# Possible Analogue for the Heart Mountain Detachment

The Heart Mountain detachment in north-western Wyoming is **a major geological puzzle.** Hauge states:

> *'Despite more than 100 years of study, the Heart Mountain detachment remains among the world's most puzzling geological structures.'*[1]

According to the standard geological timescale, Heart Mountain is one of many blocks of Palaeozoic limestone and dolomite that has slid over Cretaceous to Eocene rocks in the north-western Big Horn Basin (see Figure 1).

The blocks of the Heart Mountain detachment outcrop over an area of about 3,400 km$^2$ that stretches from near Cooke City, Montana, to just south-east of Cody, Wyoming. The blocks, many of which are about 300 m high with a surface area of about 4 km$^2$, were transported as much as 50 km south-eastward over the valley fill sediments of the Big Horn Basin.[2] The fault near the break-away zone lies mostly **within** the Ordovician Big Horn Dolomite. This is most puzzling because a thick layer of shale, a much more suitable rock for a fault plane, lies just below the detachment fault. The valley fill sediments upon which the blocks slid are hardly even deformed.

The Heart Mountain detachment is a type of large overthrust, except in this case the blocks are believed to have slid down a 2° incline. Most large overthrusts, which supposedly have slid either along a horizontal plane or an **upward** sloping ramp, are different from detachments.

There have been many theories attempting to explain the Heart Mountain detachment. Lately, the theories have been pruned down to two that are locked in combat. One of these theories is the catastrophic gravity sliding model of William Pierce and associates.[3-5] They believe that earthquakes and volcanism, associated with the Absaroka Mountain Volcanics to the west, broke up the carbonates and sent them rapidly careening eastward down the gentle slope. The Absaroka Mountain Volcanics mostly outcrop in eastern Yellowstone Park, but are found on top of and between many of the detached blocks. The giant detachment slide was accomplished in anywhere from minutes to several days.

The second model, developed by Thomas Hauge[6,7] possibly in reaction to Pierce's catastrophic model, is a slow downward creep of a once continuous block over a long period of time. Erosion has since left the carbonate blocks as remnants. Hauge argues that Pierce's model is inadequate, because the slope is too low for catastrophic sliding and the earthquakes associated with volcanism are supposedly not strong enough to accomplish the task. He also claims that Pierce's extensional mechanism has no modern or ancient analogue:

> *'The detached-block model was a conceptual orphan, in that all other known allochthons were then thought to be contractional and the closest known "extensional" analogs were long-runout landslides, which deposited chaotic rubble rather than coherent detached blocks.'*[8]

Now, there is an analogue for Pierce's model — a long-runout landslide that also transported large **blocks without breaking them apart.** A new survey of the ocean floor on either side of the Hawaiian Ridge has revealed ubiquitous long-runout landslides that mostly occurred during

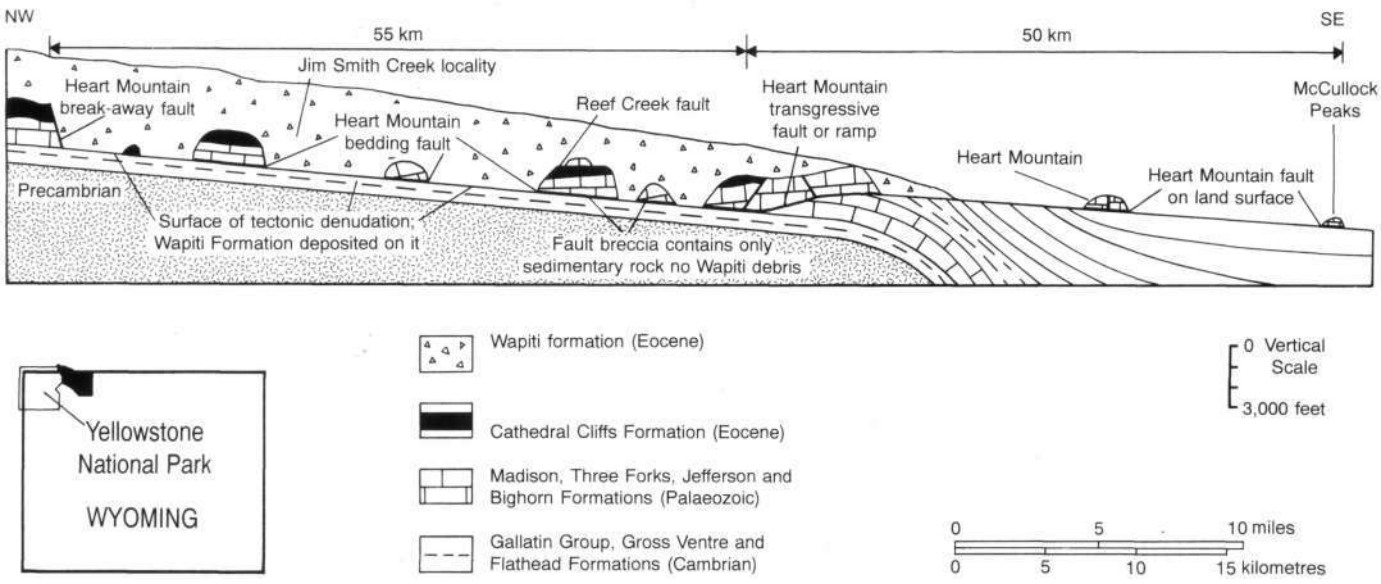


***Figure 1.*** *Generalised cross-section through the Heart Mountain detachment fault area in north-western Wyoming, showing the magnitude and scale of movement of the fault blocks.*

Pleistocene time in the geological timescale.[9] One submarine slide in particular, the South Kona Landslide off the south-west coast of the island of Hawaii, revealed giant landslide blocks that slid into the deep ocean.[10] Numerous blocks of basalt lava became detached from near the shoreline of the island and slid rapidly up to 80 km oceanward. The last 40 kilometres crossed over the relatively flat bottom beyond the base of the island slope! Nine blocks exceed 5 km in greatest dimension and stick up hundreds of metres above the ocean bottom. The largest block stands 700 m high and is 11.5 km by 7.5 km in area! Other large blocks have been documented in other deep-ocean areas off the Hawaiian Ridge. The blocks in these landslides are larger and slid farther than the Heart Mountain detachment.

Scott Rugg presents an excellent model for rapid detachment faulting during the catastrophic later stages of the Genesis Flood.[11] Within the Flood model, it seems reasonable that giant earthquakes from mountain uplift and the rapid volcanism of the Absaroka Volcanics shook the carbonates loose and caused them to catastrophically slide with other volcanic debris downhill into the western Big Horn Basin. A catastrophic submarine slide, instead of a subaerial slide, similar to the South Kona Landslide, would more easily account for the long-runout of the Heart Mountain detachment. The fact that the Absaroka Mountains are well-bedded, up to 3,000 m thick, and aerially extensive suggests that the Heart Mountain detachment occurred underwater and that the Big Horn Basin was a deep trough at the time. The volcanic debris associated with the Heart Mountain detachment has recently been suggested to be a *huge debris slide.*[12] If this is shown to be correct, it adds credence to the catastrophic detachment theory. It will also be one of the few giant pre-Pleistocene landslides.[13]

## REFERENCES


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## QUOTABLE QUOTE: Christianity and Science

***'But some will object, "If we allowed appealing to God anytime we don't understand something, then science itself would be impossible, for science proceeds on the assumption of natural causality." This argument is a red herring. It is true that science is not compatible with just any form of theism, particularly a theism that holds to a capricious god who intervenes so often that the contrast between primary and secondary causality is unintelligible. But Christian theism holds that secondary causality is God's usual mode and primary causality is infrequent, comparatively speaking. That is why Christianity, far from hindering the development of science, actually provided the womb for its birth and development.'***

Moreland, J. P., 1989. **Christianity and the Nature of Science: A Philosophical Investigation,** Baker Book House Company, Grand Rapids, Michigan, p. 226.