Preliminary Assessment of Arch-top Lineaments in Laramide Arches, Wyoming–Montana (USA), and Ga-scale Tectonic Significance

Jeffrey W. Bader[1], Jacob O. Thacker[2], Abdelmalek Abes[3], Yasser Laichaoui[4], and Houari Boumediene[5]

[1]North Dakota Geological Survey
[2]New Mexico Bureau of Geology and Mineral Resources
[3]University of North Dakota
[4]University of Sciences and Technology
[5]Algeria

Abstract

Lineaments within basement exposures in Wyoming and Montana may provide clues for fault reactivation during the Late Cretaceous–Paleogene Laramide orogeny. They are km-scale and occupied by erosional valleys within Archean granitic and high-grade metamorphic rocks atop Laramide arches. Some lineaments are previously mapped as dikes and faults. The nature and origin of these features have received little attention and have not been analyzed with modern tools or in the context of plate tectonics. It is suspected their formation is likely related to: 1) lithology; 2) regional strain during Precambrian and/or Laramide tectonism; and/or 3) localized strain. We present a geospatial analysis of lineaments from the Beartooth Mountains (MT-WY) using ENVI and GIS software to assess genetic relationships, possible origins, and possible implications for tectonics, natural resources, and geomorphic response.

Beartooth Mountains lineaments range in length from < 1 km to 35 km. Straight geometries across peak and valley topography suggests that the lineaments are planar sub-vertical features (joints and/or faults). Four orientations are apparent: NE-SW, WNW-ESE (dominant), and ENE-WSW, NW-SE (less dominant). These orientations are comparable but not exclusive to Proterozoic dikes mapped at scale 1:125,000 in the southeast part of the range. A Precambrian age of formation for the features is suggested by the similarity between Precambrian dike orientations, and apparent lack of such features in Cambrian and younger sedimentary cover (e.g., Beartooth Butte).

Orientations are consistent with formation as conjugate fractures/faults formed under NE–SW (latest Neoarchean) and NW–SE (Paleoproterozoic) contraction inboard of Precambrian convergent margins, and at the very least suggest that a basement structural framework was established on this part of the Wyoming Province during the Precambrian. Evidence for dextral ductile shear along NE–SW structures also suggests a Precambrian origin for these features. However, reactivation of this structural framework appears likely, as faults of similar orientation to lineaments accommodated movement during the Laramide, most notably along trends that are oriented WNW-ESE (ESE-striking segment of Beartooth thrust and the Nye Bowler fault zone) and NE-SW (SSW-striking segment of Beartooth thrust and the Fromberg fault zone). Brittle deformation, possibly attributable to Laramide orogenesis, is also indicated where faults along these trends cut Precambrian intrusions. Continued work will assess similar features in Laramide ranges across Wyoming to develop a regional-scale model of the structural framework and its possible role on fault reactivation from Precambrian to present.

Structural Geology & Salt Tectonics Wednesday, July 27 10:35 AM