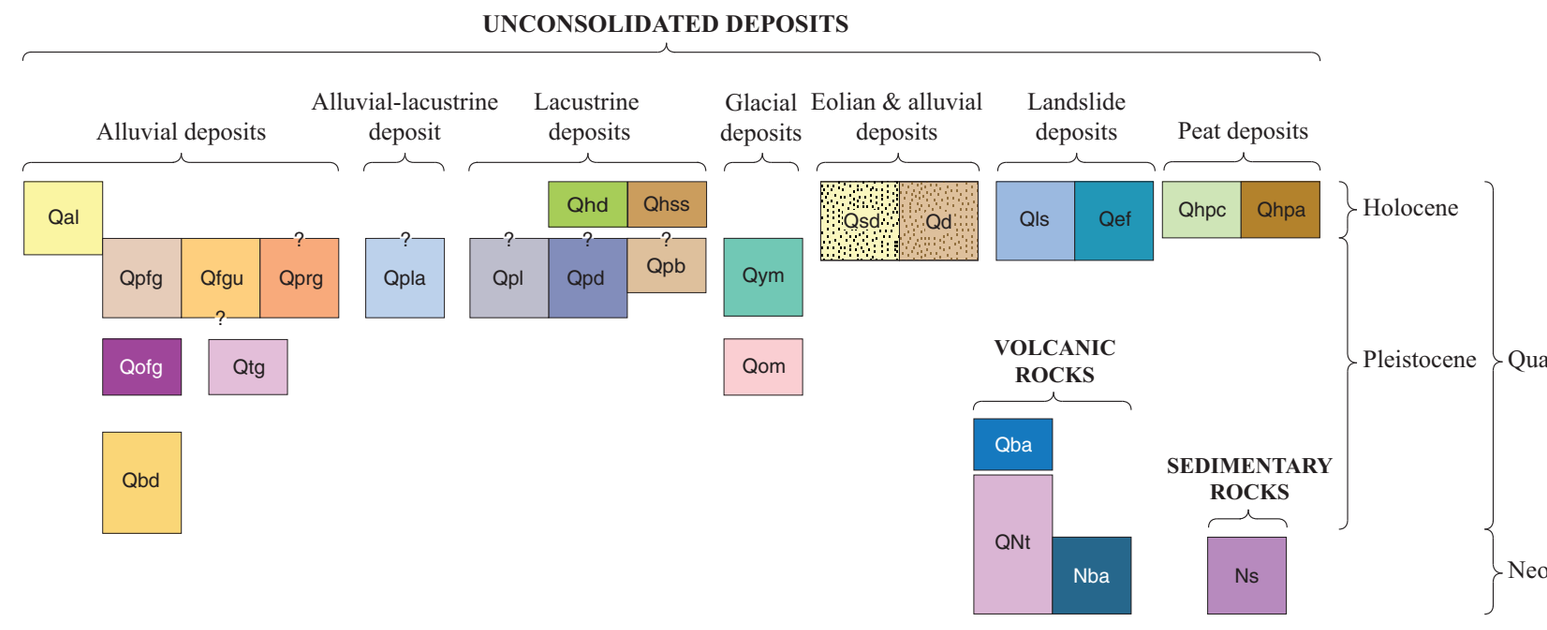
CORRELATION OF MAP UNITS



LIST OF MAP UNITS

UNCONSOLIDATED SURFICIAL DEPOSITS

Alluvial deposits

- Qal — **Alluvium (Holocene and late? Pleistocene)**
- Qpfg — **Alluvial fan gravel (late Pleistocene)**
- Qfgu — **Fan gravel, undifferentiated (late Pleistocene)**
- Qprg — **Recessional alluvial fan gravel and sand (late Pleistocene)**
- Qofg — **Older fan gravel (middle? Pleistocene, Bull Lake glaciation?)**
- Qtg — **Thrust gravel (middle? Pleistocene, Bull Lake glaciation?)**
- Qbd — **Upland bench deposits (early Pleistocene?)**

Alluvial-lacustrine deposit

- Qpla — **Lake Centennial deposits and alluvium (late Pleistocene)**

Lacustrine deposits

- Qhd — **Delta deposits (Holocene)**
- Qhss — **Silty shoreline complex (Holocene)**
- Qpb — **Low beach and shoreline ridges (late Pleistocene?)**
- Qpl — **Lake Centennial deposits (late Pleistocene)**
- Qpd — **Lake Centennial deltaic deposits (late Pleistocene)**

Glacial deposits

- Qym — **Glacial moraines, younger (late Pleistocene, Pinedale glaciation)**
- Qom — **Glacial moraines, older (middle Pleistocene, Bull Lake age?)**

Eolian and alluvial deposits

- Qsd — **Alluvial and eolian sand, undivided (Holocene and late Pleistocene)**
- Qd — **Dune sand (Holocene and late Pleistocene)**

Landslide deposits

- Qls — **Landslide deposits, undifferentiated (Holocene and late Pleistocene)**
- Qef — **Earthflow deposits (Holocene and late Pleistocene)**

Peat deposits

- Qhpc — **Peat of central wetland (Holocene)**
- Qhpa — **Peat above water plane (Holocene)**

VOLCANIC ROCKS

- Qba — **Basalt (early Pleistocene?)**
- QNt — **Welded tuffs (early Pleistocene and Neogene)**
- Nba — **Basalt (Neogene)**

SEDIMENTARY ROCKS

- Ns — **Sedimentary rocks (Neogene)**

EXPLANATION

Contact—Identity and existence certain, location approximate

Contact—Identity or existence questionable, location inferred

Normal fault—Dashed where approximately located; short dashed where inferred; dotted where concealed, queried where uncertain

Delta front escarpment

Flow direction on alluvial fan

Inferred flow direction on buried alluvial fan

Form lines at margin of alluvial fan

Stream flow direction on high bench

Fluvial scarp

Glacial cirque and diagrammatic ice flow

Ridges in landslide thrust gravel

Lake shoreline

Ice thrust ridge at shoreline of modern lake

Moraine crest

Flow in old stream channel

Sand dune migration direction

Approximate water plane boundary of central wetland

Conical depression, possibly related to faulting

03P14 **Exposed or auger section**

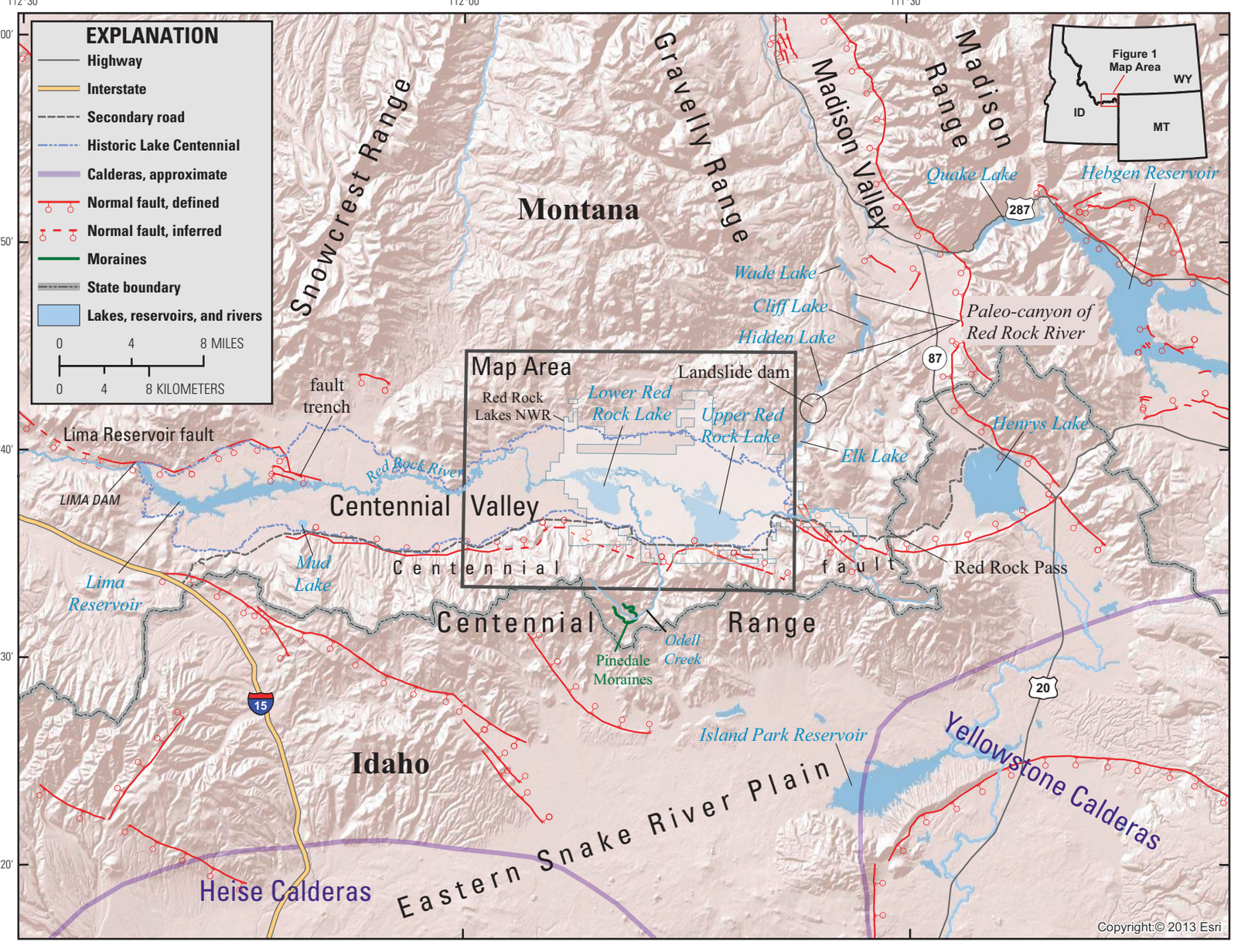


Figure 1. Location of the Red Rock Lakes map area. Note the string of lakes (Elk, Hidden, Cliff, and Wade Lakes) define a paleo-canyon of the Red Rock River northward into the Madison Valley. The eastern Snake River Plain is also the track of the Yellowstone hotspot, which is associated with late Cenozoic volcanism, faulting, and uplift (Pierce and Morgan, 1992). The two youngest caldera groupings along the hotspot track are calderas of the Heise volcanic field (6.6–4.45 Ma; Morgan and McIntosh, 2005) and calderas of the Yellowstone volcanic field (2.05–0.64 Ma; Christiansen, 2001). Quaternary faults are shown in red and faults other than Centennial fault and the Lima Reservoir fault are from U.S. Geological Survey and Montana Bureau of Mines and Geology (2006). The Centennial fault extends, with right-stepping en echelon faults, from east of Henrys Lake (Myers and Hamilton, 1964; Morgan and others, 2008) through Red Rock Pass (Witkind, 1975) to the bold front of the Centennial Range east of Odell Creek. Westward from Odell Creek, the fault is poorly expressed for 15 km and then becomes well defined for 18 km to Mud Lake (Witkind, 1975; Petrik, 2008). At Mud Lake, fault offset switches to the north side of the valley as the Lima Reservoir fault (Myers and Hamilton, 1964; Bartholomew and others, 2002). This fault continues west to beneath the Lima Dam (Anastasio and others, 2010).

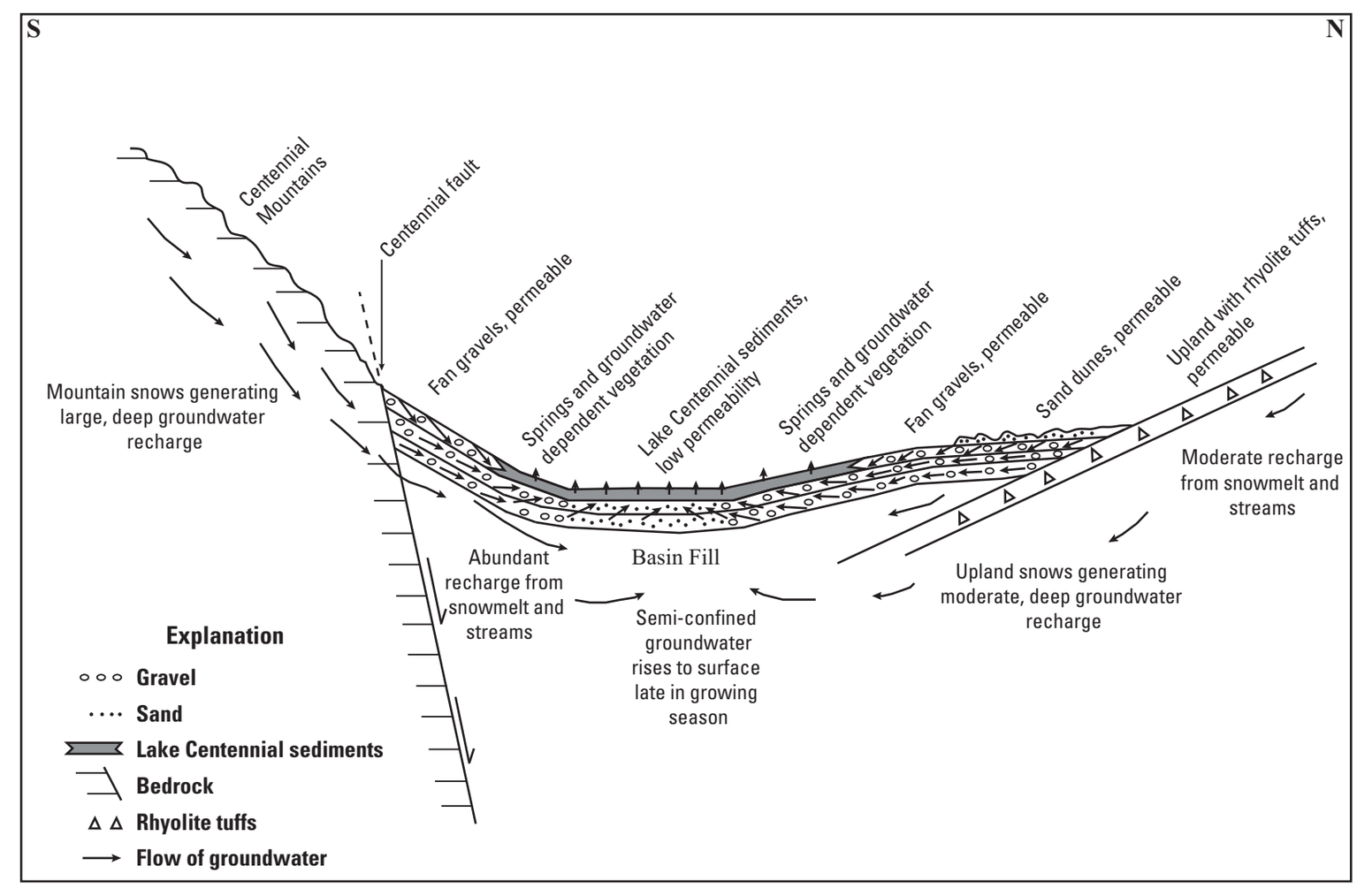


Figure 2. Diagrammatic cross section portraying flow of groundwater. Low permeability Lake Centennial sediments floor the central part of the valley and confine the groundwater in more permeable sands and gravels beneath them (see text). This semi-confined groundwater percolates upward and thus helps sustain the wetlands late in the growing season.

SCALE 1:24 000

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Center Director, USGS Geosciences and Environmental Change Science Center
Box 25046, Mail Stop 980
Denver, CO 80225
(303) 236-5344

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Surficial Geologic Map of the Red Rock Lakes Area, Southwest Montana

By
Kenneth L. Pierce, Tara L. Chesley-Preston, and Richard S. Sojda

2014

Base from U.S. Geological Survey, Metzel Creek, Lower Red Rock Lake, Elk Springs, Winslow Creek, Slide Mountain and Upper Red Rock Lake, Mont., 1:24,000, 1988
Base hydrology from U.S. Fish and Wildlife Service and Montana Natural Heritage Program, 2010, National Wetlands Inventory (NWI)
North American Datum of 1983 (NAD 83)
Montana State Plane Coordinate System, SPCS 83 FIPS zone 2500
Lambert Conformal Conic
Manuscript approved for publication July 22, 2014

Publishing support provided by:
Denver Publishing Service Center

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Suggested citation:
Pierce, K.L., Chesley-Preston, T.L., and Sojda, R.L., 2014, Surficial geologic map of the Red Rock Lakes area, southwest Montana: U.S. Geological Survey Open-File Report 2014–1157, 22 p., scale 1:24,000, *http://dx.doi.org/10.3133/ofr20141157*.

ISSN 2331-1258 (online)