The Origin of Comb Ridge

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(An excerpt and images from his new book: *Geological Evolution of the Colorado Plateau)*

Comb Ridge is a lofty sinuous spine of red sandstone that stretches over 80 miles across northern Arizona and southeast Utah. This monocline, as these structures are called, begins near Kayenta and snakes northward to fade away near the west flank of the Abajo Mountains. Monoclines are a peculiar component of the Colorado Plateau, with their long ridges of steeply tilted strata in a region otherwise known for its miles of flat-lying sedimentary rocks. They are hard to miss. Although not confined to the Colorado Plateau, their concentration here is unique. Similar structures make up the San Rafael Swell, Capitol reef, and Colorado National monument near Grand Junction. All are closely related in origin and timing.

The term monocline refers to a single-limbed fold; in simple geometric terms, a gargantuan ramp. The ramp of steeply tilted strata separates uplifted regions from those that have dropped downwards, relatively speaking. At Comb Ridge the uplifted region lies to the west in the form of Monument Upwarp, which includes Cedar Mesa, the San Juan River Canyon, and Monument Valley. The net result is older Paleozoic rocks to the west separated from younger Mesozoic rocks immediately east by the colossal ramp of Comb Ridge. Another notable result of this uplift is the ensuing deep incision into the uplift by energized rivers as their runoff seeks a path to lower elevations. The deep narrow canyons of Cedar Mesa owe their existence to Monument Upwarp.

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The monoclines formed at the same time as the jagged Rocky Mountains of Colorado and Wyoming. This mountain-building event is the result of a widespread pulse of compression that rippled across western North America 65 to 50 million years ago. The stronger crust of the Colorado Plateau resisted the large scale uplift of alpine mountains but did not escape unscathed.

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Comb Ridge Origins (continued)

Most monoclines are the surface expression of a reverse fault in the older rocks deep beneath the surface (see attached figure for possible inclusion here). This intense compression shoved older rocks eastward and upward over younger rocks along a low angle fault, tilting the sedimentary layers far above. The surface representation of this deep fault after ~50 million years of erosion creates the current incarnation of Comb Ridge – a hogback of fiercely resistant red sandstone coupled with the adjacent cottonwood-lined valley of Comb Wash, hewn from easily eroded shale and siltstone. Both are clear expressions of the monocline.

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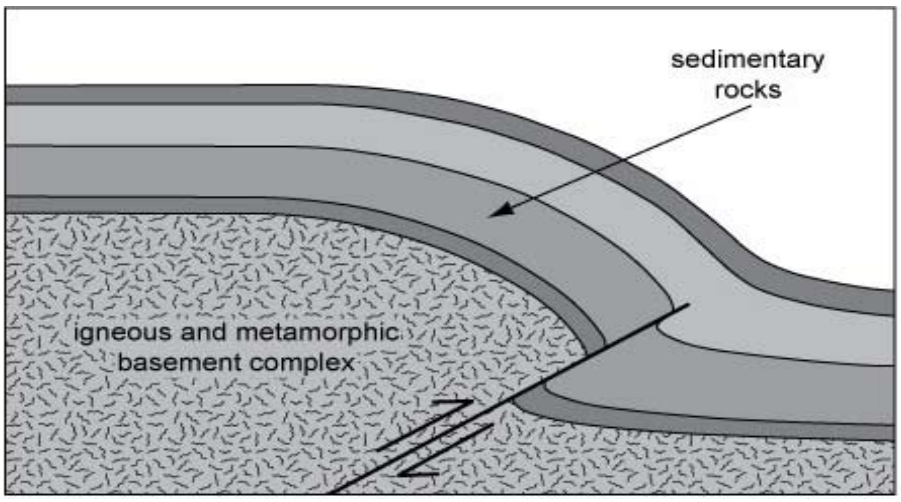

Cross-section through a typical monocline showing the inferred reverse fault at depth that at the surface is expressed as a simple ramp-type fold.

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