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CONTRASTS IN LATE PLEISTOCENE TO HOLOCENE FLUVIAL BEHAVIOR ALONG THE MIDDLE RIO CHAMA

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Abstract.— A preliminary analysis of terraces along the middle Rio Chama indicates that there was an episode of rapid valley aggradation within the last 700 years. Input of sandy sediment from Mesozoic and Cenozoic sedimentary and volcaniclastic rocks in the drainage basin was apparently sufficient to overwhelm discharges in the study reach and cause substantial aggradation, despite snowmelt runoff from the high-elevation upper basin.

Quaternary geologic mapping and research have documented long-term fluvial activity along the upper and lower Rio Chama (e.g. Gonzalez and Dethier, 1991; Love and Connell, 2005), but little work has been done on the middle river between El Vado Dam and Abiquiu Reservoir. We made a reconnaissance study of a 5 km reach in this area near Burns Ranch (UTM 13 0349748E 4024363N), where the contributing drainage area is about 3900 km^2. This reach of the Rio Chama is mostly alluvial in character with local bedrock outcrops in the channel. Rapids appear to be related to local input of large boulders by tributary debris flows and flash floods. The active channel and floodplain are flanked by fluvial terraces and tributary alluvial fans. The alluvial fans contain abundant fine-grained red sediment derived from the Petrified Forest Formation of the Chinle Group. Gravelly terrace deposits contain abundant quartzite and other resistant rock types derived from the high-elevation upper basin. The gravels cap strath surfaces cut on Triassic Chinle Group sandstones and mudstones, and are associated with terrace treads 8-32 m above present bankfull level (higher terraces exist but were not investigated). At one locality, the fill underlying an 8 m terrace tread is notable for imbricated quartzite boulders up to 2 m in *b*-axis diameter near its base, indicating transport under extreme flood conditions. Limited soil observations, e.g. stage I carbonate morphology, indicate that this terrace predates the late Holocene, but age is uncertain and it is possible that a Holocene fill-cut terrace with finer-grained deposits overlies the older bouldery fill at this locality. Higher terraces in this group are likely latest Pleistocene in age or older.

We also observed widespread lower terraces with treads one to four meters above bankfull level, underlain by sandy fill deposits. Stratigraphy below a 4 m terrace tread includes a 3 m thick lower unit of moderately to well-sorted medium to coarse sand, with well preserved crossbeds and laminations, interpreted as fluvial channel deposits. A lack of conspicuous buried soils within this part of the section implies relatively rapid aggradation. A charred pine branch at 2.0 m above bankfull yielded a ^{14}C age of 500 ± 60 BP, corresponding to two sigma calibrated age ranges of 1298-1371 AD (24% probability) and 1378-1496 AD (74% probability). These deposits are overlain by reddish, more poorly sorted sand. The color and texture of this upper unit implies a significant contribution from local tributaries, and it is possibly distal fan sediment. A very weak, 10 cm-thick soil in the deposit exhibits primarily A horizon development and indicates a latest Holocene age.

The evidence described above for an episode of rapid valley aggradation within the last 700 years is consistent with observations of widespread aggradation between ca. 1400 AD and the late 1800s along disparate drainages of the southern Colorado Plateau (Hereford, 2002). These range from small ephemeral washes to the Colorado River in Grand Canyon. What is notable about the Rio Chama example, however, is the close proximity of the study reach to high-elevation headwater basins that generate voluminous snowmelt runoff from 250-750 mm of accumulated precipitation in mountain snowpacks (mean annual values from Western Regional Climate Center, http://www.wrcc.dri.edu/). These mountain headwater basins are also generally well-vegetated, and bedrock exposures are typically of hard Proterozoic metamorphic rocks that typically yield little sandy sediment. The expected high peak discharges and limited sediment supply from the headwaters would limit the potential for aggradation, especially with sandy sediment. Nonetheless, input of sandy sediment from Mesozoic and Cenozoic sedimentary and volcaniclastic rocks was apparently sufficient to overwhelm discharges in the study reach and cause substantial aggradation.

The Rio Gallina, which enters the Rio Chama a few kilometers above the study reach, may have contributed a significant proportion of this sediment from friable sandstones in the Cretaceous and especially Paleocene to Eocene rocks in this drainage basin (e.g., Smith, 1992). Hereford (2002) hypothesized that much of the upper Holocene valley-fill alluvium on the southern Colorado Plateau was sourced primarily from bedrock weathering (as opposed to erosion of older valley alluvium), and related aggradation to reduced frequency of large floods during the Little Ice Age. Until climatic controls on hillslope vegetation and weathering in this area are better understood (e.g., Burnett, 2004), however, the relative importance of discharge variations versus sediment supply in promoting aggradation will remain unknown. On the Rio Chama study reach, it is also unclear whether the post-1300 AD sandy fill may be inset within older fine-grained Holocene alluvium indicating earlier episodes of aggradation to similar levels.

Lower terrace treads 1-2 m above bankfull level are mostly underlain by sand and finer sediments as well. We suspect that at least some of the lower terraces may represent Rio Chama flood plain surfaces abandoned after construction of El Vado Dam in 1935-1936, but further data are necessary to assess whether sediment trapping and flow regulation by that structure have caused significant downstream incision, as experienced on many simi-

lar western rivers (Williams and Wolman, 1984). This reach of the Rio Chama exhibits some striking contrasts in fluvial activity from late Pleistocene to modern time.

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