DESCRIPTION OF MAP UNITS

CRETACEOUS SEDIMENTARY ROCKS

Ked Edwards Formation (Cretaceous)—Thinly bedded micritic limestone with gray and brown chert nodules. Only present as poorly exposed, thin (less than 20 feet thick) erosional remnants that cap two hills above an elevation of about 1940 feet in the northwest part of the quadrangle.

UNCONFORMITY

PALEOZOIC SEDIMENTARY ROCKS

MOORE HOLLOW GROUP

RILEY FORMATION

\_rh Hickory Sandstone Member (Late Cambrian)—Quartz sandstone. From Hunt and Helper (2024): "Subdivided into three informal units (upper, middle, and lower) based upon variations in color, grainsize, porosity, bedding thickness, cementation, and topographic expression (Mutis-Duplat, 1982; Becker, 1985). Where not differentiated, the unit generally consists of brown to red quartz sandstones. Diagnostically there is little to no calcite and glauconite. Locally a major aquifer in the subsurface. The contact with the overlying Cap Mountain is placed at the first resistant calcareous cemented sandstone, which is often expressed as a topographic scarp and heavily vegetated break in slope. About 400 ft thick (Becker, 1985)."

\_rh(u) Upper Hickory (Late Cambrian)—Sandstone. Hematitic quartz arenite. From Hunt and Helper (2024): "Massive to thinly-bedded, red, medium- to coarse-grained, well-rounded, moderately sorted, friable, hematite and limonite cement, and glauconitic with calcite cement toward the top. Hematite locally forms ooids-like coatings around quartz grains. Poorly exposed recessive unit, forms topographically low benches that develop deep red soils often used for cultivation or agricultural purposes. Unit grades into overlying Cap Mountain, marked by calcite-cemented sandstone with increased resistance and relief in landscape. The unit is locally an aquifer. About 75 ft thick (Becker, 1985)."

\_rh(m) Middle Hickory (Late Cambrian)—Quartz arenite. From Hunt and Helper (2024): "Thick- to thin-bedded, with laterally continuous beds, quartz and hematite cement (increasing upward), fine- to coarse-grained, rounded to subrounded, poorly sorted, smaller scale trough cross-bedding, light brown to orangish brown, and phosphatic brachiopods, and abundant trace fossils. Locally silty laminations and interbeds. Laterally continuous mudstone and siltstone interbeds. This unit is indurated and forms ridges, outcrops and low hills owing to a weathering-produced, near-surface lithification process (Brann Johnson, personal communication). The unit is often thickly vegetated. Little to no agriculture and is considered an aquitard (Brann Johnson, personal communication). Up to 145 ft thick (Becker, 1985)."

\_rh(l) Lower Hickory (Late Cambrian)—Sandstone. Quartz arenite. From Hunt and Helper (2024): "Massive and discontinuous beds, large amplitude trough cross-bedding, very coarse- to medium-grained, quartz and hematite cement, poorly sorted, rounded to subrounded, light to dark brown, friable, locally conglomeratic with feldspar grains, granitic to metamorphic pebbles and at base. Ventifacts described and mapped near the base (Alexander, 1952). Very porous and permeable and locally is a major aquifer unit. Recessive and poorly exposed unit that forms topographically low benches with well-developed soils often in agricultural use. Top of the unit is the first resistant, well-cemented sandstone. Unit rests unconformably on the Precambrian surface and has variable thickness, ranging from 0 to about 55 ft thick (Becker, 1985)."

UNCONFORMITY

MESOPROTEROZOIC IGNEOUS ROCKS (SUPERSUITE)

SYN- TO POST-KINEMATIC GRANITES (SUITE)

=tm Town Mountain Granite (Mesoproterozoic)—From Hunt and Helper (2024): "Porphyritic to equigranular, pink, fine- to coarse-grained granite. Composed of pink microcline (up to 3 cm), vitreous gray quartz, cloudy white plagioclase, biotite and hornblende, and containing aplitic to pegmatitic granite dikes and milky quartz veins. Locally topaz-bearing (White, 1960). Undeformed microcline phenocrysts locally define a flow foliation and/or lineation, especially near pluton margins. Granite occurs in plutons up to 13 miles in size that tend to be circular vertical cylinders with concentric textural variations. Boundaries range from sharp and regular to highly irregular with wide zones of mixed rock; U/Pb zircon ages for these bodies are 1119-1070 Ma (Walker, 1992; Reed, 1999). Weathers to form grus aggregate; where granite is deeply weathered and grus well developed it locally underlies areas in cultivation. The large granite body in the south-central portion of the quadrangle is the Eckert pluton (Barker and Reed, 2010). It is undated, however the Katemcy Pluton to the northwest is reported to be 1070 ± 2 Ma (U/Pb zircon age; Walker, 1992).

=fg Fine-grained granite (Mesoproterozoic)—Fine-grained gray and pink granites, often foliated or migmatitic, thought to be derived from partial melting of Valley Spring Gneiss (Salyapongse, 1978).

=i Pegmatite or aplite (Mesoproterozoic)—Small bodies of pegmatite or aplite consisting of quartz and feldspar.

=q Quartz vein (Mesoproterozoic)—Vein quartz. Milky white, monomineralic veins of quartz, most too small to map but up to 1.5m wide, that cut across gneissic foliation or schistosity.

mETAiGNEOUS rOCKS (sUITE)

=fg Fine-grained granite (Mesoproterozoic)—Fine-grained gray and pink granites, often foliated or migmatitic, thought to be derived from partial melting of Valley Spring Gneiss (Salyapongse, 1978).

=mi(ts) Tremolite schist (Mesoproterozoic)—Tremolite schist. Slightly foliated, dark green, non-resistant, composed nearly entirely of tremolite with secondary chlorite and opaque oxides (Droddy, 1978).

=mi(md) Metadiorite (Mesoproterozoic)—Metadiorite. Black and white, fine- to medium-grained, poorly exposed xenolith(?) within Town Mountain Granite of the Eckert Pluton. About 70% zoned and altered plagioclase, 25% amphibole and biotite (replacing amphibole) and 5% quartz and opaque oxides (Droddy, 1978).

=mi(mb) Metabasalt (Mesoproterozoic)—Metabasalt (Droddy, 1978). Hydrothermally altered basaltic breccia containing dark green chlorite (~50%) and plagioclase (An01; ~20%) with light green epidote (20%) and quartz veins. Known only from a shaft astride the trace of the E-W fault near the eastern edge of the map.

MESOPROTEROZOIC METAMORPHIC ROCKS

VALLEY SPRING GNEISS SUPERSUITE

=vs(5) Unit 5-calc-silicate-bearing gneiss and quartz-feldspar gneiss (Mesoproterozoic)—Mainly fine-grained foliated calc-silicate-bearing gneiss and quartz-feldspar gneiss with minor quartzite, biotite and hornblende schist, amphibolite and plagioclase-pyroxene rock (Droddy, 1978). Foliated calc-silicate-bearing gneiss has mm-scale green calc-silicate-rich laminae that alternate with light pinkish to grayish feldspar bands. Microcline and plagioclase predominate (up to 70%; oligoclase more abundant than microcline), quartz is highly variable (6-52%, commonly 28-40%). Calc-silicates are actinolite (up to 22%), green clinopyroxene (up to 12%), occasional brown andraditic garnet (intergrown with clinopyroxene; up to 10%) and epidote (up to 18%), with accessory calcite, titanite, and Fe oxides. Forms rounded knobs. Lacks green calc-silicate patches common to Unit pCvs(4) and is finer grained. Gradational to pCvs(3) over hundreds of meters by decrease in amphibole, with a resultant lighter color. Relative increase in amphibole and epidote marks pCvs(2) contact. Equivalent to Mutis-Duplat (1982) unit VS2 and contains layers of unit VS1(4). Approximately 550 m thick in SW corner of map.

=vs(5bhs) Unit 5-biotite-hornblende schist (Mesoproterozoic)—Biotite-hornblende schist (Droddy, 1978). Dark gray, fine-grained, interlayered with quartz-feldspar gneiss. Equivalent to VS2(2) of Mutis-Duplat (1982).

=vs(4) Unit 4-quartz-feldspar gneiss (Mesoproterozoic)—Mostly pink quartz-feldspar gneiss with either accessory mica or calc-silicates (Droddy, 1978). Forms prominent NE- to NW-trending ridges. Contact with pCvs(1b) and pCvs(2) is marked by a micaceous or hematitic horizon in the west-central part of the quadrangle; not as well defined elsewhere. Contact with pCvs(3) is an increase in amphibole content and hence a transition from pink to dark green over a few tens of meters. Unit pCvs(2) gneiss is slightly lighter with fewer calc-silicates, and pCvs(2) has parallel feldspar bands that are largely absent or poorly developed in pCvs(4). Equivalent to unit VS1 of Mutis-Duplat (1982) but includes parts of his units VS2 and VS3. Approximately 1220-1280 m thick (Droddy, 1978).

=vs(3) Unit 3-actinolite-rich gneiss (Mesoproterozoic)—Actinolite-rich gneiss (Droddy, 1978). Calcium-rich, slightly foliated, fine- to medium-grained, pink and green, with abundant green amphibole, albite, microcline and lesser quartz (10%). Comprises discontinuous outcrops not confined to a stratigraphic horizon – most lie near or at top of pCvs(2), but biggest is at pCvs(4)-pCvs(5) contact. In both cases it is always found near pCvs(1b). Distinctive for abundance of green amphibole (21-36%; tremolite-ferrotremolite). Plagioclase (An2) is more abundant than microcline; quartz is present at about 10%; contains rare pale green clinopyroxene. Locally overlain by unit pCvs3.

=vs(2) Unit 2-calc-silicate-bearing gneiss and quartz-feldspar gneiss (Mesoproterozoic)—Well-foliated, pink, fine-grained quartz feldspar gneiss, with or without foliation-parallel calc-silicate (actinolite, andradite, epidote) (Droddy, 1978). Forms broad ridges over 120m high. Locally overlain by Unit pCvs(3); in direct contact with pCvs(4) or pCvs(1b). Contact with pCvs(1b) is gradational and poorly exposed. Pink, resistant, gneissic bands up to 2 cm thick are composed of quartz and microcline that alternate with less resistant light pink to white bands of quartz and plagioclase. Biotite, muscovite and opaque oxide are common up to a few percent. Calc-silicate -bearing gneiss, most common near the base, contains abundant, distinctive greenish patches of elongate brown andradite, actinolite and epidote (replacing plagioclase and actinolite) with accessory titanite and opaque oxide. Ca-silicates comprise 15-25% in these gneisses that otherwise contain 25-40% quartz, 12-25% microcline and 24-40% albite (An2).

=vs(1c) Unit 1c-chlorite-rich gneiss (Mesoproterozoic)—Chlorite-rich gneiss (Droddy, 1978). Lenses of fine-grained greenish gneiss containing chlorite (replacing amphibole), quartz and albite. No potassium feldspar. Lenses are localized to pCvs(1b).

=vs(1b) Unit 1b-biotite gneiss, migmatite, muscovite schist or hematite schist (Mesoproterozoic)—Biotite gneiss, migmatite, muscovite schist or hematite schist (Droddy,1978). Abundant biotite and Fe-Ti oxide; complexly interlayered with pCvs(1a); contacts, gradational over 20-30m, are marked by an increased grain size and mica content. Gneisses forms rounded ridges and knobs, schist and migmatites weather to flatter terrain. This unit is not restricted to a single stratigraphic horizon but is instead within, or in contact with, units pCvs(1a), pCvs(2), pCvs(3), pCvs(4) and pCvs(5). Heterolithic, coarser grained and more mica-rich than pCvs(1a). Microcline 30-50%, quartz 30-40%, plagioclase 10-20%, mica 10-20%, Fe-Ti oxides 5%. Granoblastic gray to red and black biotite gneiss is the most common subtype containing quartz (up to 68%, commonly30-40%), microcline (up to 60%, commonly 30-50%), plagioclase (up to 44%, commonly10-20%), biotite (up to 25%), muscovite (to 5%; replacing sillimanite) and Fe-Ti oxide (to 5%), with both magnetite and ilmenite present. More foliated gneiss of this variety contains ovoid quartz-muscovite-sillimanite pods that weather out in relief. These are microcline deficient; a few contain almandine-spessartine garnet.

=vs(1a) Unit 1a-microcline-rich gneiss (Mesoproterozoic)—Microcline-rich gneiss (Droddy, 1978). Pink, fine-grained, weakly foliated with an appearance that resembles fine-grained granite. 60-70% microcline, 25-30% quartz, 10% opaques, with minor albite and biotite. Two varieties: 1) a moderately foliated, compositionally layered fine-grained gneiss with abundant microcline porphyroblasts up to 1-2 mm in size; 2) poorly foliated, relatively quartz-rich (to 40%) gneiss with elongate quartz up to several mm long.

LOST CREEK GNEISS SUITE

=lc Lost Creek Gneiss augen gneiss (Mesoproterozoic)—Granitic augen gneiss (Droddy, 1978; Hunt and Helper, 2024). Medium- to coarse-grained, pink, slightly foliated with elongate microcline augen (to 3cm) and subparallel biotite-rich bands (up to 1mm thick) that wrap augen. Sharp but interfingering contact with pCvs(5). Poorly exposed. A single sample contains 55% feldspar (subequal albite and microcline), 50% quartz, 4% biotite and <2% magnetite. Microcline augen are perthitic, twinned and contain albite inclusions. Albite (An4-13) is also within myrmekite around microcline, and as anhedral grains.