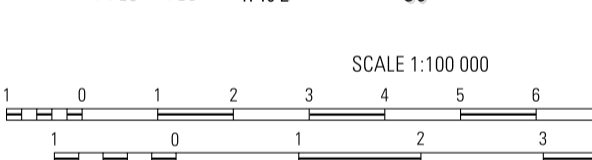


- LIST OF MAP UNITS**  
(Some unit exposures on the printed or plotted map are too small to distinguish the color for unit identification. These units are labeled where possible, and unlabelled units are attributed in the database.)
- SURFICIAL DEPOSITS**
- M Man-made/modified land (Holocene)
  - Qal Alluvium (Holocene and Pleistocene)
  - Qol Eolian deposits (Holocene and Pleistocene)
  - Qch Landslide deposits (Holocene and Pleistocene)
  - Qd Talus and colluvium (Holocene and Pleistocene)
  - Till (Holocene and Pleistocene)—Divided into:
    - Qp Till of Neoglacial age (Holocene)
    - Qp Till of Canyon Creek advance of Cabot Creek glaciation of Scott, 1977 (Pleistocene)
    - Qp Till of Suttle Lake advance (Cabot Creek glaciation of Scott, 1977) (Pleistocene)
    - Qp Till of Jack Creek glaciation of Scott (1977) (Pleistocene)
  - Qot Outwash (Holocene and Pleistocene)—Divided into:
    - Qot Outwash of Suttle Lake advance (Pleistocene)
    - Qot Outwash of Jack Creek glaciation (Pleistocene)
    - Qot Sand and gravel (Pleistocene)
    - Qot Alluvial fan deposits (Pleistocene)
    - Qot Diatomite (Pleistocene)
    - Qot Sedimentary rocks and deposits (Pleistocene and Pliocene)
- OLDER ROCKS AND DEPOSITS OF THE CASCADE RANGE AND NEWBERRY VOLCANO**
- Young volcanic rocks of Santiam and McKenzie Passes
- Young lava flows (Holocene)—Divided by composition and ejective source
- Qyhc Basaltic andesite and andesite of Collier Cone
  - Qyhc Andesite of Four In One Cone
  - Qyhc Basaltic andesite of Yappa Crater
  - Qyhc Basalt and basaltic andesite of Beknap Crater
  - Qyhc Young tephra
  - Qyhc Basaltic andesite of Little Belnap (Following from its form Santiam volcanic field)
  - Qyhc Basaltic andesite of Little Nash Crater
  - Qyhc Basalt of Lost Lake chain of cones
  - Qyhc Basaltic andesite of Nash Crater
  - Qyhc Basalt of Sand Mountain chain of cones
  - Qyhc Basaltic andesite of Twin Craters
  - Qyhc Basalt of inaccessible cone
- Basalt of the Cascade Range and Newberry volcano
- Basalt (Holocene?) and Pleistocene?—Divided locally into:
- Qyb Basalt of Sims Butte (Holocene or Pleistocene)
  - Qyb Basalt of Cayuse Crater (Holocene or Pleistocene)
  - Qyb Basalt of Egg cone (Holocene or Pleistocene)
  - Qyb Basalt of Kosawa Butte (Pleistocene)
  - Qyb Basalt of Newberry volcano (Pleistocene)—Divided into:
    - Qybhc Porphyritic basalt
    - Qybhc Highly porphyritic basalt
    - Qybhc Large-foliated basalt
    - Qybhc Basalt near Ashfall
    - Qybhc Very fine grained basalt
    - Qybhc Basalt of cones at summit and southeast flank of Cache Mountain (Pleistocene)
    - Qybhc Basalt of Condon Butte (Pleistocene)
    - Qybhc Basalt of Kosawa Mountain (Pleistocene)
    - Qybhc Basalt of Burnt Top (Pleistocene)
    - Qybhc Basalt of Two Butte (Pleistocene)
    - Qybhc Basalt of Craig Lake (Pleistocene)
    - Qybhc Basalt of Wizard Falls (Pleistocene)
    - Qybhc Basalt of Garrison Butte (Pleistocene)
    - Qybhc Basalt of Santiam Pass (Pleistocene)
    - Qybhc Basalt of Booth Lake (Pleistocene)
    - Qybhc Basalt of Little Brother (Pleistocene)
    - Qybhc Basalt of Plainview (Pleistocene)
    - Qybhc Basalt of The Island (Pleistocene)
    - Qybhc Basalt (Pleistocene and Pleistocene?)
    - Qybhc Basalt (Pleistocene)
- Basaltic andesite of the Cascade Range
- Qya Basaltic andesite (Holocene?) and Pleistocene?—Divided locally into:
    - Qyah Basaltic andesite of La Cumbre Crater (Holocene or Pleistocene)
    - Qyah Basaltic andesite of Mount Bachelor (Pleistocene and Pleistocene?)
    - Qyah Basaltic andesite of South Sister (Pleistocene)—Divided on basis of intervening andesite (Qya) into younger and older parts.
  - Qybhc Basaltic andesite of summit cone
  - Qybhc Basaltic andesite of upper flanks

- Qybhc Basaltic andesite of Hoodoo Butte (Pleistocene)
- Qybhc Basaltic andesite of Maxwell Butte (Pleistocene)
- Qybhc Basaltic andesite of Scott Mountain (Pleistocene)
- Qybhc Basaltic andesite of Tumalo Mountain (Pleistocene)
- Qybhc Basaltic andesite of Summit Butte lava field (Pleistocene)—Divided into:
  - Qybhc Basaltic andesite of Blugrass Butte
  - Qybhc Basaltic andesite of Graham Butte
  - Qybhc Basaltic andesite of Fiveville Butte
  - Qybhc Basaltic andesite of Fourmile Butte
  - Qybhc Basaltic andesite of Sixville Butte
  - Qybhc Basaltic andesite of Cold Spring (Pleistocene)
  - Qybhc Basaltic andesite of Millican Crater (Pleistocene)
  - Qybhc Basaltic andesite of Black Crater (Pleistocene)
  - Qybhc Basaltic andesite of Red Hill (Pleistocene)
  - Qybhc Basaltic andesite of Middle Sister (Pleistocene)
  - Qybhc Basaltic andesite of North Sister (Pleistocene)
  - Qybhc Basaltic andesite of Three Fingered Jack (Pleistocene)
  - Qybhc Basaltic andesite of Black Pine Spring (Pleistocene)
  - Qybhc Basaltic andesite of Trout Creek Butte (Pleistocene)
  - Qybhc Basaltic andesite of Mount Washington (Pleistocene)
  - Qybhc Basaltic andesite of Substrate Point (Pleistocene)
  - Qybhc Basaltic andesite of Pilot Butte (Pleistocene)
  - Qybhc Older basaltic andesite (Pleistocene)
- Qybhc Andesite of the Cascade Range
- Qybhc Andesite of South Sister—Divided at summit into:
  - Qybhc Andesite of summit
  - Qybhc Andesite of east flank
  - Qybhc Andesite of Hogz Rock and Hayrick Butte
  - Qybhc Andesite of Middle Sister
  - Qybhc Andesite and dacite of First Creek (Pleistocene)
- Qybhc Dacite, dyke-dacite, and thysite of the Cascade Range
- Qybhc Dacite (Pleistocene)—Divided locally into:
  - Qybhc Dacite of South Sister
  - Qybhc Dacite of Middle Sister
  - Qybhc Dacite of Lane Plateau
  - Qybhc Dacite of Todd Lake
- Qybhc Rhyolite (Pleistocene)—Divided locally into:
  - Qybhc Rhyolite of Rock Mesa and Devils Hill chain of vents (Holocene)
  - Qybhc Rhyolite or dacite (Pliocene or Miocene)
- Qybhc Rhyolite (Holocene and Pleistocene)—Youngest rhyolite shown separately
- Qybhc Rhyolite of Rock Mesa and Devils Hill chain of vents (Holocene)
- Qybhc Rhyolite or dacite (Pliocene or Miocene)
- Qybhc Dacite, dyke-dacite, and thysite of the Cascade Range
- Qybhc Dacite (Pleistocene)—Divided locally into:
  - Qybhc Dacite of South Sister
  - Qybhc Dacite of Middle Sister
  - Qybhc Dacite of Lane Plateau
  - Qybhc Dacite of Todd Lake
- Qybhc Rhyolite (Pleistocene)—Showing vent floor relation for some cones in units Qybhc and Qybhc with Tsbh
- Qybhc Fault—Dashed where approximately located; dotted where concealed. Ball and bar on downthrown side
- Qybhc Fractured ground—Showing trend of gapping fractures or normal faults with results of fragmental deposits of rhyolite of Rock Mesa (Gm, south flank of South Sister). Includes some small grabens where fractures show paired. These fractures likely were propagated by late tuff (Qybhc) of upper cone chain of vents northeast of Mount Washington, where 1.2-2.0 km deep linear fractures faulted by monogenic rhyolite flows extend as far as 300 m beyond quarter deposits along trend N. 10° E.
- Qybhc Crater rim—Shown for relatively young cinder cones
- Qybhc Shield volcano vent location—Showing vents (vental conduit) for small to broad shield volcanoes such as Little Belnap or other cones where vental conduit is not found by mapping near-vent deposits (units Qybhc, Qybhc, or Tsbh). Location placed on basis of topographic contouring on Cascade Range. Shows vent for suspected Deschutes Formation vent in basaltic andesite of Oden Falls (Tsbh)
- Qybhc Pumice-fall deposits—Showing typical localities. Some localities composed more fully in appendix 1 and table 5. Deposits range in composition from rhyolite to andesite and result from several unventilations during middle and late Pleistocene time. Shows isolated occurrences during middle and late Pleistocene time.
- Qybhc Isopach—Showing thickness in centimeters for three Holocene tephras-fall deposits erupted from vents in map area
- Qybhc Tephras of Blue Lake crater—Contour interval 25 cm, and maximum contour shown is 120 cm. Deposit is thicker than 20 cm (one probe limit) along southwest shore of Suttle Lake and likely much thicker between Blue and Suttle Lakes. Thicker around south vent, and north shore of a vent now flooded by Blue Lake. Age probably about 1,200 ± 300 B.P. (Thickness data from R.A. Jensen and D.R. Sherrod, unpub. data, 1995)
- Qybhc Tephras of Devils Hill chain of vents—Contours show thicknesses of 10, 25, 50, and 100 cm. High-temperature, highly porphyritic, dyke-dacite, and ash, phenocrysts are plagioclase, hypersthene, and minor Fe-Ti oxides and amphibole. Age about 2,000 ± 200 B.P. or B.P. Overlies tephras of Rock Mesa. Data from Scott (1987)
- Qybhc Tephras of Rock Mesa—Contours show thicknesses of 10, 25, 50, 100, and 200 cm. Compositionally and microscopically similar to rhyolite tephras of Devils Hill chain of vents. Radioactive ages overlap with those of the stratigraphically higher Devils Hill unit, about 2,000 ± 300 B.P. or B.P. Stratigraphic evidence suggests that both deposits and an intervening deposit interval spanned a period of no more than several centuries. Data from Scott (1987)
- Qybhc Basaltic andesite—Locally divided into:
  - Qybhc Basaltic andesite of Littlelaw Butte
  - Qybhc Basaltic andesite of Steamboat Rock
  - Qybhc Basaltic andesite of Oden Falls
- Qybhc Ash-flow tuff and lava flows of Deschutes Formation—Shown where exposed within Deschutes Formation (Tsbh) along canyon walls of Deschutes River and its tributaries
- Qybhc Andesite
- Qybhc Dacite
- Qybhc Ash-flow tuff—Locally divided into:
  - Qybhc Tuff of Deep Canyon
  - Qybhc Tuff of Fremont Canyon
  - Qybhc Tuff of The Peninsula
  - Qybhc Tuff of Lower Bridge
- Qybhc Debris-flow deposits
- Qybhc Rhyolite of Clute Butte (Miocene)
- Qybhc Rhyolite southwest of Steelhead Falls (Miocene)

Scale from U.S. Geological Survey, 1960. Universal Transverse Mercator, zone 10. 25,000:1 ratio



Geologic map compiled by E.M. Taylor, 1974-85; D.R. Sherrod, 1984-96; M.L. Farns, 1992-95; W.E. Scott, 1983-94, 1995; R.M. Conroy, 1995-96; G.A. Smith, 1998. Other sources shown in index of mapping. GIS database by R.D. Koch. Edited by J.L. Zigar. Digital cartography by R.D. Koch, Kathryn Nanz, and Tappin Lindquist. Manuscript approved for publication April 29, 1999.

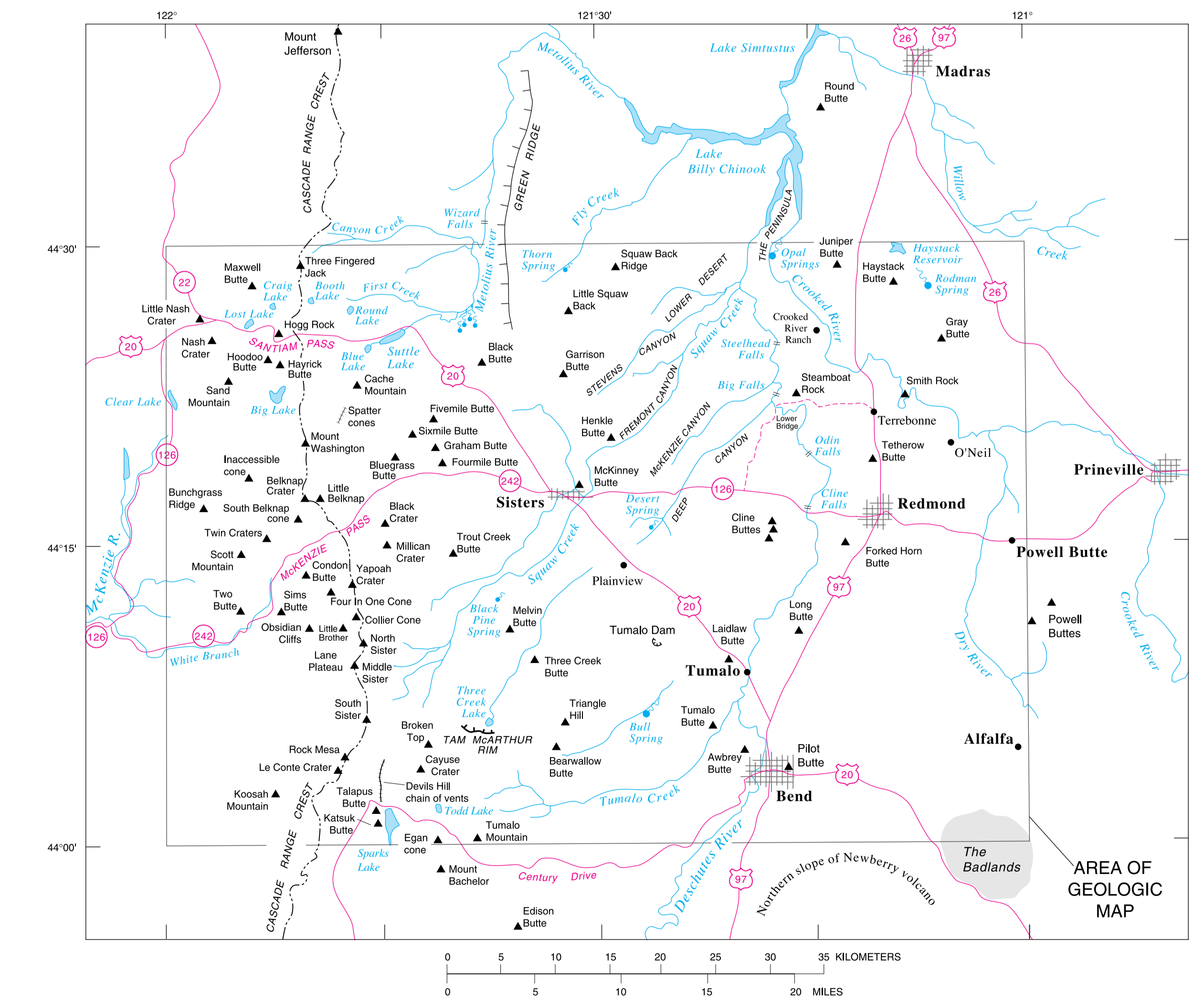
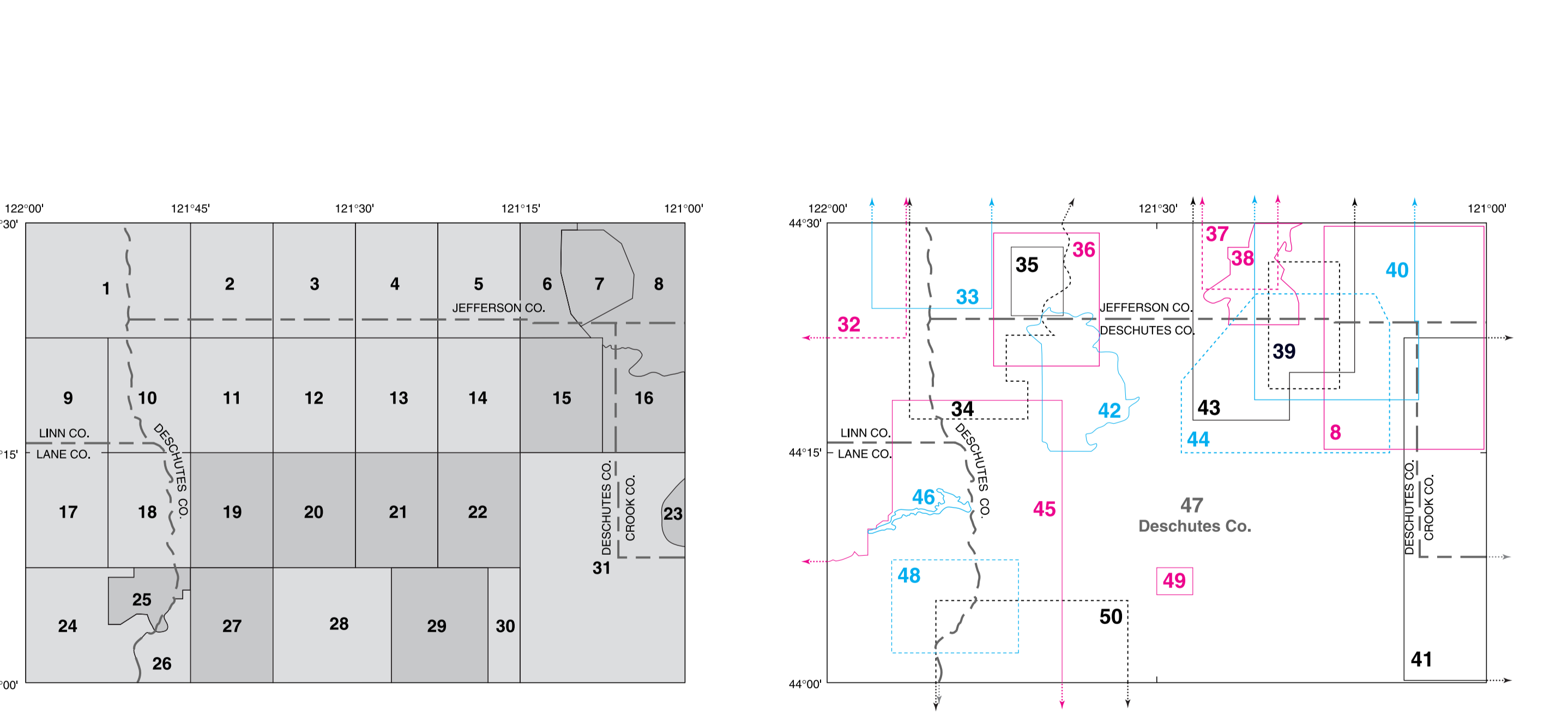


Figure 1. Location of geographic names used in text.



- Index of sources of mapping**  
(Quadrangle names correspond to U.S. Geological Survey 7.5 topographic quadrangles unless indicated otherwise)
- A. Chief sources**
1. E.M. Taylor and D.R. Sherrod, unpub. map of Santiam Junction and Three Fingered Jack quadrangles
  2. E.M. Taylor, W.E. Scott, and D.R. Sherrod, unpub. map of Black Butte quadrangle
  3. M.L. Farns and E.M. Taylor, unpub. map of Little Square Back quadrangle
  4. M.L. Farns, unpub. map of Square Back Ridge quadrangle
  5. Farns and others, 1996
  6. M.L. Farns and D.R. Sherrod, unpub. map of west half of Old City quadrangle
  7. G.A. Smith, unpub. map of John Day Formation from Haystack Reservoir to Gray Butte
  8. Robinson and Rosenfeld, 1979
  9. E.M. Taylor, unpub. map of Clear Lake quadrangle
  10. E.M. Taylor, unpub. map of Mt. Washington quadrangle
  11. E.M. Taylor, unpub. map of Black Crater quadrangle
  12. E.M. Taylor, unpub. map of Sorrow quadrangle
  13. Taylor, 1968
  14. D.R. Sherrod and D.E. Stensland, unpub. map of Clute Falls quadrangle
  15. D.R. Sherrod and E.M. Taylor, unpub. map of the Tumalo Falls and west half of She-Vin Park quadrangles
  16. D.R. Sherrod, unpub. map of east and central townships of O'Neill quadrangle
  17. E.M. Taylor, unpub. map of Lanes Lake quadrangle
  18. E.M. Taylor, unpub. map of North Sister quadrangle
  19. Taylor and Farns, 1995
  20. Taylor and Farns, 1994
  21. Taylor and Farns, 1994
  22. McDaniel, 1989
  23. Welschstein, 1981
  24. E.M. Taylor, unpub. map of Substrate Point and southeast sequence of South Sister quadrangles
  25. Wornat, 1982
  26. E.M. Taylor, unpub. map of southeastern part of South Sister quadrangle
  27. Taylor, 1978
  28. D.R. Sherrod and E.M. Taylor, unpub. map of the Tumalo Falls and west half of She-Vin Park quadrangles
  29. Minner, 1992
  30. D.R. Sherrod, unpub. map of east half of Bond quadrangle
  31. D.R. Sherrod, unpub. map of Forked Horse Butte, Powell Butte, Bond, Bend, Apples, and Ashfall quadrangles
  32. Black and others, 1987
  33. Davis, 1980
  34. Scott, 1973
  35. U.S. Army Corps of Engineers, 1953a
  36. Peterson and Gish, 1972
  37. Smith, 1986, fig. 6-35
  38. Walker, 1981
  39. Smith, 1986, fig. 6-36
  40. Skrems, 1931
  41. Brown and others, 1980a
  42. Bacon and others, 1990; geologic map provided as written comment. See Bacon, 1996
  43. Canaan, 1985
  44. Stensland, 1979
  45. Taylor and others, 1987
  46. Schick, 1994
  47. Peterson and others, 1975
  48. Clark, 1981
  49. HBL, 1992a, fig. 3.3
  50. Scott and Gaudin, 1992
  51. U.S. Army Corps of Engineers, 1953b
  52. Peterson and Gish, 1972
  53. Smith, 1986, fig. 6-35
  54. Walker, 1981
  55. Smith, 1986, fig. 6-36

Figure 2. Sources of mapping used for geologic map 2A, chief sources; 2B, other sources consulted.

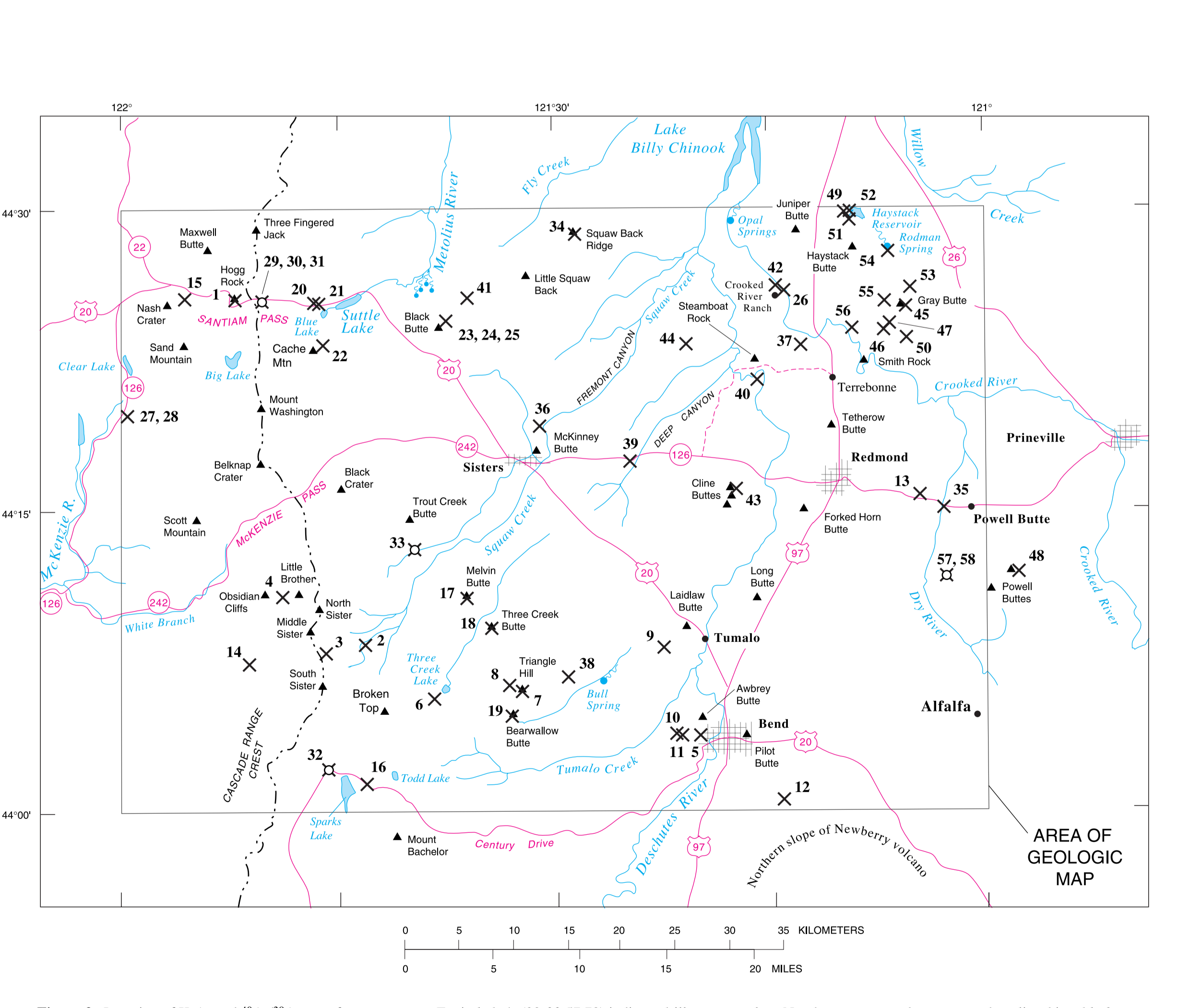


Figure 3. Location of K-Ar and 40Ar/39Ar ages from map area. Encircled x's (29-33, 57, 78) indicate drill-core samples. Numbers correspond to map numbers listed in table 2.

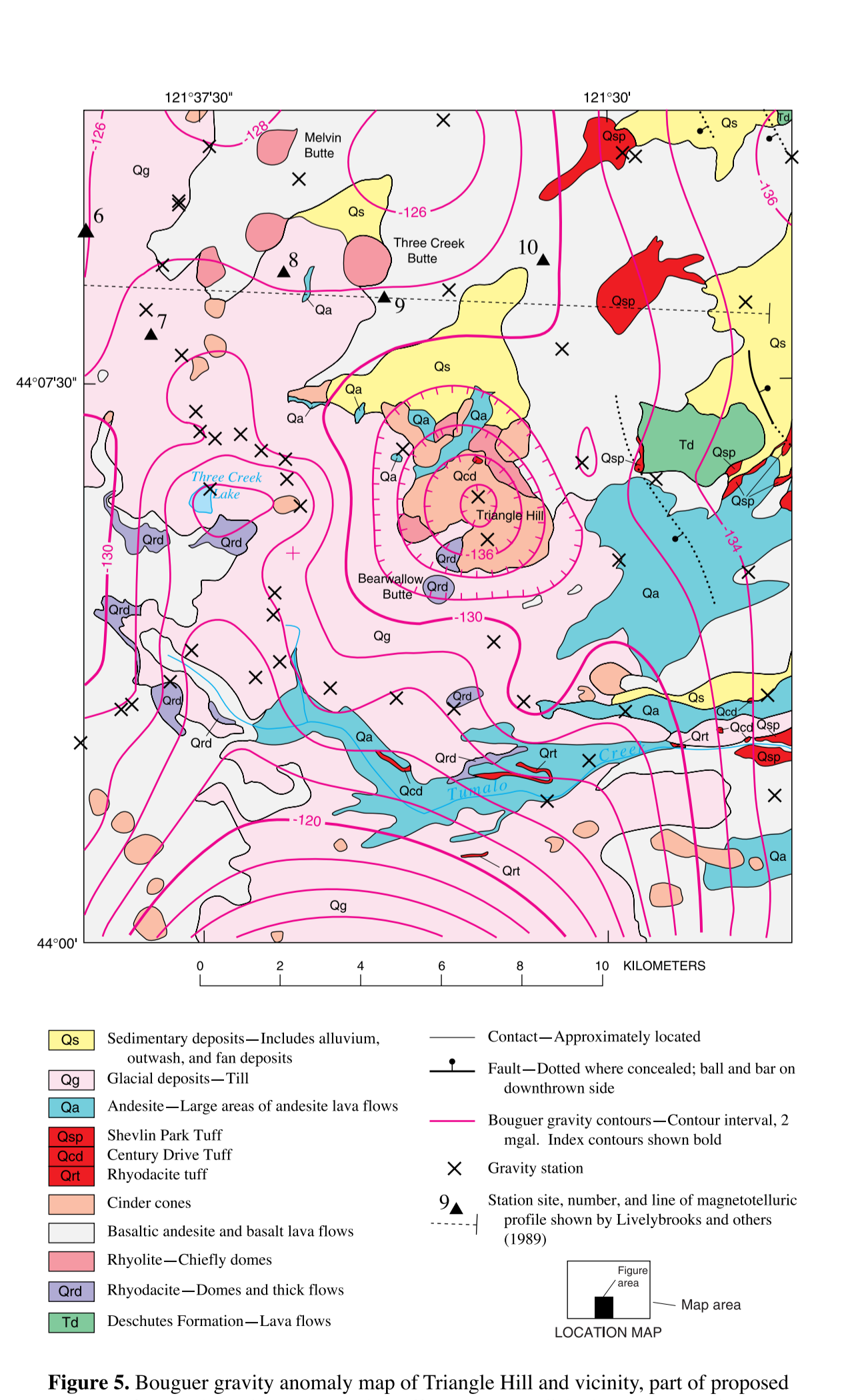


Figure 4. Bouguer gravity anomaly map of Triangle Hill and vicinity, part of proposed vent area for Bend Pumice and Tumalo Tuff. From unpublished Bouguer gravity map of Bend 30 x 60-minute quadrangle plotted using U.S. Geological Survey map of Bend 30 x 60-minute quadrangle (unpub., 1995). For similar published depiction, see Pitts and Couch, 1978; differences between these two versions result from the different contouring algorithms used.

U.S. Geological Survey, Reston, Virginia 20192  
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