20-m-thick basal mylonite overlain by highly strained gneisses and megacrystic granitoids, both of which host hundreds of pseudotachylyte fault veins and thin mylonite zones. Locally, part of the shear zone is defined by a strongly foliated, fine-grained granitoid cut by pseudotachylyte and ultramylonite. The presence of mylonitized pseudotachylyte in part of the shear zone suggests that seismogenic faulting and plastic flow occurred cyclically at mid-crustal depths. Kinematic indicators are consistent with top-to-the-south Proterozoic compression. The GCSZ is cut by the Phanerozoic Grizzly Creek fault, an east-west striking, north-dipping reverse fault that coincides with the hinge of a monocline that bounds the southern margin of the Laramide White River uplift. We will discuss applications of our work to understanding earthquake rupture dynamics, Proterozoic tectonics, and the Precambrian ancestry of Phanerozoic structures and fluvial incision in the southern Rockies. The trip will involve a four-mile round-trip trail hike and a steep, off-trail traverse on both days.

407. Coal Geology in the Mesaverde Group along the Eastern Edge of the Greater Green River Basin in Northwestern Colorado and South-Central Wyoming

Cosponsored by *GSA Coal Geology Division*

Fri.–Sat., 26–27 Oct. Nick Jones, Wyoming State Geological Survey, P.O. Box 1347, Laramie, WY 82073, USA, +1-307-766-2286 ext. 243, njones@uwyo.edu. Min: 5; max: 30. Cost US$205 (1ON, L, R).

This trip begins in Denver and travels through northwestern Colorado and southwestern Wyoming. We will visit several coal mines (both surface and underground) and observe coal-stratigraphic variability in the Mesaverde Group from outcrops (coal blooms) along the eastern extent of the Greater Green River Basin. At stops during the trip, information regarding the geology will include stratigraphic nomenclature of the Mesaverde Group, depositional environments, peat forming systems, and the resultant coal resources. Other topics of discussion will include coal distribution, utilization, coal conversion technologies, and coalbed natural gas developments along the eastern edge of the Atlantic Rim.

408. Geoarchaeology of the Clary Ranch Paleoindian Sites, Western Nebraska

Fri., 26 Oct. David W. May, Dept. of Geography, University of Northern Iowa, 205 Innovative Teaching and Technology Center, Cedar Falls, IA 50614, USA, +1-319-273-6059, dave.may@uni.edu; Dave Rapson; Matthew G. Hill. Min: 22; max: 40. Cost US$105 (L, R).

This trip will visit two late Paleoindian sites in the Ash Hollow drainage, a major tributary to the North Platte River in western Nebraska. These two sites are contemporary and are believed to represent complementary dimensions of a single settlement and subsistence system. One is a bison processing area; the other a camp. Emphasis will be on interdisciplinary research in the basin and at the sites, including geomorphology and early Holocene stratigraphy in the basin, paleoenvironmental reconstruction using several lines of evidence, and Paleoindian archaeology. A visit to a local museum (Ash Hollow Cave) is included as well.

409. From Buttes to Bowls: Repeated Inversions in the Landscape of the Colorado Piedmont

Cosponsored by *Colorado Geological Survey; Colorado Scientific Society*

Fri., 26 Oct. Matthew Morgan, Colorado Geological Survey, 1313 Sherman St., Suite 715, Denver, CO 80203, USA, +1-303-866-2066, matt.morgan@state.co.us; Vincent Matthews III. Min: 5; max: 20. Cost US$110 (L, R).

Mesas and buttes of the central Colorado Piedmont are composed of at least two distinct rock types that differ in their cohesiveness and ability to withstand erosion. The lower parts are friable, early to middle Paleogene sandstones of the Dawson Formation. The caprock is composed of one or more resistant formations: Castle Rock Conglomerate, Wall Mountain Tuff, and Larkspur Conglomerate—all of late Paleogene age. These formations were originally deposited in topographic lows. The lower slopes of the buttes are armored with colluvium composed of fragments of the capping units, and commonly form relict faceted slopes. Once the caprock of a butte or mesa has been removed by erosion, the poorly consolidated Dawson Formation quickly erodes out of the center. This leaves the armored lower slopes of the former butte as an erosionally resistant, circular ridge standing as much as 100 m above the surrounding topography. This process produces a topographic low where the peak of the butte once stood. Some buttes have prominent alluvial fans that record the main phase of butte removal and excavation of the central part of the armored slopes. Soil profiles and height above modern streams indicate the oldest preserved gravel deposit is of middle Pleistocene age; the youngest alluvial fans were deposited during the Holocene. This field trip will visit key outcrops between Larkspur and Sedalia, Colorado, that display the anatomy of colluvium rings and armored slopes. We will also discuss their methods of formation, preservation, and rates of erosion.

410. The Beautiful Vail Valley: A Classroom in Geologic Hazards and Mitigation

Cosponsored by *Colorado Geological Survey*

Sat., 27 Oct. Vincent Matthews III, Colorado Geological Survey, 1313 Sherman Street, Room 715, Denver, CO 80203, USA, +1-303-866-3028, vince.matthews@state.co.us; Jonathan White; Mark A. Gorman II, University of Colorado, 1300 30th St. D5-12, Boulder, CO 80303, USA, +1-303-786-0999, mark.gorman@colorado.edu; Jason Pardo; Bryan Small; Ian Miller. Min: 12; max: 45. Cost US$75 (L, R).

The beautiful, glaciated Vail Valley has a variety of geological hazards. Land-use decisions relative to mitigation of these hazards are also quite varied. Several excellent examples of the consequences of following recommended mitigations, as well as examples of the consequences of ignoring recommended mitigations, will be pointed out on this trip.