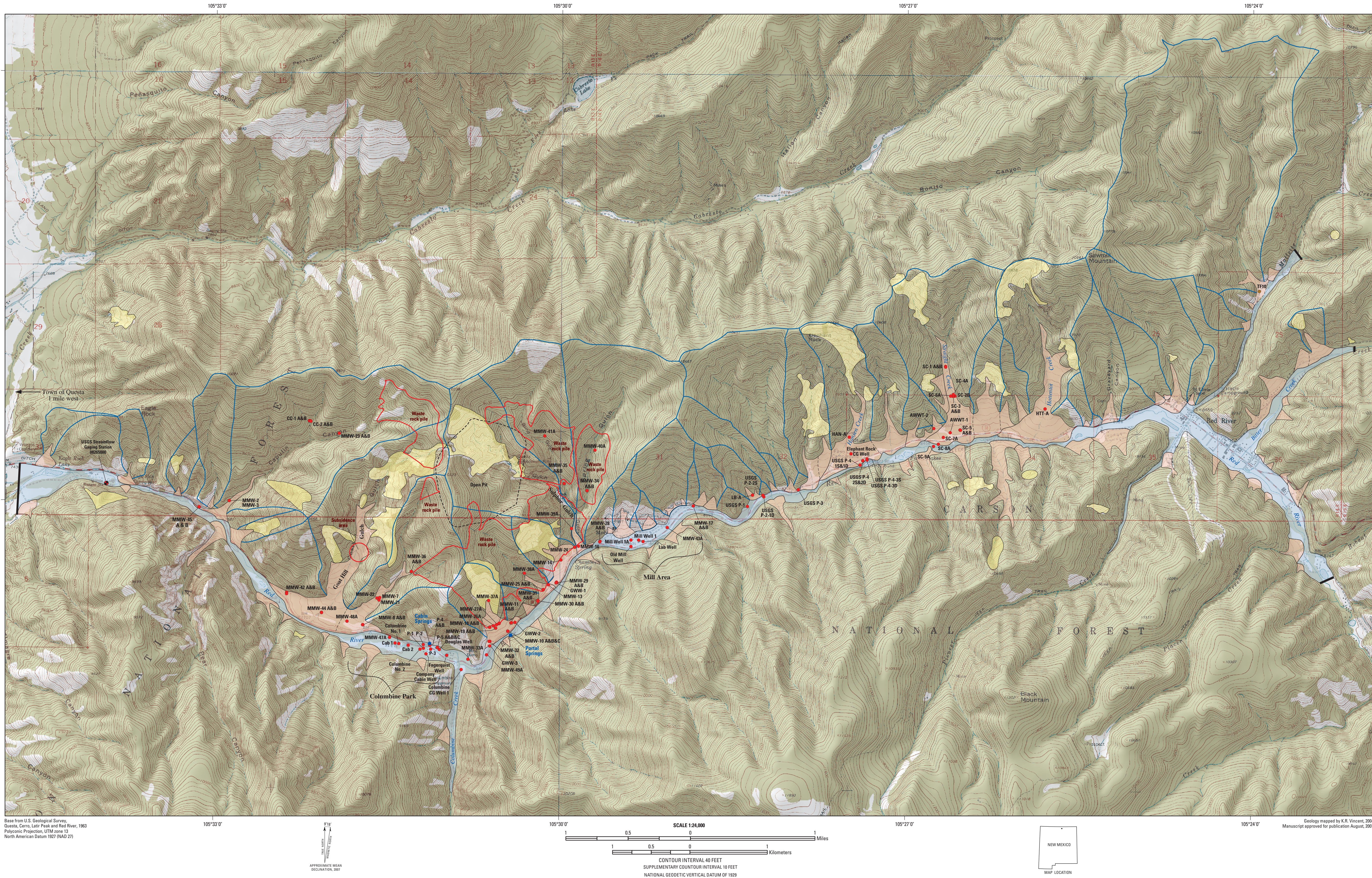




DESCRIPTION OF MAP UNITS

[This surficial geologic map (modified from Vincent, in press) was based on interpretation of stereo-pair aerial photographs, interpretation of high-resolution topographic maps provided by MolyCorp, Inc. (written commun., 2001), which are available for a portion of the area, and inspection of the landforms in the field.

The map depicts the locations of major alluvial deposits, and sites of rapidly eroding hillslopes called “alteration scars” (Meyer and Leonardson, 1990). The unmapped areas consist of bedrock hillslopes that are generally vegetated and mantled by colluvium. Sediments deposited by the Red River and several large tributaries are distinguished from sediments deposited by smaller, and ephemeral, tributary streams. The latter deposits generally have the form of alluvial fans. Mining disturbed certain areas, indicated on the map, principally after 1965. In those areas, the alluvial deposits and alteration scars are depicted as they appeared on photographs and maps prepared prior to mining disturbance. The topographic base map was created using photographs taken in 1962.

The age of the deposits is Quaternary, but the ages at the base of the deposits have not been refined. Most of the sediments located within several meters of the ground surface were deposited during the middle to late Holocene, and the alteration scars were active during the middle to late Holocene, if not before. Near-surface age constraints are based on limited radiocarbon dating, and the general lack of soil development. Organic A-horizons are present, but carbonate or clay B-horizons are not present. All deposits are probably less than 80 m thick.]

Red River alluvium—Sediment deposited by the Red River and its four largest tributary streams. The landforms consist of streambeds, flood plains, and low stream terraces. The sediment generally consists of clast-supported, sandy pebble-gravel or sandy cobble-gravel. The clasts are rounded or subrounded. The matrix generally consists of sand. Locally, the deposits consist of sand or silt overlain by sediment. Beds are 0.1 to greater than 1 m thick, and tend to be continuous over length scales of 10 m. Stratification is subhorizontal and weakly developed. Soil development in the deposits is minimal. The gravel deposits are shown by this report to be permeable compared to other sediments in the area, although locally the gravel is partially cemented with compounds of iron and manganese

Alluvial fan deposits—Sediment deposited by ephemeral streams that are tributary to the Red River and that generally form alluvial fans (also called debris fans in this report). The nature of the sediment largely depends on whether or not an alteration scar is currently present within its tributary catchment.

Alluvial fans shed from catchments that do not contain alteration scars typically consist of clast-supported, sandy pebble-gravel or sandy cobble-gravel. These deposits resemble Red River gravel, with two exceptions. First, fine-grained overbank sediments are sparse. Second, soil horizons are present. The fans are typically forested; usually a thin layer of organic duff covers the sediment and overlies an organic soil A-horizon. In addition, buried A-horizons are present within the subsurface. In one 3-m-high exposure, eight buried A-horizons were observed. Most of these fans are not active at present, having no active stream channels and having been truncated at their distal margins by the Red River without being gullied by their tributary stream.

Certain alluvial fans shed from catchments that do not contain alteration scars, however, resemble fans that do have scars in their catchments except at the surface. They are not active at present. They have surficial duff and organic A-horizons and typically do not have stream channels.

Alluvial fans shed from catchments that currently contain alteration scars typically consist of very poorly sorted, matrix-supported gravel that is pale yellow. The deposits are somewhat cohesive and are able to hold a vertical face greater than 5 m high. The clasts are typically pebble and cobble in size, but boulders are occasionally present. The clasts are angular to subrounded. The matrix consists of sandy silt or silty sand. Beds are 0.1 to greater than 1 m thick and tend to be discontinuous over length scales of 10 m. Stratification generally parallels the ground surface. Debris-flow levees are abundant. The fans are active. The dynamic nature of stream channels has been observed since the onset of this project in 2001, and debris flows have proven hazardous in recent decades (Plumlee and others, in press). Evidence of partial burial of living trees by debris-flow sediments is observed. The fans are forested, but duff is thin and discontinuous, and surficial organic soil A-horizons are not obvious or are thin (<5 cm). In addition, buried soil horizons are very few in number or are not present within the deposits. The fans tend to have a single channel rather than multiple distributary channels typical of other types of fans (Vincent and others, 2004). Where a fan extends across the full width of the Red River valley, the toe of the fan is partially breached by the Red River and the tributary stream has incised into the distal portion of the fan. These fan deposits are shown by Vincent (in press) to be substantially less permeable than Red River gravel

Alteration scars—Rapidly eroding hillslopes that are unvegetated, steep and rugged, and pale yellow. Pale yellow refers to a specific color mix (Munsell Color, 2000) that is imparted by jarosite, which is a weathering product of pyrite. The name “alteration scar” (Meyer and Leonardson, 1990) is informal but is commonly used by geologists and engineers working in the area. The locations and shapes of the scars were modified from the previous mapping of Robertson GeoConsultants (2001, fig. 1).

The scar material consists predominantly of rhyolite or andesite bedrock that has been altered in two ways. First, after emplacement, the volcanic rocks were altered by hydrothermal fluids derived from fairly shallow magma chambers. Around the intrusions, there is vertical and lateral zoning, in a general sense, in the type and extent of alteration (Ludington and others, 2005). The largest assemblage is characterized by an abundance of secondary quartz, sericite (fine-grained muscovite), and pyrite. Second, where these altered rocks are at or close to the ground surface, they experience chemical weathering (Plumlee and others, in press). The sulfide minerals are easily weathered, producing acid that promotes further disintegration of the rock. The resulting material erodes quickly, producing debris flows

----- **Contact or boundary of map unit**—Dashed where location is approximate

----- **Boundary of the topographic watershed of a tributary stream**—Number used to identify the catchment

----- **Outline of major mining-related feature**—These features include an open pit, several waste-rock piles, and a zone of ground subsidence resulting from mining by underground block caving

----- **Open pit area**

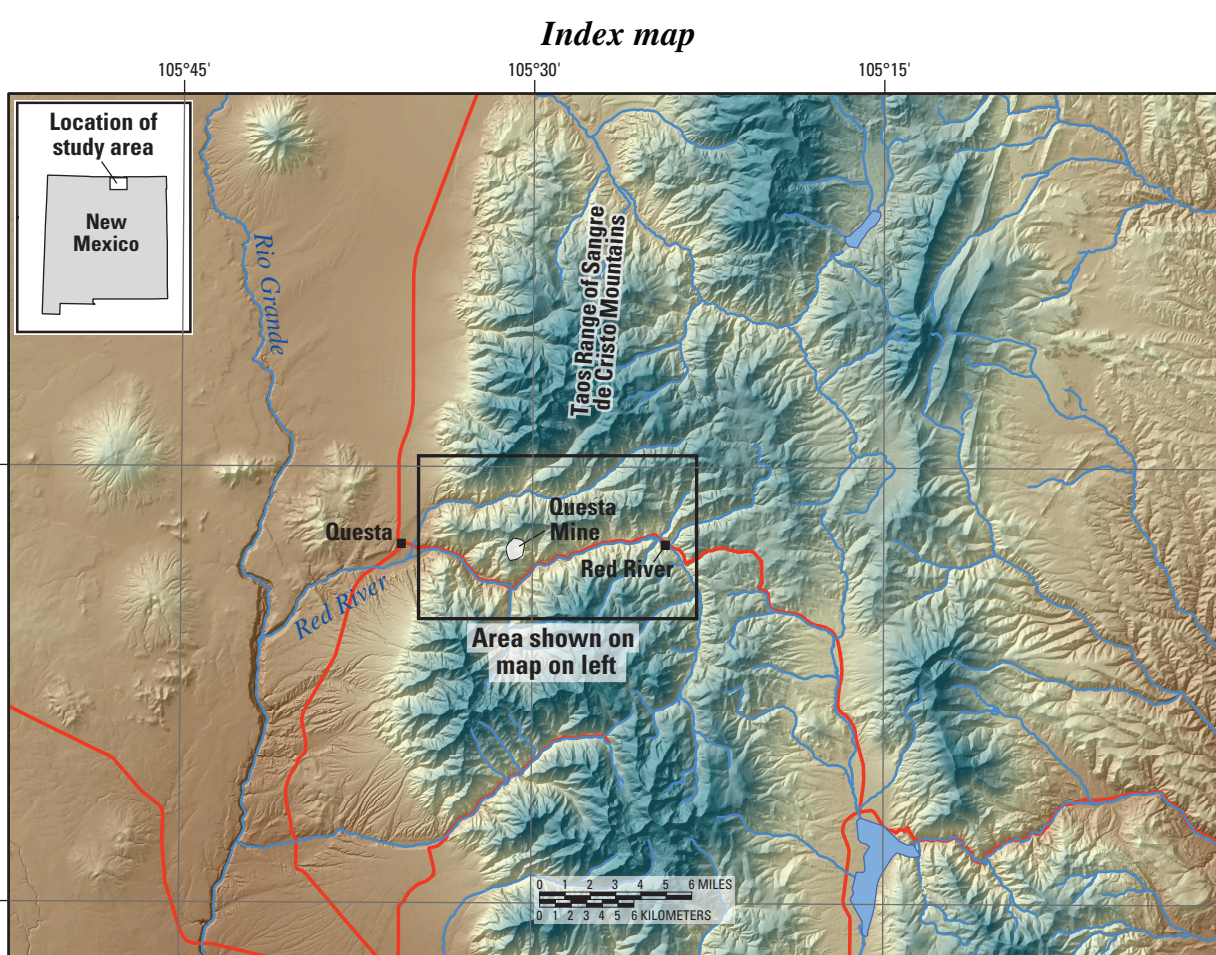
----- **Limit of mapping**

HT-A • **Water well location and identifier**

Cabin • **Spring or ground-water seep**—The names are informal, and the locations are approximate because the sites of emerging ground water are lengthy zones, and observers have given the position of ground-water emergence at variable locations

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Surficial Geologic Map Showing Late Quaternary Sediments, Waste Rock Piles, Wells, Catchments, and Tributary Streams in the Middle Red River Valley, New Mexico

By
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2008