GEOLOGIC MAP OF ALLUVIAL FANS ALONG THE ZAPATA AND BLANCA SECTIONS OF THE NORTHERN SANGRE DE CRISTO RANGE-FRONT FAULT SYSTEM, SOUTH-CENTRAL COLORADO

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DESCRIPTION OF MAP UNITS

QUATERNARY SURFICIAL DEPOSITS

Young Alluvial Fan Deposits

Qay3 ALLUVIUM OF THE YOUNGEST FAN SURFACES
The topographically lowest, undissected surfaces that encompass the most recent debris flow deposits on alluvial fans. Generally occur as either lobes or channels within fan complexes. Rough surface morphology is produced by preservation of young to very young, fresh, unweathered boulder debris flow deposits. Boulder debris flow deposits comprise levees of poorly imbricated cobble to large boulders varying from clast support to support of fine sand to pebble matrix. Lobes are generally composed of clast-supported, sub-angular to round cobbles to large boulders, devoid of matrix. Cobbles and boulders display minimal to no weathering and primary depositional features display little to no signs of modification. Boulders are fresh and ring with strike of hammer.

Qay2 ALLUVIUM OF THE SECOND YOUNGEST FAN SURFACES
Deposits that are entrenched by and topographically above Qay3. Undissected to slightly dissected surfaces display rough primary depositional fabric. Generally occur as segments within northern fan complexes or as individual depositional lobes of larger fan complex. Rough surface morphology is produced by preservation of young boulder debris flow deposits. Boulder debris flow deposits comprise levees of poorly imbricated cobble to large boulders varying from clast-support to support of fine sand to pebble matrix. Lobes are generally composed of clast supported, sub-angular to round cobbles to large boulders, devoid of matrix. Cobbles and boulders are minimally weathered and primary depositional features display very minimal signs of modification.

Qay1 ALLUVIUM OF THE THIRD YOUNGEST FAN SURFACES
The topographically highest units of Qay subdivisions. Undissected to slightly dissected surfaces that display rough fabric. Occur as segments within northern fan complexes and as large individual depositional lobes of some larger fan complexes. Rough surface morphology is produced by preservation of young boulder debris flow deposits. Boulder debris flow deposits comprise levees of massive to poorly imbricated cobble to large boulders varying from clast-supported to support of fine sand to pebble matrix with minimal reworking. Lobes are generally composed of clast-supported, sub-angular to rounded cobbles to large boulders, devoid of matrix. Cobbles and boulders are minimally weathered and primary depositional morphology display few signs of modification.

Intermediate Alluvial Fan Deposits

Qai3 ALLUVIUM OF THE YOUNGEST INTERMEDIATE FAN SURFACES
Lowest topographic position of the intermediate deposits that sit above Qay deposits. Rough surface texture from preserved primary depositional morphology. Significant winnowing of fine-grained material from matrix of debris flow levee and lobe deposits and variable aeolian input of silt within cobble to large boulder interstices. Diffusion of primary depositional morphology is evident by infilled topographic lows of fine-grained sand to cobble-sized particles.

Qai2 ALLUVIUM OF THE SECOND YOUNGEST INTERMEDIATE FAN SURFACES
Surfaces are rough to moderately rough due to moderate disintegration of primary depositional morphology. Topographically below Qai1 and older deposits and perched above younger deposits. Most levee and lobe morphology of primary deposition is masked by diffusion of depositional morphology and input of aeolian fines. Boulders are sub-angular to round, and fresh to heavily weathered. Most heavily weathered boulders have disintegrated into angular fragments. Where large boulders are present, they thud with a hammer strike and display protruding mafic xenoliths. Vegetation grows pervasively throughout unit and includes pinon, juniper pines, sages, and grasses.

Qai1 ALLUVIUM OF THE OLDEST INTERMEDIATE FAN SURFACES
Topographically highest of intermediate deposits. The most significantly entrenched intermediate deposits. Moderately rough to somewhat smoothed surface texture from disintegration of primary depositional morphology. Occur as distinct fan lobes and as perched stand-alone surfaces. Levee and lobe morphology of primary depositional fabric has been diffused by structural collapse and aeolian input of fines. Stage II-III carbonate horizons and rinds formed in soil sequences. Cobbles to large boulders range from sub-angular to rounded, many are buried. Clasts range from slightly to heavily weathered and disintegrated.

Old Alluvial Fan Deposits

Qao3 ALLUVIUM OF THE THIRD OLDEST FAN SURFACES
Smooth, segmented surfaces. Surfaces occur as both large depositional fan lobes and as fragmented, stand-alone, perched levels. Diffusion of primary depositional features evident by infilling of topographic lows and disintegration of levee and lobe highs. Smooth surfaces are made up of fragmented, rotten boulders with heavy aeolian input. Stage II to IV carbonate soil horizons occur with Qao3.

Qao2 ALLUVIUM OF THE SECOND OLDEST FAN SURFACES
Smooth to segmented surfaces with minimal to extensive incised channelization. Primary depositional features have been extensively reworked from heavily degraded debris flow levees and lobes to ridge and swale topography. Clasts are rotten and whole to fractured and angular with moderate to intense weathering.

Qao1 ALLUVIUM OF THE OLDEST FAN SURFACES
The oldest surfaces at the highest elevation within individual alluvial fans. Deeply entrenched and segmented smooth surfaces. Primary depositional features are masked by substantial modification. Large boulders are heavily weathered and disintegrated. Clasts are fractured and angular due to weathering.

Alluvium/Colluvium

Qc COLLUVIUM
Poorly sorted, angular clasts supported by poorly sorted, course-grained matrix. Generally occur close to valleyward opening of drainage basins and on edges of segmented fan deposits.

Qal ALLUVIUM (UNDIFFERENTIATED)
Active to inactive channelized deposits of undifferentiated alluvium.

Qic INCISED CHANNEL
Headward eroding, channels incised into fan surfaces. Fan surfaces that have incised channels mappable at the 1:24,000 scale are predominantly the relatively oldest deposits.

Qtu FLUVIAL TERRACES (UNDIFFERENTIATED)
Flights of pebbles to large boulders in sandy matrix. Terraces make up nested suites propagating from glaciated drainage basins. These terraces occur atop and entrenched in alluvial fan surfaces.

Qog OLD GRAVEL
Angular to sub-round, boulder to large boulders buried by silt-medium sand. Makes up steeply sloping, flat surfaces.

Qdbu DRAINAGE BASIN DEPOSITS (UNDIFFERENTIATED)
Includes talus cones and aprons, moraines, till, hillslope, fluvial, soil, regolith, and aeolian deposits.

Aeolian Deposits

Qdb BARCHAN DUNES
Groups of, and individual crescent-shaped sand dunes.

Qdp PARABOLIC DUNES
Parabolic dunes that have slip face facing dunefield.

Qss SAND SHEET
Encompasses sandy grasslands, nebkah dunes that form around vegetation, transverse and parabolic dunes.

Landslide Deposits

Qls LANDSLIDE DEPOSITS
Mapped translational and rotational hillslope failure deposits are those that display scarp and toe. Poorly sorted, matrix supported, angular to sub-round clasts make up this texturally immature deposit.

Qlso OLD LANDSLIDE DEPOSITS AND COMPLEXES
Flat to hummocky topography of slightly to extensively weathered, cobbles to large boulders, within silt to coarse-sand matrix.

Glacial Deposits

Qmp PINEDALE-AGE MORAINE DEPOSITS
Sharp-crested moraine deposits composed of poorly sorted cobbles to large boulders in a coarse-grained sand to pebble matrix.

Qmbl BULL LAKE-AGE MORAINE DEPOSITS
Round-crested moraines built from slightly to heavily weathered, poorly sorted cobbles to large boulders in a coarse-grained sand to pebble matrix.

Qgft GLACIO-FLUVIAL TERRACES
Perched terraces of till above channels, within glaciated drainage basins, proximal to fan apex.

Qmu MORAINE DIAMICT (UNDIFFERENTIATED)
Undifferentiated moraine deposits and till.

TERTIARY (MIOCENE) SEDIMENTAY ROCKS

Santa Fe Group

Tsf SANTA FE FORMATION
The Santa Fe Formation is the lower member of the Santa Fe Group sediments, overlain by the Alamosa Formation. The Santa Fe Formation is a volcaniclastic conglomerate interfingered by coarse-grained sand with carbonate cement. Conglomerate is matrix-supported by feldspathic litharenite, fine to coarse-grained sand. Framework grains are pebble to cobble-sized, sub-angular to sub-round volcanic rock fragments. Variegated color, generally pink, orange, light-brown, or tan. Induration varies upon location, as does attitude of beds that are commonly tilted ~14-45 degrees. In the mapping area, tilted Tsf underlies Qoa1 beneath an angular unconformity.

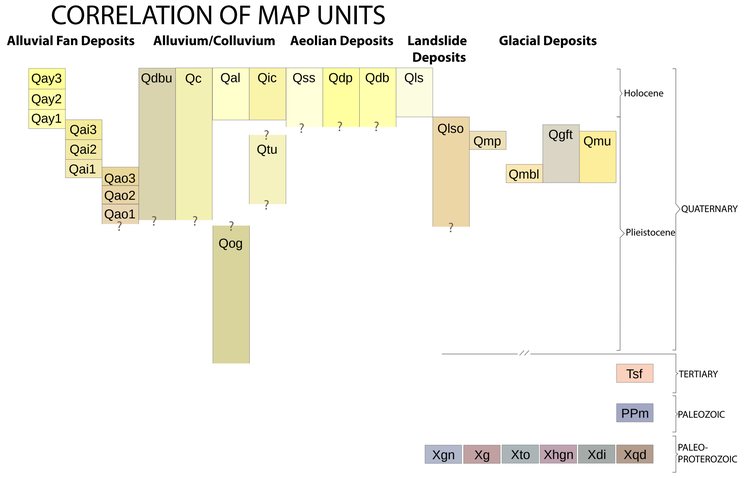
PALEOZOIC ROCKS

PPm MINTURN FORMATION
Coarse-grained litharenite to polymict conglomerate. The Minturn formation represents sedimentation from the Ancestral Rocky orogen into the Central Colorado trough (Hoy and Ridgway, 2002).

PALEOPROTEROZOIC ROCKS

Xgn MIXED GNEISS
Xto TONOLITE GNEISS
Xdi DIORITE
Xg METAGABBRO
Xhgn HORNBLENDE GNEISS
Xqd QUARTZ DIORITE

CORRELATION OF MAP UNITS



MAP SYMBOLS

- **contact**
- **normal fault** *Sangre de Cristo fault system*
- **strike and dip of bedding**

Bedrock mapping and previous surficial mapping by;

Bruce, R. M., and Johnson, B. R., 1991, Reconnaissance Geologic Map of parts of the Zapata Ranch and Mosca Pass Quadrangles, Alamosa and Huerfano Counties, Colorado: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2168, scale 1:24,000.

Hoy, G.R. and Ridgway, K. D., 2002, Syndepositional thrust-related deformation and sedimentation in an Ancestral Rocky Basin, Central Colorado trough, Colorado, USA: Geological Society of America Bulletin, v. 144, p. 804-828.

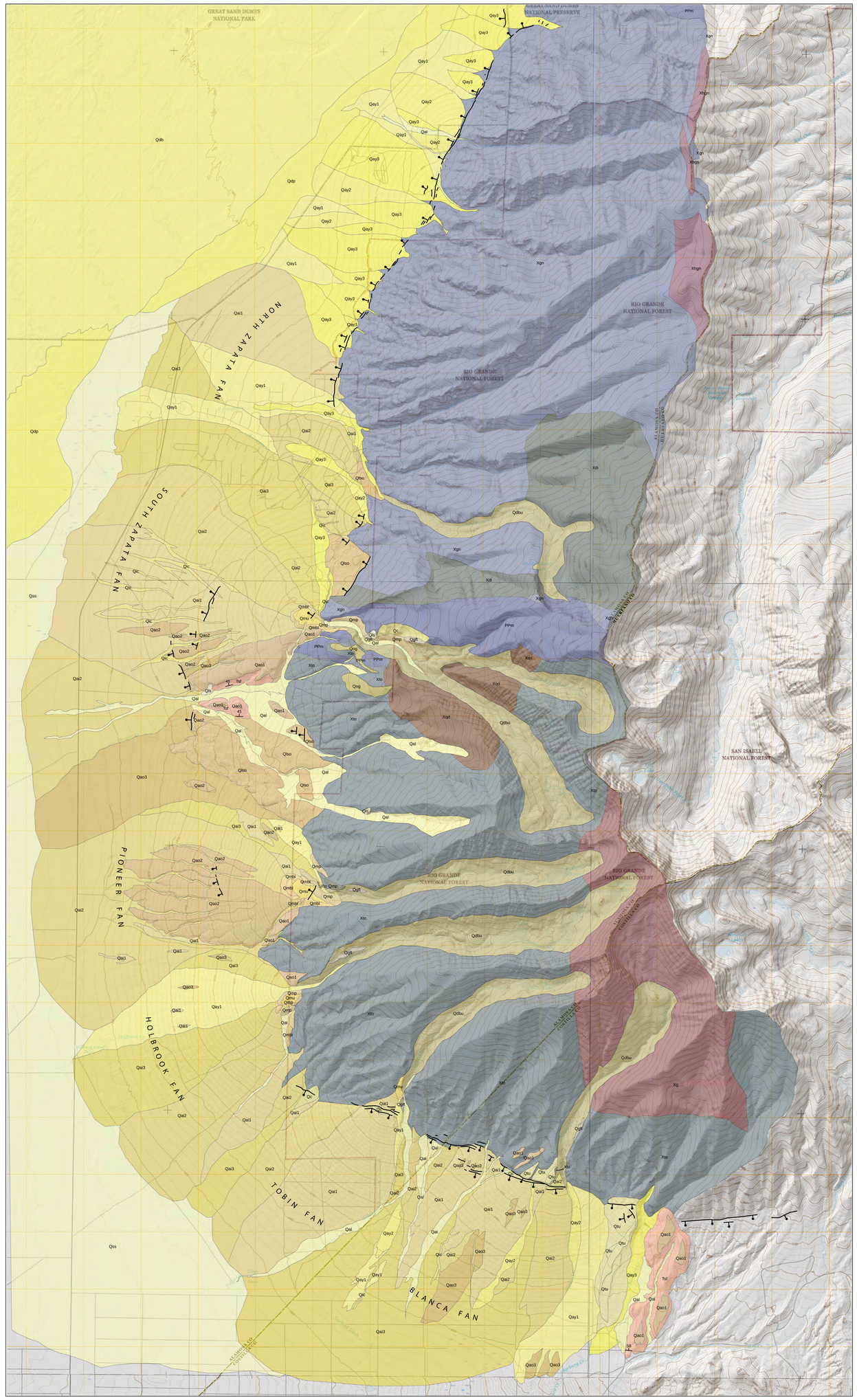
Johnson, B. R., Bruce, R. M., and Lindsey, D. A., 1989, Reconnaissance Geologic Map of the Medano Pass Quadrangle and part of the Liberty Quadrangle, Alamosa, Huerfano, and Saguache Counties, Colorado: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2089, scale 1:24,000.

Johnson, B. R., and Bruce, R. M., 1991, Reconnaissance Geologic Map of parts of the Twin Peaks and Blanca Peak Quadrangles, Alamosa, Costilla, and Huerfano Counties, Colorado: U.S. Geological Survey

Lindsey, D. A., Soulliere, S. J., Hafner, K., and Flores, R.J., 1985, Geologic Map of Rio Alto Peak and Northeastern part of Mirage Quadrangles, Custer and Saguache Counties, Colorado: U.S. Geological Survey, Miscellaneous Field Studies Map MF-1787, scale 1:24,000.

Lindsey, D. A., Johnson, B. R., Soulliere, S. J., Bruce, R. M., and Hafner, K., 1986, Geologic Map of the Beck Mountain, Crestone Peak, and Crestone Quadrangles, Custer, Huerfano, and Saguache Counties, Colorado: U.S. Geological Survey, Miscellaneous Field Studies Map MF-1878,1:24,000 scale.

McCalpin, J.P., 1982, Quaternary geology and neotectonics of the west flank of the northern Sangre de Cristo Mountains, south-central Colorado: Colorado School of Mines Quarterly, n. 77, p. 97



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1,000-meter grid: Universal Transverse Mercator, Zone 13S
10 000-foot ticks: Colorado Coordinate System of 1983 (north zone)

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Imagery ..... NAIP, July 2013
Roads ..... U.S. Census Bureau, 2015 - 2016
Roads within US Forest Service Lands ..... FSTopo Data with limited Forest Service updates 2005, 2016
Names ..... GNIS, 2016
Hydrography ..... National Hydrography Dataset, 2013
Contours ..... National Elevation Dataset, 2012
Boundaries ..... Multiple sources; see metadata file 1972 - 2016
Public Land Survey System ..... BLM, 2011
Wetlands ..... FWS National Wetlands Inventory 1977 - 2014

UTM GRID AND 2015 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
MN 8° 31' 151 MILS
GN 0° 21' 6 MILS

U.S. National Grid
100,000-m Square ID
DB
Grid Zone Designation
13S

SCALE
MILES 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10,000
FEET 0 1000 2000
KILOMETERS 0 1 2
METERS 0 1000 2000

COLORADO
MAP LOCATION

1 Medano Ranch
2 Zapata Ranch
3 Mosca Pass
4 Dry Lakes
5 Twin Peaks
6 Blanca Peak
7 Bailey
8 Blanca
9 Fort Garland
ADJOINING 7.5' QUADRANGLES
MAP EXTENT IN RED

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route
FS Primary Route
FS Passenger Route
FS High Clearance Route
Check with local Forest Service unit for current travel conditions and restrictions.

CONTOUR INTERVAL 40 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.19

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