

Geology Papers

Introduction to the Geology of the Mount Shasta Region

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Subduction of Earth's Crustal Plates

As you drive along I-5 through Siskiyou County, mountains flank you on both sides. To the west stand the Klamath Mountains, which are of blocks of ocean floor crust and sediment that have been folded and faulted into their present positions. To the east stand Mt. Shasta and several lesser peaks of the Cascade range that have been built by flows of lava and ash. As different as these two ranges are, both are the results of the same geologic process: subduction. The North American continent is part of a large plate of the Earth's crust that is moving slowly southwestward over the deeper mantle. Along the Pacific Northwest coast, from Cape Mendocino to southern British Columbia, North America is overriding several smaller plates of oceanic crust. As these plates slide down into the mantle -- or are subducted -- sediment and pieces of oceanic crust are scraped off and added to the leading edge of the continent, forming the Klamaths. The downgoing plates also carry seawater into the mantle. As the plates are heated, this water is released and causes the surrounding rocks to partially melt. The molten rock, called magma, then rises buoyantly towards the surface. Some magmas erupt to form volcanoes, but most cool slowly and solidify at depth to form bodies of crystalline rock called plutons. Such bodies may later be exposed by erosion, as the Castle Crags pluton has been.

Growth of Mount Shasta

Subduction has continued along the Northwest coast for many millions of years, but the young Cascade peaks we see today record only a short span of this activity. The Mt. Shasta volcanic center, for example, has been active for about 600,000 years. A large mountain, called ancestral Mt. Shasta, once stood on the site of today's peak. About 350,000 years ago the north flank of this volcano collapsed, forming a great landslide that swept out across the Shasta Valley. The small hills that lie just east of I-5 between Weed and Yreka are blocks of the old mountain that were carried in the slide. No one knows what caused ancestral Mt. Shasta to collapse, but we do know that as volcanoes age they become more susceptible to slope failure. Magmas rising into a volcanic cone release gases and drive the circulation of hot, sulfurous ground waters that alter fresh lavas and ash to clay. This clay is much weaker than the original rocks and as it forms a volcano will become "rotten" inside. Once Mt. Shasta's predecessor had been altered, the shaking of an earthquake or the added weight of water from a wet winter might have been enough to trigger the slide. The present Mt. Shasta has been built during the past 250,000 years in a series of four eruptive episodes. The first episode formed the Sargents Ridge cone,

whose glaciated core rises above the Old Ski Bowl. Subsequent eruptions added Misery Hill, Shastina and, finally, the Hotlum dome which forms the present summit. Each episode began with violent eruptions from a central vent that sent flows of hot rock and gas sweeping down the mountain's flanks. Weed and Mt. Shasta City are both built on deposits from such flows that occurred about 9,400 years ago during the episode that built Shastina. As each eruptive episode drew to a close a plug of pasty lava welled up into the vent, sealing it and building a rounded dome. Black Butte is such a dome that formed low on the flank of the mountain rather than at one of its major eruptive centers. The butte's summit peaks expose the top of the dome, but its flanks are now mantled by an apron of steep talus.

Potential for Future Eruptions of Mount Shasta

Mt. Shasta is relatively quiet today, as it has been during much of its history. Each of the eruptive episodes that contributed to the mountain's growth is thought to have lasted only a few hundred to a few thousand years. Between these relatively brief periods of activity, glaciers carved into the peak and mudflows coursed down the creeks that drain its flanks. In fact, at present, mudflows spawned by heavy rains or an unusually warm spring may be one of the greatest threats the mountain poses to nearby communities. As long as subduction continues along the Pacific Northwest coast, so will the threat of eruptions from Mt. Shasta and the other Cascade volcanoes. Studies of the mountain's past activity suggest that residents of Siskiyou County have about a one in three or four chance of witnessing an eruption during their lifetimes. The magmas that feed these eruptions seldom rise to the surface without making their presence known well in advance, however. The occurrence of shallow earthquakes beneath the mountain, changes in its shape, or increases in the temperatures of its thermal springs may all herald the onset of a volcanic eruption. Today, Mt. Shasta is being monitored for seismic activity and deformation by members of the U.S. Geological Survey. Their goal is to predict the timing and location of any future eruption, and thereby minimize injuries or damage it might cause.

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