Schooner Gulch State Beach

Rocks from Points Unknown

Schooner Gulch State Beach is located west of the San Andreas Fault—the boundary zone between the North American continental and the Pacific oceanic tectonic plates. About 25 million years ago, these two huge tectonic plates began to slide past each other along the San Andreas Fault. The oceanic crust to the west of the San Andreas Fault (Pacific plate) has now moved north several hundred miles relative to the continental crust (North American plate) on the east side of the San Andreas Fault.

Features/Process:
Deep-sea sedimentation, concretions, and effects of differential weathering

Sedimentary rocks in the area of Schooner Gulch and Bowling Ball Beach consist of Miocene-aged rocks (about 10 million years old) locally known as the Gallaway Formation. The Gallaway Formation is one of several that constitute the Gualala Block—an area of rock that crops out near Point Arena along the coast west of the San Andreas Fault. The rocks within the block are believed to have traveled several hundred miles northwest along the San Andreas Fault. Unfortunately, geologists have not been able to find rocks south and east of the fault that match those of the

What you can see: During low tide, you can see spherical concretions, "bowling balls", aligned along bowling alley-like lanes. Close examination of the sedimentary strata that form the "lanes" shows the structures and textures formed by seldom-seen deep oceanic processes. The strata formed through successive episodes of a submarine phenomenon known as density currents in which thick plumes of high density slurries of sediment rapidly flushed across the seafloor and down submarine canyons.

Gualala Block to constrain the actual amount or style of displacement. The Gallaway Formation and the Gualala block are pieces of the geologic jigsaw puzzle that are yet to be resolved.

Gallaway Formation

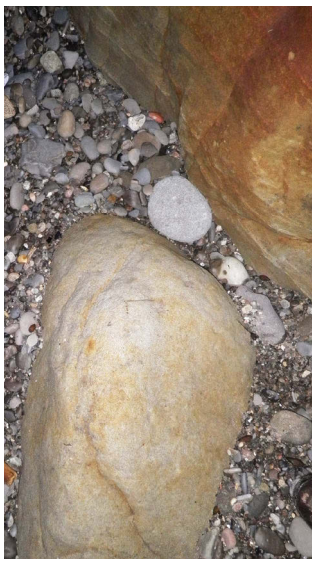
The rocks of the Gallaway Formation consist of alternating layers of sandstone, shale, and mudstone. The rocks represent the sediment load deposited on a deep ocean basin. The sediments were flushed off the continent by rivers and washed across the continental shelf as dense slurries in density currents. As the "clouds" of particles settled, they formed layers according to mass—denser ones settled faster and less dense ones landed atop the layers of denser, heavier sediments. After deposition, the weight of the sediments and the precipitation of minerals between the rock particles cemented the grains together and transformed the loose sediment into solid sedimentary rock. The layering is preserved in the rocks that are now somehow at sea level several hundred miles from their place of origin.

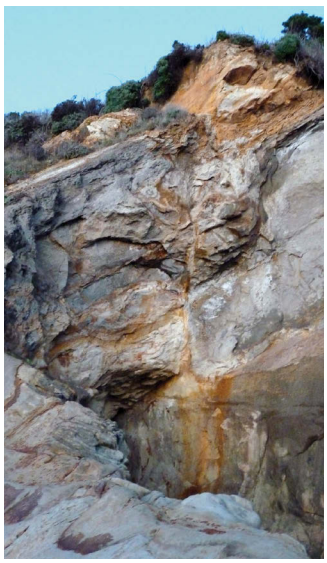
Turbidites

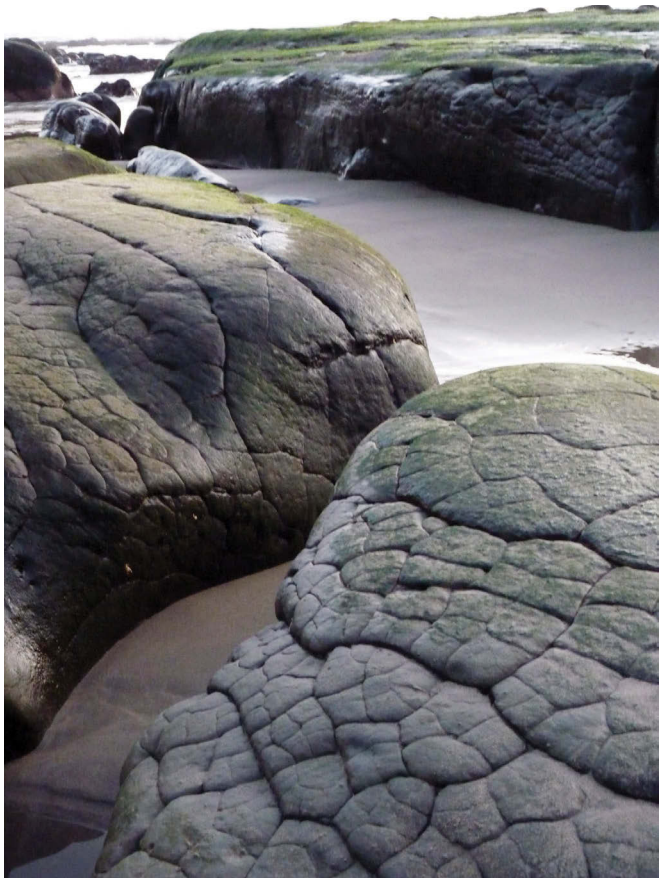
These deposits are called turbidites in reference to the turbulent currents that carried the sediments. Turbidites typically exhibit a sequence of graded beds where coarse sediments (pebbles) are at the base of each sequence of deposition grading upward into sandstone, and then fine-grained shales and mudstones at the top of the deposit. As each new turbidity current flows down the canyon, coarse material is deposited on top of the fine-grained sediment at the top of the previous turbidity flow making very well-defined sequences of sandstones, shales, and mudstones. These represent recurring episodes, with deposits from instantaneous (undersea landslide) events followed by periods of quiescence.

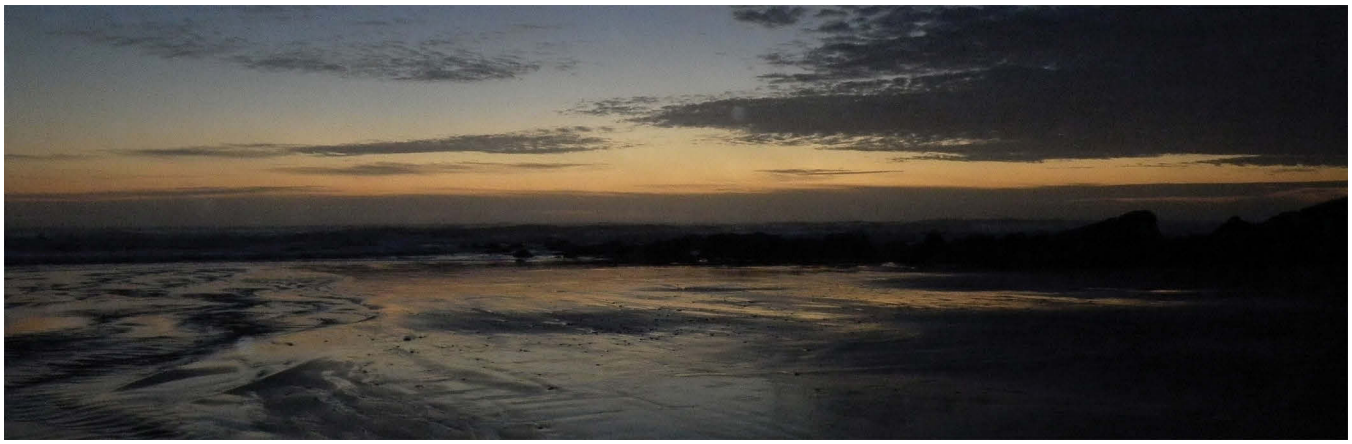
Bedding structures that consist of laminations, ripples and convolutions are preserved in the bedding after the sediments came to rest. At Bowling Ball Beach, turbidite structures exposed in the sea cliff face include convoluted laminations, ripples, parallel laminations, slumps and other structures that can be seen in the individual bedding layers.

Why it's important: Geologic oddities can arise from unusual combinations of unrelated geologic conditions. One such example is Bowling Ball Beach where concretions (odd enough in their own right), tilted outcrops of alternating hard and soft strata (not unusual), and wave erosion along the coastline (very common) combine to create a very unusual spectacle.









Concretions

A concretion is a compact mass of mineral material, usually spherical or disk-shaped embedded in a host rock. Concretions often develop in sediments around the nucleus of organic material whose decay locally changes the pH. This leads to precipitation of a cement around a nucleus (often a piece of shell or fossil). Calcite or silica crystallizes around the nucleus, forming a much harder and more weather-resistant mass than the surrounding host rock. The spherical masses eventually weather out of their parent rock as hard, rounded boulders.

Bowling Ball Beach

Bowling Ball Beach is located just north of Schooner Gulch. Here the tilted sandstone beds contain concretions that vary from about two feet to five feet in diameter. Some of the concretions have not completely weathered out of the sandstone beds and can be seen high up in the sandstone beds exposed in the sea cliff. Others have weathered out of their sandstone host and are “arranged” on the beach below the cliff. The numerous, nearly vertical beds have been eroded by wave action to form grooves where ridges of more-resistant beds protrude above the softer, less-resistant eroded rock layers. Some of the concretions have been moved, smoothed and polished by wave action and aligned in the grooves, now appearing as bowling balls lined up in a bowling alley.

Final Thoughts

Like theater curtains that open and close with every act, the tides alternately hide and reveal the geologic stage on the beach.

Written by Dave Longstreth, California Geological Survey
Photos: Jennifer Lotery

Prepared by California Geological Survey, Department of Conservation | www.conservation.ca.gov/cgs
for California State Parks | www.parks.ca.gov

Geological Gems of California State Parks, Special Report 230 – Fuller, M., Brown, S., Wills, C. and Short, W., editors, 2015 Geological Gems of California, California Geological Survey under Interagency Agreement C01718011 with California State Parks.