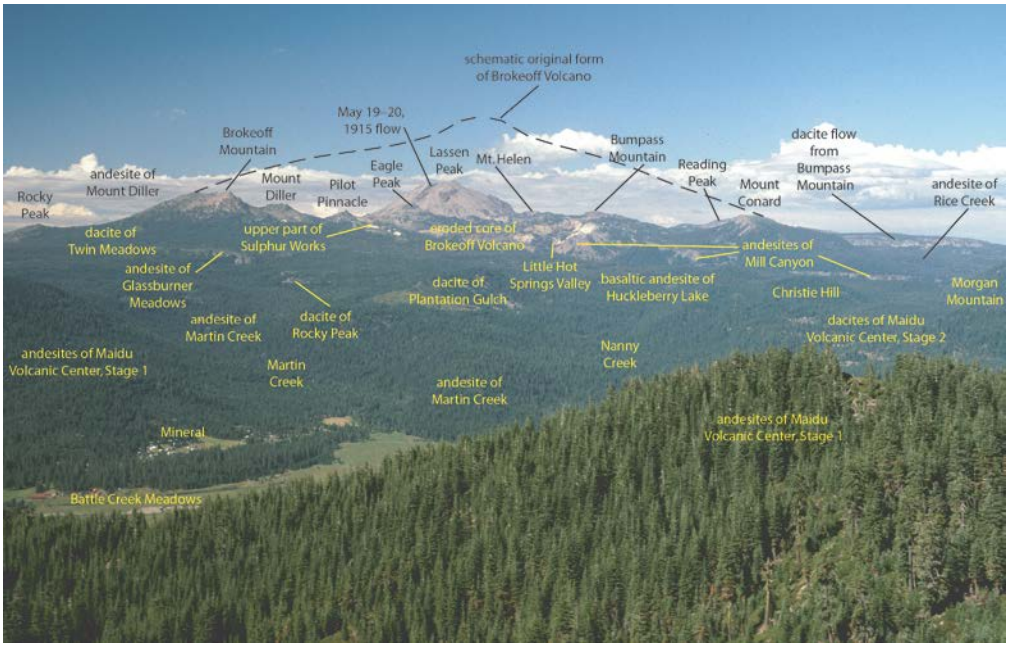
PHOTO SET FOR

GEOLOGY OF THE LASSEN COUNTRY—

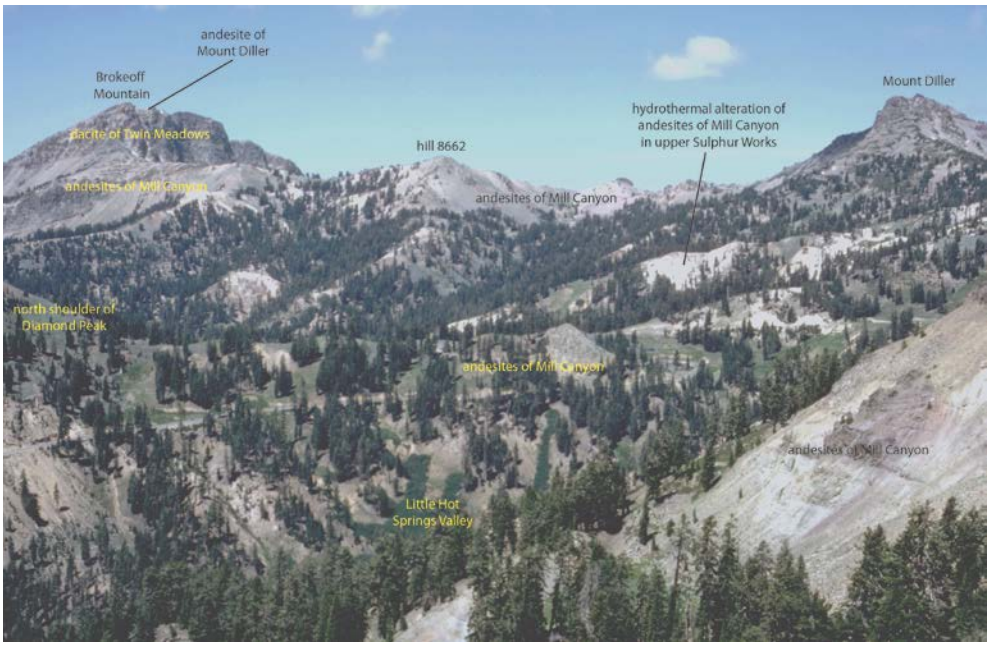
THE GEOLOGIC STORY OF LASSEN VOLCANIC NATIONAL PARK AND VICINITY

R. Forrest Hopson and Michael A. Clynne



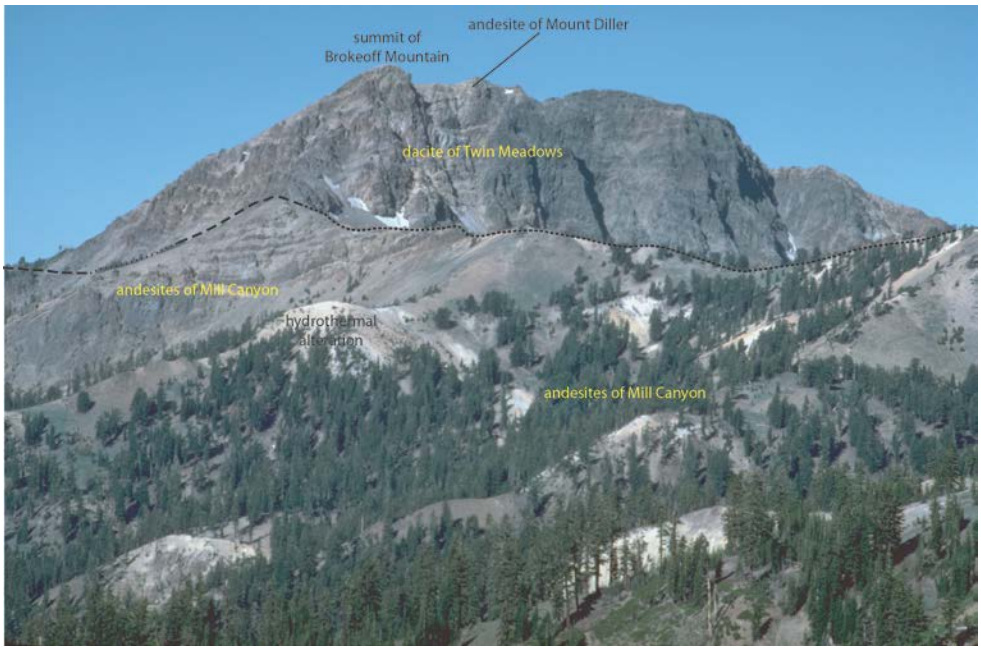
Lassen and Maidu Volcanic Centers

View looking north from Turner Mountain towards Lassen Volcanic Center. Battle Creek Meadows, now filled with glacial outwash, marks the approximate core of the Maidu Volcanic Center. The forested hill in the right foreground consists of andesites of the Maidu Volcanic Center, Stage 1, undivided (2.15–2.4 million years), overlain to the east by dacites of the Maidu Volcanic Center, Stage 2, undivided (2.1 million±46,000 years). The hills just beyond the town of Mineral are also andesites of the Maidu Volcanic Center, Stage 1, undivided, overlain by the andesite of Martin Creek (1.1–1.3 million years), a regional calc-alkaline unit. The dacite domes of Plantation Gulch, Christie Hill and Morgan Mountain are 800,000–830,000 years and are part of the Rockland caldera complex of the Lassen Volcanic Center. The dacite of Rocky Peak (803,000±27,000 years, also part of the Rockland caldera complex) makes up Rocky Peak and a prominent outcrop in the left center of the photo. The skyline comprises Brokeoff Volcano and the Lassen Domefield. The eroded core of Brokeoff Volcano is composed of the andesites of Mill Canyon (590,000–470,000 years). Mount Conard marks the east rim of the erosional amphitheater in Brokeoff Volcano. The southwest rim is marked by Brokeoff Mountain, composed primarily of the dacite of Twin Meadows (470,000±10,000 years, the uppermost unit of the Mill Canyon sequence) but capped on the west by the andesite of Mount Diller (387,000±10,000 years, part of the Diller sequence). The northwest rim is marked by Mount Diller and Pilot Pinnacle, both composed of andesite of Mount Diller. More distal units of the Diller sequence include the andesite of Glassburner Meadows (~450,000) at the left center and the andesite of Rice Creek (480,000±5,000 years) at the far right. The basaltic andesite of Huckleberry Lake (~300,000 years) is a regional calc-alkaline unit that is younger than the Brokeoff Volcano. Mt. Helen (249,000±12,000 years), Reading Peak (212,000±5,000 years) and Bumpass Mountain (232,000±8,000 years) are domes of the Bumpass sequence of the Lassen domefield. Eagle Peak (66,000±4,000 years) and Lassen Peak (27,000±1,000 years) are domes of the Eagle Peak sequence of the Lassen domefield. The dark, triangular mass on the west side of Lassen Peak is the west lobe of the dacite flow of May 19–20, 1915. Photograph by Michael A. Clynne.



Eroded core of Brokeoff Volcano

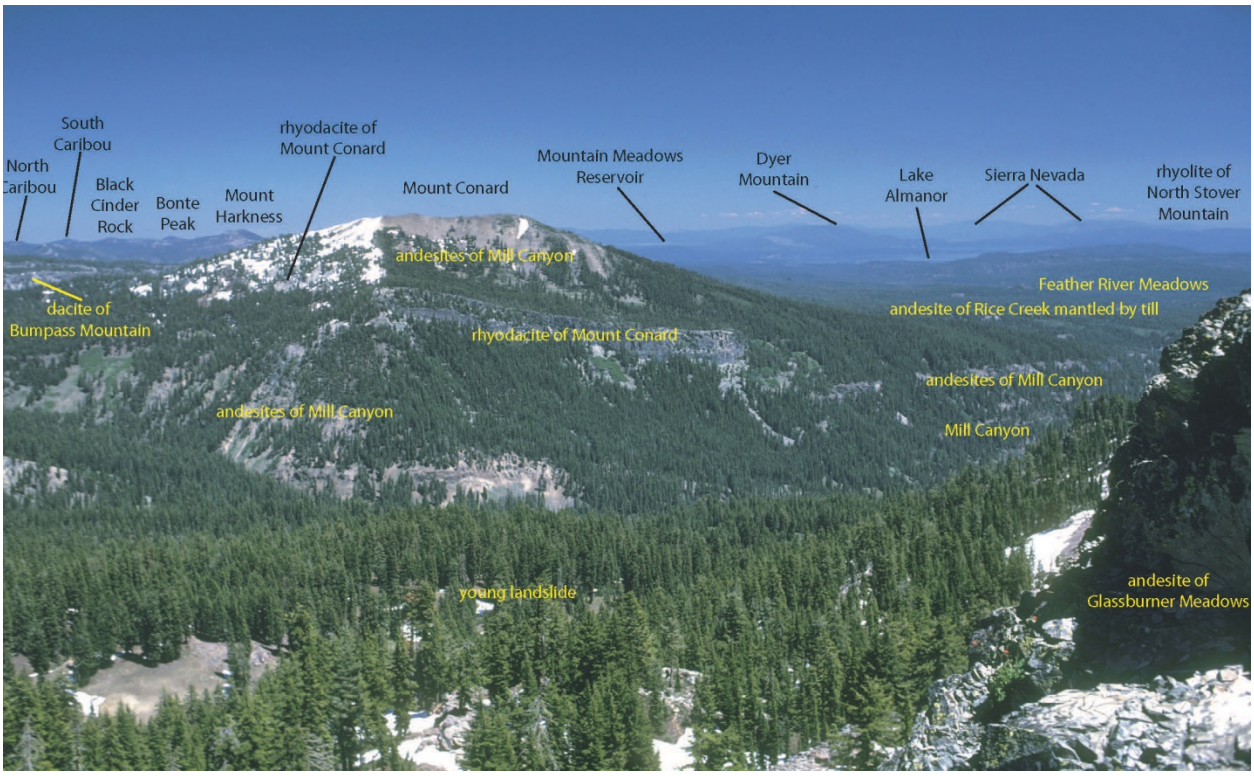
View looking west-northwest from the prominent, rugged ridge overlooking Little Hot Springs Valley, ~0.7 mile (1.1 kilometers) south-southwest of Bumpass Hell. Andesites of Mill Canyon (470,000–590,000 years, part of the Mill Canyon sequence) are extensively altered in the eroded amphitheater of Brokeoff volcano. They are overlain by the dacite of Twin Meadows (470,000±10,000 years), the uppermost unit of the Mill Canyon sequence. The overlying andesite of Mount Diller (387,000±10,000 years, part of the Diller sequence) crops out on Mount Diller and on Brokeoff Mountain (primarily on the west side, away from the camera). Photograph by Patrick Muffler.



Brokeoff Mountain

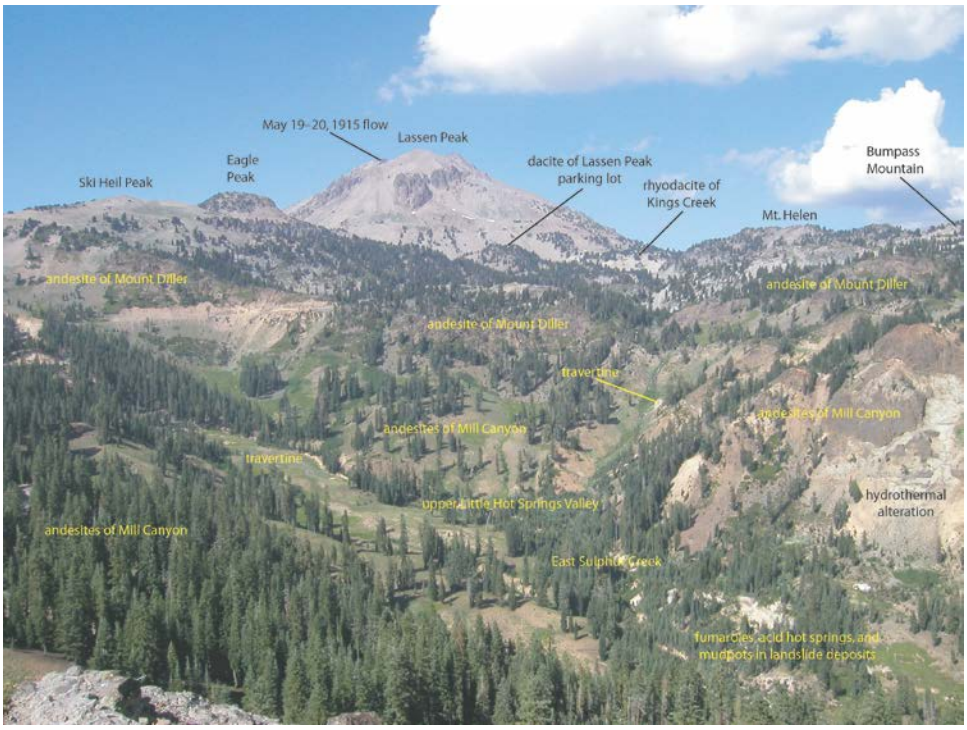
Telephoto view looking west from the trail to Bumpass Hell. Andesites of Mill Canyon (590,000–470,000 years,) are part of the Mill Canyon sequence, extensively altered in the eroded amphitheater of Brokeoff volcano. They are

overlain by the dacite of Twin Meadows (470,000±10,000 years), the uppermost unit of the Mill Canyon sequence. The overlying andesite of Mount Diller (387,000±10,000 years, part of the Diller sequence) crops out primarily on the west side of Brokeoff Mountain, away from the camera. Dotted lines indicate where contacts (dashed) are hidden by ridges between the contacts and the camera. Photograph by Patrick Muffler.



Mount Conard

View looking east toward Mount Conard from ridge 0.8 mile (1.2 kilometers) south-southeast of Brokeoff Mountain. Brokeoff Mountain and Mount Conard are respectively the west and east remnants of Brokeoff Volcano. The core of Brokeoff Volcano has been eroded by glacial, landslide and fluvial processes to form an erosional amphitheater in the andesites of Mill Canyon (470,000–590,000 years). The amphitheater is drained to the south by Mill Canyon. In the foreground is a large landslide (3,310±55 years B.P.) that flowed from the scarp below Brokeoff Mountain and south down Mill Canyon for about 4.3 miles (7 kilometers). To the right of Mount Conard is the till-mantled andesite of Rice Creek (480,000±5,000 years), part of the flanking Diller sequence of Brokeoff Volcano. The cliff at the right is andesite of Glassburner Meadows (~450,000 years), also part of the Diller sequence. The cliff on the near flank of Mount Conard is the thick, canyon-filling, rhyodacite lava flow of Mount Conard (298,000±9,000 years), a unit of the Bumpass sequence of the Lassen domefield. In the left distance, the peaks of North Caribou and South Caribou are the glaciated vents of the basaltic andesite of North Caribou and the basalt of south Caribou, both part of the Caribou chain of the Caribou Volcanic Field. Black Cinder Rock (667,000±24,000 years) and Bonte Peak (675,000–700,000 years) are highly glaciated calc-alkaline basalts and basaltic andesites that underlie the Caribou Volcanic Field. Mount Harkness (188,000±32,000 years) is a small calc-alkaline basalt to andesite volcano that marks the southern limit of active volcanism in the Cascades. To the right of Lake Almanor is the rhyolite of North Stover Mountain (1.2–1.3 million years), part of the Maidu Volcanic Center. Dyer Mountain is composed of Paleozoic metasedimentary rocks and represents the northernmost extent of the Sierra Nevada. Photograph by Michael A. Clynne.

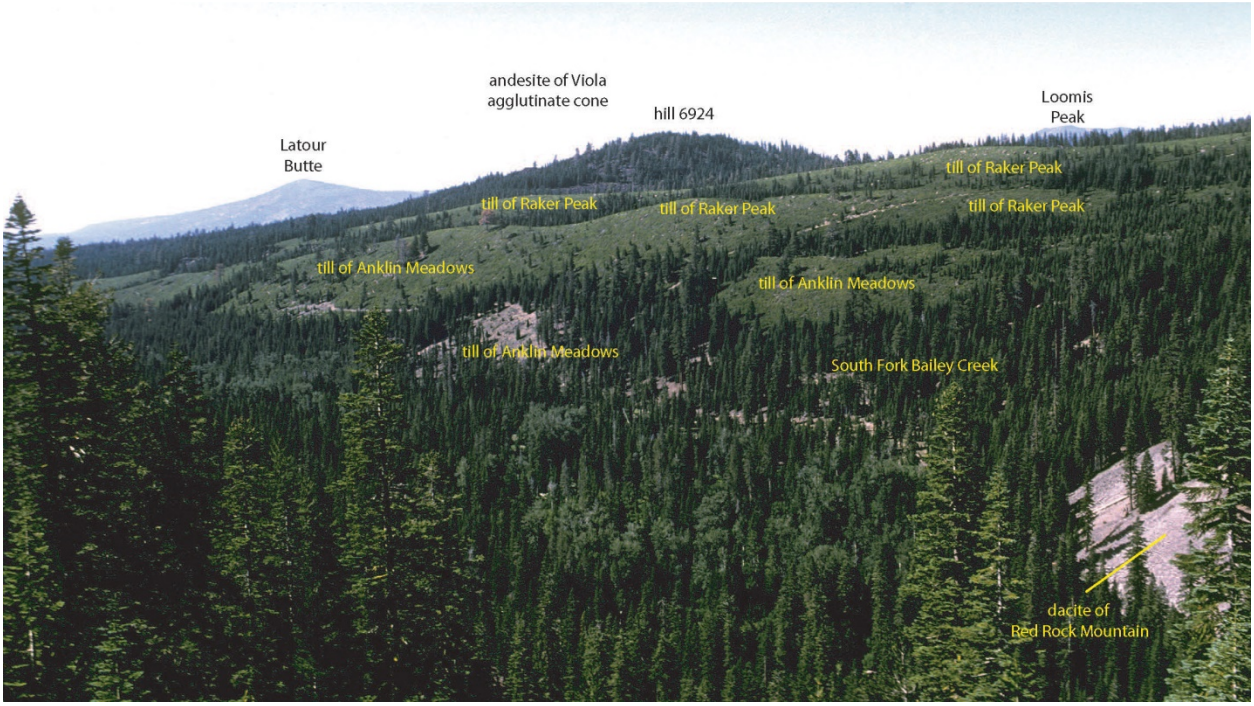


Little Hot Springs Valley

View looking north from Calif. Hwy 89 on the west side of Little Hot Springs Valley (Lassen Peak quadrangle). Lassen Peak (27,000±1,000 years), rhyodacite of Kings Creek (35,000±1,000 years), and Eagle Peak (66,000±4,000 years) are part of the Eagle Peak sequence. Ski Heil Peak (244,000±10,000 years), the dacite of Lassen Peak parking lot (250,000–260,000 years), Mount Helen (249,000±12,000 years) and Bumpass Mountain (232,000±8,000 years) are domes of the Bumpass sequence; Ski Heil Peak is mantled by tephra from the eruption of Eagle Peak. The resistant andesite of Mount Diller (387,000±10,000 years), part of the Diller sequence, marks the rim of the erosional amphitheater in Brokeoff Volcano. The underlying andesites of Mill Canyon (470,000–590,000 years) consist of interbedded flows and breccias (many hydrothermally altered) and are highly eroded by glacial, fluvial and landslide processes. Active thermal features include acid hot springs and mud pots and fumaroles that are concentrated in landslide deposits near East Sulphur Creek, as well as neutral to alkaline travertine-depositing hot springs higher in the valley. Photograph by Patrick Muffler.

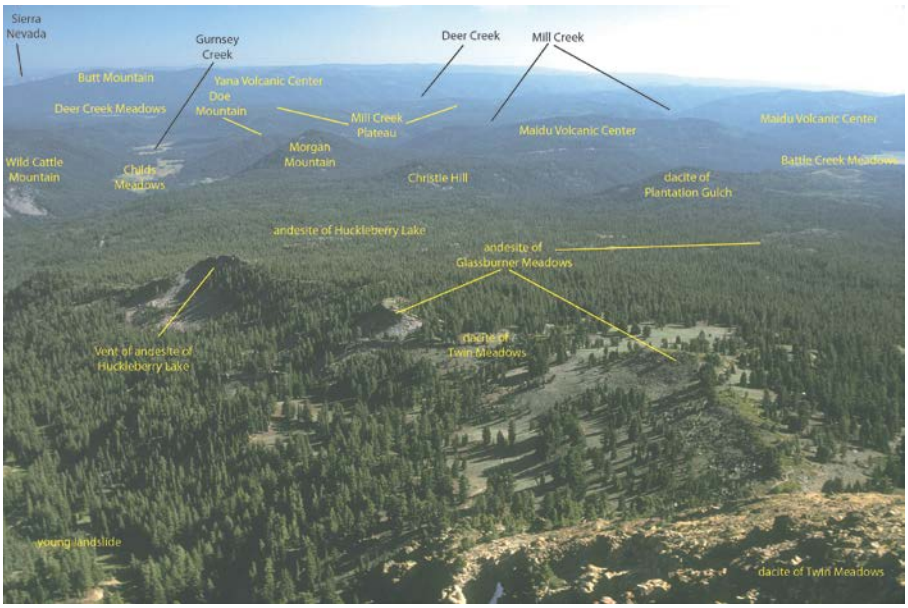
Tuya in Caribou Volcanic Field

View looking north from hill 7253, one mile northwest of Long Lake (Red Cinder quadrangle) in the Caribou Volcanic Field. This tuya (~25,000 years) formed by eruption of basaltic andesite beneath a cover of glacial ice. The tuya is the middle of three tuyas erupted along a 2.5 mile-long (4 kilometer-long north-south trend parallel to regional structure. Hill 7253 is the southernmost of the three tuyas. Foreground is basalt of hill 8030 (25,000–40,000 years) mantled by young till. Photograph by Michael A. Clynne.



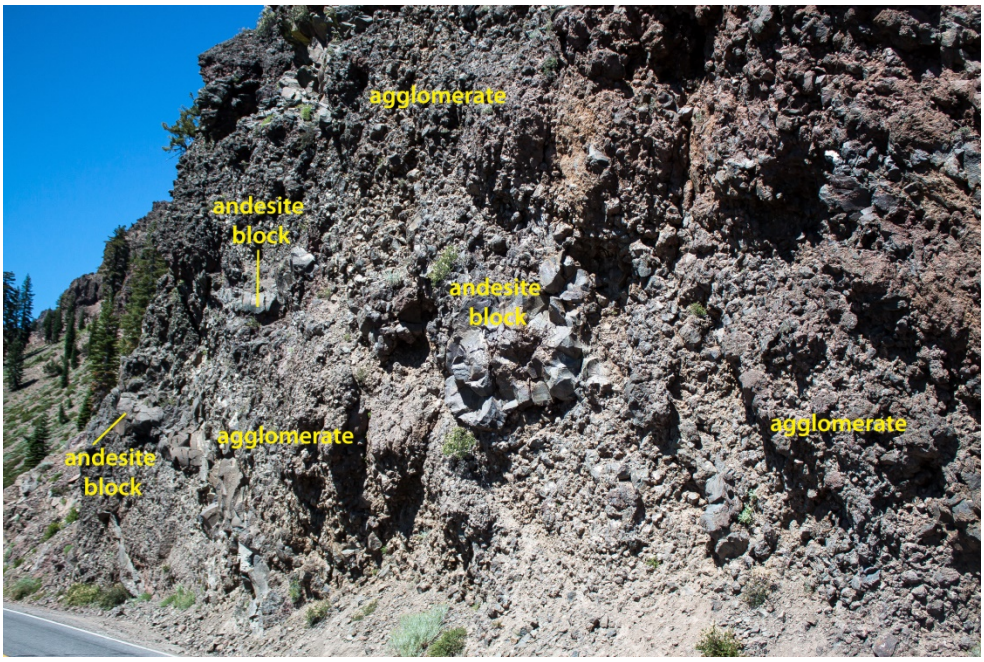
Moraines in Bailey Creek

View looking north from Red Rock Mountain across the South Fork Bailey Creek (Lassen Peak quadrangle). The brushy ridge extending from the upper right to the left center is the late Pleistocene till of Raker Peak, forming a medial moraine between South Fork and North Fork Bailey Creek. The ridge with the conspicuous bulldozer track is also till of Raker Peak, but to the left of the break in slope (above the road scar) the ridge is made up of the younger till of Anklin Meadows, as are the bare patch and the brushy patch closer to the camera. The bare slope at the lower right is dacite of Red Rock Mountain (672,000±20,000 years), a dome of the Rockland caldera complex of the Lassen Volcanic Center. Hill 6924 is the agglutinate vent of the andesite of Viola (313,000±8,000 years), part of the older Twin Lakes sequence of the Lassen Volcanic Center; its flow forms the forested slope to the left. In the right distance is Loomis Peak, composed of the rhyodacite of Loomis Peak (~300,000 years), part of the Bumpass sequence of the Lassen Volcanic Center. In the far distance on the left is Latour Butte, an andesitic volcano that is part of the Latour Volcanic Center (>3 million years). Photograph by Michael A. Clynne.



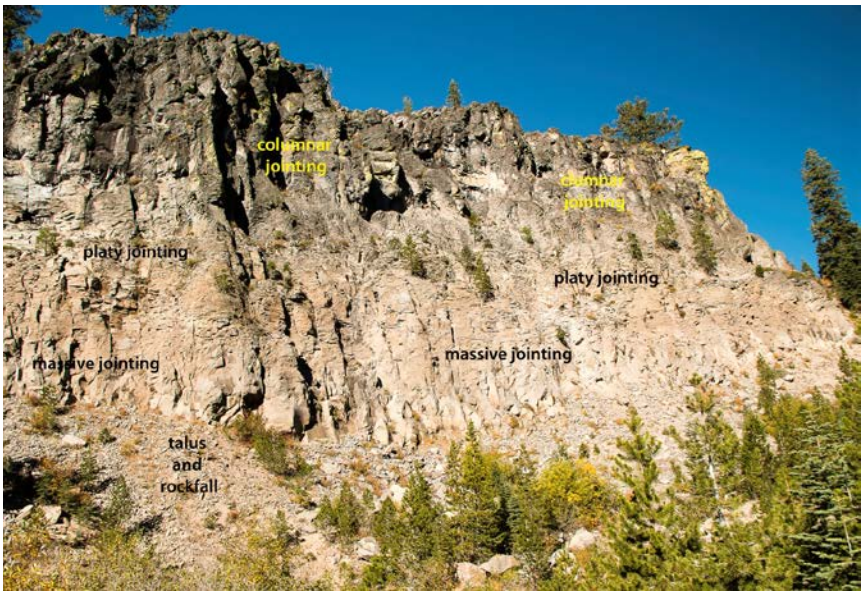
South flank of Brokeoff Volcano

View to the south from the summit of Brokeoff Mountain (Lassen Peak quadrangle). The south flank of Brokeoff Mountain is covered mostly by lava flows of the regional basaltic andesite of Huckleberry Lake (300,000 years) that is younger than the Brokeoff Volcano. The vent for the basaltic andesite of Huckleberry Lake is in the area of the cliff in deep shadow in the left of the photograph. Basaltic andesite of Huckleberry Lake overlies dacite of Twin Meadows (470,000±10,000 years), the uppermost unit of the Mill Canyon sequence) and several andesite units of the Diller sequence, including the andesite of Glassburner Meadows (~450,000 years). The forested area at the left bottom of the photograph is floored by the 3,310±55 years B.P. landslide that originated at the large scarp below Brokeoff Mountain and flowed for at least 4.3 miles (7 kilometers) down Mill Canyon. The dacite of Morgan Mountain, the dacite of Christie Hill, and the dacite of Plantation Gulch, prominent in the upper center of the photograph, are partially buried by lavas from Brokeoff Volcano. These 3 domes are part of the Rockland caldera complex and at 800,000–825,000 years are probably the oldest preserved units of the Lassen Volcanic Center. The dissected area between Childs Meadows and Battle Creek Meadows forms the east flank of the Maidu Volcanic Center. The Mill Creek Plateau (1.2–1.3 million years) is one of several large and thick rhyolite lava flows that flank the Maidu Volcanic Center. Doe Mountain (andesite of Doe Mountain) and andesites of Wild Cattle Mountain are part of the Dittmar Volcanic Center and are probably about 2.5 million years. The Yana Volcanic Center (2.4–3.4 million years) and Butt Mountain form most of the skyline. Deer Creek flows between the Maidu and Yana Volcanic Centers. The northern Sierra Nevada is partially visible beyond the Yana Volcanic Center. Photograph by Michael A. Clynne.



Agglomerate in the lower part of the Mill Canyon Sequence.

This road cut is near the center of Brokeoff Volcano. The steep eastward dip of these agglomerates, part of the andesites of Mill Canyon, 470,000–590,000 years, indicates that the vent at that time was nearby and off to the west. They are incipiently altered by fossil magmatic-hydrothermal systems at temperatures of about 390 to >570 °F (200 to >300 °C). The agglomerates were emplaced as hot debris avalanches on the southeastern slopes of Brokeoff Volcano. Photograph by R. Forrest Hopson.



Andesite of Bluff Falls quarry

Looking west at the andesite flow exposed in the face of Bluff Falls quarry along Highway 89 approximately 0.8 mile (1.3 kilometers) south of the Lassen Volcanic National Park boundary. This glacially-carved cliff modified by quarrying exposes nearly the entire sequence of this andesite flow (467,000±10,000 years). The base is a thin reddish scoriaceous flow breccia (not exposed here) that overlain by a massively-jointed, faintly flow banded,

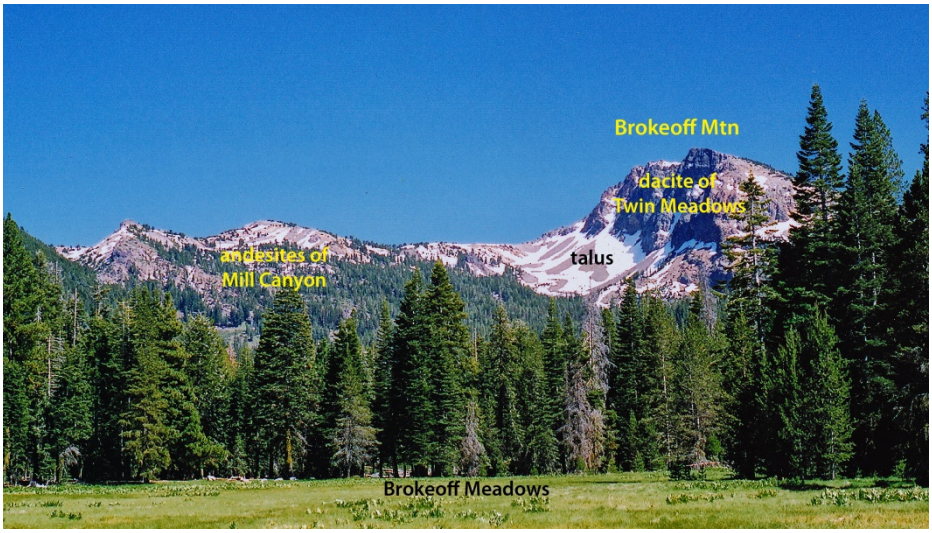
glass-rich zone. This zone grades into a thick zone of thin, platy jointing; horizontal to slightly wavy in the flow interior and highly contorted or ramped upward on the flow interior. The platy-jointed zone grades upward to a zone of crude columnar jointing. The upper surface of the flow is glassy and vesicular. The color change halfway up the cliff marks the base of the natural exposure. Large blocks at bottom of the photograph are 3–6 feet (1–2 meters) and the cliff is ~165 feet (50 meters) high. Caption modified from Muffler and Clynne (2015). Photograph by R. Forrest Hopson

Upper Blue Lake Canyon

Looking southwest from high on Lassen Peak. Blue Lake Canyon was fed by Tioga glaciers that headed in cirques on the west side of the ridge between Mount Diller and Eagle Peak. Upper Blue Lake Canyon is underlain by predominately Brokeoff Volcano lavas (andesite of Mount Diller, andesites of Mill Canyon, and dacite of Twin Meadows) and locally Lassen domefield, Bumpass Sequence dacite domes (dacites of Ski Heil Peak and Vulcan's Castle). Down canyon, the volcanic rocks are overlain by Tioga glacial till. Lateral moraines rise ~600 feet (185 meters) above the valley floor. Vulcan's Castle is an eroded Bumpass Sequence dacite dome made up of dacite of Vulcan's Castle estimated to be 250,000–260,000 years old. Red Rock Mountain just south of Blue Lake Canyon is a Rockland Caldera sequence dacite dome 672,000±20,000 years old. Photograph by R. Forrest Hopson.

Boiling Springs Lake.

Looking northwest from the overlook above the southeast shore of Boiling Springs Lake. In the foreground is Boiling Springs Lake, a hot lake with hot springs along its shores. In the distance are domes within the Lassen domefield. Bumpass Mountain is a Bumpass sequence dacite dome and lava flow 232,000 years±8,000 old. Reading Peak is Bumpass sequence dacite dome complex 212,000±5,000 years old. It is strongly glaciated and may have been larger than Lassen Peak prior to glaciation. To the left is snow-covered Lassen Peak, a 27,000±1,000-year-old Eagle Peak sequence dacite dome. Photograph by R. Forrest Hopson.



Brokeoff Mountain from Brokeoff Meadows

Glaciated Brokeoff Mountain and headwall of the south fork of Bailey Creek glacial valley. The andesites of Mill Canyon (470,000–590,000 years) overlain by the dacite of Twin Meadows (470,000±10,000 years) are Mill Canyon sequence lavas that form the lower part of Brokeoff Volcano. The Tioga till of Anklin Meadows underlies the south fork of Bailey Creek glacial valley. Photograph by R. Forrest Hopson.

Tree snag in Cinder Cone ash.

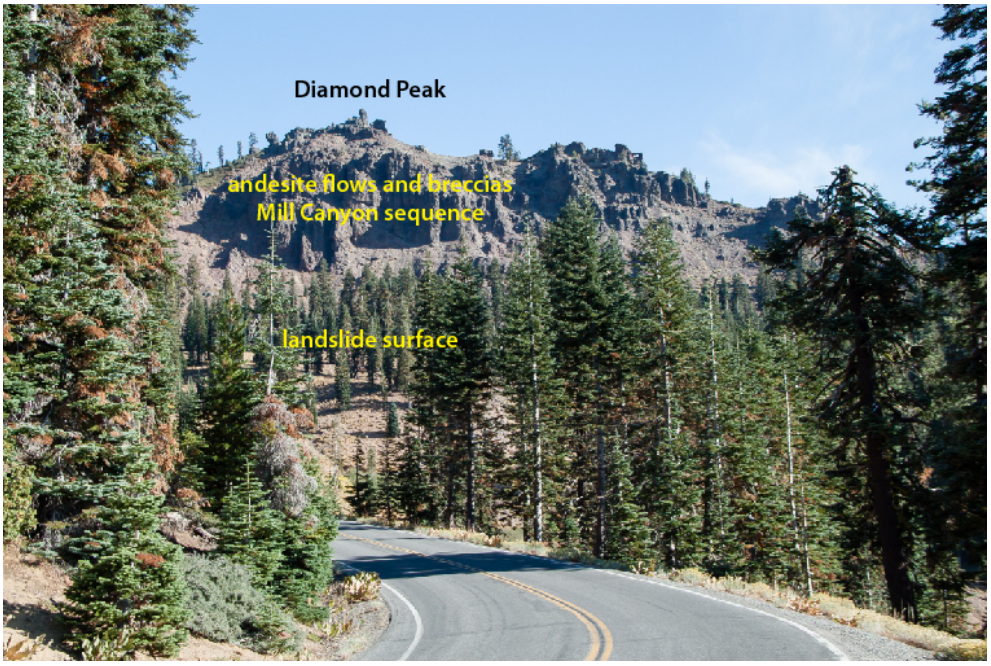
This tree was killed by ashfall from the Cinder Cone eruptions in 1666. Photograph by R. Forrest Hopson.

Mafic blob in rhyodacite of Chaos Crags (Dome C).

The mafic blob is mafic magma that broke apart upon mixing with the cooler rhyodacite magma. Quarter for scale. Photograph by R. Forrest Hopson.

Fumaroles at Devils Kitchen.

These fumaroles are emanating from talus of dacite of Panther Creek (827,000±18,000 years) that was erupted from a dome within a small group of Rockland caldera sequence lava domes exposed around the steep north and south slopes surrounding Devils Kitchen. Photograph by R. Forrest Hopson.



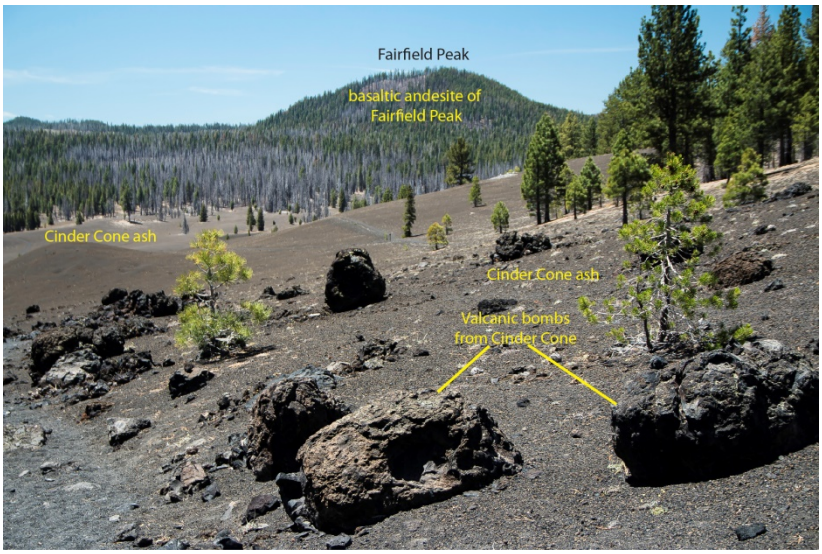
Andesite flows and breccias exposed in Diamond Peak.

Andesites of Mill Canyon, a Mill Canyon sequence group of largely thin andesite flows and associated fragmental deposits erupted from central vents in the lower part of Brokeoff Volcano 470,000–590,000 years ago. The low-

angle slope in the trees between the road and the cliff is the surface of a landslide that activated in the hydrothermally-altered core of Brokeoff Volcano 3,310±55 B.P. Photograph by R. Forrest Hopson.

Emerald Lake cirque and headwall.

Emerald Lake is a tarn occupying a Tioga-age cirque on the south slope of Ski Heil Peak, a Bumpass sequence dacite dome emplaced 244,000±10,000 years ago. The cirque headwall exposes dacite of Ski Heil Peak. Photograph by R. Forrest Hopson.



Fairfield Peak

Fairfield Peak, a Twin Lakes sequence basaltic andesite agglutinate cone (82,000±14,000 years). In the foreground and middle ground are ash and bombs from Cinder Cone that erupted in 1666. Photograph by R. Forrest Hopson.

Flow banding in rhyodacite of Kings Creek.

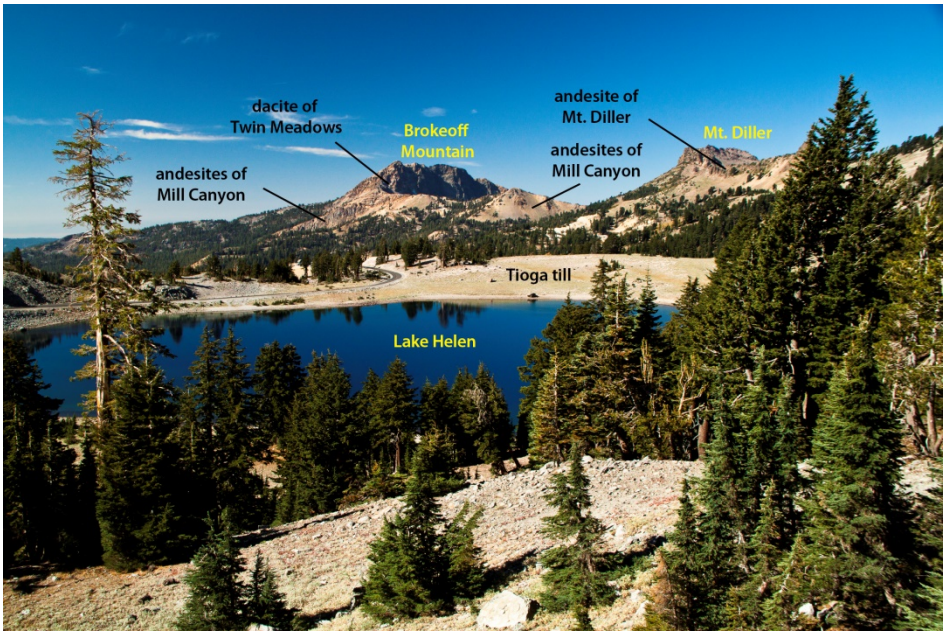
The rhyodacite of Kings Creek (35,000±1,000 years) erupted from a tuff cone at the south base of Lassen Peak. The flow bands are characterized by the light and dark layers. The layers are bands of glass (dark) and crystallized (light) rhyodacite. Photograph by R. Forrest Hopson.

Hat Mountain and Summit Lake

Hat Mountain, a Twin Lakes sequence agglutinate cone, erupted andesite cinder and a lava flow estimated to be 40,000–50,000 years old. The entire cone has been glaciated and original lava flow block surface removed by erosion. Summit Lake occupies a shallow depression in Tioga till. Photograph by R. Forrest Hopson.

Hydrothermally-altered dacite boulder at Bumpass Hell hydrothermal area.

This white to light gray dacite (dacite of Bumpass Mountain) boulder is typical of intensely altered boulders at Bumpass Hell: altered to kaolinite (whitish clay) and silica with a strong pitted appearance. Photograph by R. Forrest Hopson.



Brokeoff Mountain, Mount Diller and Lake Helen.

View across the eroded core of Brokeoff Volcano. Brokeoff Mountain is underlain by andesites of Mill Canyon (470,000–590,000 years) and dacite of Twin Meadows (470,000±10,000 years), Mill Canyon sequence lava flows. Andesite of Mount Diller (387,000±10,000 years) makes up Mount Diller. Tioga till deposited by the glacier that created the Lake Helen cirque forms the shores of Lake Helen. The upper shores are outcrop. Photograph by R. Forrest Hopson.

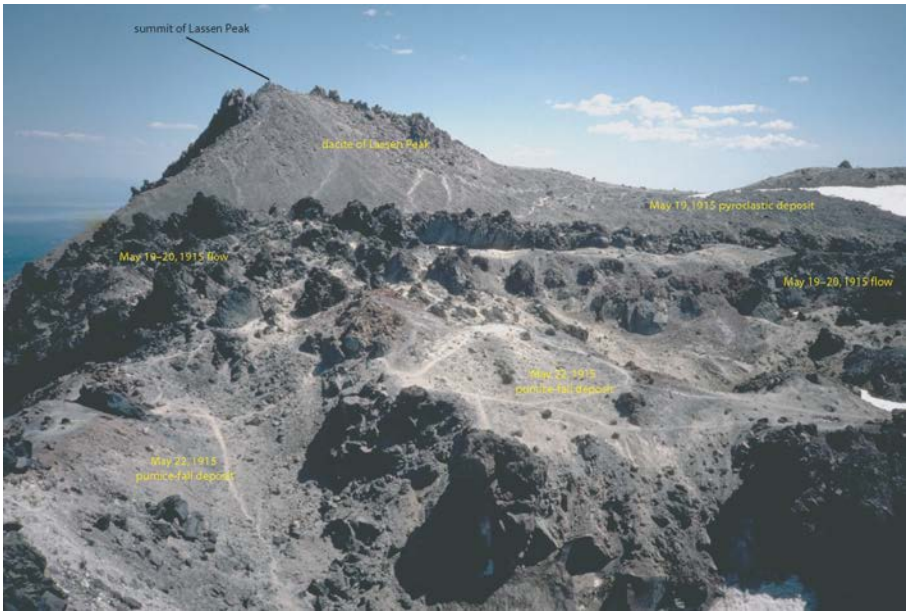
Lassen Peak from Manzanita Lake.

Lassen Peak is a 27,000±1,000-year-old dacite dome. Lassen Peak rises 2,000 feet (610 meters) above the surrounding countryside and has a volume of about 0.6 cubic miles (2.5 cubic kilometers) making it one of the largest lava domes on Earth. To the left of Lassen Peak is Dome B, a rhyodacite dome within the Chaos Crags group of domes (1,100 years). Eagle Peak, to the right of Lassen Peak, is a rhyodacite dome (66,000±4,000 years). These domes belong to the Eagle Peak sequence. Photograph by R. Forrest Hopson.

Lassen domefield looking west from West Prospect Peak fire lookout.

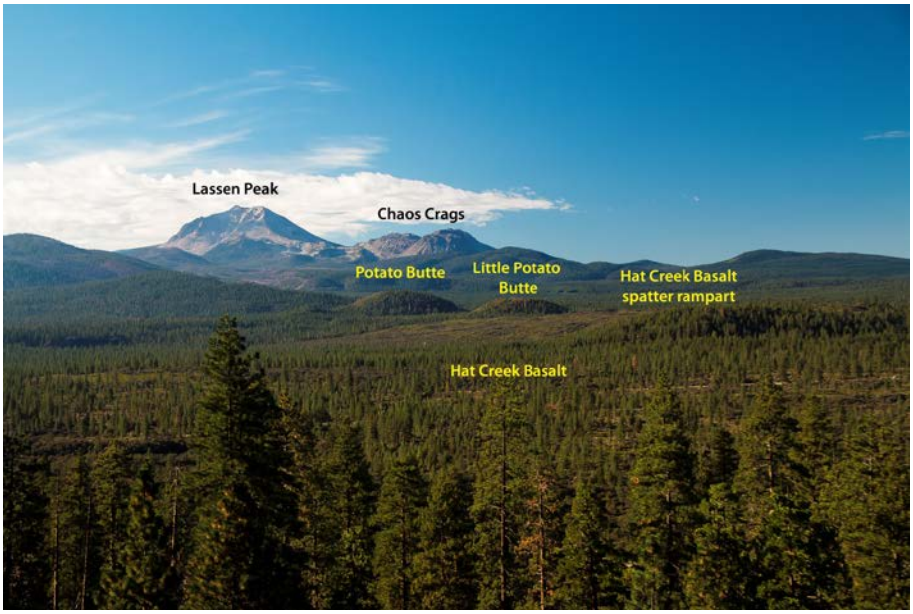
Reading Peak is a complex of dacite domes emplaced 212,000±5,000 years ago. Bumpass Mountain is a dacite dome and flow emplaced 232,000±8,000 years ago. The thick dacite flow more than 300 feet (100 meters) thick flowed a few miles to the southeast. A smaller flow flowed to the northeast of Bumpass Mountain. Lassen Peak, a dacite dome, is 27,000±1,000 years old. Crescent Crater is a dacite dome and rhyodacite flow that is 236,000±1,000 years old. The circular depression near the summit exposes the interior of the dome. Loomis Peak is a thick rhyodacite flow. It erupted from a vent located near the Loomis Peak summit and flowed toward the northwest. The Loomis Peak rhyodacite flow has not been dated but is estimated to be about 300,000 years old on the basis of geologic relations with nearby lava flows and domes. Chaos Crags are a group of six rhyodacite domes

erupted over a short interval about 1,100 years ago. Reading Peak, Bumpass Mountain, Crescent Crater, and Loomis Peak are glaciated Bumpass sequence domes. Lassen Peak and Chaos Crags are Eagle Peak sequence domes. Lassen Peak has been glaciated and Chaos Crags is unglaciated. Photograph by R. Forrest Hopson.



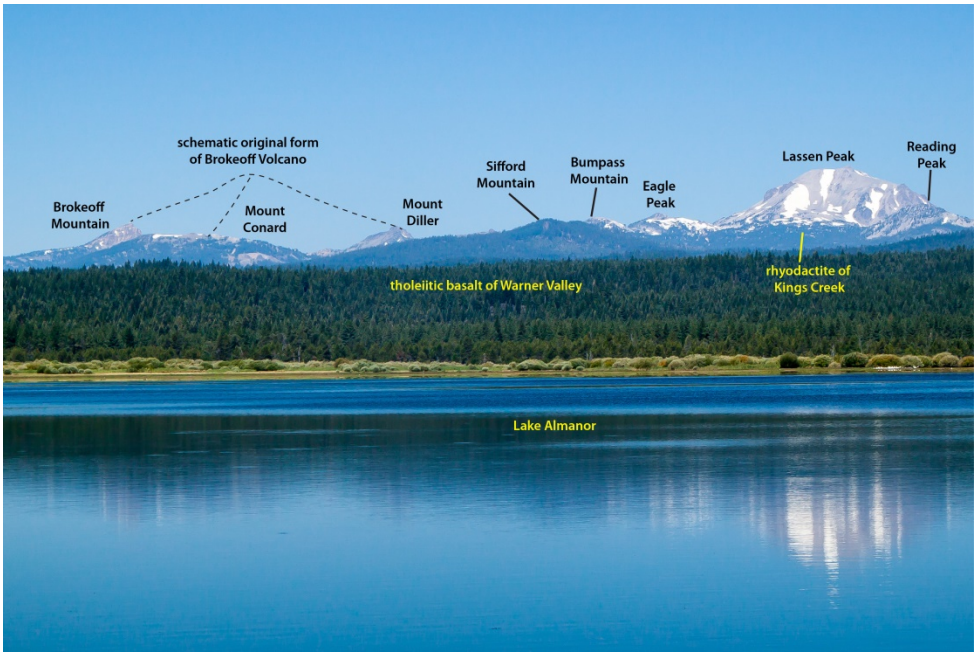
1915 crater at summit of Lassen Peak

View looking southeast at summit of Lassen Peak. The summit consists of the dacite of Lassen Peak (unit dl, 27±1,000). Deposits of the May 19–20, 1915 eruption partly fill the crater formed at the summit of Lassen Peak between May 30, 1914 and May 14, 1915. The May 19, 1915 pyroclastic deposit was formed by a phreatic explosion that reopened the summit crater through the dacite dome of May 14–19. The dacite lava flow of May 19–20, 1915 fills this crater and is mantled by the pumice-fall deposit of May 22, 1915. Photograph by Patrick Muffler.



Lassen Peak from Hat Creek Valley

Lassen Peak (27,000±1,000 years) Chaos Crags (1,100 years), cinder cones Potato Butte (77,000±11,000 years) and Little Potato Butte (67,000±4,000 years), and Hat Creek Basalt spatter rampart (24,000±6,000 years). Lassen Peak and Chaos Crags are dacite and rhyodacite domes in the northern part of the Lassen dome field. Potato Butte and Little Potato Butte are regional andesite and basaltic andesite cinder cones. The spatter rampart marks the fissure zone for the Hat Creek Basalt flow. Photograph by R.F. Hopson.



Lassen Peak from Lake Almanor

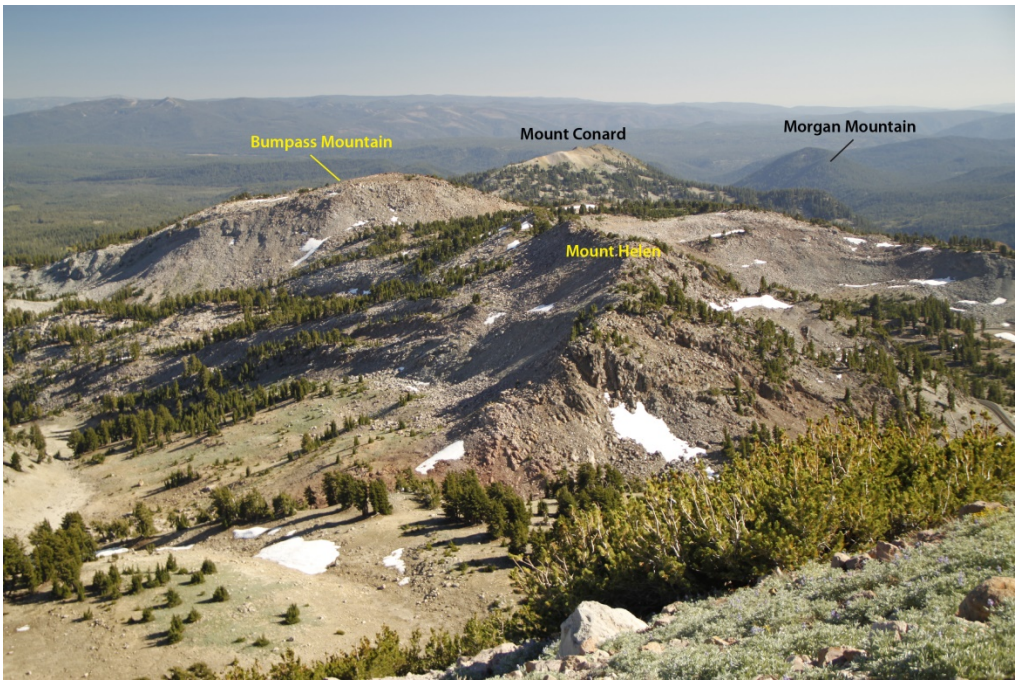
Brokeoff Mountain, Mount Conard, and Mount Diller are erosional remnants of Brokeoff Volcano. The upper parts of the volcano were worn away by glacial and stream erosion and landslides. Bumpass Mountain (232,000±8,000 years old), Eagle Peak (66,000±4,000 years old), Lassen Peak (27,000±1,000 years old), and Reading Peak (212,000±5,000 years old) are dacite domes within the Lassen dome field of the Lassen stage, the youngest of three stages that make up the Lassen Volcanic Center. In front of Lassen Peak is Sifford Mountain, a regional shield volcano that produced basaltic andesite 172,000±23,000 and 167,000±4,000 years ago. Sifford Mountain marks the southern limit of the "active" Cascade Volcanic Arc. The tholeiitic basalt of Warner Valley is a 610,000±22,000-year-old regional lava flow. Photograph by R. Forrest Hopson.

Mount Harkness from Drakesbad Meadow

Mount Harkness is a regional shield volcano made of 188,000±32,000-year-old andesite and basalt. Drakesbad Meadow in the foreground. Photograph by R.F. Hopson.

Sifford Mountain from Drakesbad Meadow

Sifford Mountain is a regional basalt and basaltic andesite shield volcano that erupted 172,000±23,000 and 167,000±4,000 years ago. Sifford Mountain marks the southern limit of the "active" Cascade Volcanic Arc. Photograph by R. Forrest Hopson.

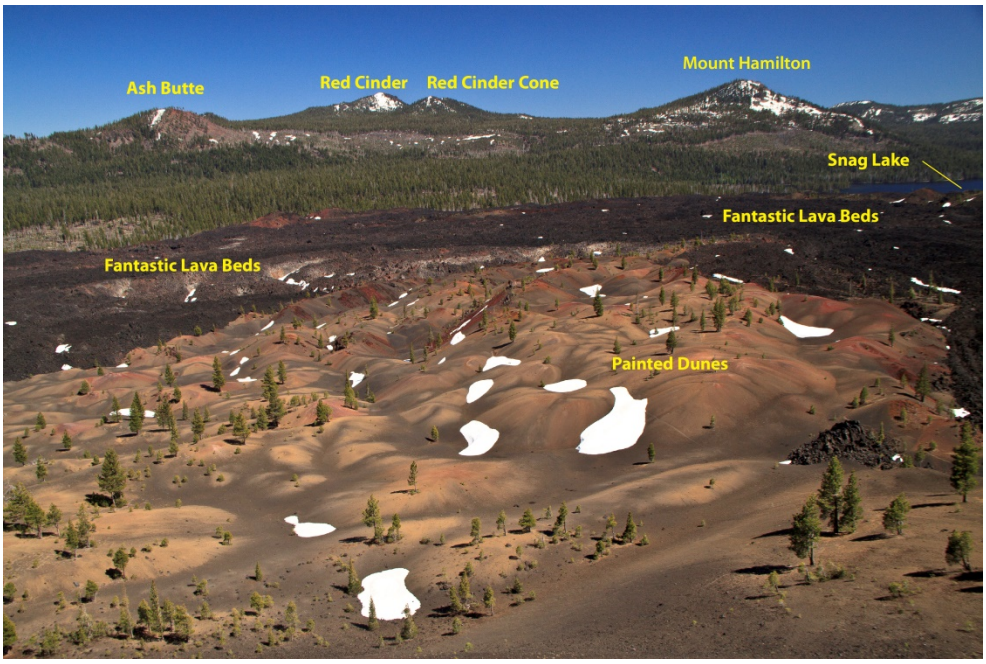


Bumpass Mountain, Mount Helen, Mount Conard, and Morgan Mountain

Bumpass Mountain (232,000±8,000 years) and Mount Helen (estimated to be 250,000–260,000 years) are Bumpass sequence dacite domes. Mount Conard, an erosional remnant of Brokeoff Volcano, and Morgan Mountain, a Rockland Sequence dacite dome estimated to be 825,000–805,000 years old, is beyond. In the distance is the Sierra Nevada. Photograph by R. Forrest Hopson.

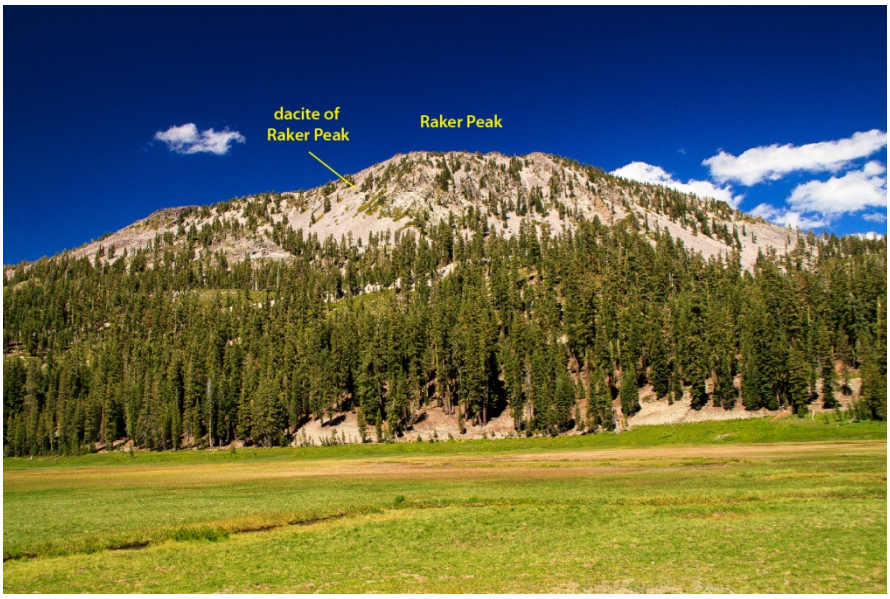
Brokeoff Volcano lavas and Lassen domefield

Predominately Mill Canyon sequence dacite domes underlain by Mill Canyon sequence lava flows and pyroclastic deposits from Brokeoff Mountain summit. The rhyodacite of Kings Creek, an Eagle Peak sequence lava flow erupted from a tuff cone at the south base of Lassen Peak 35,000±1,000 years ago. Mount Helen, Bumpass Mountain, and Reading Peak are Bumpass sequence dacite domes. Bumpass Mountain, which also consists of a lava flow, is 232,000 years±8,000 old. Reading Peak is a dacite dome complex 212,000±5,000 years old. Andesites of Mill Canyon, a Mill Canyon sequence group of largely thin andesite flows and associated fragmental deposits erupted from central vents in the lower part of Brokeoff Volcano 470,000–590,000 years ago. Areas of hydrothermal alteration are in andesites of Mill Canyon. Lake Helen occupies a Tioga-age cirque. Photograph by R. Forrest Hopson.



Painted Dunes and Caribou Volcanic Field

The Painted Dunes may have formed when rain or snow fell on the ash while the Fantastic Lava Beds beneath it were still hot. Alternatively, the Painted Dunes may have formed when the lavas flows covering marshy ground around ancient Butte Lake generated steam to oxidize the ash. The Fantastic Lava Flows are five basaltic andesite and andesite flows erupted in quick succession from the base of Cinder Cone in 1666. Ash Butte, Red Cinder, and Red Cinder Cone are cinder cones in the Caribou Volcanic Field. Ash Butte produced a basalt lava flow estimated to be 40,000–70,000 years old. Red Cinder produced an andesite lava flow 69,000±20,000 years ago and a basaltic andesite flow estimated to be 25,000–40,000 years old. Red Cinder Cone produced basaltic andesite and basalt flows estimated to be 20,000–250,000 and 25,000–40,000 years old. Mount Hamilton is consists of predominately late Pliocene to early Pleistocene andesites that were erupted during Stage 1 of Dittmar Volcanic Center and is overlain by Tioga till. Snag Lake formed when the Fantastic Lava Beds blocked the drainage of Grassy Creek. Photograph by R. Forrest Hopson.



Raker Peak from Upper Meadow

Reading Peak, a Bumpass sequence complex of deeply glaciated 212,000±5,000-year-old dacite domes in the Lassen dome field. Photograph by R. Forrest Hopson.

Hydrothermal alteration at Sulphur Works

Active hydrothermal alteration at Sulphur Works has intensively altered the volcanic bedrock, andesites of Mill Canyon (590,000–470,000 years), to kaolinite clay and silica so that the original lithology and stratigraphy are indeterminable. Photograph by R. Forrest Hopson.

Sulphur crystals growing in a cavity at Sulphur Works. Photograph by R. Forrest Hopson.

Mud pot at Sulphur Works

This photograph of the bubbling mud pot was taken in August 2011. The mud pot is about 1 foot (0.3 meters) north of the Lassen Park Road. Photograph by R. Forrest Hopson.

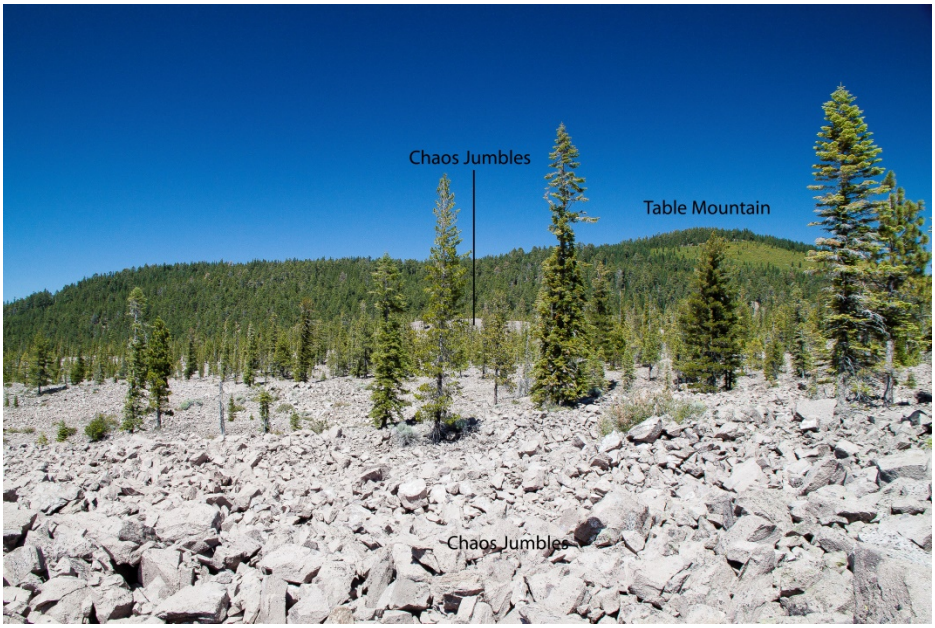


Table Mountain and Chaos Jumbles

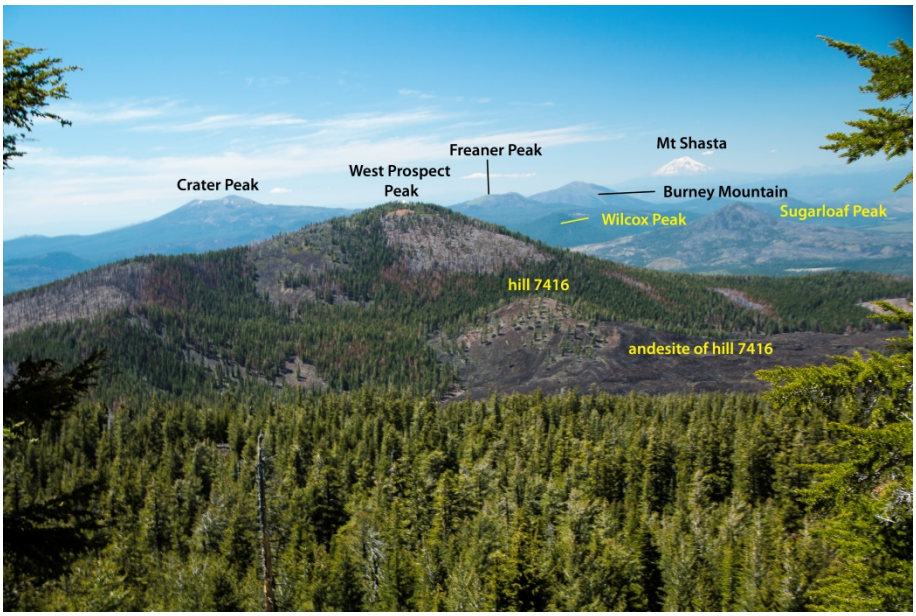
Table Mountain is a regional shield volcano built of andesite built about 700,000 years ago. Chaos Jumbles rock avalanche deposit, emplaced 278±28 years B.P., in the foreground. Photograph by R. Forrest Hopson.

Terminal Geyser

Steam rising from Terminal Geyser, a fumarole that issues into a stream. The stream follows the trace of a fault that places Stage 1 Dittmar Volcanic Center andesite (late Pliocene to early Pleistocene) against regional basalt of Sifford Mountain (middle Pleistocene). Photograph by R. Forrest Hopson.

Tuff cone, source of rhyodacite of Kings Creek

This tuff cone is the vent for the rhyodacite of Kings Creek 35,000±1,000 years ago (Eagle Peak sequence) is at the Lassen Peak trailhead. Photograph by R. Forrest Hopson.



West Prospect Peak from Prospect Peak

West Prospect Peak is a middle Pleistocene regional andesite lava cone. Hill 7416 is a cinder cone, estimated to be 12,000–15,000 years old that erupted into a cirque on the east side of West Prospect Peak and produced an andesite flow. Wilcox Peak and Sugarloaf Peak are regional andesitic lava cones. The age of Wilcox Peak is poorly constrained, but estimated to be 500,000–700,000 years old. Sugarloaf Peak is 46,000±7,000 years old. Crater Peak (Magee Volcano), Freaner Peak, Burney Mountain, and Mount Shasta are andesitic and dacitic volcanoes along the Cascade Range axis. Photograph by R. Forrest Hopson.