Dr. Patrick Muffler, US Geological Survey, Geologist Emeritus

Lassen Volcanic National Park -- a wonderland of volcanoes and thermal features

This talk will summarize 37 years of USGS volcanic and hydrothermal investigations in and around Lassen Volcanic National Park, primarily by my colleague Mike Clynne and me. Much of this presentation is based on our 1:50,000 Geologic Map of Lassen Volcanic National Park and Vicinity (USGS Scientific Investigations Map 2899, published in 2010) and on our geologic database of the 1:100,000 Lake Almanor sheet.

The Lassen volcanic region is located in the southernmost part of the Cascade Range, where the southern part of the Gorda plate is slowly being subducted beneath the North American plate. Volcanism in this region starts at ~3.5 Ma. There is a pronounced unconformity between the Quaternary volcanic rocks and the underlying Cretaceous Chico Formation and the Mesozoic plutonic and metamorphic rocks of the Sierra Nevada and the Klamath Mountains.

Quaternary volcanism in the Lassen Region built a broad platform comprising hundreds of coalescing small- to medium-sized mafic volcanoes derived from two distinct parental magmas: calc-alkaline basalt, and low-potassium olivine tholeiite basalt. Intercalated within these regional mafic rocks are a few voluminous long-lived volcanic centers that erupt the full compositional range from basalt to rhyolite. The youngest of these volcanic centers is the Lassen Volcanic center, which consists of the Rockland caldera complex (~825 to 609 ka), Brokeoff Volcano (590 to 390 ka), and the Lassen domefield (315 ka to the present). The youngest eruptions were Chaos Crags at 1,100 years B.P., Cinder Cone in 1666 C.E., and an eruption from the top of Lassen Peak in 1915. Associated with the Lassen domefield is an extensive hydrothermal system, by far the largest in the Cascade Range. Changes in intensity and location of fumarolic activity provide continuing logistic challenges to Lassen Volcanic National Park, particularly along Calif. Hwy 89 at Sulphur Works.

Biography: **Dr. Patrick Muffler** received a B.A. in geology from Pomona College, a M.A. from Princeton University, and a Ph.D. from Princeton Univiersity in 1962. He joined the U.S. Geological Survey in 1962 and has been a Scientist Emeritus with the Volcano Science Senter since retirement in 2001. He has specialized in the geology, geophysicis and geochemistry of geothermal systems, geothermal resource assessment, and volcanic geology. Principal areas of reserach have included the study of volcanic geology and geothermal phenomena in the Lassen region of northeastern California, the Cascade Range of the western United States, the Imperial Valley of southern California, Yellowstone National Park in Wyoming, the Larderello region of Italy, and the Taupo volcanic belt of New Zealand. He has acted as the coordinator of the USGS Geothermal Research Program between 1971and 1976 and then again between 1983 and 1987, the coordinator of the USGS Volcano Hazards Program between 1983 and 1987, and as the Western Regional Geologist, Senior Executive Service, USGS betwen 1997 and 2001. He has received meritorious and distinguished service awards of the Department of the Interior, and the Joseph W. Aidlin Award of the Geothermal Resources Council. He is currently a trustee of the Raymond M. Alf Museum of Paleontology, in Claremont, California.