Title: The Mountain is fractured and permeable: bedrock hydrology of the Laramie Range and mountain front areas

Bio: Ye Zhang received her B.S. in Groundwater Hydrology from Nanjing University, People’s Republic of China, her M.S. from University of Minnesota (minor in Civil Engineering), and her Ph.D. from Indiana University (minor in Scientific Computing). She is currently an associate professor at the Dept. of Geology & Geophysics, University of Wyoming. Her research interests include subsurface modeling, surface/groundwater interaction, and mountain hydrology.

Time: 10 am, March 14, 2018
Location: Earth & Environmental Sciences, Lawrence Berkeley National Lab

Abstract:
With funding from NSF EPSCoR and Wyoming Water Development Commission, we’ve established 3 long-term bedrock monitoring sites centered at the Laramie Range and its mountain front recharge areas in southeastern Wyoming. This research infrastructure includes: (1) 3 saprolite (weathered granite) wells and 9 fractured granite bedrock wells at Blair Wallis in Laramie Range; (2) 6 stream gauges, 11 riparian wells, and 7 bedrock wells completed in and downstream from outcrop of the Casper Aquifer at Belvoir Ranch, Denver Basin, which drains the eastern slope of the Range; (3) 1 snow sensor and 2 multilevel wells completed in basement granite, Fountain Conglomerate, and two Casper Aquifer intervals at Government Gulch, Laramie Basin, which drains the western slope of the Range. At all three sites, water level and temperature are being monitored. At Blair Wallis, single- and cross-hole hydraulic tests have been carried out. Based on the characterization and monitoring data collected in the past 3 years, results are summarized for each site:

(1) Blair Wallis: bedrock water level responds annually to spring snowmelts but not significantly to summer/fall rainfalls; bedrock permeability is derived from open fractures and approaches those of “medium sand”; at 3 bedrock wells, permeability diminishes with depth and becomes insignificant at ~50 m bgs, interpreted by us as the granite’s weathering front; sustained pumping at one bedrock well drained Blair Creek, a perennial creek flowing next to the well field, suggesting bedrock-supplied baseflow; streamflow in Blair Creek is thus composed of snowmelt runoff, rainfall runoff, and groundwater baseflow; between 6~19% of precipitation over the Laramie Range is estimated to infiltrate, thus bedrock groundwater is a significant component of the mountain water budget.

(2) Belvoir Ranch: streamflow, riparian, and bedrock (Casper Aquifer) water levels all respond to the same snowmelt runoffs from the Laramie Range; streamflow and riparian water levels also respond to rainfalls in summer/fall, which is not observed in the bedrock; magnitude of water level response in bedrock is controlled by distance to outcrop and proximity to permeable faults.

(3) Government Gulch: Casper Aquifer is not only receiving recharge from above via infiltration, it also receives ‘sub-charge’ from the underlying Fountain Conglomerate, likely driven by the higher hydraulic head of the Laramie Range. At this site, basin-fill aquifers (Casper, Fountain) appear hydraulically de-coupled from the basement granite over a 3-month monitoring period in Spring, 2018. For the duration of monitoring at the 3 sites, snowmelt infiltration appears to dominate bedrock recharge, while the effect of rainfall infiltration is negligible. This is likely due to high evapotranspiration and low soil moisture content in the unsaturated zone during the summer/fall dry seasons.

Selected findings of this research are reported in: (* student co-author)