

Map Unit Properties Table: Saguaro National Park-Tucson Mountain District (Saguaro West)

Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
QUATERNARY (Holocene)	Alluvium (Qal)	Sand, silt, and gravel. Locally includes small alluvial fan and colluvial deposits (Qf, Qc) at margins of valley bottoms. Deposited along streams and valley floors in the northern part of the park.	Low.	Low. Located in floodplains.	Flash flooding?	Potential animal remains.	Possible American Indian sites.	Sand and gravel.	Ephemeral stream channels susceptible to flooding.	Hiking ephemeral stream beds.	None.
	Colluvium (Qc)	Poorly sorted silt- to boulder-sized material. Grades downslope into Qf. Near-surface caliche zones locally well developed. Located on slopes and in steep valleys.	Silt: low. Caliche: high.	Limited areal extent; on slopes.	Unknown.	Potential animal remains.	Unknown. Outcrops limited in areal extent.	None documented.	Mix of boulders and lowland desert scrub.	Pack trails; Mam A-Gah Picnic Area.	None.
QUATERNARY (Pleistocene-Holocene)	Alluvial-fan deposits (Qf)	Gravel, sand, and silt in variable dissected fans. Locally contains moderately rounded to well-rounded boulders. Near-surface caliche zones locally well developed. Forms fan-shaped topography along the margins of valley bottoms.	Silt: low. Caliche: high.	Heavily developed with buildings (Old Tucson), roads, and pipelines.	Erosion may impact roads.	Potential animal remains.	Possible American Indian sites.	Sand and gravel.	Variety of lowland desert scrub plants (saguaro, cholla, prickly pear, barrel, ocotillo, creosote bush).	Arizona-Sonora Desert Museum; Desert Discovery Nature Trail; other trails.	None.
QUATERNARY (Pleistocene)	Older alluvial-fan deposits (Qfo)	Gravel, sand, and silt. May include some upper Tertiary fan deposits.	Low.	Roads and jeep trails build on fan deposits.	Erosion may destabilize structures.	Potential animal remains.	Possible American Indian sites.	Sand and gravel.	Variety of lowland desert scrub plants (saguaro, cholla, prickly pear, barrel, ocotillo, creosote bush).	Jeep trails; hiking; roads.	None.
TERTIARY (Oligocene)	Intrusive andesite (Tai)	Dark gray andesite containing sparse small phenocrysts of plagioclase and pyroxene. Limited exposures.	High.	Not mapped in park.	Limited exposure.	None.	Not mapped in park.	Plagioclase, pyroxene.	Not mapped in park.	Not mapped in park.	None.
	Intrusive dacite (Tdi)	Gray to brown porphyritic dacite containing 10% to 20% phenocrysts of blocky plagioclase and altered biotite. Intrusion at Beehive Peak possibly related to similar dacite lava flow complex (Tdr) along the southern margin of USGS map I-2205 (Lipman 1993).	High.	Not mapped in park.	None documented.	None.	Not mapped in park.	Plagioclase, biotite.	Not mapped in park.	Not mapped in park.	None.
	Intrusive rhyolite (Tri)	Light tan to gray rhyolite; locally flow layered near contacts. Contains small phenocrysts of plagioclase and biotite, commonly altered.	High.	Linear features; not applicable.	Very limited exposures.	None.	Very limited exposures.	Plagioclase, biotite.	Very limited exposures.	Very limited exposures.	None.
	Volcanics of Tumamoc Hills (Tba, Tr, Tdr)	Tba: Basaltic andesite. Dark-gray, vesicular, olivine-bearing flows. Individual flows up to 25 m (82 ft) thick; overall thickness about 100 m (300 ft). Layered with Tr and Tvs. Basal flow at eastern margin of quadrangle is plagioclase “turkey-track” andesite. Potassium-Argon (K-Ar) radiometric ages are 20 to 29.5 million years old. Tr: Rhyolitic ash-flow tuff. Tan, partly welded silicic rhyolite; sparse small lithic frags, and a few quartz sanidine phenocrysts. K-Ar sanidine ages are 26 to 30 million years old. 25 m (82 ft) thick. Tdr: Dacite-rhyolitic lava flows or domes. Massive, grayish-brown, with about 15% phenocrysts of plagioclase and oxidized biotite. Unconformably overlies several units of Cat Mountain Tuff and postcaldera lava flows. Similar to Tdi dike at Beehive Peak. Exposed southeast of the park.	High.	Not mapped in park.	Rockfall?	None.	Not mapped in park.	Olivine; Tba: once used as building stone.	Not mapped in park.	Not mapped in park.	Tba: In part erupted from spatter cone 0.5 km (0.3 mi) east of map. Tdr: Younger than TKb.
	Safford Dacite (Tsf, Tsv, Tss, Tst, Tsm)	Tsf: Lava flows. Gray to light-brown dacite and rhyolitic lava flows with 10% to 20% phenocrysts of plagioclase, biotite, and augite. Individual flows are 25 to 100 m (82 to 300 ft) thick; most sections have only 1 or 2 flows; interflow contacts are mapped; flow horizons are numbered from oldest to youngest (Tsf1 to Tsf4). K-Ar biotite ages are 39.5 million years old (Tsf1), 26.7 to 28.6 million years old (Tsf2), 25.1 million years old (Tsf4). Argon-Argon radiometric age (Ar/Ar) biotite age is 26.6 million years old (Tsf1). Tsv: Vent intrusions. K-Ar biotite age on Tsf4 is probably valid for this vent. Tss: Vent splatter. Intermixed black glassy and red-brown devitrified lenses of near-vent dacitic splatter at head of Sunset Road. Vent concealed beneath alluvial-fan deposits to east. Tst: Tuffaceous rocks. White to light-gray and tan, nonwelded ash-flow tuff, airfall tuff, tuff breccia, and minor tuffaceous sedimentary rocks. Thickness 0 to 20 m (66 ft). K-Ar biotite age 25.9 ±1.4 million years old. Tsm: Mudflow deposits. Red-brown indurated conglomerates containing predominantly rounded clasts of Safford Peak dacitic lavas as much as 0.5 m (1.6 ft) in diameter. As much as 50 m (160 ft) thick in outcrops along the ridge between Panther and Safford Peaks.	High.	Unknown. Rugged terrane with ridge crests and steep slopes.	Unknown. Possible rockfall and landsliding.	Potential plant fossils in interbedded sedimentary layers.	American Indian pictographs; other sites possible.	Plagioclase, augite, biotite.	Lowland communities of desert scrub and desert grasslands.	Pictographs near Picture Rocks Road; pack trails.	Tsv; 2 necks were probably feeder for uppermost flow preserved only on east side of Safford Peak (Tsf4) and lowermost widespread flow (Tsf1).

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TERTIARY (Oligocene)	Volcaniclastic sedimentary rocks (Tvs)	Light gray to tan, bedded, reworked tuffaceous sediments; includes conglomerate containing clasts derived from TKd of Twin Hills. Interlayered with Tba and Tr lava flows. Broadly correlative with volcaniclastic units of the Safford Dacite. Thickness 0 to 30 m (98 ft). Exposed on Tumamoc Hill.	Variable.	Slope exposures; not in park.	Unknown.	None.	Not mapped in park.	None documented.	Not mapped in park.	Not mapped in park.	None.
TERTIARY (Oligocene and Eocene?)	Tertiary colluvium (Tc)	Indurated red-brown breccia and conglomerate, containing angular clasts of Cretaceous and Tertiary lavas; probably more widespread beneath lava flows than mapped. Poorly exposed beneath and between Tertiary lavas.	Low to moderate. Forms ledges.	Limited, insignificant slope exposures in northern part of park.	Possible minor rockslides.	None.	Unknown. Limited exposures.	None documented.	Limited exposures on slopes.	Insignificant to recreation use.	None.
ROCKS OF THE TUCSON MOUNTAINS CALDERA CYCLE											
LOWER TERTIARY/ UPPER CRETACEOUS	Dikes and irregular intrusions (TKai, TKap, TKs, Kgp)	TKai: Andesite dikes. Dark-gray, sparsely porphyritic and aphanitic, containing small phenocrysts of plagioclase and augite. Northerly trending dikes may be mid-Tertiary. TKap: Porphyritic andesite. Gray, coarsely porphyritic; 61% to 62% quartz, containing 15% to 25% phenocrysts of plagioclase and altered mafic minerals. May be an irregular laccolith. Intruded semi-conformably along the TKvs-TKd contact. Exposed on north slope of Twin Hills, south of park. TKs: Porphyritic silicic dikes. Light gray to tan porphyritic rhyolite, dacite, and fine-grained granite (68% to 73% quartz). Locally flow layered near margins. Individual dikes up to 20 m (66 ft) wide and traceable along strike for up to 6 km (4 mi). May include small mid-Tertiary dikes, especially with northerly trends. One K-Ar age is 72.3 ±1.7 million years old. Silver Lily dike swarm. Kgp: Porphyritic granodiorite. Tan to light-gray, fine-grained, 63%-70% quartz, dikes and irregular plugs. Phenocrysts (10% to 30%) include plagioclase, potassium feldspar, quartz, and biotite. Most intrusions in northern Tucson Mountains may be offshoots of Amole pluton; some may be feeders for Kyap. Discontinuous alteration and disseminated weak copper mineralization. Exposed south of park in Saginaw Hill area.	High.	TKai and TKs are linear features with limited extent. TKai and Kgp are Not mapped in park.	None. TKai and TKs have limited areal extent.	None.	Minimal. Few exposures in the park.	Precious and industrial metals occur where dikes are in contact with Amole Arkose.	Limited exposures.	Insignificant to recreation use.	TKs: East-west trends typical for dikes associated with Laramide Orogeny.
	Volcaniclastic sedimentary rocks (post-collapse) (TKvs)	Well-bedded gray, tan, and buff volcaniclastic sandstone, shale, and local conglomerate; limited thickness and areal extent, lateral lithologic variability, occurrence at many stratigraphic horizons; generally poor exposure. Contains abundant detritus from underlying Cat Mountain Tuff. Thickness 0 to 50 m (160 ft); maximum thickness on northeast slope of Twin Hills, southeast of the park.	Variable.	Limited to a few outcrops in the northern part of the park.	None documented.	None.	Minimal. Few exposures in the park.	None documented.	Limited exposures.	Insignificant to recreation use.	None.
	Southeastern post-collapse volcanics (TKb, TKbi, TKa, TKd, TKdl, Kab)	TKb: Tuff of Beehive Peak. Light gray to tan, massive dacite ash-flow tuff (69% to 70% quartz) containing 35% to 45% phenocrysts of plagioclase, sanidine, resorbed quartz, and biotite. Abundant small, angular fragments of Cretaceous sandstone and intermediate-composition volcanic rocks. Mostly non-welded to weakly welded; compaction foliation commonly obscure. Nearly vertical compaction-flowage foliation of pumice well developed within a few tens of meters of TKbi. Age relations with respect to nearby postcaldera lavas, such as dacite of Twin Hills, uncertain due to lack of exposed contacts, but probably younger and unconformable. Designated Lower Tertiary or Upper Cretaceous because K-Ar biotite age (60.2 ±1.8 million years old) may be only a minimum age. TKbi: Tuff of Beehive Peak. Vent intrusion. Funnel-shaped intrusion of flow-layered dacite; similar to TKb except for no rock fragments. Well-developed flow layering, especially near contact with cogenetic tuff. TKa: Andesite. Local flow of dark-gray, sparsely porphyritic andesite (57.5% quartz). Contains a few small plagioclase phenocrysts, mostly replaced by calcite and other alteration products. Maximum preserved thickness 15 m (49 ft). TKd: Dacite. Massive, light-gray dacite lava flows (65% to 69% quartz), containing 20% to 35% phenocrysts of plagioclase, biotite, and hornblende. Most exposures consist of a single flow as much as several 100 m thick. Flow layering locally well developed near base of flows. Weakly propylitically altered throughout, suggesting that K-Ar biotite date (58.3 ±1.7 million years old) is a minimum age. Maximum preserved thickness 350 m (1,150 ft). TKdl: Dacite. Lower flow. Locally occurs on northeast slope of Twin Hills; interlayered with TKvs. Kab: Andesite. Dark-gray flows of porphyritic andesite (62% quartz). Phenocrysts (10% to 15%) of plagioclase, augite, and serpentine pseudomorphs after olivine(?). Thickness up to 50 m (160 ft).	Relatively high, but less resistant than welded tuff.	Not mapped in park. Exposed south of the park.	Not mapped in park. Exposed south of the park.	None.	Not mapped in park.	Plagioclase, sanidine, quartz, and biotite.	Not mapped in park.	Not mapped in park.	TKb: Local extent (a few sq km). Includes the abandoned names “beehive rhyolite” and “biotite rhyolite.” Previously interpreted as intrusive. TKd: formerly called “Shorts Ranch andesite”, but this name and designation are inappropriate and abandoned.
CRETACEOUS (Upper)	Amole Pluton (Kaa, Kag, Kad)	Kaa: Aplite. Dikes, sheets, and irregular veins of fine-grained aplite (77% quartz), consisting mostly of quartz and alkali feldspar. K-Ar biotite age 77.0 ±2.2 million years old. Kag: Granite. Light-pinkish-gray, medium-grained two-feldspar biotite granite (70% to 77% quartz). Contacts with granodioritic border are commonly gradational, but locally sharp. K-Ar biotite age 73.3 ±3.3 million years old. Interior of pluton. Kad: Granodiorite. Dark-gray, medium-grained, equigranular granodiorite (58% to 63% quartz), with abundant biotite. K-Ar biotite age 75 to 77 ±2 million years old; Ar/Ar biotite-orthoclase age 73.0 million years old. Border zone exposed on Amole Peak and Signal Hill.	High.	Steep slopes and peaks in western part of park; granite and granodiorite provide firm foundations.	None documented; potential rockfall.	None.	Possible American Indian sites; petroglyphs?	Sulfides, copper oxides, carbonates, phosphates.	Vegetation limited to slope wash and fractures; saguaro cactus, ocotillo, and creosote bush.	Hiking and pack trails (Hugh Norris Trail); Sus Picnic Area.	Contact and magmatic metamorphic mineralization of lava flows and sedimentary rocks.

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CRETACEOUS (Upper)	Volcanics of Yuma Mine (post-collapse volcanic rocks) (Kyap, Kya, Kyr, Kyrb)	Kyap: Porphyritic andesite. Dark-gray, massive andesitic-dacitic lava flows (62% to 63% quartz), with 20% to 30% phenocrysts of altered plagioclase and pseudomorphs after augite or orthopyroxene(?). Individual flows up to 100 m (300 ft) thick. Kya: Aphanitic andesite. Dark-gray, fine-grained andesitic lava flows (54% to 62% quartz), with 20% to 40% small phenocrysts of plagioclase, augite, and serpentine pseudomorphs after olivine or orthopyroxene. Individual flows as much as 100 m (300 ft) thick. Kyr, Kyrb: Aphanitic rhyolite and dacite. Tan to light-gray lava flows (69% to 73% quartz), with a few small phenocrysts of sanidine, plagioclase, and recrystallized biotite(?). Individual flows as much as 150 m (490 ft) thick. Kyrb is a flow breccia that surrounds a massive flow interior; only locally sufficiently large to map separately.	High.	Both steep and gentle slopes; currently has old mine workings and unpaved roads.	None documented; potential rockfall along steep slopes and ridges.	None.	Possible American Indian sites.	Plagioclase, augite, biotite, sanidine, serpentine; mineralized by magma forming the Amole Pluton.	Lowland communities of desert scrub and desert grasslands.	Remains of Old Yuma Mine; hiking trails.	Kyr: At least 5 flows present locally (Kyr1 to Kyr5 , oldest to youngest).
	Cat Mountain Tuff (caldera-forming rocks) (Kci, Kcw, Kcp, Kcn)	Kci: Intrusive rhyolitic tuff. Elongate dike-like mass of indurated (but little welded) light-greenish gray, massive tuff. Amole Arkose is locally deflected to nearly vertical attitudes near tuff dike, suggesting emplacement of dike from below. On trend with the Museum fault zone, possible caldera ring fault system; may represent ash-flow feeder dike or could represent fill or fracture in caldera floor. Truncates Kb 1.5 km (0.9 mi) northeast of Red Hills Visitor Center. Kcw: Densely welded rhyolite. Gray-brown to red-brown, massive, densely welded tuff, with dark lenses of flattened pumice, mostly 5cm to 10 cm (2 to 4 in) long but in places as much as 1 m (3 ft). Variable orientations of compaction foliation adjacent to megabreccia lenses. Flattened pumice lenses locally elongate in the plane of foliation and define a north-trending flowage lineation. Main cliff forming unit in the Tucson Mountains. Kcp: Partly welded rhyolite. Gray to light-brown tuff, containing weakly developed compaction foliation that occurs along cooling breaks within Kcw . Mapped separately from Kcn only locally (mainly between Cat Mountain and Gates Pass), where welding zonation is broad and well preserved; many cooling breaks are present. Grades into Kcw . Primarily exposed south of the Park. Kcn: Nonwelded to partly welded rhyolite. Light gray to tan tuff, lacking well developed compaction foliation. Conspicuously developed at the top of the Cat Mountain Tuff, where such less welded tuff is commonly 50 to 100 m (160 to 300 ft) thick, and also within and adjacent to megabreccia lenses and irregular masses. Many small areas of tuff within the megabreccia units are too small to show on the reference map scale. In the weakly welded tuff at the top of the Cat Mountain Tuff, multiple flow units are locally separated by thin horizons of bedded surge or airfall tuff.	Welded tuff is more resistant than partly or non-welded tuff.	Welded tuff should provide firm foundations; both steep and gentle slopes; currently contains trails and roads.	None documented; potential rockfall.	None.	Possible American Indian sites.	Specular hematite and magnetite at Wasson Peak.	Cliffs with high fracture content provide nesting habitat; slopes have abundant saguaro cactus, staghorn cholla cactus and creosote bush.	Hiking, pack trails; roads for sight-seeing.	First volcanic activity in Tucson Mountains. Bodies of tuffaceous matrix around megablocks deep within the Cat Mountain Tuff have previously been misinterpreted as irregular intrusions called "Amole latite". That interpretation is now abandoned.
	Cat Mountain Tuff, Megabreccia Member (caldera-forming rocks) (Kcm, Kcmt, Kcma, Kcms, Kcmg, Kcmr, Kcmb, Kcmp)	Kcm: Undivided. Megabreccias that are lithologically diverse, poorly exposed, or limited in extent. In addition to the predominant clast types listed below, locally contains rare fragments of unit Xp . Kcmt: Mainly clasts of Cretaceous tuff. Gray clasts of tuff with large quartz and abundant biotite phenocrysts. Compaction foliation shows chaotic orientations. Can be difficult to distinguish from Kad . Exposed tuff of Confidence Peak and along the base of the western mountain front near Gates Pass could be slightly disrupted caldera wall rocks, rather than far-traveled landslide blocks. Some Confidence Peak clasts were likely included with the Cat Mountain Tuff. Kcma: Mainly clasts of Cretaceous(?) andesite and dacite. Dark-brown to gray blocks of lava, some porphyritic with phenocrysts of plagioclase and biotite (59% to 68% quartz ₂). Clasts of "turkey-track" andesite with coarse tabular plagioclase phenocrysts are locally distinctive, especially in the West 32nd Street area and between the heads of Sweetwater Drive and Camino del Cerro. Likely southern parts of an assemblage now preserved farther north as the Silver Bell Volcanics that accumulated within and near the Silver Bell caldera after its collapse. Could also be an older Jurassic or Early Cretaceous andesitic-dacitic volcanic sequence, perhaps related to source of KJvct . Kcms: Mainly clasts of Cretaceous sedimentary rocks. Blocks of light-brown to greenish-gray, well-bedded arkosic sandstone, shale, and conglomerate. Most recognizable blocks are derived from the Lower Cretaceous(?) Ka , but large masses of volcanic conglomerate at the head of Kings Canyon may be correlative with the Upper Cretaceous Fort Crittenden Formation or with KJvc exposed locally on Brown Mountain. Bedding attitudes, shown for some large blocks, tend to vary irregularly in short distances. Some structurally coherent slab-like blocks as much as 500 m (1,600 ft) long have accumulated pseudo-conformably with respect to compaction foliation of enclosing ash-flow tuff, presumably because the slabs could raft into place "hover-craft" style, perhaps cushioned and lubricated by tuff erupting concurrently within the caldera. Kcmg: Mainly clasts of Jurassic-Cretaceous Glance Conglomerate. Blocks of conglomerate dominated by limestone cobbles derived from Paleozoic sedimentary rocks, in a gray to reddish-brown, sandy matrix. Clasts up to several meters in diameter are sparsely but widely distributed. Kcmr: Abundant clasts of Jurassic(?) flow-layered rhyolite. Blocks of phenocryst-poor, light gray to yellow, massive rhyolitic lava (76%-77% quartz), locally spherulitic and flow layered. Resembles Jurassic lava flows in Santa Rita Mountains. Most exposures are south of park. Forms resistant knobs around Gould Mine. Previously interpreted as intrusive into the Cat Mountain Tuff. Kcmb: Abundant clasts of Jurassic or Triassic Recreation Red Beds. Areas containing blocks of red-brown sandstone and siltstone as much as 50 m (160 ft) long, juxtaposed with diverse other Mesozoic and Paleozoic rock types. Smaller blocks of Recreation Red Beds distributed widely, but are weakly resistant to weathering and are commonly poorly exposed. Minor exposures. Kcmp: Abundant clasts of Paleozoic sedimentary rocks. Formations thus far identified include Pcn, Pc, Prv, Ps, Pe, PPNh, Me, Dm, Cb . Exposures limited to southern part of the park.	High.	Currently contains roads and trails.	None documented.	Hadrosaur fossils found in block of Ka megabreccia.	Possible American Indian sites.	None documented.	Rocky ground cover with ocotillo, creosote bush, and prickly pear cactus.	Jeep trails, pack trails, hiking trails.	Kcma: not confined to the mid-Tertiary, as once believed. In-place pre-caldera andesite-dacite lavas are not exposed in the Tucson Mountains but must have been present on the now-eroded and concealed walls of the Tucson Mountains Caldera.

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PRE-CALDERA ROCKS											
CRETACEOUS (Upper)	Sandstone and shale (Kss)	Unnamed arkosic gray sandstone, shale, and minor laminated limestone. Similar to the underlying Kb . Represents continuation of similar depositional processes after emplacement of the Confidence Peak tuff. Could be an upper unit of Kb . General absence of volcanic detritus is notable because volcanism was in process in the Silver Bell caldera area 30 km (19 mi) to the northwest during this time. Most of the unit has been metamorphosed to hornfels due to proximity to the Amole pluton; red-brown garnets up to 1 cm (0.4 in) across in limy sediments. Unconformably overlain by caldera-filling tuff and megabreccia. Overlies Ktc along ridge crest west of Amole Peak.	Variable.	Outcrops are northwest of the Sensitive Resource Area.	None documented; potential rockfall.	None.	Unknown.	None documented.	Lowland communities of desert scrub and desert grasslands.	Hugh Norris Trail.	Only non-volcanic Cretaceous sedimentary rocks that overlie Laramide-age silicic volcanic rocks in southern AZ.
	Tuff of Confidence Peak (Ktc)	Crystal-rich, gray, welded rhyolitic tuff with 25% to 40% quartz, feldspar, and biotite phenocrysts; erupted from the Silver Bell caldera 30 km (19 mi) northwest of the Tucson Mountains caldera about 73 million years ago. Distinguished from Cat Mountain Tuff by more biotite and larger quartz phenocrysts. Occurs widely in the Megabreccia Member of the Cat Mountain Tuff. Other in-place Ktc may be parts of megablock along west escarpment north of Gates Pass (south of Park).	High (welded tuff).	Limited exposures northwest of the Sensitive Resource Area.	None documented; potential rockfall.	None.	Unknown.	None documented.	Lowland communities of desert scrub and desert grasslands.	Crossed by Hugh Norris Trail.	Outcrops in sec. 25 are the only clearly in-place Ktc .
CRETACEOUS (Upper or Lower)	Amole Arkose (Ka)	Gray to brown siltstone, arkosic sandstone, and sparse conglomerate and finely laminated limestone. Unconformably overlies the Recreation Red Beds (JTRr). Considered correlative with the Lower Cretaceous Bisbee Group, but lithologic continuity with Upper Cretaceous sedimentary rocks that overlie Ktc suggests a partly or entirely Upper Cretaceous age. Complexly folded around gently plunging, northwest-trending axes. Detailed structural interpretations impeded by lack of marker beds. Structures shown on cross sections are greatly generalized and simplified. Deposited in lake-floodplain, lakeshore, delta, and alluvial fan environments. Thickness greater than 1,000 m (300 ft).	Sandstone and conglomerate more resistant than shale.	Forms King Canyon bottom, slopes, and ridge crest. Current developments include trails.	Rockfall? Potential flash flooding in canyon.	Freshwater gastropods and pelecypods; <i>Holestea</i> fish skeletons; algal mats; Hadrosaur remains found in megabreccia.	Potential American Indian sites, (exposures along ephemeral stream?).	Precious and industrial metals occur in contact with Silver Lily dike swarm.	Forms benches and rocky slopes with abundant creosote bush, prickly pear cactus, and saguaro cactus.	Hiking and jeep trails; Mam-A-Gah picnic area.	Fluvial and lake deposits.
CRETACEOUS/JURASSIC	Volcanic conglomerate (KJvc)	Red-brown conglomerate and volcanic sandstone; abundant cobbles of dark-gray to purple andesite and dacite. The intermediate-composition volcanic clasts contrast with the bimodal basalt-silicic rhyolite assemblage lower in the section and regionally in the Jurassic rocks of southern Arizona. Exposed in fault slices on the crest and flanks of Brown Mountain, south of park, and isolated outcrops northwest of Red Hills Visitor Center.	Variable.	Limited to minor exposures along Kinney Road.	Minor rockfall potential?	None.	None documented; limited exposure.	None documented.	Lowland communities of desert scrub and desert grasslands.	Minor exposure on bedrock knobs along Kinney Road.	May indicate start of Cretaceous-continental arc volcanism.
JURASSIC	Andesite porphyry (Jai)	Dikes and irregular bodies of porphyritic andesite (56% quartz) containing 10% to 30% phenocrysts of plagioclase in "turkey track" texture. K-Ar (plagioclase) date at 159 ±5 million years ago. Exposed south of Arizona-Sonora Desert Museum.	High.	Only exposed south of park.	Not mapped in park.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Jurassic volcanic activity.
	Rhyolite and ash-flow tuff (Jt)	Nonwelded to partly welded, pinkish-tan rhyolitic ash-flow sheet. Small and sparse pumice lapilli so compaction foliation is commonly obscure. Welding zonation is well developed; becomes less welded upward. Some quartz and altered feldspar phenocrysts; lithic fragments rare. Up to 50 m (160 ft) thick. Underlies KJvc on Brown Mountain. Bedrock knobs northwest of Red Hills Visitor Center.	High, but less than welded tuff.	Limited exposure.	Minor rockfall potential?	None.	None documented; limited exposure.	None documented.	Lowland communities of desert scrub and grasslands.	Isolated exposure on bedrock knobs.	
	Sandstone (Js)	Reddish sandstone and siltstone. Stratigraphic relations with the Jt and Jlt ash-flow sheets, and also with inferred higher and lower sedimentary units (KJvc , JTRr) remain uncertain due to limited outcrop area, lack of diagnostic marker horizons, and probable bounding faults. Minor exposures. Bedrock knobs northwest of Red Hills Visitor Center.	Less resistant than welded tuff.	Limited exposures.	Limited exposure.	None.	None documented; limited exposure.	Limited exposure.	Lowland communities of desert scrub and grasslands.	Isolated exposure on bedrock knobs.	
	Lithophysal ash-flow tuff (Jlt)	Densely welded ash-flow sheet with silica-filled lithophysal cavities a few cm in diameter in lower part and well-developed pumice compaction foliation near top. Altered outlines of phenocrysts increase upward. About 25 m (82 ft) thick. Exposed southwest of Arizona Sonora Desert Museum.	High.	Only exposed south of the park.	Not mapped in park.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	
	Basaltic ash-flow tuff (Jb)	Vesicular, dark-gray olivine basalt (50% quartz). Locally greenish due to abundant alteration of epidote. Thickness 10 to 20 m (33 to 66 ft). Exposed southwest of Arizona Sonora Desert Museum.	High.	Only exposed south of park.	Not mapped in park.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	
TRIASSIC/JURASSIC	Recreation Red Beds (JTRr)	Red-brown mudstone, siltstone, and some interlayered sandstone. Includes tuff member and volcanic conglomerate member. Exposed at Red Hills and Brown Mountain.	Low.	Southeast of Sensitive Resource Area (no access).	Rockfall?	Potential trace fossils.	Potential American Indian sites.	Piedmontite in tuff.	Reddish soil with saguaro cactus, staghorn, barrel, teddybear cholla, and creosote bush.	Hiking near Red Hills Visitor Center and in Red Hills.	Records volcanic activity and fluvial/alluvial deposition.

Map Unit Properties Table: Saguaro National Park-Tucson Mountain District (Saguaro West). Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
PERMIAN	Rainvalley Formation (Prv)	Thin-bedded limestone, dolomite, and sandstone; more than 30 m (100 ft) thick. Crops out at Snyder Hill, south of Park.	High.	Not mapped in park.	Not mapped in park.	Unknown.	Not mapped in park.	None documented.	Not mapped in park.	Not mapped in park.	Part of carbonate shelf developed in SE Arizona.
	Concha Limestone (Pcn)	Dark-gray, cherty, fossiliferous limestone. A common clast type in the Megabreccia Member of the Cat Mountain Tuff. More than 20 m (66 ft) thick. Crops out at Snyder Hill, south of park. Neither base nor top exposed.	High.	Not mapped in park.	Not mapped in park.	Marine invertebrates?	Not mapped in park.	None documented.	Not mapped in park.	Not mapped in park.	
	Scherrer Formation (Ps)	Light-brownish-gray, fine grained quartzite. Exposed near Sus Picnic area.	High.	Limited exposure.	None.	Potential marine invertebrates and burrows.	Very limited exposure.	None documented.	Minor exposures. Not applicable.	Minor exposures. Not applicable.	
PENNSYLVANIAN	Horquilla Limestone (PPNh)	Light-gray, fine-grained, thin-bedded cherty limestone and intercalated siltstone and dolomitic limestone. Forms ridge crest near Sus Picnic Area. Exposed at Twin Peaks, northwest of park.	Relatively high.	Limited exposure.	Minor rockfall potential?	Potential foraminifera, marine invertebrates, conodonts, and fish.	None documented; very limited exposure. Chert may have been used by American Indians.	Chert.	Minor exposures. Not applicable.	Outcrops adjacent to Kinney Road; roadside geology.	Permian and Pennsylvanian units are transitional between open marine and subaerial environments.
MISSISSIPPIAN (Lower-Middle)	Escabrosa Limestone (Me)	Light-gray, coarse, cherty limestone, crinoidal limestone. In park, exposed in fault block near Sus Picnic area and along Kinney Road. Minor slope deposits in isolated knobs of bedrock exposed at Twin Peaks, northwest of park. Thickness 35 m (115 ft) at Twin Peaks.	High.	Limited exposure.	None.	Potential crinoids and other marine invertebrates. Fossil coral in park collections may have come from Me.	None documented; very limited exposure.	Mined for cement.	Minor exposures. Not applicable.	Minor exposures. Not applicable.	Records maximum transgression from Antler Orogeny.
DEVONIAN (Upper)	Martin Formation (Dm)	Brown dolomite. Clasts in the Megabreccia Member of the Cat Mountain Tuff are metamorphosed to dark green and black hornfels near the Amole Pluton. In-place exposures only at Twin Peaks.	High.	Not mapped in park.	None.	None.	Not mapped in park.	Mined for cement.	Not mapped in park.	Not mapped in park.	Platform dolomite from marine transgression.
CAMBRIAN	Abrigo Formation (Ca)	Shale and sandstone, exposed only at Twin Peaks. Mapped in Rincon Mountain District.	Variable.	No outcrops in Tucson Mtn. District.	None.	Rare trilobites, brachiopods and trace fossils.	No outcrops in Tucson Mtn. District.	None documented.	No outcrops in Tucson Mtn. District.	No outcrops in Tucson Mtn. District.	Subtidal and intertidal units.
	Bolsa Quartzite (Cb)	Massive, vitreous, tan quartzite; occurs as clasts in the Megabreccia Member of the Cat Mountain Tuff. In-place exposures only at Twin Peaks. Mapped in Rincon Mountain District.	High.	No outcrops in Tucson Mtn. District.	None.	Potential trace fossils (<i>Skolithos</i>) and rare brachiopods.	No outcrops in Tucson Mtn. District.	None documented.	No outcrops in Tucson Mtn. District.	No outcrops in Tucson Mtn. District.	Transition from broad plain to tidally influenced river sediments.
PRE-CAMBRIAN (Proterozoic)	Porphyritic granite (Yg)	Light-tan, medium-grained muscovite-bearing granite, containing phenocrysts of potassium feldspar. Exposed on southern slopes of Twin Peaks.	High.	Not mapped in park.	None.	None.	Not mapped in park.	Potassium feldspar; muscovite.	Not mapped in park.	Not mapped in park.	Precambrian history.
PRE-CAMBRIAN (Archean)	Pinal Schist (Xp)	Fine-grained, gray-green quartz sericite schist exposed in place on the west side of Twin Peaks; forms sparse clasts in the Megabreccia Member of the Cat Mountain Tuff. Mapped in Rincon Mountain District.	Less resistant than granite.	No outcrops in Tucson Mtn. District.	None.	None.	No outcrops in Tucson Mtn. District.	Unknown.	No outcrops in Tucson Mtn. District.	No outcrops in Tucson Mtn. District.	Oldest rock exposed in southeastern Arizona.
AGE UN-CERTAIN	Quartz vein (qtz)	Quartz vein.	High.	Linear feature; limited extent for infrastructure.	None.	None.	Quartz may have been utilized by American Indians.	Quartz.	Not applicable.	Not applicable.	None.

Map Unit Properties Table: Saguaro National Park-Rincon Mountain District (Saguaro East)

Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance	
QUATERNARY (Holocene)	Alluvium (Qay, Qas, Qa, Qag)	Qay: Gravel and minor sand. Poorly sorted and bedded, unconsolidated. Not mapped in park. Qas: Silt and sand, with minor gravel. Generally humus-rich and gray, locally contains efflorescence of carbonate and is white; poorly sorted and bedded; unconsolidated to slightly indurated. Surface capped by immature reddish-brown soil. Commonly 0.6 to 6 m (2 to 20 ft) thick. Qa: Sand, gravel, and silt. Grayish-brown, poorly sorted and bedded; unconsolidated to slightly indurated. Thickness commonly 0.6 m to 6 (2 to 20 ft). Qag: Gravel and sand. Grayish-brown, poorly sorted and bedded; unconsolidated. Not mapped in park.	Low.	Qa and Qas are minor linear features in the northwestern part of the park; stream channel deposits	Qa: floodplain; potential flash flooding.	Potential animal remains.	Possible American Indian artifacts buried in alluvium?	Placer deposits? Sand and gravel.	Ephemeral streams; Sonoran Paloverde mixed cacti/semidesert grassland- and mixed scrub.	Crossed by hiking trail and road; near picnic area.	Qay: youngest deposits along San Pedro River and lower reaches of its tributaries.	
QUATERNARY (Pleistocene)	Terrace gravel deposits (Qt, Qts, Qtl)	Qt: Brownish-gray gravel and intercalated sand; generally coarser than underlying deposits; moderately well-sorted; poorly bedded; subrounded clasts; locally indurated by caliche. Unconformable on older gravels (QTg and QTgy). Thickness commonly 0.6 to 3 m (2 to 10 ft). Qts: Brownish-gray gravel; generally coarser than underlying deposits; well sorted; poorly bedded; unconsolidated; mostly subrounded clasts, including rhyolitic to trachytic volcanic rocks, most derived from up the San Pedro River but some of which are from the upper reaches of Tres Alamos Wash. Thickness commonly 0.6 to 6 m (2 to 20 ft). Not mapped in park. Qtl: Locally derived. Not mapped in park.	Low, except where locally indurated by caliche.	Qt: foundation for houses and roads in subdivisions.	None documented.	Potential animal remains.	Possible American Indian sites.	Sand and gravel.	Sonoran Paloverde mixed cacti/semidesert grassland-mixed scrub.	Picnic areas; Loma Verde Mine.	None.	
	Pediment and alluvial deposits (Qp, Qpa, Qpf)	Qp: Pediment deposits. Brownish-gray gravel; moderately coarse-grained; poorly bedded; locally indurated by caliche, which is particularly abundant near Cornfield Canyon. Unconformable on older alluvial deposits. Thickness commonly 0.6 to 15 m (2 to 50 ft). Qpa: Alluvial deposits. Gray to pinkish-gray gravel; mostly poorly sorted; poorly to moderately well-bedded; weakly indurated. Includes some boulder fan deposits and debris-flow deposits near the Rincon Mountains. Thickness 15 to 122 m (50 to 400 ft). Exposed along margin of San Pedro Valley; not separable from Qp south of Ash Creek Canyon or from QTs in the San Pedro Valley. Qpf: To west, thick deposit of gravel with subrounded clasts; to east, gravel deposits with subrounded clasts thin or are absent.	Low except where locally indurated by caliche.	Roads and ranch buildings. Not mapped in park.	Not mapped in park.	Potential animal remains.	Not mapped in park.	None documented.	Not mapped in park.	Not mapped in park.	Not mapped in park.	None.
QUATERNARY / TERTIARY (Pleistocene and Pliocene)	Gravel, grus and sand (QTgy)	Pediment, terrace, and basin deposits; beveled by a lower and more dissected surface than is the underlying gravel (QTg). Rincon Valley Quadrangle. Exposed in far southwestern corner of the park (sections 4 and 5, T15S, R16E).	Low.	Abundant roads outside of park.	None.	Potential animal remains.	Minor exposure; limited potential.	Sand and gravel.	Lowland desert scrub and grasses.	Minor exposures. Not applicable.	None.	
	Facies border (QTgf)	Gradational and interfingering facies contact (2-dimensional feature) marking the contact between round pebble gravel derived mainly from far upstream and subangular-pebble gravel derived locally. Mapped on the Rincon Valley Quadrangle. Contact lies southwest of the park and on the west side of the Vail Fault. Significant as a contact between 2 facies.										
	Gravel, grus, and sand (QTg)	Clasts mostly of angular to subangular cobbles that consist largely of gneissic rocks from the core of the Rincon Mountains. Limited to area south of park Headquarters building, along western border.	Low.	Headquarters building; roads.	None documented.	Potential animal remains.	Minor exposure; limited potential.	Sand and gravel.	Mixed cacti-mixed scrub.	Roads; hiking trails.	None.	
	Rubble deposits (QTgl)	Coarse blocks in jumbled disorder. Older deposits locally capped by reddish-brown soil; younger deposits have typical hummocky surfaces. Those shown with slump scarp symbol may still be active intermittently. Rincon Valley Quadrangle. Isolated deposits in central and eastern part of park.	Low. Landslide or slump masses if disturbed.	Slump deposits may reactivate; remote exposures.	Landslides may reactivate.	Potential animal remains.	Potential American Indian sites near springs.	None.	Landslide ecosystem.	Hiking and pack trails; Spud Rock campsite.	None.	
QUATERNARY/ TERTIARY (Lower Pleistocene and Pliocene)	Formation of St. David Area (QTss, QTsmh, QTsm, QTst, QTsl)	QTss: Center facies. Silt, clay, and some intercalated sand and fine-grained gravel; poorly bedded; poorly to slightly indurated; locally has gypsiferous efflorescence. Some clay may be from volcanic ash. Thickness at least 30 m (100 ft). Weathers to badland topography. QTsmh: Base of pale-orange-gray conglomeratic sand. QTsm: Margin facies. Fine-grained gravel and conglomerate, some silt and sand; moderately well sorted and bedded; grades from pink gravelly silt near center facies (QTss) to grayish-pink sandy gravel near the mountains; may include some younger alluvial deposits (such as Qpa) in Happy Valley. Marker horizon near mouth of Redrock Creek. QTst: Rhyolitic tuff. Very light gray crystal-poor tuff. Exposed along lower reaches of Paige Canyon. Thickness 0.3 to 1 m (1 to 3 ft). QTsl: Largely very coarse blocky landslide deposits. Age uncertain.	Low for poorly indurated fine-grained sediments; higher for gravel and conglomerate.	Not mapped in park.	None documented.	Potential animal remains.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Deposits in San Pedro Valley on gentle sloping topography.	
TERTIARY (Pliocene?)	Gravel and conglomerate (Tg)	Gray to pinkish-gray generally coarse-grained moderately indurated gravel and conglomerate. Contact relation to next older rock unknown. Local exposures in northeastern Happy Valley Quadrangle.	Moderately indurated.	Not mapped in park.	None.	Potential animal remains.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	None.	

Map Unit Properties Table: Saguaro National Park-Rincon Mountain District (Saguaro East). Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance	
TERTIARY (Miocene)	Nogales Formation (Tn)	Gravel and sand, semi-indurated; locally derived thick fan deposit in southeastern Rincon Valley Quadrangle; thin channel deposit 3 km (2 mi) northeast of Mountain View. Minor area mapped along east boundary of park.	Semi-indurated.	Not mapped in park.	None.	None.	Not mapped in park.	Not mapped in park.	Not exposed in Park	Not mapped in park.	None.	
TERTIARY (Miocene and Oligocene)	Pantano Formation (Tp) (Members: Tpcg, Tpa, Tpuf, Tpc, Tpu, Tplf, Tpl)	Tp: Clastic sedimentary rocks ranging in coarseness from megabreccia to claystone, mostly moderately well sorted and indurated. Clasts mainly subrounded pebbles and some cobbles of Mesozoic and Paleozoic sedimentary rocks and Precambrian granodiorites; locally derived from Tertiary volcanic rocks. May be 3,500 m (11,500 ft) thick in the subsurface near the southwestern corner of the quadrangle. Tp is mapped within the park. The members below are only differentiated in the southern part of Rincon Valley Quadrangle. They are not exposed in the park: Tpcg: Reddish-gray pebble conglomerate and some siltstone and sandstone; moderately well sorted and indurated. Unconformable on underlying rocks. Tpa: Dark-gray andesite that contains large plagioclase phenocrysts. Also informally referred to as turkey-track porphyry. Tpuf: Upper fanglomerate and conglomerate. Mainly boulder and cobble conglomerate; some thin beds of sandstone. May contain masses of monolithologic sedimentary breccia – blocks rarely more than 1 m (3 ft) across, unsorted and mostly unbedded; clasts derived from Yr; probably of fanglomerate and landslide origin. Grades laterally to fine-grained deposits. Tpc: Claystone, mudstone, shale, and some sedimentary breccia; very locally contains bedded chert, limy siltstone, and tuffaceous sandstone. Indurated to very weakly indurated. Gypsum veinlets in places. Grades laterally into coarser grained rocks. Megabreccia: blocks commonly 1 to 5 m (3 to 16 ft) across derived from: Tra, Trl, Trt, Tri, Dm, Ca, Cb, Yr. Tpu: Undivided deposits of Tpuf and Tpc. Tplf: Lower fanglomerate and conglomerate. Mainly coarse fluvial deposits; some intercalated sandstone and siltstone. Tpl: Alternating thin beds of gray oolitic limestone, sandstone, and siltstone.	Indurated to weakly indurated. Coarse sediments are more resistant than fine sediments.	Isolated exposures located primarily on lower slopes, forming relatively flat, lowland topography in northwestern part of the park.	None documented.	Potential for reworked fossils from older layers.	Limited areal extent; unknown potential for American Indian sites.	Tpc: Quarried for brick making.	Sonoran Paloverde mixed cacti/semidesert grassland- and mixed scrub.	Limited areal extent; near picnic area west of Loma Verde Mine.	Tpcg: Probably correlative with the Mineta Formation 3 to 8 km (2 to 5 mi) north of the Happy Valley Quadrangle and with the Threelinks Conglomerate 3 to 6 km (2 to 4 mi) northeast of the quadrangle.	
TERTIARY (Oligocene and younger)	Carbonate dike or vein (Tca)	Thick sheet of carbonate containing fragments of carbonate rocks probably derived from Paleozoic formations. Inferred to be derived from a thrust plate beneath the Rincon Valley Granodiorite and emplaced as a clastic dike during gravity gliding or low-angle normal faulting. Mapped as a linear feature in the Rincon Valley Quadrangle.	Relatively high.	Not mapped in park.	None.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Unknown.	
TERTIARY (Oligocene)	Rhyolite and rhyodacite (Trd)	Includes finely porphyritic dikes near Ash Creek Canyon and coarsely porphyritic dikes north of Redrock Creek, Happy Valley Quadrangle. Linear features.	Relatively high.	Not mapped in park.	None.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Unknown.	
	Rhyolitic agglomerate (Tra)	Clasts of rhyolitic welded tuff, commonly 5 to 20 cm (2 to 8 in) across, in a tuffaceous or siltstone matrix. May include some volcanic conglomerate. Minor outcrops in the northwestern part of the Rincon Valley Quadrangle.	Matrix variable.	Too limited to be applicable	None.	None.	Limited areal extent.	None.	Mixed cacti/semidesert vegetation.	Crossed by Cactus Forest Drive.	One outcrop near park Headquarters.	
	Rhyolitic lava flow (Trl)	Grayish-red lava flow at Twin Hills, just west of the western border of the park, probably near a vent that was a source of the tuff breccia and agglomerate of the northwestern corner of the Rincon Valley Quadrangle.	High.	Not mapped in park.	None.	None.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not a unit on Drewes' map.	
	Rhyolitic tuff breccia (Trt)	Very light gray to very pale orange crystal lithic tuff; in places contains small fragments of andesite. May be as old as tuff from a site 1 km (0.6 mi) south of the map and 4 km (2.5 mi) southeast of Mountain View, which is dated at 33 and 37 million years old. Exposures limited to south of Loma Verde Mine, Rincon Valley Quadrangle.	Relatively high.	Too limited to be applicable.	None.	None.	None.	Limited areal extent.	None.	Mixed Sonoran Paloverde cacti and semidesert grassland- scrub.	Minor exposures next to Cactus Forest Drive.	Unknown.
	Porphyritic andesite (Tat)	Lava flows and some pyroclastic rocks with abundant large plagioclase phenocrysts. In places contains intercalated conglomerate similar to Tplf. Limited exposures south and east of Loma Verde Mine. Forms relatively flat topography.	High.	Too limited to be applicable.	None.	None.	None.	Limited areal extent.	None.	Similar to Tra and Trt.	Poor exposures; crossed by roads.	Turkey-track porphyry.
	Intrusive rhyolite (Tri)	Three small necks of rhyolitic porphyry in the southern part of the Rincon Valley Quadrangle; few small dikes. Minor exposures near Loop Road, and east of Mica Mountain.	High.	Too limited to be applicable.	None.	None.	None.	Very limited areal extent.	None.	Surrounded by Douglas fir-mixed conifer.	Not applicable.	Probable vents for Tp tuffs.
	Happy Valley Granodiorite (Th, Tha)	Th: Moderately coarse-grained massive biotite granodiorite. Locally contains faint flow-aligned crystals. Exposed as an intrusion south of Watkins Ranch, Happy Valley Quadrangle. Tha: Aplite (same description as Th).	High.	Steep terrane; not exposed in park.	Rockfall? Not mapped in park.	None.	None.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Post-thrust intrusion.

Map Unit Properties Table: Saguaro National Park-Rincon Mountain District (Saguaro East). Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance	
TERTIARY (Oligocene to Paleocene)	Diorite (Td)	Small dikes of unmetamorphosed nongneissic dioritic rocks near Joaquin Canyon along the northern edge of the Rincon Valley Quadrangle, north of the park boundary, and other scattered localities. Mapped as linear features.	Relatively high.	Not mapped in park.	None.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	
ROCKS OF THE LARAMIDE ALLOCHTHON (Units that have been moved from their original depositional site and now lie above the surface of the Santa Catalina fault in Saguaro National Park. "Upper Plate" rock units.)												
CRETACEOUS (Lower)	Bisbee Group (Kb)	Schellenberger Canyon Formation (Ks)	Kb: The Bisbee Group consists of Upper Plate rock units mostly exposed west of Sentinel Butte and east of Camino Loma Alta Road. Minor exposures in sections 32 and 33, T14S, R16E. Ks: Gray to red shale, sandstone, and some fine-grained light-gray laminated limestone. Estimated preserved thickness less than 100 m (300 ft). Limited exposures.	Shale is less resistant than sandstone.	Unimproved roads.	None documented.	Potential algal laminations? <i>Trigonia</i> (marine clam) and vertebrates.	Unknown.	None documented.	Kb: semidesert mixed grass-mesquite vegetation types.	Unimproved roads leading to Deer Camp; Hope Camp Trail.	Kb: Type section is near Bisbee, AZ. East of the park, Kb is not part of the allochthon. Ks: Tidal flat and fan delta units signify a Late Cretaceous transgression. Kw and Kbg are proximal alluvial fan systems.
		Willow Canyon Formation (Kw)	Gray to red sandstone, conglomerate, and siltstone. Conglomerate clasts mainly of Paleozoic limestone and chert; some sandstone is from the lower part of Kb . Estimated preserved thickness more than 800 m (2,600 ft). Southern Rincon Valley Quadrangle.	Variable.	Not mapped in park.	Not mapped in park.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	
		Glance Conglomerate (Kbg)	Basal cobble and pebble conglomerate; probably lenticular. Clasts of Paleozoic rocks and locally of Precambrian rocks. Estimated maximum thickness 150 m (490 ft). In the Canelo Hills, Kbg interfingers with radiometrically dated Jurassic volcanic rocks. One minor exposure mapped in the park near the Freeman Homestead Trail (map symbol Kg on Map I-997).	Relatively high. Minor exposure.	Limited exposure; not applicable.	None.	May include fossils from older units, such as Pcn brachiopods.	Very limited exposure; probably not applicable.	None.	Semidesert mixed grass-mesquite vegetation.	Too minor to be applicable; near Freeman Homestead Trail	
		Limestone block (Kls)	Probably a landslide mass derived from Paleozoic rocks.	High, unless disturbed.	Not mapped in park.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	
TRIASSIC	Walnut Gap Formation (JTRw)	Includes volcanic conglomerate, arkose, quartzitic sandstone, and some vesicular andesite. Lies with probable angular unconformity on underlying formations. Estimated preserved thickness is at least 300 m (1,000 ft). Exposed only on eastern edge of the Happy Valley Quadrangle.	Relatively high.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not part of Laramide allochthon; correlative with JTRr .	
PALEOZOIC (Undivided)	Sedimentary rocks, undivided. (PZs)	Metamorphosed sequence of marble, hornfels, and metaquartzite, and an unmetamorphosed sequence of limestone, dolomite, shale, and sandstone. Exposed in normal faulted blocks of Upper Plate rocks. May include some Bisbee Fm and Apache Group.	High.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	
PERMIAN	Concha Limestone (Pcn)	Medium-gray fine-grained medium- to thick-bedded cherty limestone. Estimated preserved thickness about 70 m (230 ft). Found in normal faulted blocks of Upper Plate rocks. Minor outcrop in Rincon Mountains about 1.6 km (1 mi) east of the park.	High.	Not mapped in park.	Not mapped in park.	Some large productid brachiopods.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Permian strata is transitional between open marine and subaerial environments.	
	Scherrer Formation (Ps)	Very light brownish gray fine-grained quartzite and sandstone; some light-gray dolomite. Estimated preserved thickness about 120 m (390 ft). Found in normal faulted blocks of Upper Plate rocks. Minor exposures of limited areal extent within Cactus Forest Drive.	High.	Limited extent; not applicable.	Minor rockfall?	Potential marine invertebrates and burrows.	Very limited areal extent; none documented.	Unknown.	Very limited areal extent.	Too limited to be applicable.		
	Epitaph Dolomite (Pe)	Dark-gray moderately thick-bedded slightly cherty dolomite; includes a lower unit, commonly faulted out, of dolomite marlstone and some intercalated limestone. Estimated preserved thickness less than 200 m (660 ft). Found in normal faulted blocks of Upper Plate rocks. Minor exposures of limited areal extent within Cactus Forest Drive.	High.	Limited extent; not applicable.	Minor rockfall?	Potential for few marine invertebrates.	Very limited areal extent; none documented.	Unknown.	Very limited areal extent.	Too limited to be applicable.		
	Colina Limestone (Pc)	Medium-dark-gray moderately thick-bedded slightly cherty limestone. Some beds contain small white blebs of dolomite. Estimated preserved thickness less than 100 m (300 ft). Found in normal faulted blocks of Upper Plate rocks.	Relatively high.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.		

Map Unit Properties Table: Saguaro National Park-Rincon Mountain District (Saguaro East). Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance	
PENNSYLVANIAN	Earp Formation (PPNe)	Reddish-gray marlstone, siltstone, and shale, some intercalated pale-brownish-gray fine-grained limestone, and a thin bed of reddish-gray rounded chert-pebble conglomerate. Estimated thickness less than 200 m (660 ft). Found in normal faulted blocks of Upper Plate rocks within Cactus Forest Drive and southwest of the Javelina picnic area.	Variable.	Sparse outcrops. Development not recommended.	Minor rockfall?	Potential marine invertebrates and burrows.	Unknown. Limited areal extent.	Unknown.	Semidesert mixed grass-mesquite vegetation.	No access to exposures within Cactus Forest Drive.	In contact with Lower Plate rocks.	
	Horquilla Limestone (PPNh, PPNhm)	PPNh: Light-pinkish-gray fine-grained thin-to thick-bedded sparsely cherty limestone. Upper half contains much intercalated reddish-gray siltstone in units commonly 0.3 to 3 m (1 to 10 ft) thick. Unconformably overlies Me . Estimated thickness 500 m (1,600 ft). Mostly found in normal faulted blocks of Upper Plate rocks within Cactus Forest Drive and southwest of the Javelina picnic area. One small outcrop along the eastern border in Happy Valley Quadrangle. PPNhm: Metamorphosed facies in lower major thrust plate. Nearly white fine-grained slightly cherty marble. Estimated preserved thickness 150 m (490 ft). Exposure near Hope Camp Trail and along road leading to Madrona Ranger Station.	High.	Sparse outcrops. Development not recommended.	Minor rockfall?	Some beds contain fusulinids. Marine invertebrates, conodonts, and fish also possible.	Unknown. Limited areal extent.	Unknown.	Semidesert mixed grass-mesquite vegetation types.	No access to exposures within Cactus Forest Drive.	One local exposure mapped in contact with Lower Plate rocks.	
MISSISSIPPIAN (Lower-Middle)	Escabrosa Limestone (Me)	Medium-gray thick-to thin-bedded medium- to coarse-grained bioclastic (in part crinoidal) cherty limestone. Limestone and shale beds at top may be the Black Prince Limestone of Early Pennsylvanian(?) or Late Mississippian age. Estimated thickness 190 m (620 ft). One isolated, minor outcrop mapped in the normal faulted blocks of Upper Plate rocks within Cactus Forest Drive. Surrounded by PPNe .	High.	Limited extent; fault blocks.	Minor rockfall?	Potential crinoids and other marine invertebrates. Fossil coral in park collections may have come from Me .	Unknown. Limited areal extent.	Unknown. Limited areal extent.	Semidesert mixed grass-mesquite vegetation types.	Geologic interest.	Maximum transgression from Antler Orogeny.	
DEVONIAN (Upper)	Martin Formation (Dm)	Interbedded brown cherty dolomite, gray dolomitic fossiliferous limestone, and some sandstone. Estimated thickness less than 100 m (300 ft). Unconformably overlies Ca .	High.	Limited extent; fault blocks outside of the park.	Minor rockfall?	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Records the onset of the Antler Orogeny.	
CAMBRIAN	Abrigo Formation (Ca)	Brownish-gray to brown shale, sandstone, and quartzite, and light-gray thin-bedded partly bioclastic limestone and intraformational conglomerate. Estimated thickness 210 m (690 ft). Minor exposure in normal faulted blocks of Upper Plate rocks in section 11, T15S, R17E, western border of the park.	Variable.	Limited extent; remote exposures.	None.	Rare trilobites, brachiopods and trace fossils.	Unknown; limited areal extent.	Unknown; limited areal extent.	Semidesert mixed grass-mesquite vegetation types.	Limited exposure; geologic interest.	Cambrian units are in contact with Lower Plate rocks and record deposition along the southwestern margin of North America.	
	Bolsa Quartzite (Cb, Cbm)	Cb: Light- to dark-gray, purplish gray, or brownish gray coarse-grained thick-bedded quartzite and some basal conglomerate. Unconformably overlies the Apache Group. Estimated thickness 150m (490 ft). Cbm: Mostly light-gray to light-brownish-gray metaquartzite. Estimated preserved thickness less than 150 m (490 ft). Both units exposed in fault blocks with Ca .	High.	Limited extent; remote exposures.	Minor rockfall?	Potential trace fossils (<i>Skolithos</i>) and rare brachiopods.	Unknown; limited areal extent.	Unknown; limited areal extent.	Semidesert mixed grass-mesquite vegetation types.	Limited exposure; geologic interest.		
PRECAMBRIAN (Proterozoic)	Diabase (Yd)	Metadiabase and possibly some diorite; dark greenish gray; fine to coarse grained, mainly in sills. One minor exposure mapped at Sentinel Butte.	High.	Too limited to be applicable.	None.	None.	None documented.	Limited extent.	Unknown; very limited exposure.	Geologic interest.	Exposed in Upper Plate.	
	Apache Group	Dripping Spring Formation (Yds)	Banded light-colored and reddish-brown arkose, siltstone, and quartzite. Includes thin Barnes Conglomerate Member at base. Estimated preserved thickness 100 m (300 ft). Minor exposures mapped on Sentinel Butte and Rincon Creek Syncline.	Variable.	Local, limited exposures.	None.	Potential acritarchs.	None documented.	None documented.	Unknown; very limited exposure.	Geologic interest.	Exposed in Upper Plate.
		Pioneer Shale (Yp)	Reddish-brown shale, siltstone, and argillite. Includes very thin basal angular-pebble Scanlan Conglomerate Member. Probably unconformably overlies Pinal Schist. Estimated preserved thickness 100 m (300 ft). Minor exposures mapped on Sentinel Butte.	Variable.	Local, limited exposures.	None.	None.	None documented.	None documented.	Unknown; very limited exposure.	Geologic interest.	Exposed in Upper Plate.
	Rincon Valley Granodiorite (Yr)	Massive medium-grained biotite granodiorite or locally biotite-hornblende granodiorite; some quartz monzonite. K-Ar age on hornblende 1,560±100 million years old and on biotite from same specimen 1,450±50 million years old. Age relations to other Precambrian rocks uncertain. Isolated outcrops west of Santa Catalina Fault near Loma Verde Mine. Massive exposures south of Sentinel Butte. Considered part of the "Catalina Gneiss" by Bezy (2005).	High.	Currently contains campsites (Hope Camp) and unimproved roads.	None documented.	None.	Possible American Indian sites associated with Rincon Creek and tributaries.	Biotite.	Not certain; possibly in the Sonoran Paloverde mixed cacti/Sonoran creosote-bursage vegetation type.	Unimproved roads; camping (Hope Camp).	Correlative with Johnny Lyon Granodiorite? In contact with Lower Plate rocks.	

Map Unit Properties Table: Saguaro National Park-Rincon Mountain District (Saguaro East). Gray-shaded rows indicate map units in the accompanying GIS data but not mapped within the park.

Age	Unit Name (Symbol)	Features and Description	Erosion Resistance	Suitability for Infrastructure	Hazards	Paleontological Resources	Cultural Resources	Mineral Occurrence	Habitat	Recreation	Geologic Significance
ROCKS OF THE LARAMIDE AUTOCHTHON (Units that have not been moved from their original depositional site and lie below the surface of the Santa Catalina fault in Saguaro National Park. "Lower Plate" rock units.)											
PRECAMBRIAN (Proterozoic)	Johnny Lyon Granodiorite (Yj, Yja)	Yj: Massive medium to coarse-grained biotite-hornblende granodiorite and quartz monzonite. Forms western half of a small batholith that intrudes Continental Granodiorite. Uranium-lead (U-Pb) age on zircon from Johnny Lyon Hills is 1,600±30 million years old. Intruded Yc. Yja: Small bodies, only some of which are mapped, and border phase of granodiorite.	High.	Not mapped in park.	None documented; Not mapped in park.	None.	Not mapped in park.	Biotite, hornblende, quartz.	Not mapped in park.	Not mapped in park.	Yr and Yj may represent fore-arc basin above subduction zone.
	Wrong Mountain Quartz Monzonite (Yw, Ywm, Ywa)	Yw: Large intrusive complex of stocks and layered sheets of moderately coarse grained to fine-grained biotite muscovite gneissic quartz monzonite. Typically contains garnet but few other accessory minerals. Locally grades into hybridized (partly assimilated?) Ych. Weakly to moderately foliated and lineated; generally more massive near core of gneiss dome. K-Ar ages of 23.5±0.9 and 24.8±0.9 million years old may record a Tertiary thermal event. Forms the main unit of the Rincon Gneiss Dome. Cores Tanque Verde and Rincon Peak anticlines. Ywm: Stock of nearly massive rock. Composition similar to gneissic quartz monzonite, but foliation weak and lineation absent to the unaided eye. Weathers to bold crags. Ywa: Aplite, alaskite, and pegmatite in pods and sheets. Many too small to map. Units are considered part of the "Catalina Gneiss" by Bezy (2005).	High.	Remote, rugged part of park; pack trails and campsites.	Remote rockfall potential.	None.	Possible American Indian sites and petroglyphs.	Garnet.	Crags and fractured cliffs in higher elevations provide nesting sites; includes many vegetation types: lowland mixed cacti-scrub to highland Ponderosa pine.	Pack trails; camping; hiking.	Part of metamorphic core complex. Ywm: May be last body of heated rock to be recrystallized during late Oligocene time.
	Metadiorite (Ydi)	Dark-greenish-gray amphibolite-rich small dikes, sills, and irregular masses. Relation to diabase unit (Yd) unknown. Mapped linear features.	High.	Limited extent; in rugged terrain.	None.	None.	Limited areal extent.	None.	Fractures and erosion provide sites for animals.	Irregular, linear exposures in backcountry.	May have economic interest. Precious and industrial metals often along margins.
	Dikes (Yri)	Light-brownish-gray to medium-gray rhyolitic to andesitic dikes, probably metamorphosed; some foliated. Limited areal extent.	High.	Limited extent; not in park.	Not mapped in park.	None.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.	Not mapped in park.
	Continental Granodiorite (Yc, Yca, Ych)	Yc: Dark-gray, coarsely porphyritic generally very coarse grained moderately to strongly foliated and lineated metagranodiorite. Locally large feldspar phenocrysts grade into augen. Dark minerals, chiefly biotite and chlorite, form pervasive meshwork throughout rock. Accessory sphene and titaniferous magnetite are usually abundant and apatite and zircon are common. In places intruded by unmapped thin layered sheets of Yw. Exposed on crest and flanks of Tanque Verde anticline. Yca: Granodiorite with many small intrusive bodies of aplite commonly as layered intrusives. Aplite probably largely of Yja and of quartz monzonite of Ywa. Ych: Gneissic granodiorite and quartz monzonite having textures and compositions between those of Yc and Yw. Typically contains highly elongated pods of recrystallized biotite and muscovite, is coarse grained, and in places contains small augen or phenocrysts. Units considered part of the "Catalina Gneiss" by Bezy (2005).	High.	Outcrops in park's backcountry; pack trails and camp sites.	None documented; rockfall potential for backcountry hikers.	None.	Possible American Indian sites.	Feldspar, biotite, chlorite, sphene, titaniferous magnetite, apatite, zircon.	Rocky terrain; fractures; dotted with ocotillo, creosote bush, occasional prickly pear and barrel cactus, and saguaro cactus.	Backcountry recreation; pack trails and camping; Tanque Verde Ridge Trail to Juniper Basin campsite.	Part of metamorphic core complex.
	Wrong Mountain Quartz Monzonite and Continental Granodiorite (Ywc)	Gneissic granodiorite (Yc), and abundant thin layered sheets of gneissic quartz monzonite (Yw) and of associated aplitic rocks (Ywa). Grades into mylonitic gneiss low on flanks of gneiss dome. Locally the layering is migmatitic. Exposed on flanks of Tanque Verde and Rincon Peak anticlines.	High.	Exposed in park's backcountry; pack trails and campsites.	None documented; rockfall potential?	None.	Possible American Indian sites.	Copper, lead; large feldspar crystals.	Rocky terrain; sparse vegetation and few springs.	Backcountry recreation; Tanque Verde Ridge Trail.	Part of metamorphic core complex.
PRECAMBRIAN (Archean)	Pinal Schist (Xp, Xpq, Xpc, Xpa, Xppq, Xpr)	Xp: Mainly mica schist; includes muscovite schist, muscovite-biotite schist, some phyllite, metaquartzite, mylonitic and migmatitic gneiss, and aplite. Strongly and probably multiply deformed through dynamic and thermal events. Xpq: Light-gray fine- to medium-grained metaquartzite. Main exposure encircles Happy Valley Lookout Tower. Xpc: Thin beds of light-gray metaconglomerate. Not mapped in the park. Xpa: Schist containing abundant small aplite bodies, largely as layered intrusives. Aplite probably largely of quartz monzonite of Ywa. Not mapped in the park. Xppq: Mixed metaquartzite, phyllite, and schist; may be in upper part of Pinal Schist like that found in the Happy Valley Quadrangle a few kilometers to the east. Not mapped in the park. Xpr: Laminated and locally schistose rock probably of volcanic origin. Local exposures near Catalina Fault Complex, sections 11 and 14, T15S, R17E.	Less resistant than granite or granodiorite.	Unimproved roads, pack trails, and campsites in park's backcountry.	None documented; rockfall potential for backcountry visitors.	None.	Possible American Indian sites.	Muscovite, quartz.	Lower elevations: prickly pear and saguaro cactus and abundant creosote bush. Higher elevations: ponderosa pine, oak, and Douglas fir.	Backcountry recreation; pack trails and camping.	Represents a marine environment that once received much sand, silt, and clay from a nearby continent. Part of metamorphic core complex. Oldest rocks in southern AZ.
AGE UNCERTAIN	Limestone and marble (ls)	Metamorphosed carbonate and calc-silicate rocks. May be as young as Permian or may possibly be an unrecognized facies of the Pinal Schist (Xp). Limited areal extent.	High.	Limited areal extent.	None.	None.	Limited areal extent.	Marble.	Limited areal extent.	Limited areal extent.	Unknown.
	Site of copper (Cu) mineralization	In Rincon Valley Quadrangle; in Wrong Mountain Quartzite (Yw)	Localized site	No mining.	Not applicable.	None.	Unknown.	Copper.	Not applicable.	Mineralogical interest.	Natural reactions to magmatic fluids and rock contacts.
	Site of lead (Pb) mineralization	In Rincon Valley Quadrangle; in Wrong Mountain Quartzite (Yw)	Localized site	No mining.	Not applicable.	None.	Unknown.	Lead.	Not applicable.	Mineralogical interest.	