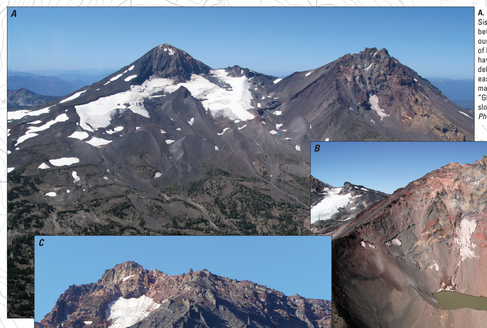
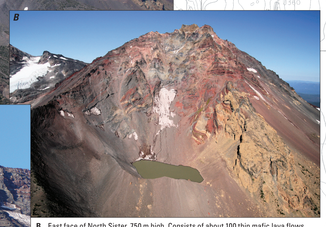
U.S. Department of the Interior
U.S. Geological Survey

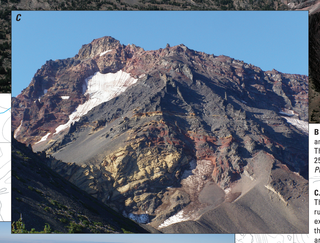
Scientific Investigations Map 3186
Sheet 1 of 2
Pamphlet and CD-ROM accompany map



A. East faces of Middle Sister and North Sister. Dacitic "Black Hump" is in saddle between them. Altered zones are conspicuous on summit of Middle Sister and east ridge of North Sister. Diller and Hayden Glaciers have left complex of Neoglacial moraines, debris principally supplied by erosion of eastern one-third of Middle Sister cone. Thick mafic lava flows form "Prouty Pinnacle" and "Glisan Pinnacle" atop North Sister, helping slow destruction of fragmental edifice. *Photograph by John Scurlock, 2007.*

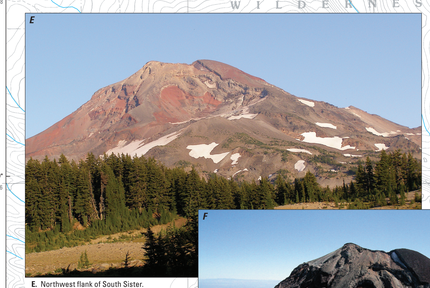


B. East face of North Sister, 750 m high. Consists of about 100 thin mafic lava flows and intercalated layers of red scoria, capped by thick summit lava flows. Remnant of Thayer Glacier feeds cirque lake. Pervasively altered yellow-orange buttress on right, 250 m thick, consists of east-dipping, palagonitized, ash-rich fragmental flow deposits. *Photograph by John Scurlock, 2007.*



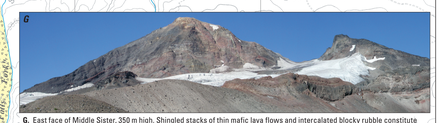
C. Steep northeast face of North Sister. Remnant of Villard Glacier is in cirque below. Thick summit lava flow makes up "Glisan Pinnacle," which overlies hundreds of thin rubbly lava flows that are intercalated with red-oxidized agglutinate and scoria falls exposed on 800-m-high face below. Flows that form ridge at upper right are thicker than those on most of edifice. Ash-rich phreatomagmatic fallout layers in lowest 150 m are pervasively altered to yellow-orange palagonite and riddled with dikes, many of which also cut through overlying stack of thin lava flows. *Photograph by Judy Fierstein, 2009.*

D. View southeastward across saddle between North and Middle Sisters. Small ice-mantled peak in saddle is dacitic "Black Hump." In left foreground, ice-ravaged mafic edifice Little Brother is separated from North Sister by Little Ice Age trough of Collier Glacier. Both North Sister and Little Brother expose numerous oxidized scoria falls, whereas smooth black Middle Sister cone is cloaked by mafic lava flows. Brick-red ridge extending north (left) from North Sister is part of younger north-south vent alignment. Beyond South Sister cone (at upper right), which has several pocket glaciers, is smooth cone of Mount Bachelor behind it and rugged, barren Broken Top volcano to its left. *Photograph by John Scurlock, 2007.*

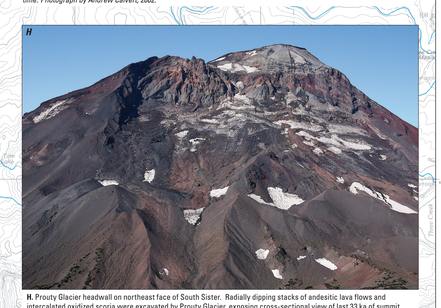


E. Northwest flank of South Sister. Skyline epaulet high on right shoulder is thin agglutinate sheet that fell during most recent summit eruption. Headwalls of cirques expose thick red cinders that are intercalated with stack of radially dipping lava flows that built current cone. *Photograph by Judy Fierstein, 2008.*

F. Aerial view of northwest summit of South Sister. Lost Creek Glacier and its cirque are in center, and Eugene Glacier and its cirque are toward bottom left. Summit mafic agglutinate mantles its right shoulder, covering gray fragmental dacite deposit from explosive eruption about 24 ka. Fingerlike lobes of dacite lava dribble down northwest ridge atop fragmental deposit and beneath capping agglutinate. Entire edifice visible here was built between 30 and 20 ka. *Photograph by John Scurlock, 2007.*



G. East face of Middle Sister, 350 m high. Shingled stacks of thin mafic lava flows and intercalated blocky rubble constitute most of upper half of Middle Sister cone. Ice-sculpted pile of lavas at right, variously called "Black Hump," "Prouty Point," or "Step Sister," has 190 m of relief and consists of at least five flows. Hayden Glacier is below both summits; 25-m-thick cliff in front of right side of glacier is terminal lobe of fissure-fed andesitic scoria, spatter, and fountain-fed lava flow that drapes south flank of North Sister; dated at 21±6 ka, this flow (unit anh) is much younger than North Sister but about same age as Middle Sister and "Black Hump." Well-formed moraine in foreground was left by Hayden Glacier in Little Ice Age time. *Photograph by Andrew Calvert, 2002.*



H. Prouty Glacier headwall on northeast face of South Sister. Radially dipping stacks of andesitic lava flows and intercalated oxidized scoria were excavated by Prouty Glacier, exposing cross-sectional view of last 33 ka of summit activity in 350 m of vertical relief. Dipping stacks are truncated at about 9,800 ft elevation, forming ragged rim of a broad paleocrater. Gray, stratified, dacitic phreatomagmatic deposit 150 m thick makes up upper slopes of edifice, capped only by thin ledge of mafic agglutinate on skyline. Beneath Hodge Crest (left shoulder of edifice) is another thick, gray phreatomagmatic deposit, this one cut by many dikes that altered host fallout, which erodes into colorful spires. Little Ice Age moraines in foreground are barren and unstable. *Photograph by John Scurlock, 2007.*

I. View northwestward of South Sister and "Devils chain" rhyolites to its left. Sparks Lake basin is in foreground. Unforested "Devils chain" is string of nearly contiguous, virtually uneroded rhyolite lava domes and flows aligned north-south along 5 km stretch on southeast apron of South Sister. Largest of these is Newberry flow (right center, below South Sister), only 2.5 km from summit of South Sister. All were extruded about 2,000 years ago, during the most recent eruptive episode at South Sister, which also ejected pumice fall that still mantles much of the area. *Photograph by George Cagwin, 2009.*

J. South Sister edifice, viewed northward from east shore of Sparks Lake. Visible are five rhyolitic units of different ages: Unforested 2-ka rhyolite of "Devils chain" rests on forested 35-ka flow lobe from adjacent Devils Hill dome. Three pale-gray spurs form sharp salients that extend to elevations only 550 m below darker andesitic summit of South Sister. Each spur is a petrographically distinctive rhyolite lava, and they yield ages of (from left to right) 51 ka, 30–24 ka, and 35 ka. On skyline, South Sister summit and Hodge Crest are separated by cirque of Lewis Glacier. *Photograph by George Cagwin, 2009.*

Base from U.S. Geological Survey, 1:24,000, provisional 1988:
Broken Top, Linton Lake, North Sister, South Sister, Trout Creek Butte

Projection and 1,000-meter Universal Transverse Mercator grid, zone 10

1927 North American Datum

APPROXIMATE MEAN DECLINATION, 2010

SCALE 1:24 000

1 MILE
1 KILOMETER
CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP LOCATION

Geology mapped by Wes Hildreth and Judy Fierstein, 2000–2009; K-Ar and Ar/Ar dating by Andrew T. Calvert

GIS database and digital cartography by J.E. Robinson and Judy Fierstein

Edited by Taryn A. Lindquist; digital cartographic production by Kathryn Nimz

Manuscript approved for publication October 27, 2011

Geologic Map of Three Sisters Volcanic Cluster, Cascade Range, Oregon

By
Wes Hildreth, Judy Fierstein, and Andrew T. Calvert

2012

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For sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225, 1-888-ASK-USGS

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Suggested citation: Hildreth, Wes, Fierstein, Judy, and Calvert, Andrew T., 2012, Geologic map of Three Sisters volcanic cluster, Cascade Range, Oregon: U.S. Geological Survey Scientific Investigations Map 3186, pamphlet 187 p., 2 sheets, scale 1:24,000. (Available at http://pubs.usgs.gov/sim/3186/.)

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