Geologic Overview of West Salt Creek Landslide

Rex Cole, Verner Johnson, and Dave Wolny
Colorado Mesa University

Late in the afternoon of May 25, 2014, a deadly landslide occurred in the West Salt Creek drainage approximately six miles southeast of Collbran, Colorado, on the lower northern flank of Grand Mesa. Even though landslides and other mass-wasting events are very common on Grand Mesa, this occurrence, which involved approximately 39 million cubic yards of material, was unprecedented within the scope of human observations in the area. Consequently, geoscientists and engineers from the U.S. Geological Survey, U.S. Forest Service, Colorado Geological Survey, Mesa County, Colorado School of Mines, Colorado Mesa University, and others rapidly initiated research and monitoring activities.

The slide on May 25th was a reactivation of a much older landslide block in the upper reaches of West Salt Creek. This block was covered by mature evergreen and aspen trees, and known to be unstable by local residents. Bedrock at the scarp and in the upper part of the valley consists of weathered siltstone, marlstone, and lean oil shale of the Eocene Green River Formation (Anvil Points and Parachute Creek Members). The Eocene Shire Gulch Member of the Wasatch Formation crops out in the lower part of the valley. A thin interval of Eocene Unita Formation may overly the Green River Formation at the headwall. The area south of the headwall (Sheep Flats area) is underlain by Goodenough formation (Miocene ?) and Pleistocene glacial deposits (Grand Mesa Formation). Landslide debris consists mainly of blocks of Green River Formation, with subordinate soil and colluvium containing basalt clasts and fragments of limestone from the Goodenough formation, plus numerous trees. At the headwall, the Green River strata exhibit numerous fractures that are oriented roughly parallel to the scarp. Observations made using CMU's seismic network show that the event was not a result of an earthquake, but strictly a mass-wasting event. Once triggered, the landslide traveled about 2.8 miles in approximately three minutes (according to the seismic record from the CMU seismograph network) at elevations ranging from 9,740 to 7,420 feet (total relief of 2,320 ft). The maximum velocity of the flow has been estimated at between 50 and 75 mph (Coe et al., 2014). The velocity was high enough for the flow to overtop the valley walls of West Salt Creek at two locations. The maximum thickness of the flow is approximately 150 feet based ArcGIS© digital elevation modeling maps. These displays clearly define areas removal and deposition have occurred.

Mapping by the U.S. Geological Survey show that the WSC event occurred in at least five stages (Coe et al., 2014): (1) an initial debris flow; (2) a high-energy rock avalanche, which produced the large rotational block near the headwall scarp (now partially occupied by a small pond); (3) movement of the upper central core of the avalanche; (4) a second debris flow; and (5) slow movement

of the upper central core. Six factors are thought to have been contributing factors to the event: (1) presence of an unstable older landslide; (2) weak, naturally fractured bedrock; (3) melting of the late-season snow pack; (4) significant rain just prior to the release; (5) steep slopes; and (6) gravity. There is no scientific evidence that natural-gas drilling or completion work contributed to this event.