U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

GEOLOGIC MAPS OF ST. JOHN, U.S. VIRGIN ISLANDS

by

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DESCRIPTION OF MAP UNITS

Dikes 3 m or more in width are shown where space permits.
Alphanumeric symbols following color names are taken from the rock color chart of Goddard and others (1970).

Qs — Surficial deposits (Quaternary)--Qs, alluvium, swamp deposits, beach deposits, beachrock, and artificial fill. Only the alluvium is likely to contain material as old as Pleistocene

Tr — Red Hook Tonalite Porphyry (new name) (Tertiary)--Tr, dikes and small hypabyssal intrusions of yellowish-gray (5Y 7/2), pinkish-gray (5YR 8/1), and grayish-yellow-green (5GY 6/2) porphyritic tonalite characterized by large bipyramidal quartz and barrel-shaped biotite phenocrysts. Groundmass aphanitic to fine-grained and locally spherulitic. Phenocrysts, as abundant as 45 percent, of quartz, plagioclase, biotite, less commonly hornblende, and prominent apatite. Quartz and plagioclase commonly in growth aggregates, either singly or together. Bipyramidal and embayed quartz phenocrysts commonly 1 cm to as much as 3 cm across. Plagioclase phenocrysts complexly zoned with many reversals. Biotite typically completely replaced by vermiculite. Named for prominent dikes at Red Hook, Eastern St. Thomas quadrangle, where the dikes are intruded along late brittle faults

Te — Explosion breccia (Tertiary?)--(Shown only on map of distribution of dikes.) Te, mafic dike 15 to 20 cm thick contains 60 percent or more xenoliths of keratophyre, greenstone, gabbro, and tonalite. Observed only on the east side of Dittlif Point where it can be traced for about 20 m across outcrop of Water Island Formation. Cuts a diabase dike that is interpreted to be unit Td but could be unit Kcm

Tl — Hornblende lamprophyre (Tertiary)--Tl, dark, aphanitic dikes with prominent hornblende phenocrysts as large as 3 by 1 cm and, in places, clinopyroxene phenocrysts as large as 1 cm. Typically smaller plagioclase phenocrysts are present, and the rock is magnetite-bearing. Most Tl dikes are younger than dikes of unit Td, but some mafic dikes cut hornblende lamprophyre

Tt — Biotite-hornblende tonalite (Late Eocene)--Tt, non-foliated very-light-gray to medium-light-gray, medium-grained biotite-hornblende tonalite and minor gabbro, diorite, granite, and pegmatite. Tonalite composed of interstitial quartz (10 to 15 percent), subhedral, strongly and complexly zoned plagioclase, biotite partly altered to chlorite, hornblende, and magnetite.

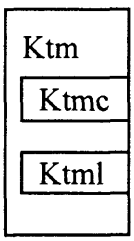
Gabbro composed of plagioclase, hornblende, clinopyroxene, apatite, and pyrite and (or) magnetite. Granite is very light gray, fine- to medium-grained and contains quartz, orthoclase (about 35 percent), strongly zoned plagioclase, biotite altering to chlorite, zircon, and magnetite. White pegmatite contains quartz, slightly perthitic orthoclase (poikilitic crystals up to 1.5 cm across), reddish isotropic garnet, and minor diopside, sphene, allanite, and calcite. Shows copper stain. Tt contains many xenoliths of stratified country rock (fine-grained gray granofels, siliceous hornfels, and calc-silicate) and gabbro (unit Td?); also contains pockets of skarn with massive sulfide and copper stain. Sharp contacts; post-kinematic to tight folds and cleavage in country rock. Produces contact metamorphic aureole as wide as 2 km. Part of The Narrows pluton, which is also exposed in Tortola, British Virgin Islands. $^{40}Ar/^{39}Ar$ plateau age on hornblende of 38.81 $\pm$0.14 Ma, (written communication, 1997, M.J. Kunk, U.S. Geological Survey)

Td

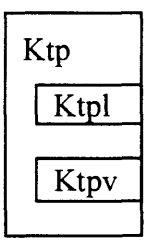
Diabase, gabbro, and diorite (Tertiary)--Td, near-vertical dikes ranging in thickness from a few cm to several tens of meters and complex bodies of multiple dikes, some with internal layering parallel to walls. Chilled margins typical; columnar jointing not typical. Color index, grain size, and texture vary; mostly diabase or gabbro with diabase margins. Amygdules present locally. Primary minerals include plagioclase, clinopyroxene, commonly hornblende, magnetite, and (or) pyrite, and in some dikes, quartz. May be porphyritic with phenocrysts of plagioclase, clinopyroxene, and (or) hornblende. Thicker bodies commonly contain epidosite nodules and disseminated epidote. Secondary, pale, commonly fibrous amphibole, chlorite, and epidote are common. In northern half of St. John, progressively metamorphosed to amphibolite facies assemblages. Also toward the north, many dikes carry the same penetrative cleavage as the enclosing stratified rocks; some broken into segments aligned parallel to cleavage. Other dikes are post-cleavage. The dikes intrude all stratified units and are intruded by tonalite (Tt). Probably includes dikes of more than one age. Some may be intrusive equivalents of extrusive rocks in the enclosing or overlying stratified units. Others may be part of the tonalite (Tt) intrusive cycle, and a very few cut hornblende lamprophyre (Tl). Most interpreted to be part of an early Tertiary pre-tonalite (Tt) magmatic cycle, as suggested by Donnelly and others (1990)

Tutu Formation (Upper Cretaceous: upper Turonian, upper Santonian, or younger)--Volcanic wacke, shale, conglomerate, calcareous siltstone, sparse limestone, and rare basalt and andesite or their metamorphosed equivalents. Many rocks are calcareous. All within contact aureole of Tt; hornfels, calc-silicate, and marble common. Clasts in conglomerate dominantly

basalt and andesite. Limestone clasts locally abundant. Clasts of plutonic rocks rare, but present. Graded beds, slump folds, and disrupted slabs of metasandstone and metasiltstone in metaconglomerate indicate deposition by turbidity currents on an unstable slope, perhaps a trench wall. Tight tectonic folds with axial plane cleavage also present, as well as boudins of competent hornfelsed sandstone and silt beds in marble. Distinguishing between soft sediment and tectonic folds difficult in places where cleavage is not apparent. Youngest stratified unit. Basal contact not exposed; in apparent conformity with underlying Outer Brass Limestone



Mandal Member (new name)--Ktm, medium- to thin-bedded metamorphosed sandstone, siltstone, shale, and limestone. Siltstone typically calcareous and sandstone commonly with a calcareous matrix. Sparse conglomerate, mostly limestone conglomerate in beds as thick as 3 m. Marble contains calcite, plagioclase, tremolite, brown garnet, epidote, and opaques. Metamorphosed calcareous siltstone and sandstone contain brownish garnet (locally as large as 3.5 cm), diopside, tremolite, plagioclase, calcite, opaques, and minor quartz. On Whistling Cay, garnet-rich, bedded calc-silicate contains isotropic reddish garnet, bright green diopside, plagioclase, wollastonite, phlogopite, sphene, pleochroic amphibole, and quartz. Dark grayish-red (5R 3/2), very-fine-grained metasandstone contains abundant reddish-brown biotite and cordierite clouded with tiny inclusions. Named for exposures on the east side of Mandal Point, Eastern St. Thomas quadrangle. About 750 m exposed on St. John. Ktmc, Congo Cay Limestone Lens (modified from Donnelly, 1966)--Tightly folded vertical beds of marble, calc-silicate, and siliceous hornfels exposed on Congo Cay and Carval Rock. Dominantly white to medium-light-bluish-gray (5B 6/1) marble that is 98 percent calcite plus accessory plagioclase, white mica, and opaques, or the accessories plagioclase, tremolite, wollastonite, sphene, and opaques. Calcite grain size typically 1 to 3 mm but may be as large as 1 cm. Stratigraphic position of rocks on CongoCay within the Tutu Formation is not known. Here correlated with similar rocks on Whistling Cay and Mary Point that are within the Mandal Member. Ktml, marble, calc-silicate rock, and marble conglomerate



Picara Member (new name)--Ktp, thick- to medium-bedded, metamorphosed volcanic wacke, conglomerate, siltstone, limestone, and rare andesite or basalt. Locally calcareous. Clasts in conglomerate of metamorphosed andesite, basalt, and limestone. Pebble and cobble conglomerate more common than boulder conglomerate. Ribby outcrops of metasiltstone and metawacke common. Calcareous nodules locally present. Named for exposures on the peninsula of Picara Point, Central St. Thomas quadrangle.

About 600 m thick on St. John. Ktpl, marble conglomerate and calc-silicate-rich beds north of Maho Point. Calc-silicate assemblages include plagioclase-biotite-hornblende and plagioclase-hornblende-diopside-calcite. Two layers of marble and calc-silicate on Waterlemon Cay not mapped separately. Assemblage there includes brown garnet (some anisotropic and as large as 2 cm), diopside, wollastonite (blades as long as 2 cm), sphene, calcite, monazite, and sulfide. Ktpv, medium-dark-gray (N4) porphyritic meta-andesite south of Maho Point. Contains relict phenocrysts of glomerophyric plagioclase and prominent clinopyroxene as large as 3 x 6 mm. Metamorphic amphibole replaces clinopyroxene; fibrous amphibole and chlorite abundant in groundmass and impart a foliation

Ko

Outer Brass Limestone (Donnelly, 1966) (Lower Cretaceous: upper Turonian to upper Santonian: Pessagno, 1976; oral communication to Rankin, March 1997)--Ko, thin-bedded calc-silicate, beds of white to blue-gray calcite marble (H_2S odor when broken) as thick as 3 m, and metamorphosed matrix-supported cobble conglomerate with andesite clasts in carbonate matrix. Heterogeneous calc-silicate at Annaberg Point includes, in various assemblages, calcite, plagioclase, epidote, brown isotropic garnet, diopside, vesuvianite, and wollastonite. About 100 m thick

Kla

Kl

Klb

Louisenhoj Formation (Cretaceous: Albian to Turonian or Santonian)--Kl, strongly cemented volcanic conglomerate, breccia, volcanic wacke, shale, chert, andesite, basalt, tuff, and rare limestone. Overlies the Water Island Formation with apparent conformity. Detrital units are dominantly volcaniclastic. Lavas and flow breccias present but sparse. Massive conglomerate and breccia consisting of large boulders and slabs of basalt or andesite cannot be far from primary volcanic rocks. Conglomerate, breccia, and coarse sandstone are typically pale-green, greenish-gray, or grayish-blue-green. Matrix may be calcareous. Xenocrysts of plagioclase and pyroxene are notable constituents of some clastic rocks. Dominated by thick conglomerate beds typically interlayered with sequences a few to several meters thick of siltstone and sandstone. Conglomerate may be either clast or matrix supported. Graded beds as thick as 6 m; some cross bedding. Soft sediment deformation and rafts of broken finer grained beds common. Clasts larger than 0.5 m abundant throughout the formation; largest subrounded clast 3 m across. Breccia blocks are larger, probably as large as tens of meters.

Clasts of porphyritic clinopyroxene andesite and basalt constitute the bulk of the formation. Typically they contain about 20 percent prominent phenocrysts, commonly 5 to 10 mm across, of clinopyroxene and stubby zoned plagioclase, either singly or together. In some rocks, pyroxene

phenocrysts are overgrown by hornblende; a few rocks have hornblende phenocrysts as well. Small amygdules are pervasive in some clasts. Other clast lithologies include pumice (not common), limestone, keratophyre, and phenocryst-poor basalt like that in the Water Island Formation. Differences in clast populations suggest local sources. Keratophyre and phenocryst-poor basalt are locally abundant near the basal contact. Limestone clasts, some fossiliferous, on Rata and Ramgoat Cay.

Metamorphism increases to the northeast. Biotite, pale amphibole, and epidote appear in andesite; epidote, hornblende, and lesser amounts of biotite appear in basalt. From central St. John to the north and east, most rocks are foliated. At least 1.5 km thick on the west coast of St. John and may be as thin as 0.5 km at Leinster Bay.

Kla, porphyritic andesite lava, some vesicular. Phenocrysts of stubby plagioclase and pyroxene. Pillowed on Ramgoat Cay. Highly brecciated on Camelberg Peak and could be aa lava. May be more abundant than shown on map because of the difficulty in the field of distinguishing between conglomerate/breccia and homogeneous lava.

Klb, porphyritic, locally amygdaloidal, basalt and pillow basalt. Abundant (as much as 40 percent) stubby plagioclase phenocrysts, typically 3 to 4 mm but as much as 15 mm long, and less abundant clinopyroxene. Near Ajax Peak, recrystallized to greenschist facies assemblages. Appears to be restricted to the base of the formation

Lameshur Volcanic-Intrusive Complex (new name) (Lower Cretaceous: Aptian to lowermost Albian)

Klm

Klm, Undivided--Includes the Water Island Formation and the Careen Hill Intrusive Suite. Dominantly keratophyre and volcaniclastic rocks derived from them, but includes basalt and basaltic andesite, an unknown volume of trondhjemite and gabbro, and minor chert. Several varieties of keratophyre distinguished by size and mineralogy of phenocrysts and mode of emplacement. Keratophyre occurs as lava flows, breccia, layered tuff, dikes, and small hypabyssal intrusives. In all varieties, quartz phenocrysts are embayed, if present, and phenocrysts of plagioclase (albite as determined by Donnelly, 1963; 1966) and quartz form growth aggregates, either singly or together. Plagioclase phenocrysts not zoned or weakly zoned. Groundmass medium grayish blue (5PB 4/2) to medium dark gray (N4). Keratophyres become progressively lighter colored as content of albite phenocryst and(or) weathering increases. Mafic rocks occur as pillow lava, pillow breccia, dikes, and rare small plutons. All rocks may exhibit local intense deuteric hydrothermal alteration, which may include silicification, oxidation, sulfidization, and the development of box-work

textures and, locally, gossan. Named for the Lameshur Bays on the south coast of St. John. Unit Klm is mapped where size and mineralogy of phenocrysts vary over short distances and the distinction between extrusive and intrusive rocks is not readily apparent

No stratigraphic order is implied for the units below

Careen Hill Intrusive Suite (new name)

Hypabyssal trondhjemite (Kct), coarsely porphyritic keratophyre (Kcc), intrusive equivalents of all keratophyre units of the Water Island Formation, gabbro and sheeted dikes intrusive into the Water Island Formation or isolated on islands. Except for some Kct and Kcc, columnar jointing characterizes the keratophyre and is used as one of the criteria for mapping these bodies as intrusives. The larger keratophyre intrusive bodies form sharp isolated hills along the south coast of St. John and around the harbor of Charlotte Amalie, St. Thomas. The name is taken from Careen Hill in Charlotte Amalie

Kct

Trondhjemite--Kct, fine- to medium-grained, commonly porphyritic with quartz and twinned nonzoned albite phenocrysts. Groundmass typically a granophyric intergrowth between quartz and albite. Commonly granophyric intergrowths radiate from albite phenocrysts. Forms Leduck Island where columnar jointing is prominent and Flanagan Island, where it is not. Also occurs as clasts in tuff breccia of the Water Island Formation in eastern St. John. On Leduck Island is light-bluish-gray (5B 7/1), coarsely porphyritic with less well developed granophyric texture in groundmass that contains subhedral albite and equant quartz. Grain size is about 0.1 mm. On Flanagan Island is medium-bluish-white (5B 9/1); contains a few percent clinozoisite as well as chlorite

Kcc

Coarsely porphyritic keratophyre--Kcc, 20 to 30 percent prominent quartz and plagioclase phenocrysts, typically 5 to 10 mm across. Groundmass varies from exceedingly fine grained similar to extrusive keratophyre to coarser with plagioclase laths up to 0.3 mm long. At higher metamorphic grade, coarse epidote appears in plagioclase phenocyrsts and epidote, pale amphibole, and shreddy biotite appear in groundmass. Blue-green amphibole is in groundmass along Center Line Road at an elevation of 320 ft. Widespread as dikes in the Water Island Formation and cuts the tonalite (Kct) of Flanagan Island. Plugs form the sharp hills of Maria Bluff, northeast of Chocolate, Hole, and north of Cocoloba Cay

Kcp

Porphyritic Keratophyre--Kcp, about 20 percent conspicuous quartz and albite phenocrysts up to 3 mm across in a medium dark-bluish-gray (5B 4/1) aphanitic groundmass of randomly oriented plagioclase laths 0.1 mm long, interstitial quartz, and magnetite dust. Accessory apatite and allanite. Glomerophyric plagioclase surrounded by granophyric intergrowths. Forms a small unaltered plug west of Lameshur, Western St. John quadrangle and sparse dikes

Kca

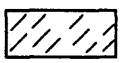
Phenocryst-poor Keratophyre--Kca, may contain up to 10 percent, small (generally less than 2 mm across) phenocrysts of quartz and plagioclase. As intrusive equivalent of unit Kwa of the Water Island Formation forms a small pluton north of Bovocoap Point and sparse dikes

Kcf

Plagioclase-phyric keratophyre--Kcf, 5 to 15 percent plagioclase phenocrysts, 1 to 3 mm long, in a groundmass of typically felted plagioclase microlites and interstitial quartz. As intrusive equivalent of unit Kwf of the Water Island Formation forms the small plutons on Ram Hill and the peninsula of Dittlif Point, and sparse dikes

Kcm

Gabbro--Kcm, dark-greenish-gray, fine-grained porphyritic, with small (2 mm or less) subhedral phenocrysts of clinopyroxene and plagioclase in a groundmass of randomly oriented plagioclase laths about 0.5 mm long,clinopyroxene, chlorite, leucoxene, and opaques. Forms an intrusive body on Bovocoap Point, and probably occurs as dikes in the Water Island Formation. May be more abundant than shown on map



Sheeted dike complex-- (no symbol; overprint pattern only). Better developed on St. Thomas than on St. John. Dominantly keratophyre, but includes diabase as well. Dikes trend northeast (as does the diagrammatic overprint pattern) and dip moderately to steeply northwest. On St. John mapped on the south side of Salt Pond and at Harbor point.

Water Island Formation

Definition modified from Donnelly (1966) to exclude intrusive rocks. Dominantly (80 percent) extrusive keratophyre and volcaniclastic rock derived from it, about 20 percent basaltic lava, breccia, and hyaloclastite; minor radiolarian or chert. No internal stratigraphic order recognized. The groundmass of the keratophyre is commonly spherulitic. With increasing metamorphic grade to the north and east, the spherulites are recrystallized and stand out as ovoids, some as large as 4 cm, on weathered surface. Lower contact of formation not exposed. Interpreted to have been deposited on oceanic plateau crust. Upper contact is conformable and is exposed at several localities in southwestern St. John and nearly exposed south of Ajax Peak. Formation at least 2 km thick.

Several varieties of keratophyre are distinguished by size and mineralogy of phenocrysts; all have intrusive equivalents in the Careen Hill Intrusive Suite. Ash-flow tuffs are notably absent

Kwp

Porphyritic keratophyre--Kwp, 10 to 25 percent conspicuous quartz and plagioclase phenocrysts, typically less than 5 mm across, in an aphanitic groundmass. Flow layering present locally. Mapped distribution is approximate; appears to constitute less than 10 percent of formation on St. John

Kwa

Phenocryst-poor keratophyre--Kwa, referred to as aphyric keratophyre in field notes, may contain up to 10 percent small, generally less than 2 mm across, phenocrysts of quartz and plagioclase. Many outcrops are untextured but many display flow layering and flow folds. Includes lava, flow breccia, some bedded tuff, and some volcaniclastic rock. Dominant unit of the Water Island Formation on St. John

Kwf

Plagioclase-phyric keratophyre--Kwf, 5 to 10 percent plagioclase phenocrysts 1 to 3 mm long in a groundmass that is commonly a felted mass of oriented aphanitic feldspar laths. Flow layering visible in some outcrops. Extrusive equivalent of unit Kcf of the Careen Hill Intrusive Suite. Exposed in the vicinity of Lameshur Bays. Because phenocrysts are small and sparse, some areas mapped as Kwa could be Kwf

Kws

Basalt and basaltic andesite--Kws, amygdaloidal pillow lava, pillow breccia, and hyaloclastite. Called spilite by Donnelly (1966). Na_2O and CaO contents, however, are in the range of basalt. Pillows are typically about a meter across. Tubular bodies as long as 3 m have been observed. Amygdules are commonly in concentric shells within pillows. Interstices between pillows filled with calcite or epidosite. Bedding and topping direction determined from pillow asymmetry at Harbor Point, peninsula between Elk Bay and Haul Over (Rankin, in press, plate 1c), and eastern Red Point, all in eastern St. John. Bedding, but no topping direction, observed at several other localities. Excellent exposures of pillow breccia and hyaloclastite are found in coastal outcrops between Salt Pond Bay and Ram Head and on Dittlif and Contant Points. Fragments of breccia are commonly deformed against one another

Groundmass of least altered basalt consists of plagioclase microlites, typically randomly oriented, and opaque dust in a cryptocrystalline mesostasis. Small (millimeter range), sparse phenocrysts of glomerophyric plagioclase and clinopyroxene. Epidosite segregations common and, in places, pillows have epidosite cores. Secondary minerals in southern St. John include prehnite and pumpellyite (identified optically only), chlorite, calcite, and leucoxene. Zeolites probably the result of burial metamorphism. To the north and east toward the Tertiary plutons, pale amphibole and finally pleochroic amphibole appear in the groundmass

Clinopyroxene is replaced by epidote and pale amphibole; farther north by pleochroic amphibole. The metamorphic assemblage adjacent to the tonalite at Please includes quartz, plagioclase, hornblende, diopside, garnet, and calcite.

Most basalt, including breccia fragments, is amygdaloidal; some is scoriaceous (amygdules a few millimeters across make up 30 or more percent of rock.). Flattened amygdules on Kiddel Point are as long as 10 cm. Amygdules filled with combinations of quartz, calcite, chlorite, epidote, and plagioclase, as well as prehnite and pumpellyite, locally; at higher grade, pale amphibole and clinozoisite in radiating sheaves

Kww

Volcanic wacke and bedded tuff--Kww, volcanic wacke consists of subrounded to angular clasts of keratophyre of all varieties, basalt and trondhjemite in a matrix that is probably comminuted keratophyre but includes xenocrysts of quartz and plagioclase. Constituents poorly sorted and up to more than a meter across; bedding may be poorly defined. Graded bedding rare but present. Pumiceous keratophyre clasts rare except between Grootpan and Kiddel Bays where submarine pumice flows may be present. Trondhjemite clasts, thought to be from Kct, up to boulder size, found in Kww in cove 0.65 km northeast of Long Point and the easternmost privateer Point. Bedded tuff locally; no shards seen in the few thin sections available. Difficult to distinguish between tuff and chert in the field

Kwr

Radiolarian Chert--Kwr, light-blue-gray to dark-gray bedded chert containing radiolaria. Mapped where radiolaria have been observed, such as at Kiddel Point on the shore of Salt Pond Bay

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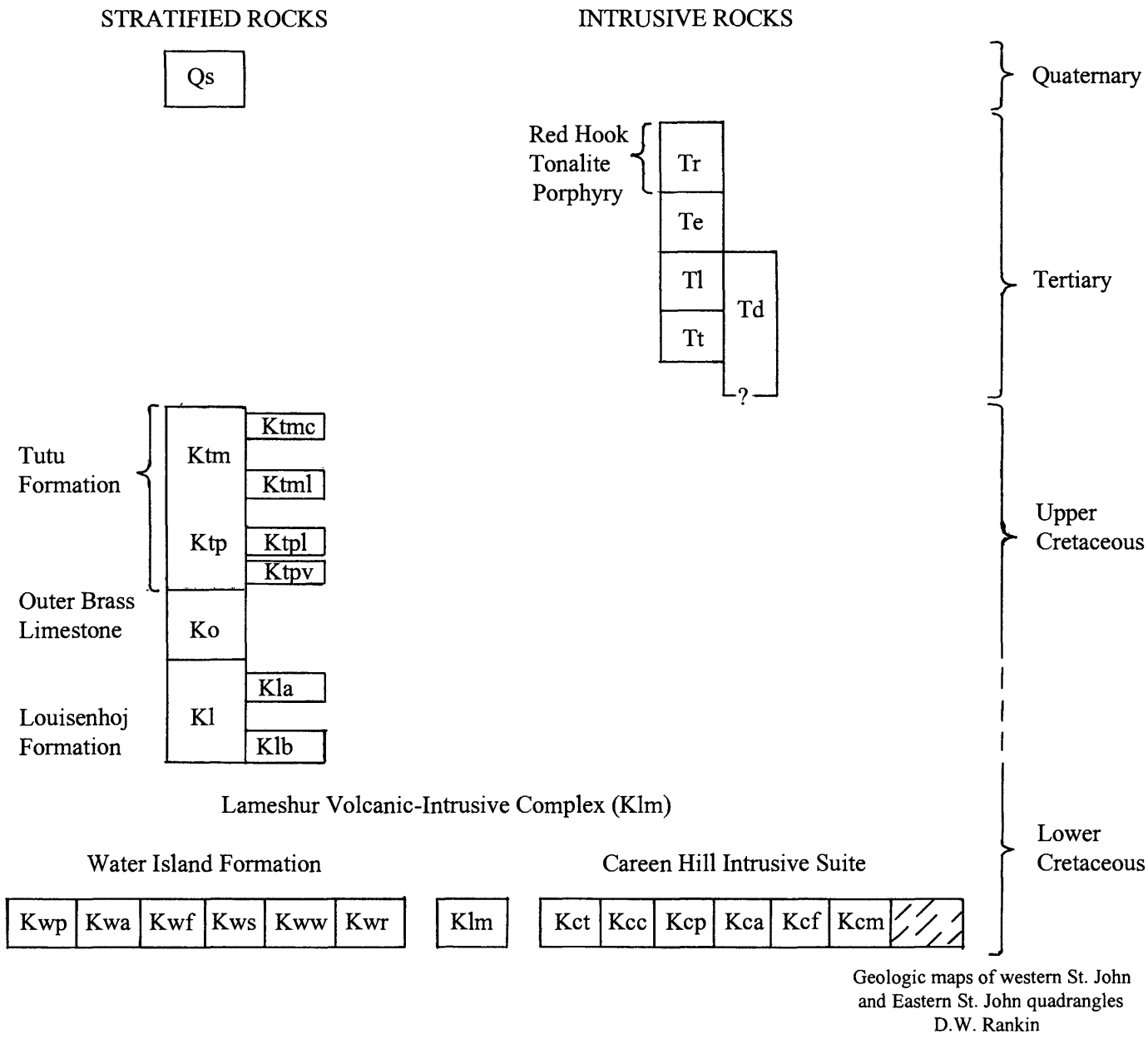
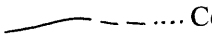
CORRELATION OF MAP UNITS



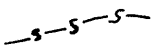
Geologic maps of western St. John and Eastern St. John quadrangles
D.W. Rankin

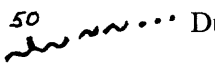
EXPLANATION OF MAP SYMBOLS

Where two or more symbols for planar or linear features are combined, their intersection marks the point of observation. Where a planar feature and linear feature are combined, the center of the planar feature marks the point of observation. For linear symbol alone the base of the arrow marks the point of observation.

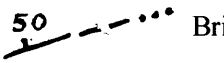

Contact, dashed where approximately located, dotted where covered by water or surficial material (Qs)


Apparent attitude of bedding or layering on cross sections

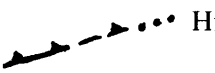

Scratch contact. On a colored map the line would mark the end of one color or overprinted pattern with no contact shown



Ductile fault or local shear zone, broken where approximately located dotted where covered by water or Qs. Angle of dip given if known



Brittle fault, dashed where approximately located, dotted where covered by water or Qs. Angle of dip given if known. Relative movement shown by arrows and (or) U and D for up and down. On cross sections T=toward and A=away


High angle reverse fault, dashed where approximately located, dotted where covered by water or Qs.

Strike and dip of inclined bedding, ball indicates younging direction of beds known from sedimentary features


Strike of vertical bedding

Strike and dip of overturned bedding


Horizontal bedding

Symbols used for sedimentary features by which the younging direction was determined

Graded bedding

Cross bedding

Channelling

Strike and dip of inclined flow layering, layering of amygdules, or layering of pillows

Strike and dip of layering of pillows for which topping direction is known

Strike and dip of inclined foliation

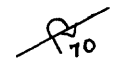

Strike and dip of vertical foliation

Symbols used when bedding and foliation have same strike

Coplanar, inclined

Coplanar, vertical

Parallel strike different dip. Dip of foliation is number closest to strike line



Coplanar, overturned

Other permutations are used

Strike and dip of spaced cleavage

Strike and dip of inclined joint set

Strike and dip of vertical joint set

Dikes 3 m or more in thickness (shown on geologic map where space permits)

Trend of dike, attitude not known

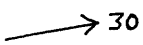
Strike and dip of inclined dike

Strike and dip of vertical dike

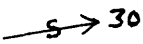
Macroscopic folds

Anticline showing dip direction of limbs

Syncline showing dip direction of limbs



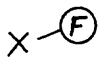
Trend and plunge of fold axis



Trend and plunge of fold axis, s - fold looking down plunge

Trend and plunge of fold axis, z - fold looking down plunge

Trend and plunge of axis of columnar joints



Fossil locality

Area of hydrothermal alteration

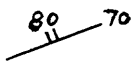
Pillow lava, right-side-up, shown only on cross section B-B'

Explanation for map showing attitude and distribution of dikes on St. John

Map Symbols

Strike and dip of inclined dike 3 m or more in thickness

Strike and dip of vertical dike 3 m or more in thickness

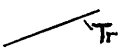


Strike and dip of inclined dike less than 3 m thick

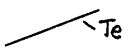
Strike and dip of vertical dike less than 3 m thick

For some dikes, only strike is shown because dip could not be measured

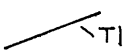
Rock units



Tr, Red Hook Tonalite Porphyry



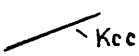
Te, Explosion breccia



Tl, Hornblende lamprophyre


Td, (letter symbol omitted) Diabase, gabbro, and diorite

Careen Hill Intrusive Suite (No sequence at intrusion implied)



Kcc, coarsely porphyritic keratophyre

Kcp, Porphyritic keratophyre

Kca, Phenocryst-poor keratophyre

Kcf, Plagioclase-phyric keratophyre

Kcm, Diabase