U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Geologic map of the Fife Peak quadrangle, Cochise County, Arizona

By

John S. Pallister[1] and Edward A. du Bray[1]

Open-File Report 92-242

1992

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American stratigraphic code.

[1]Denver, Colorado

DESCRIPTION OF MAP UNITS

[Ages for Tertiary igneous rocks are $^{40}Ar/^{39}Ar$ determinations by L.W. Snee (Pallister and others, 1990), except where otherwise noted. Plutonic and volcanic names are in accord with the IUGS system (Streckeisen and others, 1973; Le Bas and others, 1986), except the subalkaline-alkaline division of Irvine and Baragar (1971) is used. The terms accessory and trace, where referring to mineral abundances, indicate <1 percent and <0.1 percent by volume, respectively. SiO_2 ranges based on the mean values and standard deviations of du Bray and Pallister (in press).]

SURFICIAL DEPOSITS

Qal **Alluvium (Holocene and Pleistocene)**--Unconsolidated to poorly consolidated silt, sand, gravel, and peaty material in valley bottoms. Includes alluvial-fan deposits and colluvial deposits at valley margins

Qaf **Alluvial-fan deposits (Holocene and Pleistocene)**--Poorly sorted, braided distributary deposits of silt- to boulder-size material; forms aprons adjacent to topographic highlands

Qc **Colluvium (Holocene and Pleistocene)**--Poorly sorted silt- to boulder-size material on slopes and in steep valleys. Locally includes small alluvial-fan, talus, and landslide deposits

TERTIARY ROCKS ASSOCIATED WITH THE TURKEY CREEK CALDERA

Moat deposits and related dikes

A sequence of rhyolite lava flows and tuffs and subordinate sedimentary rocks deposited in moat of Turkey Creek caldera and in a paleovalley that breached the northern caldera wall along what is now Pine Creek. The tuff map units contain block-and-ash flows, probably derived from collapse of lava domes, as well as variably welded pumiceous ash-flow tuffs. Gradational contacts between welded tuffs and overlying rhyolite lavas in several localities suggest that some of the lavas are rheomorphic tuffs

Aphyric rhyolite lava and rhyolite tuff (Oligocene)--Aphyric or sparsely porphyritic high-silica rhyolite lava flows and tuffs. Divided into three eruptive units on the basis of stratigraphic position, subtle petrographic differences, and distinct trace-element geochemistry (du Bray and Pallister, in press). Arcuate map distribution, tabular form, lack of preserved lava dome morphology, and aphyric character suggest accumulation of hot (near or above liquidus) and relatively low viscosity lava flows within caldera moat

Tmr_3 **Unit 3 (rhyolite lava)**--Light-gray to reddish-gray rhyolite lava (77-78 percent SiO_2), lavender near base. Typically aphyric; trace sanidine phenocrysts and biotite microphenocrysts locally present. Flow layered and flow folded. Spherulitic and axiolitic (with respect to flow layers) devitrification and granophyric recrystallization common. Found as erosional remnants capping ridges northeast and southwest of Fife Peak. Grada-

remnants capping ridges northeast and southwest of Fife Peak. Gradational contact with underlying tuff (Tmt_3) suggests origin as rheomorphic tuff. Maximum exposed thickness approximately 130 m; top removed by erosion

Tmt_3 **Unit 3 (rhyolite tuff)**--Lavender to reddish-gray rhyolite (76-78 percent SiO_2) ash-flow tuff. Aphyric and lithic poor, except near base where quartz, sanidine, and plagioclase xenocrysts and rhyolitic lithic fragments are found. Thickness 20-80 m

Tmr_2 **Unit 2 (rhyolite lava)**--Light-gray to reddish-gray, phenocryst-poor rhyolite (76-78 percent SiO_2) lava. Flow layered and intricately flow folded, locally massive. Aphyric or sparsely (0-2 percent) porphyritic or microporphyritic with small (<1 mm) phenocrysts of sanidine, quartz, and opaque oxide minerals; accessory biotite and zircon present in some samples. Devitrified, except at basal flow contact where black or green glassy breccia (shown near center of map, 1 km south-southeast of Boundary Tank) or flow-layered perlite is locally exposed. Spherulitic and axiolitic (with respect to flow layers) devitrification and granophyric recrystallization common. Contains secondary (vapor-phase) quartz and feldspar crystals, commonly (1) within or between thin flow bands, (2) in amygdules, (3) in cores of spherulites, or (4) forming a patchy granophyric groundmass. Forms resistant ledges and massive cliffs in exhumed moat of Turkey Creek caldera. Maximum thickness approximately 300 m

Tmt_2 **Unit 2 (tuff)**--Ash-flow deposits and intercalated air-fall tuff and volcaniclastic sedimentary rocks. Mainly light-gray to orange or pink, poorly to densely welded, crystal-poor, rhyolite ash-flow tuff. Typically very sparsely porphyritic; phenocrysts (<1 percent) are quartz and sanidine (both <1 mm) and microphenocrysts of opaque oxide minerals. Similar in phenocryst assemblage and chemistry to overlying rhyolite lava (Tmr_2), however, some ash flows contain more abundant (about 1 percent) phenocrysts of plagioclase, sanidine, and accessory biotite. Pumice fragments show axiolitic devitrification and granophyric cores. Degree of welding variable within and between flows. Individual ash flows and intercalated volcaniclastic sedimentary beds range in thickness from <1 m to several tens of meters. Forms multiple low-relief cliffs or slopes below steeper cliffs of rhyolite lava (Tmr_2). Maximum thickness about 100 m

Tmr_1 **Unit 1 (rhyolite lava)**--Light-gray to reddish-gray or brown rhyolite (76-78 percent SiO_2) lava. Exposures in this quadrangle limited to its eastern boundary, in the vicinity of Fife Canyon. Description based mainly on exposures to the east, in the Rustler Park quadrangle (Pallister and others, in press). Flow layered and intricately flow-folded but locally massive. Typically aphyric or crystal poor (<5 percent) with sanidine, quartz, and opaque oxide minerals; locally contains trace amounts of plagioclase, hornblende, and clinopyroxene. Some plagioclase and mafic silicates form resorbed crystal clots that are probably xenocrystic. Similar to rhyolite lava of eruptive unit 2 (Tmr_2), except for more

variable phenocryst assemblage, less evolved trace-element composition (du Bray and Pallister, in press), and stratigraphic position. Devitrified, except at basal flow contact where perlitic glass locally contains spherulitic zones and geodes. Carapace breccia locally exposed at margins of lava flows. Flow interiors recrystallized to granophyre and contain vapor-phase quartz and feldspar in amygdules. $^{40}Ar/^{39}Ar$ ages: 26.64±0.13 Ma and 26.93±0.17 Ma for lava samples from near Ida Peak and at Flys Peak (east of map area, in adjacent Rustler Park quadrangle), respectively. Thickness 0-20 m near Fife Canyon, reaches 150 m thickness in Rustler Park quadrangle

Tmrb **Biotite rhyolite lava (Oligocene)**--Biotite-bearing rhyolite lava flows and domes. Gray to brownish- or yellowish-gray (devitrified) or black (glassy), phenocryst-rich (5-20 percent) rhyolite (73-74 percent SiO_2). Contains phenocrysts of plagioclase, sanidine, quartz, biotite, opaque oxide minerals, and trace amounts of zircon and monazite. Plagioclase also forms small (<1 mm) oscillatory zoned (andesine cores) crystals; xenocrystic origin suggested by common resorption, wormy glass inclusions, and occurrence in small crystal clots, commonly with biotite. Perlite locally preserved at basal contact is spherulitic in some outcrops. Flow interiors devitrified and locally granophyric. Thickness 0 to >300 m; maximum thickness in graben near Rattlesnake Peak (east of map area, in adjacent Rustler Park quadrangle) and at Fife Peak

Tmtb **Biotite rhyolite tuff (Oligocene)**--Biotite-bearing ash-flow deposits. Yellow-brown to orange, massive to poorly bedded block-and-ash deposits composed of 30-40 percent pumice blocks (1-20 cm in diameter) and 10-20 percent rhyolite lithic clasts in a tuff matrix; pumice blocks and tuff matrix both contain 2-5 percent small (<1-2 mm) phenocrysts of plagioclase, sanidine, quartz, conspicuous biotite, and opaque oxide minerals. Pink to orange pumiceous ash-flow tuffs exposed locally. Slope forming, and typically poorly exposed, except where block-and-ash flows are thick. Mantles lava dome of biotite rhyolite at Fife Peak; overlaps in age with biotite rhyolite lava (Tmrb). Formed by explosive eruptions and by collapse of biotite rhyolite lava domes; pyroclastic equivalent of biotite rhyolite lava (Tmrb). Thickness 0-120 m

Tms **Sedimentary rocks (Oligocene)**--Red to reddish-brown or orange, interbedded volcaniclastic breccia, conglomerate, and sandstone. All contain abundant volcanic debris; clasts of Rhyolite Canyon Tuff (described below) and (or) dacite porphyry (described below) abundant at some localities. Matrix typically fine grained, highly altered, hematitic, and probably ash rich. Thickness approximately 0-10 m in map area; thicker to southeast in Chiricahua Peak 7½-minute quadrangle

Resurgent intrusion, ring dike, and extrusive equivalents

Forms resurgent intrusion and ring dike within Turkey Creek caldera; ring dike is feeder for, and is buried by, chemically equivalent dacite porphyry lava flows exposed to east in Rustler Park quadrangle (Pallister and others, 1990; Pallister and others, in press). The near absence of caldera-floor rocks between resurgent intrusion

and intracaldera tuff, scarcity of megabreccia in tuff, and lack of chemical equivalents of lower and middle members of outflow facies within intracaldera tuff suggest that resurgent phase of porphyry may be a thick (>1 km) sill within caldera fill (Pallister and du Bray, 1990; du Bray and Pallister, in press). Intrudes and metamorphoses intracaldera Rhyolite Canyon Tuff (Trci) along a contact that dips away from center of caldera. $^{40}Ar/^{39}Ar$ ages: 26.97±0.13 Ma for a sample of dacite porphyry lava (Tdpl) from northeast of Barfoot Peak (east of map area, in adjacent Rustler Park quadrangle), and 26.84±0.13 Ma for a sample from resurgent intrusion (Tdpi) near Turkey Pen Canyon (southeast of map area, in adjacent Chiricahua Peak quadrangle). The volcanic name dacite is applied to most of these porphyritic rocks because their fine grain size precludes modal analysis and because they are found as lava flows or hypabyssal intrusions. Porphyry that is sufficiently coarse grained for modal analysis is volumetrically minor

Tdpi **Dacite and monzonite porphyry (Oligocene)**--Gray to tan, massive, highly jointed feldspar porphyritic dacite (63-67 percent SiO_2) and monzonite porphyry (modal compositions of coarser grained samples vary from monzonite to quartz monzonite and locally to monzogranite). Contains megacrysts (5 mm to >3 cm across) of alkali feldspar and plagioclase, and small (typically 1 cm across) inclusions of hornfels. Alkali feldspar is commonly zoned, forms overgrowths on plagioclase, and is variably exsolved to microperthite; cores of some alkali feldspar phenocrysts are resorbed. Plagioclase phenocrysts (1-3 mm) are zoned from albite rims to andesine cores. Also contains glomerocrysts of albite-andesine and phenocrysts or microphenocrysts of sanidine, quartz, biotite, hornblende, clinopyroxene, opaque oxide minerals, and trace amounts of apatite, zircon, and sphene. Phenocryst assemblage highly variable. Phenocrysts of resorbed quartz are present locally and groundmass quartz is abundant in granophyre. Clinopyroxene and hornblende are common accessory or trace phases, but are less common than biotite. Groundmass of the resurgent intrusion grades from coarse "cuneiform" granophyre, most common at its lowest exposed levels, through medium- to fine-grained granophyre, higher in the body

Tdpl **Dacite porphyry lava (Oligocene)**--Extrusive equivalent of dacite and monzonite porphyry (Tdpi). Shown only in cross section. Exposed extensively to the east in the adjacent Rustler Park quadrangle (Pallister and others, in press)

Intracaldera and outflow facies Rhyolite Canyon Tuff (Oligocene)

Quartz-sanidine rhyolite ash-flow tuff (76-78 percent SiO_2) erupted from the Turkey Creek caldera (Pallister and others, 1990). Phenocrysts composed almost entirely of sanidine and quartz; sanidine is typically more abundant (ratios vary from 2:1 to about 1:1). Divided into intracaldera and outflow facies; intracaldera facies (Trci) is chemically equivalent to only the uppermost member of outflow facies (not present in map area) (Latta, 1983; du Bray and Pallister, in press); lower and middle members are slightly more siliceous and have distinct trace-element abundances. $^{40}Ar/^{39}Ar$ ages for samples from type section of outflow facies (northeast of map area, at Chiricahua National Monument) are 26.94±0.16 Ma and 26.93±0.12 Ma for upper and lower members, respectively. Intracaldera facies tuff contains rare zones of megabreccia, including large slabs of brecciated dacite of Faraway Ranch Formation

(Tfv) near the contact with the resurgent intrusion south of Fife Peak

Trca **Aplite and rhyolite**--Rootless dikes and sills of quartz-sanidine rhyolite and aplite at the contact with dacite porphyry of resurgent intrusion (Tdpi). Inferred to represent *in situ* melts of intracaldera Rhyolite Canyon Tuff. Evidence for inferred mode of origin is textural and compositional. Quartz phenocrysts in units Trca and Trci are texturally similar and chemical composition of the aplite and rhyolite dikes overlaps that of the intracaldera tuff (Trci) (du Bray and Pallister, in press)

Trci **Intracaldera facies**--Reddish-brown, red, pink, orange, or gray rhyolite ash-flow tuff. Lithic poor to lithic rich (typically <5-20 percent) and crystal rich (10-30 percent). Forms a compound cooling unit consisting of a thick (>1 km) lower cooling unit and an upper composite(?) cooling unit composed of several thin ash flows, locally rich in dark-gray fiamme. Sanidine has chalky appearance (partly replaced by clay minerals), except at high stratigraphic levels and near contact with resurgent intrusion (Tdpi) where chatoyant crystals are present; quartz rounded and resorbed. Accessory opaque oxide minerals and trace amounts of clinopyroxene are variably altered to hematite and replaced by alteration minerals. Dark-gray fiamme in upper cooling unit are macroscopically similar to glassy and fine-grained extrusive phases of dacite porphyry. Fiamme contain variably disaggregated feldspar megacrysts (texturaly similar to those in dacite porphyry) in an aphanitic groundmass and are compositionally similar to intracaldera tuff. Fiamme are densely welded, but recrystallization commonly obscures eutaxitic foliation. Foliation dips radially away from center of caldera due to doming, presumably related to resurgent intrusion of dacite porphyry magma (Tdpi). Intracaldera tuff is intruded and metamorphosed by porphyry (Tdpi) at base. Tuff near contact recrystallized to granophyre and locally melted. Brecciated dacite (Tfv) derived from the Faraway Ranch Formation, are found in large masses of megabreccia within and at the base of the tuff, south of Fife Peak. Thickness 1-1.5 km above intrusive contact with porphyry

—·—·—·— Ash bed--Light-gray ash beds mark contact between lower and upper cooling units and between ash flows in upper unit; base of upper unit locally marked by vitrophyre

Trco **Outflow facies**--Light-gray to tan quartz-sanidine rhyolite ash-flow tuff. Lithic poor (<5 percent) and phenocryst rich (10-20 percent). Sanidine chatoyant and forms subhedral, lath-shaped phenocrysts, 1-4 mm in length. Quartz typically rounded and embayed, <1-3 mm in diameter. Also contains accessory opaque oxide minerals and trace clinopyroxene (augite), zircon, and apatite. Eutaxitic and vitroclastic; locally spherulitic. Only proximal edge of outflow sheet exposed in quadrangle; deposited on basement rocks (Tfv) that underlie northern flank of Turkey Creek volcano. Contact with moat deposits defines outer limit for paleotopographic margin of the caldera. Where well exposed, north and east of quadrangle, forms a compound cooling unit, consisting of upper, middle, and lower members (depositional units) separated by air-fall and surge deposits (Pallister and others, in press). Undivided in

this quadrangle; most exposures probably equivalent to middle and lower members. Maximum exposed thickness in this quadrangle is approximately 90 m. Accumulated to greater thickness (140 m inferred along section A-A') in a buried paleovalley coincident with Pine Creek, and in an uplifted paleobasin at Chiricahua National Monument, north of the quadrangle. Composite thickness of entire outflow facies at type section in Chiricahua National Monument approximately 400 m

—·—·— Cooling break--Near Boundary Tank

VOLCANIC AND SEDIMENTARY ROCKS THAT PREDATE THE TURKEY CREEK CALDERA

Tfv **Faraway Ranch Formation (Oligocene)**--Assemblage of interfingering lava flows and near-source pyroclastic rocks. At least five lithologically and compositionally distinct volcanic rock types are in this poorly exposed and highly weathered unit. Red to brown, hornblende- and (or) biotite-bearing plagioclase porphyritic dacite (three different units, with 63-68 percent SiO_2) and dark-gray basaltic andesite (53 percent SiO_2) comprise the lower part of the formation, which is exposed in this quadrangle. These units contain trace amounts of sphene, apatite, and zircon. Ages of volcanic rocks from lower part of the unit are not known. Rhyolite (74 percent SiO_2) lavas and pyroclastic rocks constitute the upper part of the formation, which is exposed to the north (in adjacent Bowie Mountain South quadrangle, Drewes, 1981). K/Ar (biotite) ages are 28.6±2.0 and 28.3±0.8 Ma (recalculated using IUGS constants--Steiger and Jäger, 1977) for samples of rhyolite lava from the upper part of the formation (Marjaniemi, 1969). The dacite and basaltic andesite form basement rocks that underlie the northern flank of the Turkey Creek caldera. Large masses of brecciated biotite dacite within and at the base of the intracaldera facies of Rhyolite Canyon Tuff south of Fife Peak are thought to be landslide megablocks derived from the northern wall of the caldera

TKp **Sedimentary and volcanic rocks of Pinery Canyon, undivided (Tertiary or Cretaceous)**--Shown only in cross section. Presence in subsurface inferred from relations in Rustler Park quadrangle (Pallister and others, in press)

Kb **Bisbee(?) Group, undivided (Lower Cretaceous)**--Limestone, siltstone, and shale. Shown only in cross section. Presence in subsurface inferred from relations in Rustler Park quadrangle (Pallister and others, in press)

Contact--Dashed where approximately located

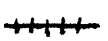

Unconformity along caldera wall, between moat deposits, and underlying Rhyolite Canyon Tuff or Faraway Ranch Formation--Semicircles on down dip side


Structural margin of Turkey Creek caldera--Dotted where concealed by moat deposits; position approximate; hachures on down-thrown side


High-angle fault--Dashed where approximately located; dotted where concealed. Ball and bar on downthrown side

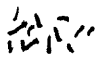
Strike and dip of foliation

Strike and dip of joints


Quartz vein


Zones of silicification


Breccia--Brecciated volcanic rock of Faraway Ranch Formation exposed at contact between intracaldera tuff (Trci) and resurgent intrusion (Tdpi)


Basal breccia of moat rhyolite lava flow

GEOLOGIC OVERVIEW

The Fife Peak quadrangle straddles the northern margin of the Turkey Creek caldera, a mid-Tertiary (27 Ma) volcanic depression formed during eruption of the Rhyolite Canyon Tuff and partial evacuation of an underlying rhyolitic to dacitic magma chamber (Marjaniemi, 1969; Pallister and others, 1990; du Bray and Pallister, in press). The caldera is deeply eroded; volcanic and shallow plutonic levels are exposed. Shortly after eruption of the Rhyolite Canyon, the central part of the caldera was intruded and domed and the structural margin was intruded by dacite and monzonite porphyry. In the Rustler Park quadrangle to the east, dacite porphyry was erupted from a ring dike within the structural margin and accumulated as a series of thick lava flows within the caldera moat (Pallister and others, 1990). A series of rhyolite lava flows, small-volume tuffs, and sedimentary rocks were then deposited in the caldera moat.

Erosion has modified the topographic expression of the caldera. The topographically high margin of the caldera rim was located within what is now Pinery Canyon. Erosion-resistant moat lavas and the ring intrusion now form the topographic highlands south of Pinery Canyon. The outflow facies of the Rhyolite Canyon Tuff accumulated in a northwest trending paleovalley along what is now Pine Creek, and it accumulated to a greater thickness in a paleobasin north of the quadrangle at Chiricahua National Monument. An isolated exposure of moat deposits near the northern quadrangle boundary indicates that the Pine Creek paleovalley breached the caldera wall.

The most prominent structural feature in the quadrangle is a north-northwest-trending horst that passes through Fife Peak. Intracaldera tuff (Trci) and moat rhyolite of unit 3 (Tmr_3) are juxtaposed along the western boundary fault, yielding a total vertical displacement of more than 300 meters. Last motion on the western fault postdates the youngest moat deposit, consistent with late down-to-the west faulting observed in the Rustler Park quadrangle (Pallister and others, in press). The eastern fault is not present in North Witch Canyon; either the fault predates and is buried beneath the moat deposits, or displacement dies out to the north. Both interpretations link early development of the horst to caldera resurgence. Exposures east and southeast of Fife Peak are not adequate to distinguish whether the tuff of moat unit 2 (Tmt_2) is banked or faulted against the horst block.

ACKNOWLEDGMENTS

Our field work was facilitated by the cooperation and assistance of the Southwestern Research Station (SWRS) of the American Museum of Natural History, Chiricahua National Monument, and the University of Arizona. We especially thank Wade Sherbrooke, Pam Limberger, and Christina Schwartz of SWRS for assistance and for providing a stimulating research environment. David Moore, Chuck Milliken, and Dick Armstrong provided accommodations and assistance during our work in the National Monument. We thank Joe Austin, Carol Hudson, and Billie and Jean Riggs for providing access through their land.

REFERENCES CITED

Drewes, Harald, 1981, Geologic map and sections of the Bowie Mountain South quadrangle, Cochise County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-1363, scale 1:24,000.

Drewes, Harald, 1982, Geologic map of the Cochise Head quadrangle and adjacent areas, southeastern Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-1312, scale 1:24,000.

Drewes, Harald, and Brooks, W.E., 1988, Geologic map and cross sections of the Pedregosa Mountains, Cochise County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-1827, scale 1:48,000.

du Bray, E.A., and Pallister J.S., in press, An ash-flow caldera in cross section: ongoing field and geochemical studies of the Turkey Creek Caldera, SE Arizona: Journal of Geophysical Research.

Irvine, T.N., and Baragar, W.R., 1971, A guide to the chemical classification of the common volcanic rocks: Canadian Journal of Earth Sciences, v. 8, p. 523-548.

Latta, J.S., 1983, Geochemistry and petrology of the ash flows of Chiricahua National Monument, Arizona, and their relation to the Turkey Creek caldera: University of Arizona M.S. thesis, 194 p., 1 pl.

Le Bas, M.J., Le Maitre, R.W., Streckeisen, A., and Zanettin, B., 1986, A chemical classification of volcanic rocks using the total alkali-silica diagram: Journal of Petrology, v. 27, p. 745-750.

Marjaniemi, D.K., 1969, Geologic history of an ash-flow sequence and its source area in the Basin and Range Province of southeastern Arizona: University of Arizona Ph. D. dissertation, 176 p., 1 pl.

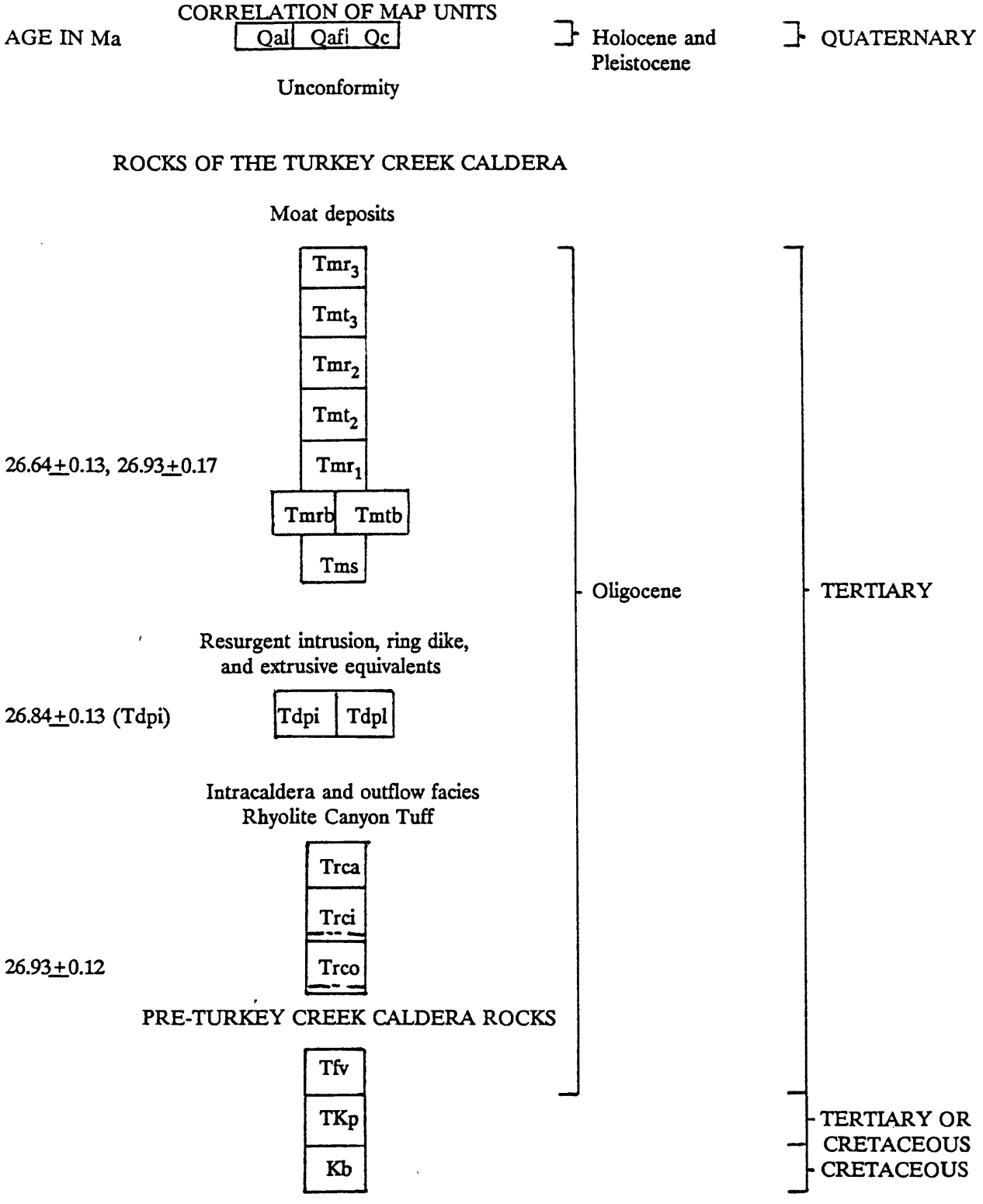
Pallister, J.S., du Bray, E.A., Rosenbaum, J.G., Snee, L.W., and Yager, D.B., 1990, Calderas in 3-D, Chiricahua Mountains, southeast Arizona, *in* Gehrels, G.E., and Spencer, J.E., eds., Geologic excursions through the Sonoran Desert region, Arizona and Sonora: Arizona Geological Survey Special Paper 7, p. 31-40.

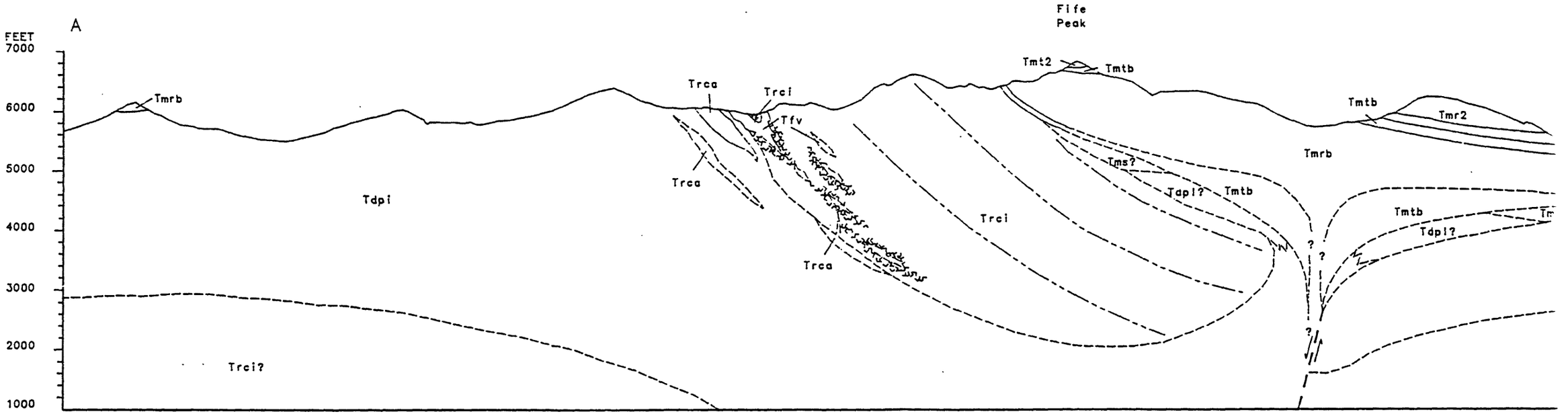
Pallister, J.S., du Bray, E.A., and Latta, J.S., IV, in press, Geologic map of the Rustler Park quadrangle, southeast Arizona: U.S. Geological Survey Geologic Quadrangle Map GQ-1696, scale 1:24,000.

Steiger, R.H., and Jäger, E., 1977, Subcommission on geochronology--Convention on the use of decay constants in geo- and cosmochronology: Earth and Planetary Science Letters, v. 36, p. 359-362.

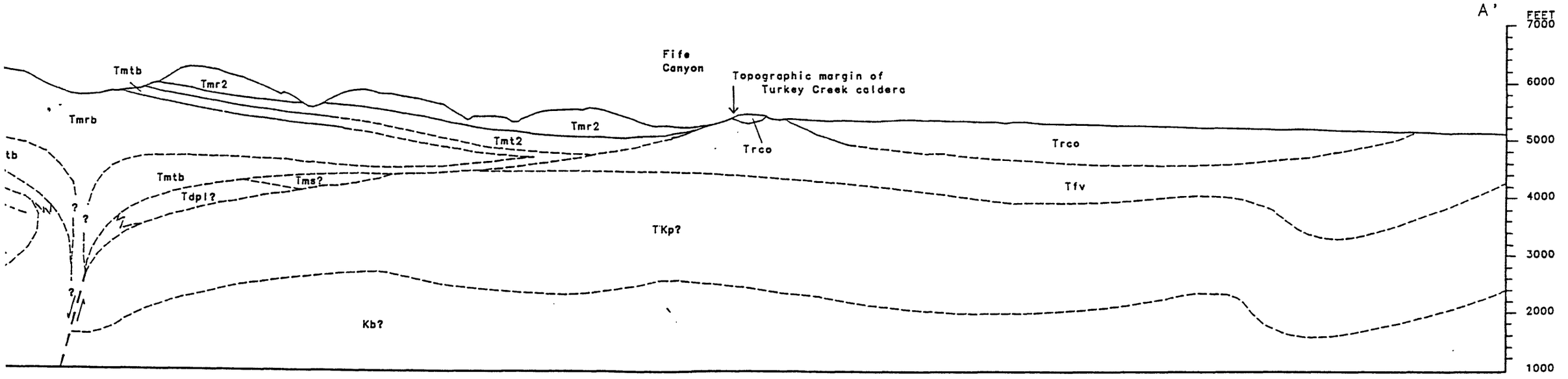
Streckeisen, A.L., 1973, Plutonic rocks, classification and nomenclature recommended by the IUGS subcommission on the systematics of igneous rocks: Geotimes, v. 18, no. 10, p. 26-30.

CORRELATION OF MAP UNITS





1000 feet = 305 meters
Surficial units not shown; geologic relations below 4500 feet inferred


A'
FEET
7000
6000
5000
4000
3000
2000
1000
Fife
Canyon
Topographic margin of
Turkey Creek caldera
Tmtb
Tmr2
Tmrb
Tmr2
Tmt2
Trco
Trco
tb
Tmtb
Tms?
Tdpl?
Tfv
TKp?
Kb?