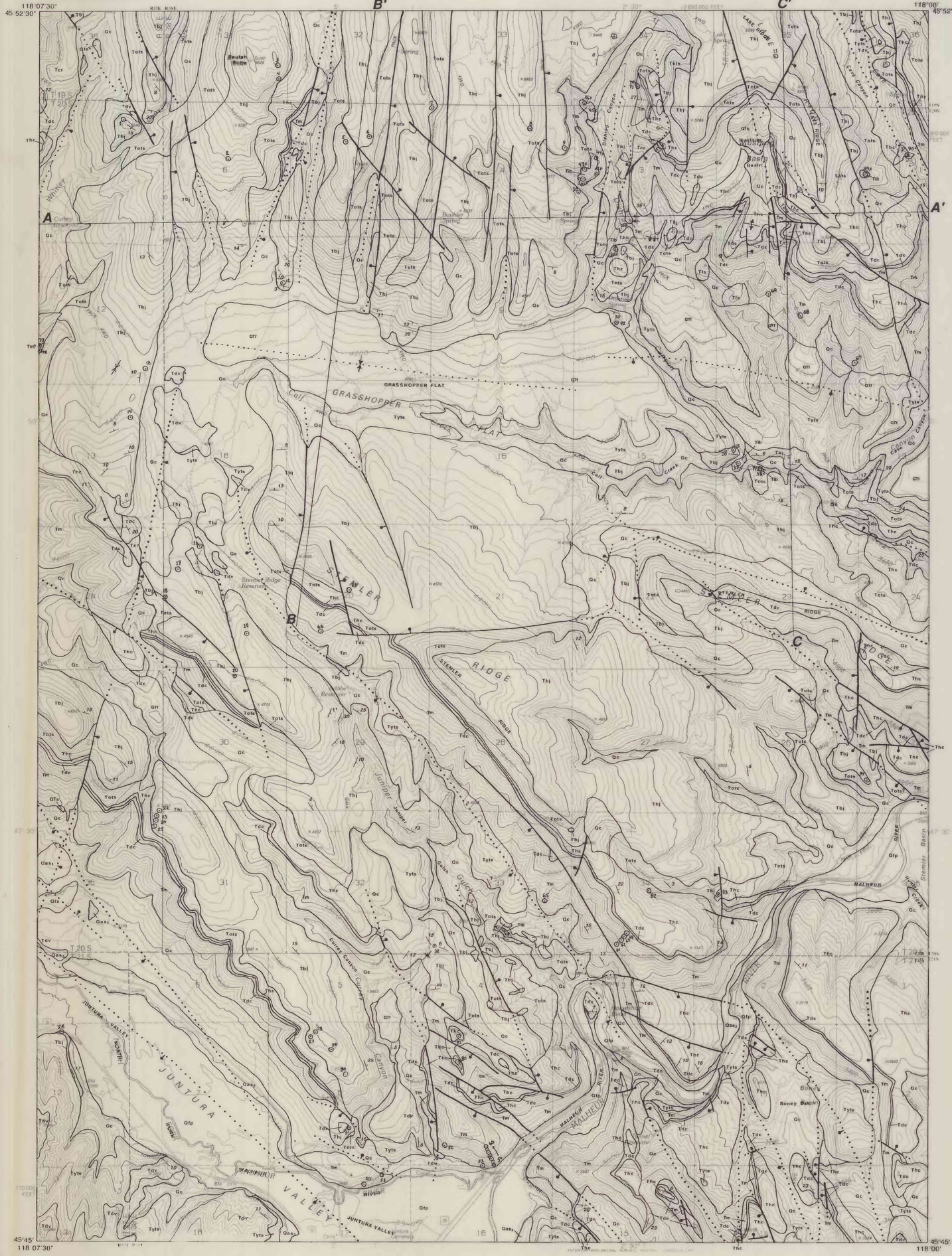
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 98-105
Pamphlet accompanies map



Base from U.S. Geological Survey, 1990
Lambert Conformal Conic projection

GN Mv
0° 44'
22 mils
17°
22 mils

UTM GRID AND 1990 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

1 0 1 KILOMETER
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

CONTOUR INTERVAL 40 FEET
SUPPLEMENTARY CONTOUR INTERVAL 20 FEET

To convert feet to meters multiply by .3048
To convert meters to feet multiply by 3.2808

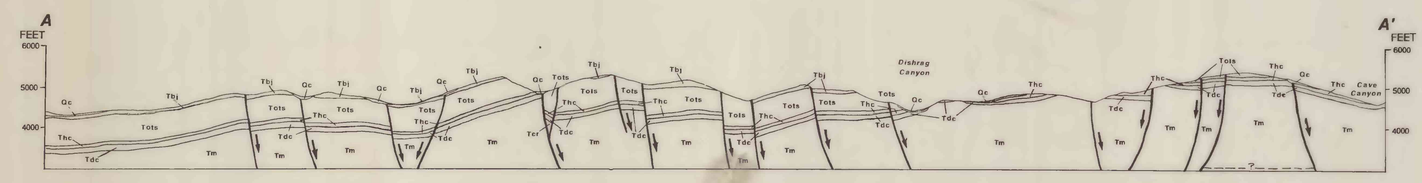
QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 Beulah
2 De Armond Mountain
3 Westfall Butte
4 Petes Mountain
5 Jonesboro
6 Selle Gap
7 Jonesboro
8 Monument Peak

ADJOINING QUADRANGLE NAMES

Geology mapped in 1995-96
Reviewed by Jim Evans and Vic Camp



GEOLOGIC MAP OF THE STEMLER RIDGE QUADRANGLE MALHEUR COUNTY, EASTERN OREGON

By

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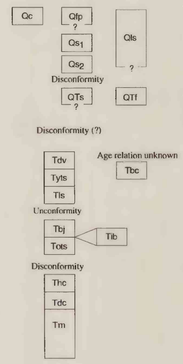
CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qc **Colluvium and Alluvium (Holocene and Pleistocene)**—Unconsolidated slope-wash detritus, alluvium, and alluvial fan deposits

Qfp **Flood-plain deposits (Holocene and Pleistocene)**—Unconsolidated to poorly consolidated sand and silt of the Malheur River and Juntura Valley. Grades into adjacent stream terrace deposits (in unit Qs_2)

Qls **Landslide deposits (Holocene and Pleistocene)**—Large cohesive monolithologic blocks, jumbled boulders of ridge-capping rock, and hummocky unconsolidated deposits of mixed lithology (sec. 36, T. 19 S., R. 37 E., NW¼ sec. 2 T. 20 S., R. 38 E.; sec. 36, T. 20 S, R. 37 E.)

Stream-terrace deposits (Pleistocene and Pliocene?)—Three paleo-river terraces are preserved in the south-facing slopes of Juntura Valley. These deposits are inset one into the next with decreasing age. Outcrops of these stages occur at elevations 3,600 ft (QTs), 3,300 ft (Qs_2), and 3,000 ft (Qs_1) elevation. Divided into:

Qs_2 **Unit 1 (Pleistocene)**—Poorly sorted cobbly to pebbly sandstone overlain by 2 m of tan, thinly bedded, poorly indurated sandstone. Overlies Devine Canyon Tuff at the west edge of map and abuts against the basalt of Malheur Gorge at the east end of exposure. Contains rounded clasts from basalt and tuff exposed in the area. Grades into flood-plain deposits (Qfp)

Qs_1 **Unit 2 (Pleistocene)**—Composed chiefly of fine-grained, well-sorted, poorly indurated sandstone with sporadic pumice and cobbles in NE ¼ sec. 36, T. 20 S., R. 37 E. Stream-cut exposure is 3.5 m thick; base and top are not exposed. Beds at 1-, 2-, and 3-m height from base contain discontinuous lenses of pale-tan pumice lapilli. Cobbles of basalt (Tm, Tbj), Dinner Creek Ash-flow Tuff (Tdc), and Devine Canyon Ash-flow Tuff (Tdv) occur near the top of the unit. The matrix, which encompasses 90-95 percent of the unit, is composed of massive, well-sorted reworked tuffaceous sedimentary material that was probably derived chiefly from unit of younger tuff and tuffaceous sedimentary rocks (Tyts)

QTs **Unit 3 (Pleistocene and Pliocene?)**—Deposit of rounded and disk-shaped stream cobbles of Dinner Creek Ash-flow Tuff (Tdc) and basalt (Tbj and Tm), generally less than 10 cm across, perched 183 m above the Juntura Valley floor (SW¼ sec. 26, T. 20 S., R. 37 E.; 3,600-ft elevation). Unit represents the highest river stand preserved in the map area. A similar thick sequence of terrace gravel of an ancient Malheur River drainage perched between 3,700- and 4,000-ft elevation is located 1.6 km south of the map in the Juntura quadrangle (sec. 22, T. 21 S., R. 38 E.). May be Pliocene

QTf **Alluvial fan deposits (Quaternary and Pliocene)**—Poorly sorted, unconsolidated sediment. Contains angular boulders of basalt of Juniper Gulch as large as 0.5 m, with lesser amounts of Dinner Creek Ash-flow Tuff to 1 m across. Disconformably overlies unit of younger tuff and tuffaceous sedimentary rocks and poorly exposed Devine Canyon Ash-flow Tuff in Grasshopper Flat

Tdv **Devine Canyon Ash-flow Tuff (Miocene)**—Moderately to densely welded crystal-rich tuff. Lower densely welded zone is light gray to greenish gray. Phenocrysts (10-15 percent) include alkali feldspar, quartz, and green clinopyroxene. The tuff originally covered more than 18,600 km² of southeastern Oregon and had a volume of approximately 195 km³ (Greene, 1973). Outcrop in map area is along the northeastern margin of the welded part of the tuff. Remnant outcrops are scattered throughout the area where deposited in fault-bound valleys. Maximum thickness in study area is about 7 m but averages 3 m. Measured thicknesses represent minimum values, however, because the nonwelded to poorly welded uppermost part has been removed by erosion. Age is late Miocene (fig. 2); a $^{40}Ar/^{39}Ar$ single-crystal age of 9.68±0.03 Ma was obtained from sanidine in the tuff (A.L. Deino and A.L. Grunder, unpub. data, 1993). Previous K-Ar ages on sanidine range from 8.7 to 10.3 Ma (Fiebelkorn and others, 1983). Unit has normal-polarity magnetization (Stimac and Weldon, 1992)

Tyts **Younger tuff and tuffaceous sedimentary deposits (Miocene)**—Unconsolidated fine-grained tuffaceous sediments and very fine-grained ash deposits. Forms gentle grassy slopes and is exposed only in streams and road cuts. As much as 100 m thick in map area where it was deposited in fault-bounded valleys, but it is as much as 200 m thick in the adjacent quadrangle to the east (Kittleman and others, 1967; Evans, 1990, map unit Tts). Thickness is approximate, as base and top are rarely exposed. From Grasshopper Flat, base of unit decreases in elevation to the southeast at a gradient of 18 m/km as it approaches the Malheur River 6 km east of the map area. The unit unconformably overlies the basalt of Juniper Gulch and is conformably overlain by the Devine Canyon Ash-flow Tuff. Similar sedimentary units are ubiquitous beneath the Devine Canyon Ash-flow Tuff to the west and south (Greene and others, 1972; Johnson, 1994; Sherrod and Johnson, 1994; Johnson, 1995; Johnson, 1996). A pale-gray ash bed more than 2 m thick near the top of the unit near Dishrag Spring (table 1, no. 92) is compositionally similar to the Devine Canyon Ash-flow Tuff and may be an nonwelded part of the tuff. Abundant angular blocks of the welded tuff were found capping the unit near the confluence of Calf Creek and Cave Canyon, suggesting that the tuff once capped the unit in the valley that forms the Calf Creek drainage. Age is middle and late Miocene on basis of Barstovian (middle Miocene) flora and fauna (Shotwell and others, 1963) and capping late Miocene Devine Canyon Ash-flow Tuff

Tls **Tertiary landslide deposit (Miocene)**—Large blocks of basalt of Juniper Ridge, Dinner Creek Ash-flow Tuff, and basalt of Malheur Gorge exposed near the base of the fault scarp south of Mustang Basin (E½ sec. 10 and W½ sec. 11, T. 20 S., R. 38 E.). Age is late or middle Miocene. Overlain by the younger tuff and tuffaceous sedimentary deposits (Tyts)

Tbc **Basalt of Cave Creek (Miocene)**—Massive nonvesicular olivine basalt lava flows. Floors the stream bed of Cave Canyon and laps onto the canyon walls in the NW¼ sec. 1, T. 20 S., R. 38 E; exposed thickness is 15 m. The central section has well-developed lower colonnade, central entablature, and poorly developed upper colonnade. Shape, form, and location suggest emplacement as an intracanyon lava flow. Flow top is eroded, and talus mantles the lower contact. Unit is glassy to very fine-grained with seriate olivine phenocrysts up to 2 mm across, 1 percent. Groundmass has needles of plagioclase and clinopyroxene. Compositionally similar to the basalt of Juniper Gulch (fig. 2; table 1, no. 93), but lithologically it differs from nearby flows of that unit. Additionally, it appears to have erupted directly on the floor of the well-developed 180-m-deep Cave Canyon, a topographic feature that postdates the basalt of Juniper Gulch. Age relation uncertain to the unit of younger tuff and tuffaceous sedimentary deposits (Tyts) found higher in the canyon

Tbj **Basalt of Juniper Gulch (Miocene)**—Flows of calc-alkaline diktytaxitic olivine basalt lava forming rim rock through much of map area. This basalt is part of the Tims Peak Basalt, which is laterally continuous over 500 km² and ranges from 10 to 60 m thick (Kittleman and others, 1967; Evans, 1990; Ferns and others, 1993). Recent work by Binger (1997), however, indicates that Tims Peak Basalt can be subdivided into compositionally distinct mappable units including the basalt of Juniper Gulch. Occurs chiefly as fine-grained diktytaxitic flows with 1 to 5 percent olivine to 2 mm in diameter as 1the only phenocryst phase. Some capping flows are coarser grained and have up to 15 percent plagioclase phenocrysts as long as 5 mm. Flows in which plagioclase phenocrysts are present tend to be more evolved chemically (for example, table 1, Nos. 16-18; fig.3). Compositionally similar basalt (Tib) intrudes the underlying sedimentary unit (Tots) in Juniper Gulch, upper Dishrag Canyon, and at the confluence of Dishrag Canyon and Calf Creek and may have been feeders for the Juniper Gulch flows. The unit unconformably overlies the older tuffaceous and sedimentary rocks (Tots) and is overlain by the younger tuff and tuffaceous sedimentary deposits (Tyts). Age is middle Miocene; $^{40}Ar/^{39}Ar$ age of 13.37±3.56 Ma was obtained on the Tims Peak Basalt by Lees (1994)

Tib **Intrusive pillow basalt (Miocene)**—Fine-grained olivine basalt intrudes the unit of older tuffaceous and sedimentary rocks (Tots; fig. 1). This is the pillow-basalt breccia of Evans (1990) which he included with the older tuffaceous and sedimentary rocks. These rocks are compositionally similar to the basalt of Juniper Gulch (fig. 3; table 1) and probably represent the feeders for that unit. In Juniper Gulch palagonitic lava flows that form radially jointed pillows up to 40 cm in diameter are fed by brecciated, scoriaceous dikes that intrude the sedimentary sequence. Evans (1990) reports similar rocks within 1 km of the northeast corner of the map. At the junction of Calf Creek and Dishrag Canyon, 5- to 10-m-high pinnacles of brecciated basalt agglomerate of similar composition are interpreted as a volcanic neck. Finely bedded sedimentary strata dip 80-85° away from the neck. The basalt is glassy to very fine grained with clear groundmass plagioclase needles and up to 5 percent seriate olivine to 2 mm across. Similar basalt is exposed in Dishrag Canyon (W½ sec. 3, T. 20 S., R. 38 E.) as massive dikes or agglomeratic spires with radially fractured basalt in a palagonitized ashy matrix

Tots **Older tuffaceous and sedimentary rocks (Miocene)**—Comprises diatomaceous sediment, clay, fine-grained sandstone, and lapilli-fall deposits. Present throughout the map area beneath the basalt of Juniper Gulch. Thickness varies from 20 to 140 m within the quadrangle and increases to over 200 m north of map area (Haddock, 1967), reflecting either extensive erosion or synextensional paleotopographic relief existing before emplacement of the basalt of Juniper Gulch. Unit unconformably overlies the Hunter Creek Basalt (Thc), underlies the basalt of Juniper Gulch (Tbj), and is intruded by unit of vent agglomerate, dikes, sills, and pillow basalt (Tib) that fed lava flows of Tbj (see intrusive pillow basalt above). A 30-m-thick outcrop of sedimentary rock (E½ sec. 34, T. 20 N., R. 38 E.) has repetitive centimeter-scale layers of white to very light gray diatomaceous sediment and light-gray clays interbedded with thick beds of pumice lapilli and thin beds of ash and fine-grained sandstone. One moderately consolidated pumice-fallout deposit is composed of about 95 percent pale-gray pumice lapilli less than 1 cm in diameter that weather to light tannish orange, less than 5 percent obsidian balls 1 to 4 mm in diameter, and sparse clear feldspar phenocrysts. Previously mapped as the Tims Peak sedimentary and volcaniclastic unit by Haddock (1967), the Bully Creek Formation of Kittleman and others (1967) and Ferns and others (1993), and pillow basalt breccia of Evans (1990)

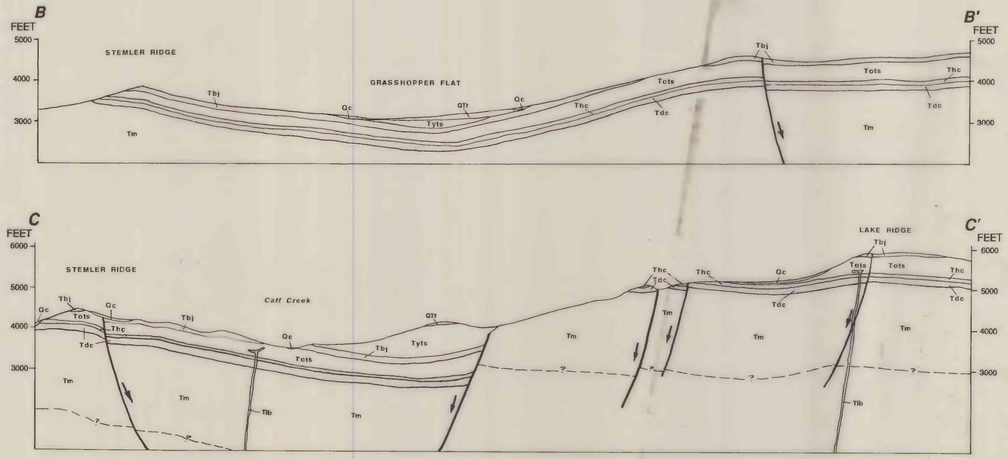
Thc **Hunter Creek Basalt (Miocene)**—Massive, black, very fine-grained aphyric basaltic andesite and andesite lava exposed throughout the map area, formally named the Hunter Creek Basalt by Kittleman and others (1965). Laterally continuous flows may have originally covered over 3,500 km² (Greene and others, 1972); Ferns and others, 1993). Thickness of the unit ranges from 1 to 90 m (Haddock, 1967), but outcrop in the Stemler Ridge quadrangle is rarely more than 5 m thick. Commonly includes 2-5 m of poorly exposed underlying tuffaceous and scoriaceous sedimentary strata. Characterized by abundant groundmass Fe-Ti oxides, distinct talus of equant cobbles with hydration rinds, and discrete rounded talus-striped hilltops above the Dinner Creek Ash-flow Tuff. It is more evolved than, but compositionally similar to, late flows of the basalt of Malheur Gorge (Tm). The unit disconformably overlies the Dinner Creek Ash-flow Tuff (Tdc) and underlies older tuffaceous and sedimentary rocks (Tots), which obscures outcrop on gentle slopes. Age is middle Miocene; $^{40}Ar/^{39}Ar$ age of 15.8±0.59 Ma was obtained by Lees (1994)

Tdc **Dinner Creek Ash-flow Tuff (Miocene)**—Named by Kittleman and others (1965). Occurs most commonly as purplish-pale-brown to grayish-red, densely welded ash-flow tuff forming prominent cliffs throughout the map area. Contains 1-3 percent plagioclase phenocrysts and trace amounts of quartz and clinopyroxene. Commonly has a well-developed vapor-phase zone of abundant irregularly shaped vesicles up to 10 cm in diameter with secondary amorphous silica. This zone mimics a lithophysal zone, but no lithophysae were seen. A lower light tannish-gray, moderately welded zone with grainy sandstone-like texture, and glassy black basal vitrophyre are locally present but uncommon. Lacking are upper nonwelded to moderately welded zones; if once present, they have been removed by erosion. Although no pumice or fiamme were found in any welding zone, a 3- to 4-m-thick, poorly to moderately consolidated pumice fallout deposit was found in slopes 5 m below the densely welded part of the tuff in two locations. Thickness of the unit ranges from 10 to 30 m, including underlying fallout deposits. The tuff covers more than 2,000 km² with maximum thickness of the welded portion of >100 m east of the map area (Evans and Binger, 1997). Unit overlies the basalt of Malheur Gorge (Tm)and underlies the scoriaceous rocks included in the Hunter Creek Basalt (Thc). Analysis of the densely welded part of the tuff shows it to be a sodic high-silica rhyolite with high barium (table 1). Age is middle Miocene; K-Ar ages of 14.7±0.4 and 15.3±0.4 Ma were obtained from plagioclase separates (Fiebelkorn and others, 1983)

Tm **Basalt of Malheur Gorge (Miocene)**—Thick sequence of aphyric to sparsely porphyritic, very-fine-grained tholeiitic basaltic andesite lava flows. Originally called the "unnamed igneous complex" by Kittleman and others (1965), and later named the basalt of Malheur Gorge by Evans (1990). Lower part of this unit is the compositional and temporal equivalent of the Imnaha Basalt, and the thin upper part is correlative with the Grande Ronde Basalt; both are formations of the Columbia River Basalt Group. Flows are chiefly pahoehoe but are intercalated with brecciated 'a'a-type flows. Unit is over 200 m thick in the map area but base is not exposed. Over 600 m of the basalt of Malheur Gorge is exposed farther east in the Jonesboro quadrangle (Evans, 1990). In the Stemler Ridge quadrangle the unit is mostly aphyric but may contain 0.5-2 percent olivine phenocrysts as large as 2 mm across. Widely separated discrete outcrops of andesite (fig. 2; table 1, nos. 51, 66, 70, and 71) cap the sequence of basaltic andesite flows. They are indistinguishable in the field from basaltic andesite in the unit. Coarsely plagioclase-phyric flows of this unit are found lower in the section in the Jonesboro quadrangle 2 km east of the map area. A coarsely plagioclase-phyric flow (15-20 percent plagioclase to 2 cm in diameter; no. 72) looks like lower flows of the basalt of Malheur Gorge in the Jonesboro quadrangle (Evans, 1990) but is the compositional equivalent of the less-evolved basalt of Juniper Gulch; it is overlain by a chemically similar aphanitic basalt (no. 73). The basalt of Malheur Gorge is overlain by the Dinner Creek Ash-flow Tuff. Recent attempts to date these flows by $^{40}Ar/^{39}Ar$ laser-fusion techniques gave a range of ages from 18.4 to 14.4 Ma (Lees, 1994). However, the lack of weathering or erosion between flows suggests a much shorter eruptive period. The 16.6-Ma Steens Basalt ($^{40}Ar/^{39}Ar$ ages from the basal and upper flows by Swisher and others, 1990) is correlative with the lower units of the basalt of Malheur Gorge (Johnson, 1995; Binger, 1997; V. Camp, J. Johnson, M. Ross reconnaissance mapping, 1996-97). The ages from the youngest flows of the basalt of Malheur Gorge, the Dinner Creek Ash-flow Tuff, and the Hunter Creek Basalt overlap, but weighted mean ages are consistent with stratigraphy (fig. 2). We interpret the isotopic ages to indicate that the basalt of Malheur Gorge was emplaced between 16.6 and 15.7 Ma (fig. 2)

References in accompanying pamphlet

- Contact—Approximately located
- Fault—Approximately located, dotted where concealed. Ball and bar on downthrown side
- Anticline—Showing crestline
- Syncline—Showing troughline
- Monocline—Abrupt increase of dip in direction of arrows
- 19 Strike and dip of inclined beds
- ⊕ Horizontal strata
- 22 ⊙ Rock sample locality—Showing sample number; see table 1 for analytical data and table 2 for geographic coordinates
- Fallout deposit beneath Dinner Creek Ash-flow tuff



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