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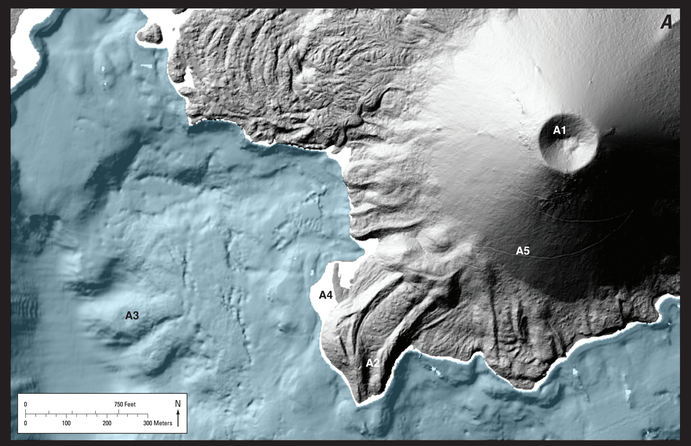
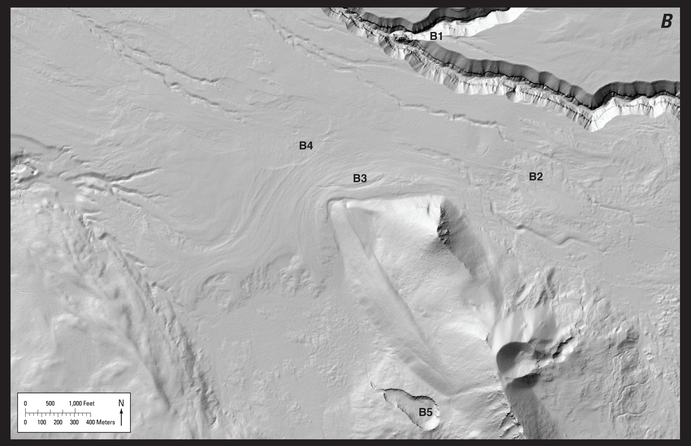
Scientific Investigations Map 3223

INTRODUCTION

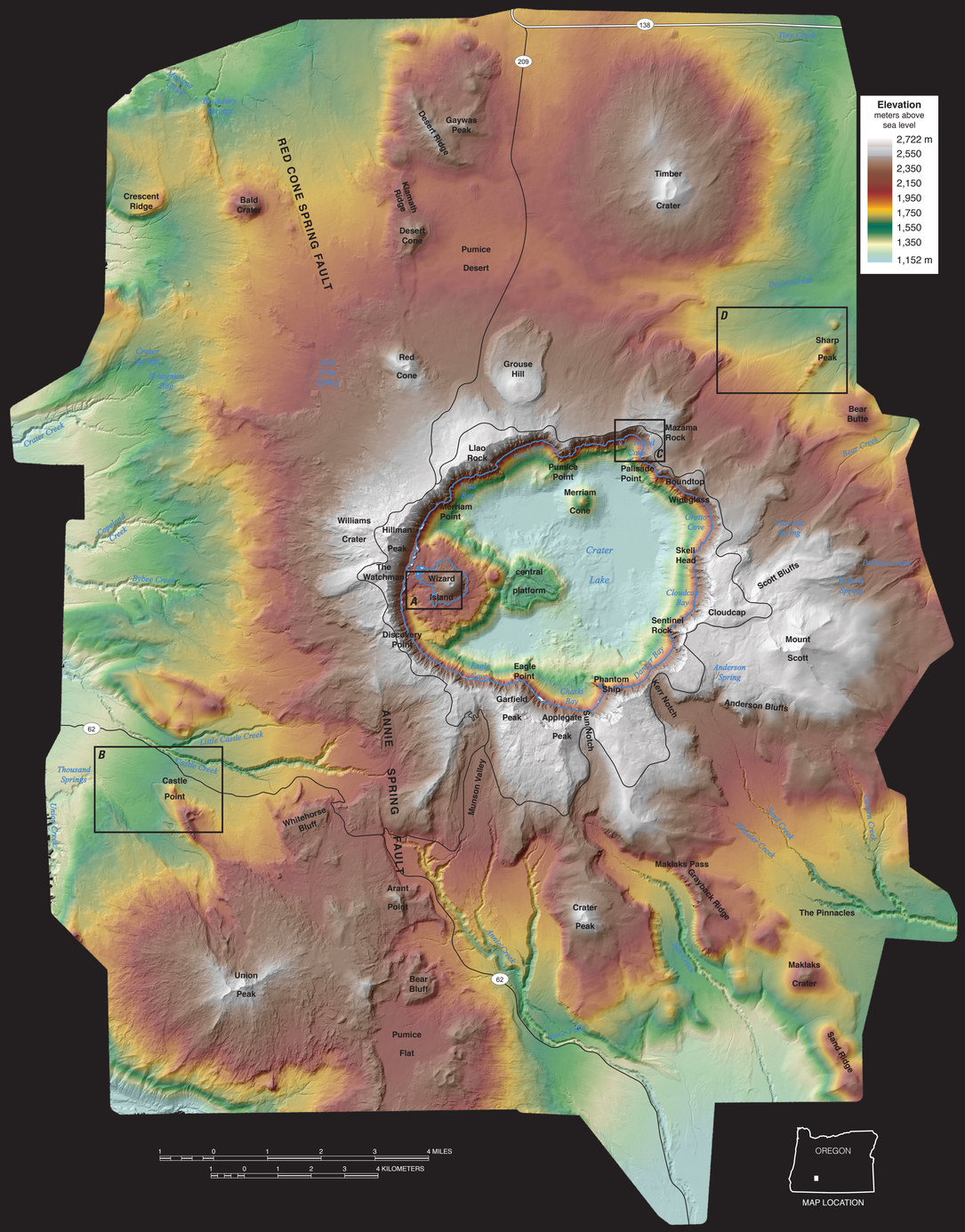
Crater Lake partially fills the caldera that formed approximately 7,700 years ago during the eruption of a 12,000-ft-high volcano known as Mount Mazama. The caldera-forming, or climactic, eruption of Mount Mazama devastated the surrounding landscape, left a thick deposit of pumice and ash in adjacent valleys, and spread a blanket of volcanic ash as far away as southern Canada. Prior to the climactic event, Mount Mazama had a 400,000-year history of volcanic activity similar to other large Cascade volcanoes such as Mounts Shasta, Hood, and Rainier. Since the caldera formed, many smaller, less violent eruptions occurred at volcanic vents below Crater Lake's surface, including Wizard Island. A survey of Crater Lake National Park with airborne LiDAR (Light Detection And Ranging) resulted in a digital elevation map of the ground surface beneath the forest canopy. The average resolution is 1.6 laser returns per square meter yielding vertical and horizontal accuracies of ±5 cm. The map of the floor beneath the surface of the 1,947-ft-deep (593-m-deep) Crater Lake was developed from a multibeam sonar bathymetric survey and was added to the map to provide a continuous view of the landscape from the highest peak on Mount Scott to the deepest part of Crater Lake. Four enlarged shaded-relief views provide a sampling of features that illustrate the resolution of the LiDAR survey and illustrate its utility in revealing volcanic landforms and subtle features of the climactic eruption deposits. LiDAR's high precision and ability to "see" through the forest canopy reveal features that may not be easily recognized—even when walked over—because their full extent is hidden by vegetation, such as the 1-m-tall arcuate scarp (B4) near Castle Creek.

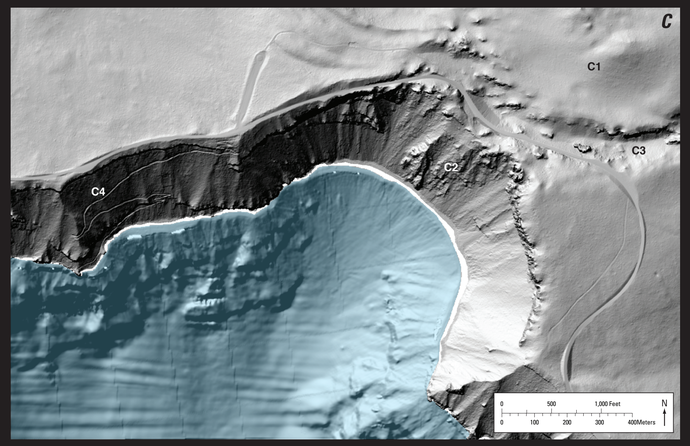


A. Wizard Island (A1) rises from the floor of the lake to 760 ft (233 m) above Crater Lake's surface. The island is made of andesitic lava and scoria (dark, frothy ejected lava) erupted approximately 7,000 years ago as the lake was filling to almost its present level. Lava flows with marginal levees (A2) surround the cinder cone and can be followed from the high-resolution LiDAR data into the lower-resolution bathymetry beneath the lake's surface. Farther offshore are drowned lava deltas (A3) that formed as lava flowed into the lake when the lake level was lower. A series of these older, drowned shorelines help us understand the lake filling history. The white band (A4) surrounding Wizard Island lacks precise elevation data in shallow water where bathymetric data were not collected. The Wizard Island boat dock can be seen on the island's southern shore to the east of a large leveed lava flow. The Wizard Island foot trail (A5) winds its way through the forest going up the south side of the cinder cone.

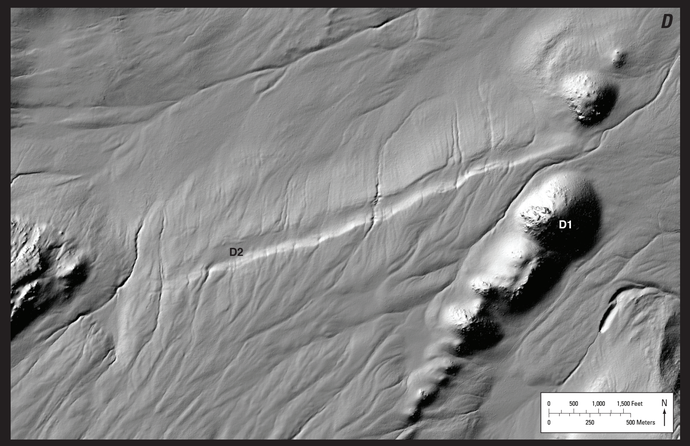


B. Two creeks, Little Castle and Castle, flow through gorges cut into Mount Mazama's climactic pyroclastic-flow deposit. The deposit formed from a mixture of hot gas, pumice, and ash that moved rapidly down the slopes of Mount Mazama and into adjacent valleys. At the confluence of the creeks (B1), the climactic pyroclastic-flow deposit is about 330 ft (100 m) thick. Through the forest cover, LiDAR reveals features on the surface of this deposit. Many thinner flow deposits have finger-shaped flow lobes (B2). One prominent pyroclastic-flow deposit extends past Castle Point and banks in against it and a low ridge of glacial deposits. At the toe of this flow are a series of finger-shaped flow lobes. An extensional rift (B3) at the nose of Castle Point scars the surface of this deposit. After deposition, the deposit began to compact because of cooling and settling. The rift opened as the deposit tilted away from the point toward the deposit's thickest part at the valley center, where compaction was the greatest. A 1-m-tall arcuate scarp (B4) faces west, where the margin of a pyroclastic flow deposit became unstable, collapsed, and fed a thin secondary pyroclastic flow to the northwest. South of Castle Point are crater vents for young basaltic flows, one round and one pear shaped (B5). The basalt erupted after the glaciers retreated, but before the Mazama climactic eruption, between about 13,000 and 7,700 years ago.





C. On the northeast edge of Crater Lake, the scallop-shaped Cleetwood Cove formed during the climactic eruption of Mount Mazama as the mountain foundered into the opening caldera. Northeast of the cove is the Cleetwood rhyodacite lava flow (C1), which erupted as little as a few months before the climactic eruption. When the caldera collapsed, the lava flow still had a molten interior that oozed into the caldera, forming a rugged tongue between the high cliffs on either side of Cleetwood Cove. The drainage of lava from the main flow down the caldera wall (C2) and to the northeast—beyond this view—caused the cooler, more ridged lava-flow surface to sag and crack apart (C3). This opened up large rifts that can be seen adjacent to the Cleetwood Trail parking lot and Rim Drive. The trail to the tour boat landing (C4) is visible zigzagging its way down the caldera wall. The white band separating bathymetry survey from LiDAR survey lacks precise elevation data in shallow water where bathymetric data were not collected. Parallel east-west apparent grooves on lake floor and north-south stitching are artifacts of bathymetric data processing.



D. Sharp Peak (D1) is the largest of 12 rhyodacite lava domes that erupted about 18,000 years ago to the northeast of the caldera. The linear trend of the domes suggests they erupted along a radial fracture created by Mount Mazama. Just to the north of Sharp Peak is a long northeast-trending rift (D2) found in the climactic pyroclastic-flow deposit. The rift opened as the deposit compacted and tilted to the north toward the valley center, where the deposit is thickest. The tilting of the deposit's surface pulled it away from the high-land south-southwest of Sharp Peak. In the southwest quarter of the image, running water rapidly carved parallel northeast-trending gullies into the loose surface of the climactic pyroclastic-flow deposit. The LiDAR reveals many features like this within Crater Lake National Park.

DATA SOURCES

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ADDITIONAL READING

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Under Trees and Water at Crater Lake National Park, Oregon

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