Geology in the Vicinity of Pigeon Point Light Station State Historic Park

Introduction

The Pigeon Point Light Station sits on a rocky bluff overlooking the Pacific Ocean that has survived thousands of years of ocean waves and storms due to the resistant geology of the underlying bedrock (Figure 1). The rocks beneath the lighthouse are part of the fascinating Pigeon Point Formation, which outcrops for about 10 miles (16 km) along the San Mateo County coast from just south of Pescadero to just north of Año Nuevo Point. These rocks are well exposed in the sea cliffs and at low tide in the wave cut beaches north and east of Pigeon Point (Figures 2 and 3) where they are overlain by marine terrace deposits.

Figure 1. Lighthouse located on a resistant rocky bluff of the Pigeon Point Formation.

Figure 2. Conglomerate overlying mudstone of the Pigeon Point Formation. Conglomerate is a sedimentary rock made up of rounded pebbles and cobbles with sand filling the spaces in-between. Mudstone is a sedimentary rock made up of clay sized particles.

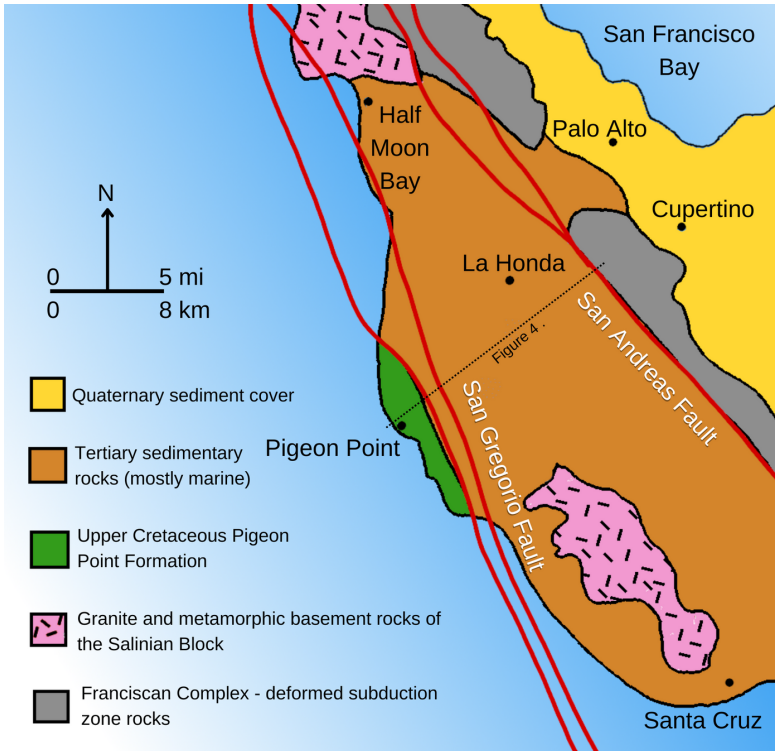

Figure 3. Geologic map of San Francisco Bay Area showing the Pigeon Point Formation and associated faults. Modified from Jaikla (2021).

Pigeon Point Formation

The Pigeon Point Formation consists of mudstone, sandstone and conglomerate that have been folded and extensively faulted. Fossils are rare in the Pigeon Point Formation. However, gastropods, ammonites, and foraminifers have been found and help establish that the rocks are between 100 and 66 million years old (Upper Cretaceous). The rocks at Pigeon Point itself represent two types of deep-water deposits. The Point is made up of conglomerate deposited at the bottom of a deep submarine canyon like those seen off the California coast today. Above the conglomerate is a complex of mudstone, pebbly mudstone, and thin sandstone beds showing extensive internal mixing and folding and representing slumps, slides, debris-flows, and turbidity currents that moved down the steep canyon after conglomerate activity had largely ceased. All of these rocks have been transported several hundred kilometers northward along faults of the San Andreas Fault system in post-Cretaceous time. Although the rocks are on the coast now, geologists have interpreted that the original sediments were deposited many miles offshore in very deep water somewhere far south of their current location. Rocks underlying the Pigeon Point Formation are not exposed in the vicinity. However, rocks immediately west of the San Andreas Fault in central California are part of the Salinian Block which generally consists of granitic and metamorphic rocks. A water well drilled

near the lighthouse in 1996 penetrated approximately 45 feet (14 meters) of granitic rock underlying conglomeratic deposits of the Pigeon Point Formation. This well may provide the best-known evidence for a Salinian basement below the Pigeon Point Formation (Figure 4).

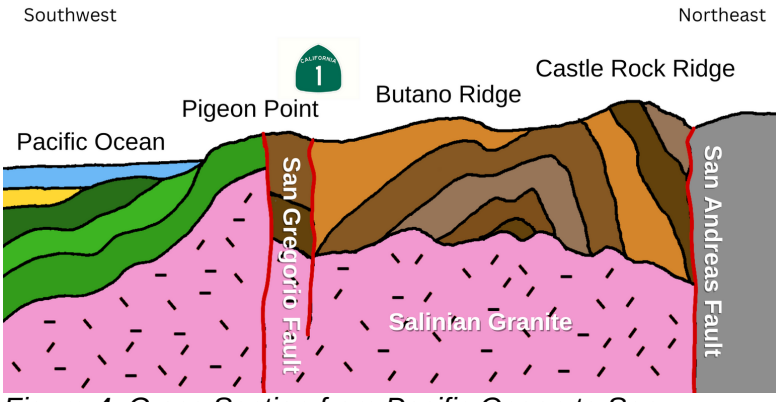

Figure 4. Cross Section from Pacific Ocean to San Andreas Fault. Modified from Alt and Hyndman (2016).

Geologists have identified similar rocks in Monterey County known as the Atascadero Formation that correlate with the Pigeon Point Formation across the San Gregorio-Hosgri Fault (Figure 5). Slip along the San Gregorio-Hosgri Fault, which separates the two formations, is estimated to be 97 miles (156 kilometers) over the last 10 million years for an average slip rate of 0.6 inches (1.6 centimeters) per year based in part on correlation of the Pigeon Point Formation with the Atascadero Formation across the fault. Both formations have similar sandstone compositions and ages.

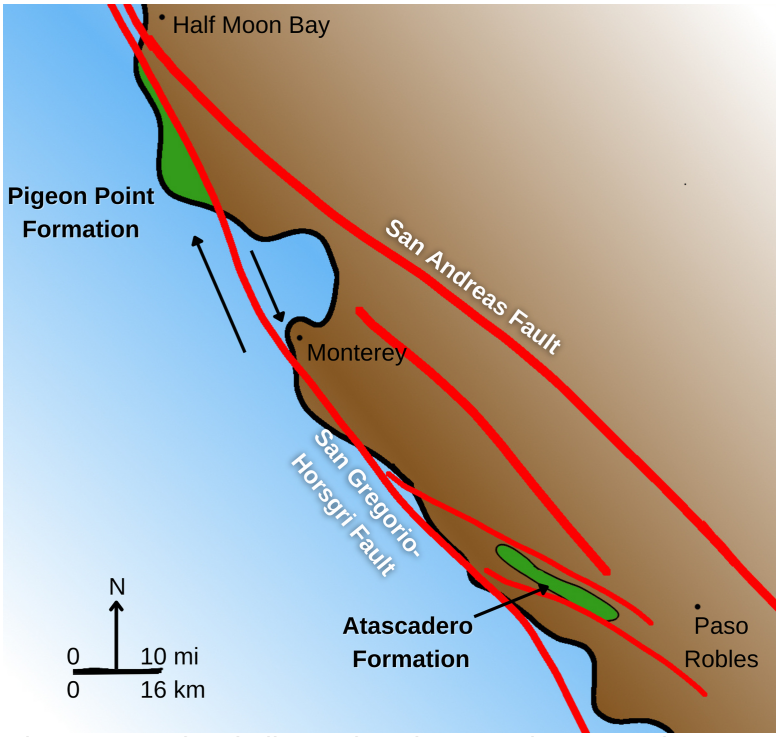

Figure 5. Rocks similar to the Pigeon Point Formation, known as the Atascadero Formation, were offset almost 100 miles by the San Gregorio-Hosgri Fault.

Marine Terrace Deposits

Marine terraces make up a large part of coastal California's landscape and represent uplifted beaches and shallow wave-cut platforms that formed during ancient high stands of sea-level. The terrace deposits typically consist of poorly to moderately consolidated sand and gravel generally less than 100 feet (30 meters) thick (Figure 6). There are as many as six marine terraces adjacent to Pigeon Point, occurring at elevations from 23 to 500 feet (7 to 153 meters) and dating from about 80,000 to perhaps 600,000 years ago (Weber, 2001).

Figure 6. Photo of marine terrace deposits overlying Pigeon Point Formation. Note the angular unconformity between the two units.

Additional Information:

Alt, David and Hyndman, Donald W., 2016, Roadside Geology of Northern and Central California. Mountain Press.

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Lowe, D. R.,1979, Stratigraphy and sedimentology of the Pigeon Point Formation, San Mateo County, California: in Nilsen, T.H., and Brabb, E.E., eds., Geology of the Santa Cruz Mountains, California. Geological Society of America, Cordilleran Section, Field Trip Guidebook.

Sloan, Doris, 2006, Geology of the San Francisco Bay Region, University of California Press.

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