



| | IGNEOUS ROCKS | | |
|---------------------|---|--------|---|
| <u>Flows</u> Qbm | Basalt of the Malpais (middle Holocene) Gray, vesicular basalt that contains 5% phenocrysts of pyroxene (0.5 | | NMBGMR Open-file Geologic N |
| Intrusion | 2.0 mm-long). Groundmass is 0.1-0.3 mm and a mix of plagioclase and pyroxene(?). Up to several meters thick. | Tcm | Cub Mountain Formation (lower to middle Eocene) White to pale yellow to light reddish gray, channell, 24 Jun sandstones interbedded with reddish floodplain deposits of mudstone and very finefine-grained sandstone. The slightly coarser texture of the sand (mostly mediumgrained) and reddish finegrained sandstone beds serve to distin- |
| Tit | | | guish this unit from the underlying Crevasse Canyon Formation. Channefill sandstones are tangentially cross stratified (foresets up to 50 cmthick) or horizontal-planar-bedded (mostly laminated to very thin). Sand is fineto coarse-grained (mostly mediumgrained), subrounded to subangular, moderately to westbred, locally glauconitic, |
| | mlong. Feldspar grains are commonly platy and stacked on top of one another, producing a foliated texture. Up to 25% mafic, unidentified mafic minerals 0.1-0.5 mm long. Up to 1% quartz and 1-5% possible sanidine. Orangish swirly pattern is common on weathered surfaces. | | and composed of quartz with subordinate feldspar and 35% mafic and lithic grains that include volcanic grains (field estimates). Locally, very coarse sand and pebbles are present in the channells; gravel are subrounded, moderately sorted, and composed of quartz + quartzite, rhyolite, and chert. Pebbles are 12 mm in length. Sand matrix |
| Tits | Trachyte sill (upper Eocene to lower Oligocene) Trachyte, as in unit Tit, in sills that are greater than 3 m thick. | | of conglomerate beds consists of medium very coarse grained sand. Floodplain deposits consist of claystone, mudstone, siltstone, and very fine to fine-grained sandstone. Claystone is weak red to reddish brown to reddish gray |
| Tiss | Syenite sill (upper Eocene to lower Oligocene) Feldspar-rich rock with phenocrysts of albite, microline, or orthoclase. 1-5 m-thick. | | and in thin to thick, tabular beds. Mudstone is pale red to purplish red. Siltstone is reddish brown (2.5YR 5/3) and horizontal planarlaminated to ripplemarked. Very fine - to fine-grained sandstone is pinkish gray to light gray and |
| Titlc | Trachyte of Little Cub Mountain (Oligocene). Grains are 0.1-0.8 mm and composed predominately of feldspar. There are 3-8% unidentified mafic grains (possibly amphibole) 0.52 mm long. Rock has up to 10% cavities up to 7 mm long that do not seem to be connected or aligned. Rock weathers to a brown color. Maximum thickness of | | in laminated to very thin, tabular beds. The finegrained, floodplain sandstone is subangular (minor subrounded), well-sorted, and composed of quartz and feldspar(?) with 205% lithic and mafic grains (half of which are vol- canic?). Locally, beds of light gray, fine - to medium grained sandstone are present in this formation; these look |
| Tisch | 100 m. Syenite of Chaves Mountain (Oligocene?) Slightly porphyritic syenite that contains 5% phenocrysts of potas- sium feldspar (orthoclase; Weber, 1964) and biotite. This syenite forms a sill near the Cub Mountain- Sanders Canyon Formation contact. Groundmass is composed of feldspar with 10% bioite. Thickness of 120 m. | | similar to the sands in the Sanders Canyon Formation and have 20% lithic (including abundant biotite) + mafic grains. We define the base of the Cub Mountain Formation at the top of the mottled, MnO(?) concretionearing pa- leosol at the top of the Crevasse Canyon Formation. This gives a thickness range of 37670 m. |
| Tiscu | Syenite of Cub Mountain (Oligocene?) Light reddish gray to light gray (fresh) to very pale brown (weathered), porphyritic syenite that forms a stock. Groundmass is 0.40.5 mm and composed of potassium feldspar | | MESOZOIC STRATA |
| | (orthoclase; Weber, 1964) with 15% hornblende. 1015% phenocrysts of euhderal to subhedral plagioclase and orthoclase that are 118 mm-long, and 7% phenocrysts of subhedral hornblende that are 0730 mm long. | Ксс | Crevasse Canyon Formation, undivided (Upper Cretaceous) Units Kccu , Kccl , Kccda , and Kccdi , which are described in more detail below. |
| Tisw | Sill of Willow Hill (Oligocene?) – Slightly greenish light gray intrusion that caps Willow Hill. Grains are 0.1-1.0 mm, euhdral to subhedral, and are composed of feldspar with 20% mafics and trace quartz. Phenocrysts cover | Ксси | Crevasse Canyon Formation, upper part (Upper Cretaceous) Intercalated channelfill sandstones and flood- plain deposits. This fluvial sediment differs from the overlying Cub Mountain Formation by its yellowiskgreenish |
| | about 5% of rock surface, are 1-2 mm long, and consist of orthoclase (~3%) and pyroxene (~2%). Rock was called a leucosyenite by Weber (1964), who described the matrix as being composed of altered orthoclase with minor aegeriteaugite and biotite. 240250 m-thick. | | floodplain deposits and its slightly finer sand sizes in the channefills. Sandstone channel-fills commonly occur in stacked complexes 110(?) m in thickness. Individual channel-fills are very thin to thick, tabular bedded (locally internally planar-horizontal-to cross-laminated) or tangentially crossstratified (laminated to thinlybedded). Fresh |
| Tip1 | Upper trachyandesite sill at the Polly Hills (upper Eocene?) – Upper exposed sill at the Polly Hills that extends the entire length of the hills. Rock is dark gray, fine-grained, and similar in composition to the sills at Jake Hill. 5-6 m-thick. | | colors are generally white to pale yellow to olive yellow to light gray, commonly weathering to pale yellow or yellow or brownish yellow. Sand is fine- to mediumgrained, subrounded to subangular, wellorted, and composed of guartz, 5-15% feldspar, and 1-15% gray to very dark gray lithic grains and black mafic grains (field estimates). |
| Tip2 | Syenite(?) sill at the Polly Hills (Oligocene?) – Light pink, fine- to mediumgrained syenite(?) with a granular groundmass of alkali feldspar, biotite, pyroxene, and plagioclase. Slightly porphyritic, with phenocrysts of plagio- clase that are typically altered white. Crosscutting relations with the profile is unclear. ~15 m-thick. | | Floodplain sediment consists of mudstone, siltstone, and very fine of fine-grained sandstone in laminated to thin (less commonly, medium), tabular beds; coal seams are locally common and generally up to 30 ethick (although un- common, thicker coal beds are also present). Colors for floodplain strata are light olive gray to pale olive to light |
| Tip3 | Lower trachyandesite sill at the Polly Hills (upper Eocene?) – Lowest exposed sill at the Polly Hills; pinches out to the northeast. Rock is dark gray, finegrained, and similar in composition to the sills at Jake Hill. 012(?) m -thick. | | brownish gray to gray to light greenish gray. Pebbles are found in chann e lls in the upper part of the unit, in asso- ciation with thicker foresets (up to 1 mthick). Cobbles are relatively sparse, with the largest clasts being 11x6 cm. |
| Tij1 | Upper trachyandesite sill at Jake Hill (upper Eocene?) – Upper of two sills emplaced at Jakes Hill. Rock is gray to dark gray, fine-grained intrusive. Grains are 01-0.3 mm, anhedral, and composed of plagioclase with | | Gravel are scattered or in very thin to thick, lenticular beds. Gravel are rounded, moderately sorted, and composed c rhyolite, felsic intrusive clasts, quartzite, and chert. Unit is approximately 260 m thick. |
| | ~10% mafic minerals that were not identified (probably pyroxene +ámphibole). Less than 5% phenocrysts of plagioclase and hornblende. 1520 m-thick. | Kccl | Crevasse Canyon Formation, lower part (Upper Cretaceous, Coniacian? North American Stage) – Mudstone and shale floodplain deposits interbedded with minor sandstone chanfies. The floodplain deposits consist of gray |
| Tij2 | Lower trachyandesite sill at Jake Hill (upper Eocene?) – Lower of two sills emplaced at Jakes Hill. Rock is gray to dark gray, fine-grained intrusive. Grains are 01-0.3 mm, anhedral, and composed of plagioclase with | | to dark gray to greenish gray, fissile to blocky shale and mudstone. Estimate- B % coal beds or organierich mud- stone beds that are generally less than 1 rt hick. Sandstone channelfills are 1-5 m-thick, pale yellow to yellow, and |
| | ~10% mafic minerals that were not identified (probably pyroxene +ámphibole). Less than 5% phenocrysts of plagioclase and hornblende. 912 m-thick. | | contain a variety of bedding: mostly laminated to thick and tabular to cro st ratified. Sand is subrounded to suban- gular, well-sorted, and composed of quartz, 1-20% feldspar, and 3-10% lithic and mafic grains. Unit is approxi- mately 290 m thick. |
| Tita | Trachyandesite (upper Eocene to lower Oligocene) – Gray, porphyritic igneous rock in sills or dikes that contain pyroxene and/or plagioclase phenocrysts. Phenocrysts are commonly 055mm in length and subhedral; locally, | Kccda | Crevasse Canyon Formation, Dalton Sandstone(?) (Upper Cretaceous, Coniacian North American Stage) – Primarily sandstone that locally contains marine invertebrate fossils (including oysters). Sandstone is in very thin to |
| | pyroxene phenocrysts are as much as 22 mm long. Groundmass is commonly 0.0.5 mm, subhedral to euhedral and composed of plagioclase with minor pyroxene. Rock produces a strong varnish upon weathering. Dikes are | | medium, tabular beds that are internally plan d iorizontal laminated to tangential crosbaminated (up to 30 cm thick). Base of unit contains hummocky cross stratification (1 m thick or less) underlain by ~1 m of bioturbated |
| Tib | up to 6 m-wide. Basaltic dike (upper Eocene to lower Oligocene) Fine-grained, dark gray to greenish gray rock that is com- | | sandstone. Sand is pale yellow and fine to mediumgrained, subrounded to subangular, well sorted, and composed of quartz, 15-25% feldspar, and 15-20% lithic and mafic grains. Top contact drawn at a thick, calcareous, orangish |
| Tibta | monly chloritized or otherwise altered. Dikes are less than 2 m wide and generally strike eastrest. Basaltic trachyandesite (upper Eocene to lower Oligocene) – Gray (fresh), extremely porphyrtic dike rocks. | | sandstone bed with trace to very minor shell fossils(including oysters); lower part of this fingrained sandstone bed may be planarhorizontal laminated and upper part may be a sandy limestone255 m-thick. |
| | Weathers to a brownish gray color and produces a strong varnish. This distinct rock contains large, subhedral to euhedral, plagioclase phenocrysts that are 15 mm long, with trace phenocrysts up to 18 mm ong. Ground mass is 0.1-0.2 mm and composed of plagioclase with minor mafic minerals. Dikes are as wide as 6 m. | Kccdi | Crevasse Canyon Formation, Dilco Member (Upper Cretaceous, Coniacian North American Stage) – Interbed- ded gray shale and minor yellow sandstone beds. Coal bed(s) observed in unit on west slope of Willow Hill. Sand- stone is in very thin to thick, tabular beds that are internally horizontal plandaminated to crosslaminated. Strata |
| Titabr | Trachyandesite correlative to Barber Ridge unit (upper Eocene to lower Oligocene) – Gray (fresh), porphy- ritic rock with pyroxene +/ plagioclase phenocrysts. Rock weathers to brownish gray. This rock fills dikes that | Kgs | interpreted to be a mix of fluvial and lagoonal facies. Approximately 1228 m-thick. Gallup Sandstone (Upper Cretaceous, lower Coniacian Stage) Sandstone tongues interbedded with light gray to |
| Tia | strike southeast. The dikes contain 1015% pyroxene phenocrysts that are 0.523 mm long. Groundmass is 0.1-1.0 mm and composed of plagioclase with 2025% mafic minerals ~0.1 mm in size. Dikes are up to 6 m wide. | | gray shale intervals. In a given sandstone tongue, strata progress upwards from 21m of bioturbated sand to 42 m of hummocky cross stratified sand to several meters of tangential cross tratified (up to 30 cm thick foresets) and hori- |
| Tig | Gabbroic dike (upper Eocene) – Dark gray rock composed of plagioclase with ~30% mafic minerals of pyroxene or hornblende. Plagioclase is 0.1-0.5 mm and the mafic minerals are euhedral and 2 mm. | | zontal-planar laminated sand. Sand is white to pale yellow to yellow, fineto medium grained, subrounded to suban- gular, well sorted, and composed of quartz with-110% feldspar and 3-10% lithic and mafic grains. Oyster shells are |
| | LOWER TERTIARY STRATA | Karad | abundant locally. The top of the Gallup Sandstone is placed at the top of the sandstone tongue below the-coal bearing Dilco Member of the Crevasse Canyon Formation. Unit is 100110 m-thick. |
| Twtb | Walker Group, trachybasalt flows (upper Eocene) Aphanetic, very dark gray rock inferred to be a basalt. Weathered surfaces are light gray and shiny, and locally a 13 mm splotchy pattern is present. Flows appear to be 1-3 m-thick, but exposure is poor. Unit includes minor finegrained flows containing pyroxene and plagioclase | Kmd | Mancos Shale, D -Cross Member (Upper Cretaceous, middle Turonian to lowest Coniacian Stage) Dark gray to greenish gray, fissile shale. This unit is yellow and relatively sandy-silty near the western boundary of the quad- rangle, where it is in laminated to medium, tabular to wavy beds. Shale is pland orizontal laminated or very thinly bedded, and commonly silty. Sandstone beds are very thin to medium and tabular. Approximately 90t hick. |
| Twsf | phenocrysts. Age is not constrained. Unit is 115130 m-thick on the Oscura quadrangle (Koning et al., 2010). Walker Group, sediments and minor volcanic flows (middle? to upper Eocene) Conglomerates and sand- stones interbedded with minor volcanic flows that include tradchybasalt (univtb) and possibly pyroxene and | | SUBSURFACE UNITS DEPICTED ONLY IN CROSS -SECTION A -A' |
| Tws | plagioclase-phyric flows. Walker Group, sediments (middle? to upper Eocene) Light gray volcaniclastic sediment consisting of inter- bedded sandstone and conglomerate. Sandstone is fi rte very coarse-grained, subangular to subrounded, poorly | Km+Kth | Mancos Shale and Tres Hermanos Formation, undivided (Upper Cretaceous) – Upper part includes the DCross Member. This is underlain by ~30 m of sandstone of the Tres Hermanos Formation, followed by more gray, marine |
| | sorted, and composed of feldspar (probably mostly plagioclase), minor quartz, and -1125% volcanic lithic grains and mafics. Gravel consist of pebbles and cobbles that are poorly sorted, subrounded to rounded, and composed of | Kd | shale. Dakota Formation (upper Cretaceous) — Fine- to mediumgrained sandstone, with local pebbles. Sandstone is |
| | porphyritic, intermediate volcanic rocks. Unit it 270 mthick at one locality in the Oscura quadrangle to the south (Koning et al., 2010), but its thickness here is difficult to ascertain. | Trm | tangential to planar cross-stratified or in medium to thick, tabular beds. Moenkopi Formation (middle Triassic) – Interbedded sandstone and pebbly sandstone chanfiels and floodplain |
| Tsc | Sanders Canyon Formation (middle Eocene) Light gray strata that disconformably(?) overlies the Cub Moun- | 1111 | deposits that were deposited in a fluvial setting. Sand is typically light purplish white, red, reddish gray, or light gray (weathering to light brownish gray) and fineto mediumgrained. Floodplain deposits are composed of weak red to |
| | tain Formation. This fluvial sediment consists of interbedded chann d ills and floodplain deposits. Bedding in channel-fills is horizontal-planar (locally slightly wavy) in laminated to very thin beds. Locally, planar- to tangen- | | red to reddish brown mudstone, siltstone, and very fine of fine-grained sandstone. About 100 m thick in adjoining |
| | tial cross-lamination is present (foresets up to 4 cmthick). Sand is light gray, very fine - to mediumgrained (mostly fine-grained), subangular, wellsorted, and composed of plagioclase, 1-25% volcanic lithic grains, and 5- | Psa | quadrangle to the west (Zeigler and Allen, 2010). Sand Andres Formation (lower to upper Permian) – Light gray limestone and tannish dolomite that grade upward |
| | 10% potassium feldspar (field estimates). Sandstone chann d ills are typically well -cemented by carbonate (Cather, 1991). Floodplain sediment consists of claystone and siltstone in thin to thick, tabular beds that are lo- cally internally horizontal planarlaminated. About 120 m of this unit is exposed on the Cub Mountain quadrangle. | Ру | into interbedded carbonate and gypsum beds. 2 :207 0 m-thick. [Description summarized from Koning et al., 2010]. Yeso Formation (lower Permian) – Yellow and red siltstone, limestone, and gypsum. 630 m-thick. |
| Tscf | Total thickness may be as much as 400 m. Sanders Canyon Formation, fine grained (lower to middle Eocene)Light gray to maroon mudstone that is locally reduced and generally massive. Interpreted to lie near the top of the Sanders Canyon Formation 50 0 m | | |



