

DIKES TRAIL

San Isabel Nation Forest of Southern Colorado

THE DIKES TRAIL: CUCHARA BY THE SEA

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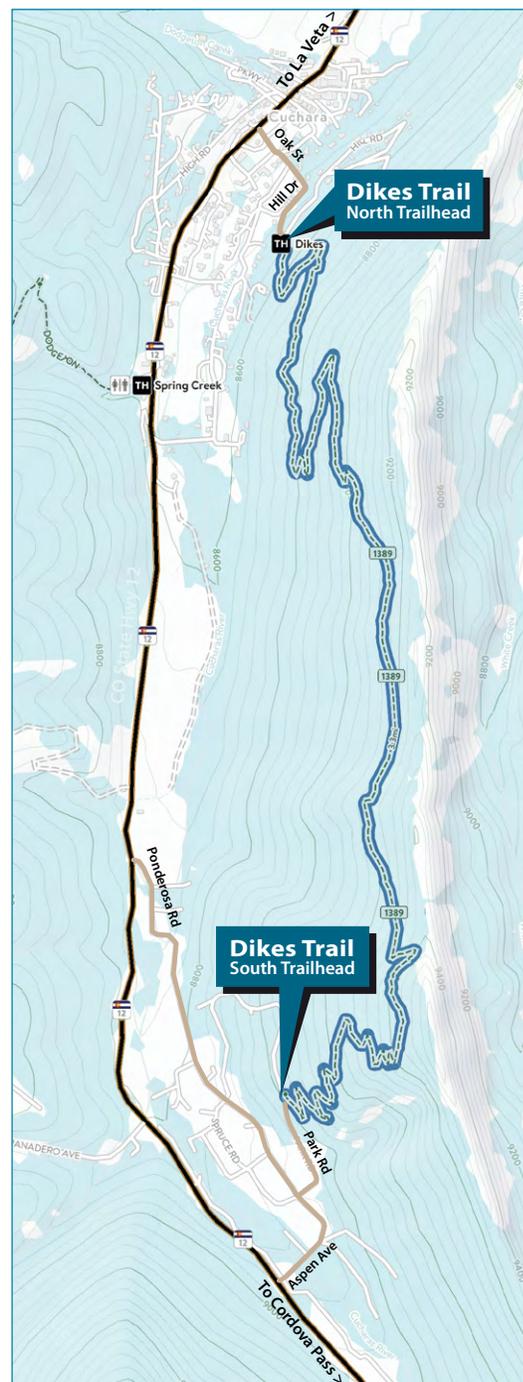
TRAIL LENGTH: Four miles roundtrip from the North Trailhead to the White Peaks vista point and back to the North Trailhead or 3.3 miles one way from the North Trailhead to the South Trailhead.

ELEVATION: 8550–9400 feet

VERTICAL RISE: 850 feet

NORTH TRAILHEAD LOCATION: From La Veta take state CO Highway 12 to Cuchara, turn left at the Cuchara Chapel (Oak St), and follow that road 0.75 miles to the trailhead.

SOUTH TRAILHEAD LOCATION: From La Veta take state CO Highway 12 past Cuchara. Turn left on Aspen Avenue. Follow that for 0.1 miles and turn left on Ponderosa Road. Continue on Ponderosa Road for 0.1 miles. Then turn right on Park Road and continue 0.2 miles to the trailhead.



ABOUT THE SAN CARLOS RANGER DISTRICT

<https://www.fs.usda.gov/r02/psicc/recreation/san-carlos-ranger-district-0>

The San Carlos Ranger District manages the southern half of the San Isabel National Forest. The district is 50 miles wide and 110 miles long with about 400,000 acres of National Forest in Fremont, Custer, Huerfano, Pueblo and Las Animas counties. Mountain ranges include the Wet Mountains, the Sangre de Cristos and the Spanish Peaks. There are three Wilderness Areas on the San Carlos Ranger District: Sangre de Cristo, Greenhorn, and Spanish Peaks.

It is home to the one of the first Forest Service campgrounds designed by Arthur Carhart, the first landscape architect of the Forest Service. Prior to Carhart being hired in 1919, the agency focused primarily on timber uses of the forest. Carhart envisioned what we now know as sustainable recreation. His recreation plan for the San Isabel National Forest was the first for the agency. He went on to work with conservationist Aldo Leopold in creating the wilderness concept. The picnic shelters and fire hearths at Davenport Campground were reconstructed in 2006 using Carhart's original designs.

There are 11 campgrounds with 210 fee campsites plus two group sites that are reservation only. These campgrounds are operated by a concessionaire (contractor hired by the U.S. Forest Service), as well as a picnic area at Lake Isabel Recreational Area and four small sites in the Cuchara Creek Recreational Area.

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BEGIN YOUR JOURNEY

The Dikes Trail zigzags its way up the flank of a rock fin above the town of Cuchara and traverses its crest, affording hikers impressive views of the town below and of the Sangre de Cristo Mountain range to the west. The Spanish Peaks region is world famous for its hundreds of spectacular dikes – fins of igneous rock that are the solidified remains of once molten magma that forcibly injected itself into weaknesses in the surrounding rock during an episode of tectonic upheaval 24 million years ago. Considering the area’s abundance of dikes, the resemblance of this trail’s rock fin to those dikes, and the trail’s name, you might reasonably expect that you are hiking on one of these dikes. But the trail wasn’t named by a geologist, and it doesn’t ascend a dike! Instead, it traverses a fin of erosion-resistant, 100-million-year-old sandstone that was tilted up on end 65–70 million years ago during the birth of the Rocky Mountains. The sand that comprises the rock was deposited on a beach at the edge of a vast inland sea that covered the interior of North America at that time. Dinosaurs ambled along this subtropical coastline. Although you won’t find a dike on the Dikes trail (visit the West Peak trail guide for the story of the dikes), you will see rocks that convey exciting stories about even older chapters of Colorado’s geologic story, when dinosaurs roamed these parts and the Rocky Mountains rose.

ASCENDING THE DAKOTA HOGBACK

Most people start the Dikes trail at the north trailhead, which is directly above Cuchara. You can shuttle a vehicle to the south trailhead to do a one-way walk of the whole trail, or you can make it an out-and-back hike to the top of the ridge and return to the north trailhead.

Starting from the north trailhead, you traverse through a series of switchbacks as you gradually ascend the forest-covered west flank of the Dakota Hogback (Figure 1). A hogback resembles a dike, but instead of being an igneous rock that intruded as liquid magma, it consists of sedimentary rock layers that were originally deposited as horizontal sheets of sediment and were subsequently tilted steeply by tectonic activity. Colorado’s Dakota Hogback was tilted up 65–70 million years ago, during formation of the Rockies.



Figure 1: The Dakota Hogback forms a prominent ridge that marks the eastern toe of the Rocky Mountains throughout Colorado, from Wyoming to New Mexico. This aerial photo is of the section just west of Denver. Photo by Sabrina Kainz.

Because of the up-to-the-west rock tilt, progressively younger rocks are exposed as you travel from west to east. Figure 2 lists the order of rock layers here, with the oldest at the bottom and youngest at the top. There are no exposed rock outcrops on this first part of the trail because it crosses the Morrison Formation, which consists mainly of mudstone, a rock type that is easily eroded. It is older than the Dakota Formation, the rock unit whose prodigious resistance to erosion produced the hogback.

The higher you climb, the better the view of the Sangre de Cristo mountains to the west becomes (Figure 3). Those mountains are built of the even older Sangre de Cristo Formation and Dockum Group sedimentary rocks (Figure 2), which are bright red in color. That color isn’t obvious across most of the vista because of the vegetation cover, but it is readily apparent in a road cut along Highway 12 that is

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ERA	PERIOD	STRATIGRAPHIC UNIT	THICKNESS (FT)	SAMPLE	
CENOZOIC	Eocene	Farisita Formation	0–1200	RB401	
		Huerfano Formation	0–2000	RB402	
		Cuchara Formation	0–5000	RB103	
	Paleocene	Poison Canyon Formation	0–2500	RB201 RB113 RB108	
		Raton Formation	0–2000	RB109, 206 207 RB208, 112	
MESOZOIC	Maastrichtian	Vermejo Formation	0–380	RB107	
		Trinidad Sandstone	0–260	RB111	
		Pierre Shale	1300–2300		
	Cretaceous	Campanian	Niobrara Formation	500–900	
		Turonian	Benton Group	350–750	
		Cenomanian	Dakota Formation	100–200	RB104, 303
		Albian	Purgatoire Formation	150–400	
		Jurassic	Morrison Formation	40–100	RB302
	Triassic	Dockum Group	Entrada Formation	0–1200	
			Sangre de Cristo Formation		RB105, 301
		Permian	Magdalena Group		
PZ	Pennsylvanian				
PROTEROZOIC	Precambrian	undivided gneiss and granite			

Figure 2: This stratigraphic column shows the names, geologic periods of deposition, and thicknesses of the rock formations present in the Raton Basin, which stretches from Walsenburg to Raton, NM. Reproduced from a published paper by Bush et al (2016).

visible in front of the Cuchara ski area from this vantage point (Figure 3). These rocks tell their own fascinating story of landscape change: they consist of debris that was eroded from an earlier mountain range that once stood to the east, on what is now the pancake-flat Great Plains.

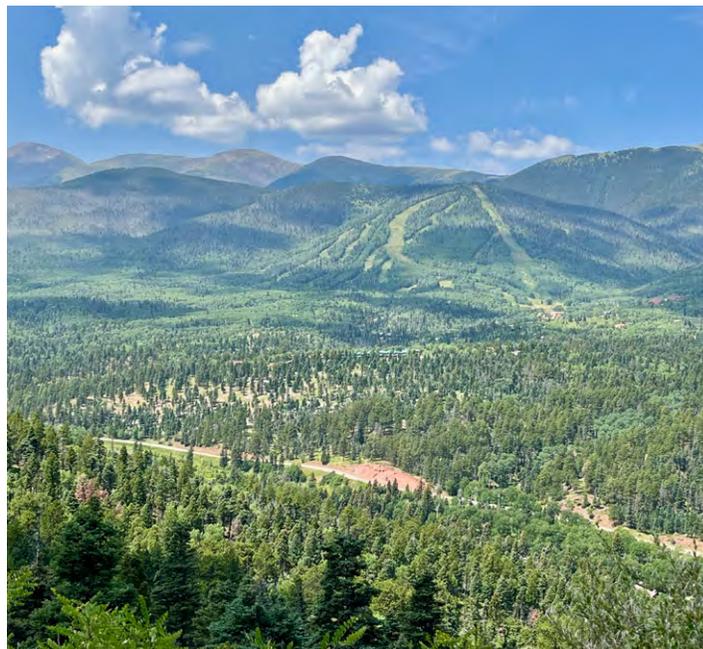


Figure 3: View of the Sangre de Cristo Range from the Dikes Trail. The ski runs at Cuchara Mountain Resort are prominent in the middle ground. The red rock visible in the road cut in front of the resort consists of debris that was eroded from the Ancestral Rocky Mountains, which stood to the east about 300 million years ago. Photo by Lon Abbott.

But 300 million years ago, that area was uplifted by faults to form the Ancestral Rocky Mountains; the area where the modern mountains stand was at that time a basin that received the debris shed from the range that rose to the east.

WALKING WHERE DINOSAURS ONCE TREAD

It's a pity that the Morrison Formation across which you are walking is covered with soil and vegetation. If you choose to walk the entire Dikes Trail, there are exposures of its distinctive multi-colored mudstone just before you begin descending the switchbacks south of the ridge crest. The Morrison was deposited in the Jurassic Period – of Jurassic Park fame. The film franchise took many liberties in its depiction of the Jurassic world, including pitting Jurassic dinosaurs against others, like the fearsome predator Tyrannosaurus Rex, that lived in the subsequent Cretaceous

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Period, so they would never have done battle with each other in real life. But dinosaurs did in fact flourish in the Jurassic, and Colorado's Morrison Formation contains one of the world's best assemblages of dinosaur bones.

The formation was named for Morrison, Colorado, a suburb of Denver, where bones of some of the most famous Jurassic dinosaurs of all, such as Stegosaurus, Apatosaurus, and Allosaurus, were first discovered. The formation here in Cuchara has not yielded an abundance of such bones, but they may be lurking under our feet, waiting to be exposed by future erosion. Jurassic Colorado was a vast, subtropical plain traversed by lazily meandering rivers. Dinosaurs would come to the rivers to drink and they occasionally died there, not infrequently when ambushed by predators. Floods would wash the bones down-river, where they accumulated on sandbars in jumbled piles that were subsequently covered by sediments that preserved them for later paleontologists to discover. Colorado has many great places to see such bone assemblages, both in place and fully assembled museum skeletons. The closest to Cuchara is the Royal Gorge Dinosaur Experience near Cañon City. Many of the skeletons on exhibit there were discovered in the Garden Park Fossil Area just north of Cañon City. You can visit some of the quarries where the bones were excavated in the Bureau of Land Management's Garden Park Fossil Area (<https://www.blm.gov/visit/garden-park-fossil-area>). Other excellent Colorado fossil locations are Dinosaur National Monument (<https://www.nps.gov/dino/index.htm>) in northwestern Colorado and Dinosaur Ridge Natural Landmark (<https://dinoridge.org/>) just west of Denver.

STANDING ON AN ANCIENT SHORELINE

Although there are no outcrops of Morrison Formation as you zigzag up the hogback's west slope in the first mile of trail, you periodically pass huge sandstone boulders that have tumbled down from the Dakota Formation above. If you examine them, you'll see that they consist of many layers, most composed of uniformly sized sand grains, but a few containing larger pebbles. The last big switchback bends to the right about 400 vertical feet below the ridge crest, after which the trail heads south-southeast for the next mile, executing a rising traverse that brings it ever closer to the ridge crest. The trail takes one more left-bending switchback to head east, towards the ridge crest,



Figure 4: Outcrop of Dakota Sandstone on the crest of the Dakota Hogback along the Dikes Trail. Foot for scale. Notice the cross beds, which are packages of layers that are all parallel to one another but at an angle to adjacent packages of layers. Cross beds form when sand cascades down the face of a dune. Note also that the rock consists of grains of fine sand, with every sediment grain approximately equal in size. Such uniform size sorting of sediment is a characteristic of beach environments and sand dunes. Photo by Sabrina Kainz.

for a few hundred yards and then bends back right to resume its southward trajectory. Take the short (100 yards) spur trail to a saddle on the ridge crest where the main trail bends back to the right. This is the trail's geologic highlight, where you can examine good outcrops of Dakota Formation sandstone (Figure 4) and are treated to a great view of the White Peaks to the east, across the valley of White Creek (Figure 5).

The Dakota here consists of layer after layer of uniform sand grains, just like those you saw on the tumbled boulders during the ascent. Several packages of parallel layers are visible here, with the layers of one package inclined at an angle to the layers in adjacent packages (Figure 4). This is a characteristic called "crossbedding"; it is produced when sand piles up in a mound, called a "dune" (desert sand dunes are great examples, but dunes form in other environments as well). As wind or water currents pile sand up at the top of the dune it periodically cascades down the lee side, depositing an inclined layer. The next sand cascade forms a layer atop the first, and so on to form the packages of parallel layers. In this manner, the dune migrates, and when the next dune passes by it deposits a similar set of layers on top, which form the overlying package.

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Figure 5: The view towards the northeast from the crest of the Dikes Trail. North White Peak (left) and Middle White Peak (right) are visible above the valley of White Creek. The White Peaks are granite intrusions, like the Spanish Peaks, that have been exposed on Earth's surface by erosion of the softer, more easily eroded sedimentary rocks that used to surround them. Layers of Dakota Sandstone that comprise the Dakota Hogback are visible in the lower left part of the photo. Notice that the originally horizontal layers are now tilted steeply down to the east. That tilting occurred during the tectonic episode that uplifted today's Sangre de Cristo range. Photo by Sabrina Kainz.

The dunes that formed these cross beds were small fields of sand dunes on the landward side of a beach, similar to the back-beach dunes one sees in innumerable beach environments today. One good example is the Oregon Dunes National Recreation Area (<https://www.fs.usda.gov/r06/siuslaw/about-area/oregon-dunes-national-recreation-area>). The uniform size of the sand grains you see here is also a typical feature of modern beaches – they are typically composed of billions of similarly-sized sand grains because the steady, rhythmic wave energy efficiently sorts sediment sizes, leaving only sand on the beach. Geologists use clues like the cross beds and the good size-sorting of the sand displayed by modern beaches to recognize that the Dakota represents an ancient beach; similar processes produced similar sediment characteristics throughout Earth history. The pebble layers you saw on the

Dakota boulders down the slope were deposited by rivers that emptied to the sea in this coastal environment.

It may seem amazing that Colorado, the highest-elevation state in the Union, was once beachfront property, but geologic processes have the luxury of vast expanses of time to completely transform each landscape over and over again. Sea level is never steady, it is always rising or falling. It was on the rise 100 million years ago when the Dakota beach sands covered Cuchara; a vast inland sea covered the mid-continent of North America, from Texas to Canada's Northwest Territories. That sea, which geologists call the Western Interior Seaway, split the continent into gigantic eastern and western islands. Cuchara occupied a beach on the east coast of the western island.

Herds of dinosaurs wandered past Cuchara on their seasonal migrations along the coastline from Boulder, in the north, to New Mexico's Clayton Lake State Park in the south and back again on what paleontologists have nicknamed the "Dinosaur Freeway". We haven't seen any dinosaur footprints embedded in the Dakota Hogback here in Spanish Peaks country, but elsewhere in the region some very impressive tracks are preserved. Once again, Cañon City is the closest place to see these marvelous relics of the past. Skyline Drive (<https://www.canoncity.org/370/Skyline-Drive>) provides a short, spectacular auto tour of the Dakota Hogback there, including footprints of ankylosaur dinosaurs. If you are heading north, Dinosaur Ridge near Denver has what is probably the single best exposure of dinosaur trackways on the Dinosaur Freeway (Figure 6), and if you are southbound, check out the tracks at New Mexico's Clayton Lake State Park (<https://www.emnrd.nm.gov/spd/find-a-park/clayton-lake-state-park-and-dinosaur-trackways/>).

PERCHED AT THE EDGE OF THE ROCKIES

The Western Interior Seaway continued to rise for the next 10–15 million years, causing the coastline to shift westward from Cuchara into Utah and Arizona. The Spanish Peaks area was inundated by the shallow sea, and mud accumulated layer by layer until it reached a staggering 3000 feet thick. The Benton Group, Niobrara Formation, and Pierre Shale (Figure 2) contain shell fossils that are the legacy of that Seaway.

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Figure 6: Footprints made by hadrosaur dinosaurs 100 million years ago on the Dakota Hogback at Dinosaur Ridge National Natural Landmark just west of Denver. Hadrosaur herds migrated along the coastline that ran southeast from Boulder to Clayton Lake State Park in New Mexico. Paleontologists have nicknamed this the “Dinosaur Freeway”, of which the Dikes Trail hogback is a part. Photo by Lon Abbott.

The Seaway then began to recede, depositing the Trinidad Sandstone on beaches and then the Vermejo Formation (Figure 2) on lowland plains and in coal swamps as it drained back eastward across Colorado. Sea level was dropping globally, but the demise of the Western Interior Seaway was hastened by the rise of the Rocky Mountains, which began about 70 million years ago.

Multiple faults formed west of Cuchara, where they stacked big sheets of Sangre de Cristo Formation rocks one atop the next to build the Sangre de Cristo Mountain range (Figure 3). The Dakota Sandstone was tilted steeply up to the west above the easternmost of those major faults, but the rock layers to the east remained undisturbed. That makes the Dakota Hogback the eastern boundary of the Rocky Mountains, geologically speaking.

To this assertion you might say: “Wait a minute, the Spanish Peaks stand east of here and they are part of the Rockies!” That’s true, but while to a geographer those mountains mark the eastern edge of the Rockies, to a geologist, they belong to the Great Plains. The reason is the undisturbed nature of the stack of sedimentary rocks east of here, which the Spanish Peaks magma bodies later intruded into. When the Sangre de Cristo range rose, erosion immediately began attacking it. The debris eroded from the range

was deposited in the Raton Basin, which extends from Walsenburg south past the New Mexico town of Raton. The sand and gravel that filled the basin formed the Raton, Poison Canyon, Cuchara, Huerfano, and Farisita formations (Figure 2), totaling a whopping 10,000 feet of debris! The layers were deposited horizontally, and they remain horizontal today because no faults developed nearby to tilt them. They occupy the Great Plains, not the Rockies.

The Spanish Peaks didn’t form as volcanoes; the magma that comprises them was intruded into that stack of horizontal Raton Basin sedimentary layers. And those magma chambers weren’t the only ones. Between 26–21 million years ago other magma bodies intruded as well, producing the rock of Silver Mountain, Mount Mestas, the many spectacular dikes that crisscross the landscape, and more. Among these intrusions were three magma bodies that form today’s North, Middle, and South White Peaks. You see them here to your east (Figure 5). You can’t see the Spanish Peaks from the Dikes Trail because these 10,000-foot-high peaks block the view.

All these magma chambers solidified to become strong granite rock. When the magmatic episode was over, the Great Plains here stood 10,000 feet (!) higher than they do today. Beginning about 18 million years ago, for reasons that geologists are still trying to decipher, river erosion began to strip away the layers of sedimentary rocks, starting at the top of the stack and working downward. The granite of the Spanish Peaks, White Peaks, and other area mountains resists erosion much better than the sedimentary layers they intruded into, so when the rivers encountered the strong granite they diverted around it to attack the much more easily eroded sedimentary rocks instead. As they meandered to and fro across the landscape, the rivers stripped sedimentary layer after sedimentary layer from the whole area, but they left the granite intrusions largely intact. The Spanish Peaks and the other granitic mountains, including the White Peaks, emerged as high spots in the landscape, with the Spanish Peaks soaring 7000 feet above the surrounding Great Plains. That slow exhumation process continues today, causing the Spanish Peaks to stand a wee bit higher above the surrounding plains with each passing year. See the West Peak trail guide for more details about the formation of the Spanish Peaks.

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HOMeward BOUND

From the saddle, you can retrace your steps back to the north trailhead or continue southward along the trail to the south trailhead. It's only about 1.3 miles from here to the southern trailhead, so that descent is much steeper than what you came up. If the incline doesn't bother you and you've arranged a shuttle and have transportation waiting for you at the south trailhead, you'll be able to enjoy panoramic vistas of the Sangre de Cristo Mountains on the descent, thanks to the thinner tree cover here. Another

bonus on this route is an outcrop of the multi-colored Morrison Formation shale that's exposed where the trail begins to descend steeply off the hogback's western flank.

Whichever descent you choose, you'll reach the trailhead and reentry into the modern world after a stroll through Colorado's Mesozoic past, when dinosaurs roamed an ever-changing landscape that evolved from vast Jurassic lowlands to beaches and then, after the Western Interior Seaway drained, the actively rising Rocky Mountains, which tilted up the Dakota Hogback (not a dike!) you just ascended.

ABOUT THE GEOHERITAGE OF HUERFANO AND LAS ANIMAS COUNTIES PROJECT

The Geoheritage Project is a partnership between La Veta Trails and the University of Colorado ThermoChronology Research and Instrumentation Laboratory (CU TRaIL), uniting scientific research with community engagement to deepen our sense of place and encourage environmental stewardship through educational trail experiences. This project uses public trails, geologic narratives, culture, and history to connect us more deeply to the land, and one another.

We invite you to hike these trails, learn from the land, and help protect the region's rich geoheritage for generations to come.

Visit www.lavetatrails.org for additional trail guides on the geology of the region.



Funding to support the project has been generously provided by:

