Castle Crags State Park

What are the Crags?

Process / Feature:
Weathering and petrology of an ophiolite and a zoned pluton, and crags

The Castle Crags are in the Klamath Mountains geomorphic province, which consists of multiple fragments of oceanic crust that have been transported to and added on (accreted) to the western edge of the North American continent by plate-tectonic processes. Rocks immediately surrounding Castle Crags consist mostly of Ordovician-aged (443–490 million year old) oceanic crust referred to as the Trinity ultramafic sheet. Ultramafic implies high concentrations of iron and magnesium.

The edifice of Castle Crags resulted from the intrusion of a granitic magma into the ultramafic rock around 160 million years ago. Millions of years of erosion have exposed the rock and shaped the picturesque spires and domes of the Castle Crags.

Zoned Pluton

Molten masses (magma) of igneous rock deep inside the earth's crust are referred to as plutons. Plutons often form as a product of rocks melting to magma deep in a subduction zone. Just as hot air tends to rise, plutons rise through the crust and cool. Over the course of many years, the magma eventually solidifies under the crust. Some of the magma may escape to the earth's surface in the form of volcanoes and lava. During the formation processes, the magma may segregate into zones of differing compositions as pressures and temperatures change. Once solidified, the differing compositions become different rock types with unusual names to distinguish them. The term "granite" is frequently used as a family name to refer collectively to various, yet specific igneous rock types.

The granitic monolith of Castle Crags is the remnant of a pluton. Castle Crags is composed of different types of granitic rock, representing different parts of the pluton. Trondhjemite and granodiorite form a core and shell, respectively. Slow cooling of the magma resulted in a concentric zoning of the pluton that is preserved and exposed in the Castle Crags rocks. The outer part of the magma cooled relatively rapidly where it was in contact with the surrounding ultramafic rocks, resulting in relatively small crystals of the rock-forming minerals. The rapid cooling around the outside of the newly-intruded pluton formed a insulating blanket of fine-grained granodiorite around the remaining magma. Slower cooling of the magma beneath the "blanket" gave the granitic crystals in the remaining magma more time to grow, producing large crystals of rectangular-shaped pink potassium feldspar prominent in the bulk of the exposed pluton.

As the magma cooled and crystallized even more, volatile gases (mostly water) contained in the magma became increasingly concentrated until the volatile concentration became so great that the remaining liquid magma "boiled". That is, the gases came out of solution and formed small bubbles in the remaining liquid magma. The resulting small bubbles are now exposed in the solidified rock as an extensive zone of well-developed "miarolitic" cavities found along the boundary between granitic rocks containing the larger potassium feldspar crystals and the trondhjemite core of the pluton.

Why it's important: Few of California's state parks display impressive monoliths adorned like a castle with towering spires, and few permit rock climbing. Castle Crags is an exception. The scenic beauty is best enjoyed from a distant vantage point where one can see the range of surrounding landforms. The monolith and its surroundings are a microcosm of the Klamath Mountains where many such monoliths intrude and stitch together a crazy quilt of much older rocks. The surrounding rocks include the Trinity ultramafic sheet, the largest exposed body of ultramafic rock in North America. The ultramafic rock is often interpreted to represent an ancient ophiolite—a slice of the oceanic crust.

What you can see: The towering light-colored granitic spires and domes of Castle Crags can be seen from the park, but are actually outside of the state park boundaries. The light-colored, erosion-resistant peaks stand out in stark contrast to the darker-colored, less-resistant ultramafic rocks (peridotite and serpentine) and sedimentary rocks underlying adjacent hills, and the towering presence of 14,162-foot-high, snow-capped Mount Shasta.

The scenic grandeur viewed from trails within the park is unrivalled, ranging from close-up views of the majestic spires and domes of the Crags, to distant vistas of the Cascade volcanoes of Mount Shasta, Mount McLaughlin, and Mount Lassen.

Exposure

After the igneous rock cooled completely and solidified, the rocks overlying the pluton were eroded by running water, landslides, and by glaciers, removing miles of overlying material and eventually exposing the bare rocks of the Castle Crags pluton. Because ultramafic rocks are less resistant to weathering than the granitic rocks, the more easily weathered ultramafics eroded at a faster rate, leaving the more resistant granitic rocks to protrude above the surrounding lands, forming the Castle Crags, the tops of which tower more than 4,000 feet above the surrounding landscape.

Final Thoughts

The state park's strategic location assure enduring access to a beautiful geological treasure, and provides entry to a federally protected wilderness area, with abundant glacially carved features.

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