Laramide deformation in the northern Bighorn arch

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The NSF EarthScope funded Bighorn Project will image the lithosphere beneath the Bighorn arch and develop 3D models to understand the mechanisms responsible for basement-involved arch creation. Model restorations require determination of the arch's slip field, which will show the relative importance of regional Laramide stress versus local gravitational stress. Gravitational strain should be shown as shortening down the dip of the flanking strata. Regional tectonic stress should result in uniformly-directed slip and strain partitioning on pre-existing weaknesses. Several en echelon, east-west trending zones on the northwest end of the arch, including a larger east-west zone containing many northeast-southwest trending faults north of Billings, Montana, have east-west trending folds that curve into northeast-verging thrusts, a more typical Laramide orientation. Detailed fracture analyses of these zones will determine whether they are areas of plunge-parallel gravitational spreading or distributed regional left-lateral slip between the craton and the Rocky Mountains. I will collect orientation and strain data from minor faults and joint sets in Paleozoic, Mesozoic, and Cenozoic units around the northern plunge of the Bighorn arch, which will be combined with data from previous studies in a GIS database. In addition, I will address a current controversy concerning fracture timing by measuring fractures in multi-age strata. Analyzing fracture data from multi-age strata will determine whether prevalent joint sets are pre-Laramide, syn-Laramide, or post-Laramide, which will improve reservoir modeling and fluid flow calculations for tight reservoirs.