You want to see sedimentary rocks? Southeast Utah is a showcase. Look at this wild country. Canyons...ridges...cliffs. On this field trip we'll explore Capitol Reef National Park, with its strata conveniently tipped on their sides. On the ground Capitol Reef is a great place to study details of sedimentary rocks, their minerals and textures. We'll walk through each layer, learning about sedimentary structures such as ripple marks and cross beds. With a little practice you can recognize different environments of deposition like tidal zones on a sea floor, river deltas, and sand dunes.

In the 1870s Mormon pioneers followed the Fremont River out of Utah's high valleys into a wild desert of red, chocolate, yellow, purple, and white rocks. Beyond Bicknell, their path was blocked by a ridge that stretched like a sailor's reef, a hundred miles north-to-south, with a crest of light colored, rounded domes. No wonder the Mormons called this barrier 'Capitol Reef'. The landscape is a tapestry of Mesozoic strata, sandstones interwoven with siltstones, layer on top of layer, an accumulation of 10,000 feet in all. Despite the name "Capitol Reef", these layers were not deposited in carbonate reefs that you may have already learned about. For the most part, these strata are composed of rock fragments, clastic sediments like silt, sand, and gravel. Each of these formations allows us to watch the parade of changing environments that marched through this part of Utah during the Mesozoic. The rocks hold many clues to the processes that initially transported their sediments, and to the environments in which the sediments were deposited. Sixty-five million years ago, after most of the formations were deposited, a spasm of mountain-building called the Laramide Orogeny gripped this part of North America, tipping Capitol Reef's strata on their sides. Starting from the west, let's follow the path of those pioneers and hike through a cross section of Capitol Reef, examining progressively younger strata along the way.

Mudstones of the Moenkopi Formation were deposited in tidal zones near the beginning of the Triassic Period, 250 million years ago. These particular ripple marks were created by currents that carried sediments in from highlands to the east. Ripples lie perpendicular to the current, with their steeper sides pointing downstream. This piece of Moenkopi was found near Capitol Reef; traces of salt crystals are preserved on its surface. Can you describe an environment where this might occur? Above the Moenkopi lie the multihued shales of the Chinle Formation. The Chinle's kaleidoscope of color is a clue that its sediments came from source areas with varying concentrations of iron-bearing minerals. Cliffs of the Wingate Sandstone tower above the Chinle. During late Triassic time, Utah lay fifteen degrees north of the equator. Its climate, once warm and moist, was becoming dry and hot as the North American plate moved northward away from the tropics. The Wingate was deposited when sheets of sand blew across this part of the world during the early

Jurassic Period. The quartz sand piled up in delicate dunes that reveal the formation's aeolian or wind-born origin.

Desert dunes were laid down first in one direction, beveled off, laid down in another direction, beveled off, then laid down once again when the wind shifted direction one more time. The maroon Kayenta Formation lies above the Wingate. Rocks of the Kayenta Formation were laid down when rivers and a wetter climate temporarily pushed back the Sahara-like desert. Moving east, and up, we reach the Navajo Sandstone, the crown jewel of this desert. Like the Wingate, wind deposited the Navajo in dunes that stood up to sixty feet high. At Capitol Reef, the Navajo, a thousand feet thick, is carved into haunting narrow canyons. Softer, more easily eroded rocks lay atop the Navajo, the Carmel and the Entrada. The Carmel Formation marks the mid-Jurassic return of shallow seas where evaporation caused gypsum to be deposited. In a region crowded with sandstones and siltstones, this gypsum in the Carmel is one of the few rocks that were created by a chemical rather than detrital process. You won't find the granular textures typical of a clastic rock within this gypsum; instead its crystals grew from a chemical solution into the shapes we see here.

Above the Carmel, Entrada Sandstone was laid down in sand dunes and tidal flats. During the Jurassic, North America continued to drift farther north away from the equator, so depositional environments were changing. These thin beds of the Summerville Formation suggest deposition close to a shoreline from sources that were repeatedly fluctuating between mud and sand. By the end of the Jurassic, volcanoes to the west and east of Capitol Reef were popping off like firecrackers. Ash from the volcanoes weathered to form bentonite clay at the top of the Morrison. Highlands to the southwest had been uplifted, so coarse gravels from there were being deposited here as part of the Morrison Formation. You can see that grains of this conglomerate display a wide variety of sizes, unlike the better-sorted grains of the wind-borne Navajo Sandstone.

With the Mancos Shale we reach the Cretaceous Period and the end of our tour of sedimentary rocks around Capitol Reef National Park. The drab color of the Mancos reflects an increase of organic material due to more humid conditions where it was being deposited. The Mancos, 3500 feet thick, was interbedded with sandstones of the Mesa Verde Group. The interbedding of Mancos mud with Mesa Verde sand is evidence that mountain-building had started in earnest as the Laramide Orogeny was getting underway throughout this part of the West. Traveling west to east alongside the memory of those Mormon wagons, we've walked through progressively younger sedimentary rocks. We've seen that each has characteristics that reflect the sedimentary environments that varied

through a span of almost two hundred million years. Together these formations add up to one of the most impressive collections of sedimentary rock on Earth.

Most of the sedimentary rocks we saw on this field trip were: Evaporites, Detrital, or Chemical? At Capitol Reef most of the sedimentary rocks are detrital in origin. You can scramble around these cliffs at Red Rock Canyon when you get tired of gambling in nearby Las Vegas. Odds are you can figure out the environment in which they were deposited. These rocks are part of the Aztec Sandstone, western equivalent of the Navajo Sandstone we saw in Capitol Reef. The cross beds are a dead giveaway that it was deposited in a wind-blown desert.