapping at scales of 1:24,000 in the Nampa Caldwell area by Wood and Anderson (1981) and along the Snake River Canyon area by Malde (1989) and in the Orchard area by Wood (1990). Elsewhere, east and west of the Orchard area, I used the 1:250,000 mapping of Rember and Bennett (1979) which has not been field checked or checked against water well information.

Hydrogeologic significance of the basalt field

The Mountain Home – Kuna lava field covers a substantial part of the western plain, however no major streams enter the field, except for irrigation canals at the western end. The ephemeral streams of Canyon Creek and Indian Creek enter from the north and lose all of their flow into the lava field. The Snake River incises to a level below the lava sediment contact, and there is a line of small springs discharging from the lavas, particularly in the Jackass Butte Quadrangle at elevations 2400 to 2600 feet.

Whitehead (1992, Plate 3) shows a west-northwest trending area about 5 miles wide in the middle of the field where the basalt is saturated over a thickness of at least 500 feet. Water level in this region is 2600 to 2800 foot elevation, with relatively low gradients (10 to 60 feet/mile (Young, 1977, Figure 6), probably on account of highly permeable stratified basalt, and low recharge. Groundwater flow appears to be generally west and southwest toward the Snake River. Depth to water is typically 400 to 600 feet in the center of the basalt field.

Some very high yields are reported from irrigation wells in the Cinder Cone Butte area: up to 2500 gpm. I am unaware of recent studies of that local area of irrigation groundwater development – since the report by Young (1977). The wells are deep (typically 1100 feet) and completed in both the basalt and underlying sediment. It is unlikely that the very high yields have been sustained for all the wells originally drilled in the area. In search of the well driller's record files, I did not run across any step tests or well tests in the basalt, although some have probably been run in the Mountain Home area – and would be known by Hiddleston Drilling Co.

In the Nampa-Kuna area, Hold (1997) has shown that many domestic wells are completed in the gravel just beneath the basalt, and elsewhere this is clearly an important, though discontinous group of gravel aquifers. On account of high permeability and good vertical hydraulic continuity in most parts of the lava field, ground-water in the lava field area is susceptible to pollution from industry, waste disposal and agricultural activity on the surface.

References

Bankey, V., Webring, M., Mabey, D.R., Kleinkopf, M.D., and Bennett, E.H., 1985, Complete Bouger gravity map of Idaho: U.S. Geological Survey Map MF-1773, 1:500,000.

Beukelman, G., 1997, Reports on the Ontario, Parma, Notus, and Boise Cross Sections: Geological and Geophysical Framework of the Treasure Valley: unpublished report to the Idaho Department of Water Resources from CGISS, Geosciences Dept., Boise State University.

Godchaux, M.M., Bonnichsen, B., and Jenks, M.D., 1992, Types of phraetomagmatic volcanoes in the western Snake River Plain: Journal of Volcanology and Geothermal Research, 52, 1-25.

Hold, Howard, 1997, Cross sections of the western Snake River Plain in the vicinity of Kuna and Caldwell, Idaho: M.S. Thesis in progress: Boise State University Geosciences Department.

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

Kuntz, M.A., Covington, H.R., and Schorr, L.J., 1992, An overview of basaltic volcanism of the eastern Snake River Plain, Idaho:*in* Link, P.K., Kuntz, M.A., and Platt, L.B., (eds.) Regional Geology of Eastern Idaho and Western Wyoming: Geological Society of America Memoir 179, p. 227-267.

Lewis, R.E., and M.A.J. Stone, 1988, Geohydrologic data from a 4,403-ft geothermal test hole, Mountain Home Air Force Base, Elmore County, Idaho: U. S. Geological Survey Open File Report 88-166, 30 p.

Malde, H.E., 1987, The Montini volcano; A lava dam on the ancestral Snake River, southwest Idaho: Geological Society of America Centennial Field Guide – Rocky Mountain Section, p. 127-130.

_______, 1987, A guide to the Quaternary geology and physiographic history of the Snake River Birds of Prey area, Idaho: Northwest Geology, v. 16, p. 23-46.

_______, 1991, Quaternary geology and structural history of the Snake River Plain, Idaho and Oregon, *in* The Geology of North America, Quaternary Nonglacial Geology: Conterminous U.S., The Geological Society of America, v. K-2, p. 251-281.

Malde, H.E., 1991, Quaternary geology and structural history of the Snake River Plain, Idaho and Oregon: in Morrison, R.B.(ed.) Quaternary Non-glacial Geeology, Conterminous U.S., The Geology of North America, Volume K-2, The Geological Society of America, Boulder, p. 251-281.

_______, 1989, Geologic Map of the Bruneau Formation in the Walters Butte and Initial Butte Quadrangles, Southwestern Idaho: U. S. Geological Survey Map MF-2063-A, 1:24,000.

_______, 1989, Geologic Map of the Bruneau Formation in the Sinker Butte and Wild Horse Butte Quadrangles, Southwestern Idaho: U. S. Geological Survey Map MF-2063-B, 1:24,000.

_______, 1989, Geologic Map of the Bruneau Formation in the Oreana and Castle Butte Quadrangles, Southwestern Idaho: U. S. Geological Survey Map MF-2063-C, 1:24,000.

_______, 1989, Geologic Map of the Bruneau Formation in the Jackass Butte and Dorsey Butte Quadrangles, Southwestern Idaho: U. S. Geological Survey Map MF-2063-D, 1:24,000.

_______, 1989, Geologic Map of the Bruneau Formation in the C.J. Strike Dam and Bruneau Quadrangles, Southwestern Idaho: U. S. Geological Survey Map MF-2063-E, 1:24,000.

Othberg, K.L., Bonnichsen, B., Swisher, C.C. III, and M.M Godchaux, 1995, Geochronology and geochemistry of Pleistocene basalts of the western Snake River Plain and Smith prairie, Idaho: Isochron/West, no. 62, May, 1995, p. 16-29.

Othberg, K.L., 1994, Geology and geomorphology of the Boise Valley and adjoining areas, western Snake River Plain, Idaho: Idaho Geological Survey Bulletin 29, 54 p.

Othberg, K.L., O'Connor, J.E., and McDaniel, P.A., 1995a, Field guide to the Quaternary geology of the Boise Valley and adjacent Snake River Valley (Idaho): Idaho Geological Survey Special Report (April, 1995), 51 p.

Rember, W.C., and Bennett, E.H., 1979, Geologic Map Series Hailey 2° Quadrangle: Idaho Geological Survey, Moscow, 1:250,000.

Whitehead, R.L., 1992, Geohydrologic framework of the Snake River Plain Regional Aquifer System, Idaho and Eastern Oregon: U. S. Geological Survey Professional Paper 1408-B, 32 p.

Wood, S. H., 1980, Geologic Maps of the Nampa, Lake Lowell, Caldwell, and Middleton 7 ½ -minute quadrangles, unpublished mapping with basalt interval depths.

Wood, S.H., and Anderson, J.E., 1981: Geology , in Mitchell, J.C. (ed.) Geological, Hydrological, Geochemical and Geophysical investigations of the Nampa-Caldwell and adjacent areas, southwestern Idaho: Idaho Department of Water Resources Bulletin 30, Part 11, p. 9-31.

Wood, S.H., 1990, Geologic Map of the Orchard Quadrangle, unpublished mapping, Boise State University 1:24,000

Wood, S.H., Squires, E., and Jackson, J., 1987, Geologic study of ground water in deep wells, southeast Boise area, Idaho: Unpublished report to Boise Water Corporation, December 22, 1987. 10 p., 11 profile cross-sections.

Wood, S.H., 1989, Quaternary basalt vent- and fissure alignments, principle stress directions, and extension in the Snake River Plain (abs.)Geological Society of America Abstracts with Programs 21, p. 161.

Young, H.W., 1977, Reconnaissance of ground-water resources in the Mountain Home Plateau area, southwest Idaho: U. S. Geological Survey Water-Resources Investigations 77-108 Open-File Report, 40 p.