Map Sheet 1 of 3
Upper part

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 94-629

See separate figure 5 for geologic information north of latitude 36°37'30" in this area of the John Kerr Reservoir.

Base from U.S. Geological Survey, Clarksville South, 1968
(photorevised 1981), Tungsten, 1968 (photorevised 1974)
Polyconic projection.

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped by J.D. Peper, December 1991; May–June 1992; and September–November 1993 and compiled from Parker (1962), Gair (1971), Assisted by T.H. Clark, May–June 1992; K.A. Gamble, July–August 1992; Nicola Van Gelb, September 1992

Manuscript approved for publication February 2, 1994

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

af
Qal
Tt

Holocene — QUATERNARY
TERTIARY
EARLY JURASSIC

IGNEOUS AND METAMORPHIC ROCKS

Jd

Clarksville batholith

Pzfg | Pzfg | Pzfg | Pzfg | Vance pluton | CZhm | CZhm

Rocks of the Vance pluton

METAMORPHOSED VOLCANIC AND SEDIMENTARY ROCKS

Zg | Zs | Zp | Zs | Zp | Zm | Zmb | Zm | Zpm | Zfm | Zpm | Zft | Zmb | Zpm

PALEOZOIC — MESOZOIC — CENOZOIC
LATE PROTEROZOIC

DESCRIPTION OF MAP UNITS

(Saprolite, which consists of a layer of variably oxidized, decomposed, and disaggregated rock, forms a blanket as much as 18 m thick that overlies undecomposed bedrock and underlies surficial deposits. Soil horizons are developed on the saprolite and on the surficial deposits)

SURFICIAL DEPOSITS

af **Artificial fill (Holocene)**—Fill material, such as dirt, rubble, riprap, sand, and gravel emplaced for construction of roads, railroads, dams, and landing strips

Qal **Alluvium (Holocene)**—Silt, sand, and minor gravel deposited along courses of modern streams generally less than 3 m above channel of present-day stream. Material mixed with varied amounts of finely comminuted organic debris in poorly drained areas

Tt **Terrace deposits (Tertiary)**—Sand, silt, and gravel deposited in channels and flood plains by streams ancestral to the Roanoke River. Deposited as much as 18 m above the modern Roanoke River channel

IGNEOUS AND METAMORPHIC ROCKS

Jd **Diabase and minor hypersthene dioritic dikes (Early Jurassic)**—Very dark gray, fine to medium-grained, locally coarse-grained labradorite-augite-magnetite diabase to 0.5- to 150-m-wide steeply dipping dikes. Diabase contains minor green hornblende, biotite, and apatite. Locally, unit is medium-grained hypersthene diorite (Parker, 1963). Large dike in Buffalo Creek, 1.5 km southeast of Clarksville, Va., is 150 m wide. Where best exposures found, unit shown on labeled lines (b-b' symbol (see Explanation of Map Symbols)). In several areas, unit shown only by labeled dike symbol (see Explanation of Map Symbols). Inferred position of dike in Pecketwood Branch area is shown by labeled dike symbol Jd; position is inferred from an anomaly on unpublished aeromagnetic map (David Daniels, USGS, unpub. mapping, 1992). No dike rock was found in Pecketwood Branch area

Pzfq **Muscovite-biotite quartz monzonite (Permian to Late Mississippian)**—Very light gray to white-weathering, very weakly foliated to massive, medium-grained quartz monzonite containing 3–10 percent muscovite and 3–5 percent dark-green biotite. Unit is small pluonlith exposed in wave-cut cliff on west side of peninsula north of Panhandle Creek

Rocks of the Clarksville Batholith

Pzfg **Foliated biotite granite (Paleozoic and Late Proterozoic)**—Light-gray to white-weathering, medium- to fine-grained, mostly strongly foliated biotite-muscovite granite; composition ranges to granodiorite, quartz monzonite, and tonalite. Equigranular to subporphyritic. Consists of approximately equal amounts of flattened gray quartz grains 1–2 mm across and altered, rounded, plagioclase and potassium feldspar grains 2–3 mm across. Biotite content is 3–5 percent; muscovite 0–3 percent. Unit forms dikes 0.3 to 0.6 m wide and subporphyritic border along foliated porphyritic granodiorite (Pzfgp). Foliation appears magmatic; internally at high angle to regional foliation and parallel to margins of body at borders. Mapped along west border of map as large body, which is probably continuous with medium-grained granite designated as Rocky Ford Granite in Buffalo–Lithia Springs area 9 km northwest of Clarksville by Lesny (1972, p. 35–36)

Pzfgp **Foliated porphyritic granodiorite (Paleozoic and Late Proterozoic)**—Strongly to locally weakly foliated, very coarse grained, porphyritic biotite granodiorite; composition ranges to granite, quartz monzonite, and hornblende granodiorite. Contains 10–20 percent hollowed, rectangular and pod-shaped phenocrysts and aggregates of potassium feldspar 2–6 cm across in groundmass consisting of gray quartz grains 4 mm across and rounded and tabular plagioclase and potassium feldspar grains 6 mm to 1 cm across. Also contains 5–7 percent green biotite books as much as 8 mm across and 0–2 percent hornblende. Deeply saprolished and poorly exposed in roadcuts; weathers to sandy soil containing elongated, pitted feldspar phenocrysts. Unit is probably porphyritic granite described as Rocky Ford Granite in the Buffalo–Lithia Springs area by Lesny (1972, p. 36)

Pzfq **Pink quartz monzonite (Paleozoic and Late Proterozoic)**—Weakly foliated, pink-weathering, equigranular, medium-grained biotite quartz monzonite containing distinctive gray quartz grains 4–6 mm across and pink feldspar. Biotite content is 3–5 percent. Unit found only as dingle dike along Spennymore Creek that is shown by labeled dike symbol q

Pzfhg **Hornblende gabbro (early Paleozoic)**—Mapped mostly in three large rounded bodies, which transect regional foliated structure, in southcentral part of map near Beaver Pond Creek, in southeastern part of map near Spennymore Creek, and in northwestern part of map near Eastland Creek. Beaver Pond Creek body is mostly dark-gray, fine- to coarse-grained, hornblende-labradorite gabbro and hornblendeclinopyroxene-labradorite gabbro that contains dendritic epidote, sericite, and chlorite. Body cut by dikes of medium-grained hornblende diorite and leucocratic, light-gray hornblende quartz diorite to tonalite near Beaver Pond Creek. Unit is also exposed in roadcuts on Va. Route 58/Buffalo, and quartz porphyry is exposures along creek. Spennymore Creek body is mostly dark-gray to black, medium- to coarse-grained hornblende-clinopyroxene-calcic plagioclase gabbro. Hedley (1973) described augite, minor olivine, and bronh hornblende replacing diopsidic pyroxene in a block of labradorite-hypersthe gabbro that must have come from this body in the Clarksville South quadrangle. North and west margins of body are medium- to fine-grained and foliated. Eastland Creek body is medium-gray to dark-gray, medium- to coarse-grained hornblende-labradorite gabbro to local clinopyroxene-rich hornblende gabbro. Contains inclusions of greenstone in outcrops along Eastland Creek in adjacent Boydton, Va., quadrangle to the north

Rocks of the Vance pluton

CZhm **Biotite metagranodiorite to quartz monzonite (Early Cambrian and Late Proterozoic)**—Strongly to weakly foliated, medium- to coarse-grained, metamorphosed granodiorite to quartz monzonite. Weathers light-gray to tan. Biotite content is 3–7 percent. Equigranular to subporphyritic, locally pegmatitic. Calcic plagioclase with relict zoning, altered to albite, epidote, and sericite. Mapped as large body in southeast corner of map; same rock type also found as thin (0.5–3 m) dikes and sills (hg) and loose blocks (hg) in adjacent hornblende metagranodiorite (CZhm) (see Explanation of Map Symbols)

CZhn **Hornblende metagranodiorite to quartz monzonite (Early Cambrian and Late Proterozoic)**—Very coarse to coarse-grained, strongly to weakly foliated, massive, light-gray- to brown-weathering, metamorphosed granodiorite to quartz diorite. Equigranular to subporphyritic, locally pegmatitic. Consists of hornblende (5–10 percent) and biotite (3–7 percent) in clots and patches 6 mm to 1 cm across; also contains gray quartz crystals 4–6 mm across. Relict coliacntic zoning visible in altered calcic plagioclase (albite, epidote, and sericite). Described as an albite granodiorite by Parker (1963) who reported as much as 20 percent potassium feldspar in

matrix. Patchy clusters of mafic minerals, as well as small rounded inclusions of fine-grained biotite-rich quartz diorite that are 1 cm to as much as 1 m across, give outcrops a blotchy, spotted appearance. Mica-rich pulmponts of phyllite, foliated inclusions of felsite and greenstone, and pods (autolithe?) of hornblende-rich diorite are common in many exposures. Includes pink quartz-potassium feldspar-muscovite-chlorite pegmatite mapped as dike (p) and loose block (p) (see Explanation of Map Symbols)

METAMORPHOSED VOLCANIC AND SEDIMENTARY ROCKS
(See figure 2 for unit thicknesses)

Zg **Greenstone (Late Proterozoic)**—Heterogeneous unit that includes massive greenstone, foliated and fissile mafic flutestaff, chlorite-muscovite schist (foliated metaclastite), amygdaloidal metabasalt, and crystal metatuff with chlorite-epidote matrix. Rocks weather dark reddish brown. Amygdaloidal metabasalt in flows 1–2 m thick makes up 5 percent of unit. Relict bedding as much as 10 cm thick commonly visible in mafic metatuff. Includes a few subordinate lenses 1–3 m thick of schistose, fissile, tan- to yellow-tan-weathering, felsic metatuff

Zs **Metasandstone (Late Proterozoic)**—White- to light-tan-weathering, fine- to medium-grained feldspathic metasandstone and subordinate pebbly metasandstone. Metasandstone is thinly and evenly laminated, rarely cross-stratified

Zp **Phyllite (Late Proterozoic)**—Brownish-gray to lead-gray, sericite-chlorite phyllite and feldspathic phyllite. Intercalated with locally more abundant thin-bedded phyllitic metasandstone; ten to white, schistose, fissile, thin-bedded felsic metatuff; massive greenstone; and thin-bedded chloritic metatuff. Rare crystal-lithic metatuff and gray phyllitic metasandstone have thin graded beds. Gray cross-laminated metasandstone is rare. White laminated metasandstone, in lenses as much as 10 m thick, is found in phyllite zone near margin of metasandstone (Zs) near mouth of Butcher Creek and along shores of unnamed northeast-trending embayment east of Butcher Creek

Zq **Quartz-pebble metaconglomerate and quartzite (Late Proterozoic)**—Clastic rocks described by Parker (1962) p. C14–C15) & interbanded with phyllite. Metaconglomerate consists of pebbles and cobbles of fine-grained gray quartz, along with rounded slabs of gray, fine-grained slate, in a sandy chlorite-sericite matrix. Quartzite is dark-gray, fine-grained, and laminated. Mapped as single lens in phyllite (Zp) 0.5 km northeast of Ivy Hill

Zgp **Greenstone and phyllite (Late Proterozoic)**—Single small lens of massive chloritic greenstone in thick layers intercalated with phyllite in exposures on unnamed hill in northeast corner of map

Zvb **Volcanic metabreccia and metaconglomerate (Late Proterozoic)**—Two thin lenses within and at margin of phyllite (Zp) mapped 1.3 km southwest of the Island Creek Public Use Area. West lens is gray, thickly layered,felsic metatuff containing angular fragments of metafelsite. East lens is brown-weathering, medium-bedded pebble metaconglomerate intercalated with thick layers of amygdaloidal metabasalt, fissile felsic crystal metatuff, and brown chloritic phyllite

Zcma **Crystal-lithic metatuff and volcanic metasandstone (Late Proterozoic)**—Mapped as two lenses near north border of map. Lens that crosses Panhandle Creek includes light-gray to tan, felsic crystal metatuff; welded metatuff; metabrychoite, chert-pebble metaconglomerate; and ironbedded volcanic metasandstone. Lens that crosses Packerwood Branch includes light-gray, thick-bedded to massive, medium-grained felsic metatuff and white, cross-laminated volcanic metasandstone

Zbs **Fissile felsic metatuff (Late Proterozoic)**—Heterogeneous unit mapped in two lenses stratigraphically below phyllite (Zp) and above coarse-grained felsic metatuff (Zft). Unit is mostly fine-grained, schistose, fissile, thin-bedded to laminated metatuff composed of feldspar, quartz, and minor amounts of white mica. Tiny rectangular orthoclase phenocrysts. Includes thin-bedded crystal tuff; rare, thin volcaniclastic metagandstone; feldspar metaporphyry; thin-bedded quartz clastic metaporphyry; metamorphosed, hypabyssal, fine-grained quartz clastic; and minor (10 percent) extrusive or hypabyssal metabasalt and mafic metatuff

Zcm **Crystal metatuff (Late Proterozoic)**—Mostly medium-grained, medium- to thin-bedded, dominantly felsic crystal metatuff that weathers tan to dark brown. Lesser amounts of thin-bedded, fissile, felsic metatuff that weathers yellow tan to white. Minor thin-bedded mafic metatuff, metabasalt, metasandstone, and quartz metaporphyry

Zmm **Pebbly metasandstone and crystal-lithic metatuff (Late Proterozoic)**—Very coarse grained pebbly metamudstone with brown matrix and cobbles of metabasalt and metafelsite as much as 10 cm in diameter. Metamudstone interlayered with light-tan, blocky, felsic crystal-lithic metatuff containing pebbles of metabasalt

Zqm **Quartz metaporphyry (Late Proterozoic)**—Mapped as three lenses of extrusive rock. Lens about 2.3 km southeast of Buffalo Junction, Va., and and lens along U.S. Highway 15 at south border of map are light-gray to white, medium-grained, massive to well-jointed, porphyritic extrusive felsic quartz-feldspar-muscovite metaporphyry containing rounded relict subhedral phenocrysts of gray quartz 4 mm across in aphanitic matrix. Lens 1 km southwest of Soudan, Va., is light-gray, medium-bedded quartz metaporphyry interlayered with pebbly felsic metatuff and thin-bedded felsic crystal metatuff. Dikes of quartz metaporphyry, shown by dike symbol qm, are fine-grained quartz metaclastic containing quartz and more rarely feldspar phenocrysts. Affinity of these hypabyssal dike rocks (qm) with Zq unit is probable but has not been demonstrated

Zd **Fine-grained quartz clastic (Late Proterozoic)**—Massive, tan-weathering, greenish-gray, very fine to fine-grained quartz clastic and quartz clastic porphyry mapped as single pod within felsic metatuff (Zbs) in southcentral part of Clarksville South quadrangle. Rock is probably hypabyssal

Zft **Coarse-grained felsic metatuff (Late Proterozoic)**—Heterogeneous unit composed chiefly (50 percent) of very coarse to coarse-grained felsic metavolcaniclastic crystal and crystal-lithic tuff, but with appreciable (25 percent) fine felsic metatuff and minor (25 percent) extrusive and hypabyssal metaforyclastic. Mafic extrusive rock, dikes, and volcaniclastic rocks are less abundant (10 percent), but mafic clasts are present in most exposures of felsic volcaniclastic rock.

Very coarse grained, clastic crystal-lithic tuff includes beds of metamudstone that contain angular to subrounded blocks of metabasalt as much as 1 m in diameter. Crystal-lithic metatuff contains subangular to rounded clasts of fine-grained felsite porphyry, crystal-lithic tuff, fine-grained quartz (metachert?), rhyodacite, and mafic metamudstone; and broken and subarded to rounded crystals of quartz and plagioclase. Intercalated fine-grained schistose quartz clastic and quartz clastic porphyry are white to tan and weather yellow tan to deep red and reddish orange. These intercalated rocks contain quartz, plagioclase, and a few percent sericite, quartz (gray subarded grains in augen with tails about 4 mm long), and tiny magnetite octahedra 1–2 mm across.

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Zcm **Crystal metatuff (Late Proterozoic)**—Mostly medium-grained, medium- to thin-bedded, dominantly felsic crystal metatuff that weathers tan to dark brown. Lesser amounts of thin-bedded, fissile, felsic metatuff that weathers yellow tan to white. Minor thin-bedded mafic metatuff, metabasalt, metasandstone, and quartz metaporphyry

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Zft **Coarse-grained felsic metatuff (Late Proterozoic)**—Heterogeneous unit composed chiefly (50 percent) of very coarse to coarse-grained felsic metavolcaniclastic crystal and crystal-lithic tuff, but with appreciable (25 percent) fine felsic metatuff and minor (25 percent) extrusive and hypabyssal metaforyclastic. Mafic extrusive rock, dikes, and volcaniclastic rocks are less abundant (10 percent), but mafic clasts are present in most exposures of felsic volcaniclastic rock.

Very coarse grained, clastic crystal-lithic tuff includes beds of metamudstone that contain angular to subrounded blocks of metabasalt as much as 1 m in diameter. Crystal-lithic metatuff contains subangular to rounded clasts of fine-grained felsite porphyry, crystal-lithic tuff, fine-grained quartz (metachert?), rhyodacite, and mafic metamudstone; and broken and subarded to rounded crystals of quartz and plagioclase. Intercalated fine-grained schistose quartz clastic and quartz clastic porphyry are white to tan and weather yellow tan to deep red and reddish orange. These intercalated rocks contain quartz, plagioclase, and a few percent sericite, quartz (gray subarded grains in augen with tails about 4 mm long), and tiny magnetite octahedra 1–2 mm across.

In fine-grained felsic metatuff, pull-apart structures in mud-entrained rip-up beds are visible in shoreline exposures along downward part of Grassy Creek southwestward from the Mount Ararat–Soudan area. Eruptive sequences 100–150 m thick of metavolcaniclastic flows, overlain by coarse-grained felsic crystal-lithic metatuff grading upward into air-fall tuff (felsic felsite), are visible in shore exposures west of Longwood Public Use Area. In cliffs along reservoir southeast of Clarksville, aggregate thicknesses of metavolcaniclastic flows are as much as 120 m.

Mafic extrusive and hypabyssal rocks and mafic metatuff are most abundant south and east of Spennymore Creek where they make up 25 percent of the exposed unit.

Unit contains local lenses of the following units:

Zmb **Metabasalt (Late Proterozoic)**—Heterogeneous unit about 1.5 km southeast of Clarksville includes metabasalt in dikes and sills, chlorite schist, chloritic epidote-quartz-albite-sericite metatuff, and felsic metatuff. Lens northeast of Grassy Creek Recreation Area along south shore of reservoir includes metabasalt flow, mafic metatuff, and felsic metatuff. South of latitude of Grassy Creek Recreational Area, this same lens includes one or several flows of metabasalt, in part porphyritic and amygdaloidal, and hypabyssal metabasalt intrusive into felsic metaporphyry and felsic metatuff

Zm **Chloritic metatuff (Late Proterozoic)**—Thinly layered to laminated, schistose, chloritic epidote-quartz-albite-sericite metatuff

Zpm **Fine-grained porphyritic metabasalt (Late Proterozoic)**—Dark-gray, very fine grained, massive, porphyritic metabasalt containing altered concentrically zoned phenocrysts of calcic plagioclase that have epidote-sericite altered cores 4 mm across in fine-grained, altered chlorite-epidote-sericite matrix. Hyalohyal with apophyses into felsic metatuff

EXPLANATION OF MAP SYMBOLS

Contact—Approximately located, dotted where concealed

Fault—Approximately located, dotted where concealed, Hall arrows show direction of probable horizontal displacement; U, upthrown side; D, downthrown side

Inferred Fault—Dotted where concealed. Showing trace of axial plane and direction of plunge and dip of limbs

Anticline

Overturned anticline

Syncline

Overturned syncline

MINOR STRUCTURES

Minor fault—Observed in outcrop. Hall arrows show direction of relative horizontal displacement; small arrow shows dip of fault

Minor antisynclinal fold—Showing bearing and plunge of axis and map pattern of folded surface

Minor anticline—Showing bearing and plunge of axis. Openly folded

PLANAR AND LINEAR SYMBOLS

(Symbols may be joined, where symbols are joined, observation is at point of intersection. Bs,gtg C, cross-stratified; G, graded; foliation is igneous unless P, fissile felsite; ps, greenstone ph, phyllite)

Strike and dip of beds

Inclined—Ball indicates top of bed determined from primary sedimentary structure

Vertical

Overturned—Ball indicates top of bed determined from primary sedimentary structure

Strike and dip of schistosity—From Parker (1963); approximately located

Inclined

Vertical

Strike and dip of foliation

Inclined

Parallel to relict bedding—Ball indicates top of bed determined from relict primary sedimentary structure

Parallel to overturned relict bedding—Ball indicates top of bed determined from relict primary sedimentary structure

Vertical

Strike and dip of closely spaced cleavage

Inclined

Vertical

Strike and dip of joints

Inclined

Vertical

Lineation—Showing bearing and plunge. Letter symbol indicates, elongate element; B, biotite streaks; C, mica and (or) chlorite crenulation axis; E, long axis of stretched clast; FA fold axis

OTHER SYMBOLS

Loose block observed at surface—Core-stone or block in deeply saprolited exposure; inferred to be near site of origin. Map unit shown by labeled symbol Jd, diabase and minor-hypersthene dioritic dike. Lithology shown by letter symbol: bg, biotite granite; a, chlorite schist; d, very fine grained quartz clastic; fg, foliated biotite granite; fl, fissile felsite; h, felsic crystal tuff; hj, foliated mafic tuff; gb, gabbro; gn, greenstone; hg, hornblende granodiorite; mb, metabasalt; p, pegmatite; pg, porphyritic granite; pq, phyllite; q, quartz; qft, quartz-feldspar with tourmaline; qm, quartz monzonite; qs, quartz sandstone; qt, quartz with hematite; rh, rhyodacite

Dike or vein—Showing trend; steeply dipping. Map unit shown by labeled symbol: Jd, diabase and minor hypersthene dioritic dike; hfq, pink quartz monzonite. Lithology shown by letter symbol: a, aplite; bg, biotite granite; d, fine-grained, clastic; gn, greenstone; p, pegmatite; q, quartz; qb, quartz-feldspar with sulfides; qh, quartz with specular hematite; qm, quartz metaporphyry; qs, quartz with sulfides; qt, quartz with tourmaline; qw, quartz with hornblende

Zone of abundant inclusions in hornblende metagranodiorite to quartz monzonite unit (CZhm)—Dotted where concealed. Ticks on side of abundant inclusions

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