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Appendix A. Map Unit Descriptions

i. Map unit abbreviations and names

The following list, sorted alphabetically by mnemonic, relates abbreviations and map unit name. Upper case letters represent age: K = Cretaceous; Q = Quaternary; T = Tertiary; TK = mixed or transitional ages.

af	Artificial fill
Kabcj	Formations A, B, C, & J
Kac	Achiote Conglomerate
Kal	Alonso Formation
Kap	Avispa and Perchas Formations, undivided
Kav	Avispa Formation
Kba	Barrazas Formation
Kbo	Boqueron Basalt
Kca	Cariblanco Formation
Kcag	Granodiorite of the Caguas pluton
Kcam	Camarones Sandstone
Kcan	Cancel Breccia
Kcar	Carraizo Breccia
Kcb	Cambalache Formation
Kce	Celada Formation
Kcg	Cerro Gordo Lava
Kcn	Canovanas Formation
Kco	Concepcion Formation
Kcoa	Coamo Formation
Kcot	Cotui Limestone
Kctt	Cotorra Tuff
Kd	Daguao Formation
Kdh	Diorite-hornblende gabbro
Kdi	Diorite
Ke	El Rayo Formation
Keo	El Ocho Formation
Kf	Figuera Lava
Kfa	Fajardo Formation
Kfd	Figuera and Daguao Formations, undivided
Kfr	Frailes Formation
Kg	Guaynabo Formation
Kh	Hato Puerco Formation
Ki	Infierno Formation
Kib	Intrusive breccia of the Daguao Formation
Kja	Jayuya Tuff
KJa	Amphibolite
KJas	Amphibolite-Serpentinite
KJb	Spillitized Basalt
KJc	Cajul Basalt

KJm	Mariquita Chert
KJs	Serpentinite
Kl	Lajas Formation
Klm	La Muda Formation
Kln	Los Negros Formation
Klo	Lomas Formation
Km	Melones Limestone
Kma	Magueyes Formation
Kmag	Martin Gonzalez Lava
Kmal	Malo Breccia
Kmam	Mameyes Formation
Kman	Manicaboa Formation
Kmar	Maravillas Formation
Kmc	Granodiorite of Morovis and Ciales stocks
Kmo	Monacillo Formation
Kp	Parguera Limestone
Kpa	Pajaros Tuff
Kpe	Penones Limestone
Kper	Perchas Formation
Kpgg	Granodiorite of plutonic complex of Punta Guayanes
Kpgq	Quartz diorite
Kpgqm	Quartz monzonite of plutonic complex of Punta Guayanes
Kpi	Pitahaya Formation
Kpo	Pozas Formation
Kpob	Two pyroxene olivine basalt
Kpsg	Granodiorite of the plutonic complex of Punta Guayanes
Kpsq	Quartz diorite of plutonic complex of Punta Guayanes
Kr	Robles Formation
Kra	Rio Abajo Formation
Krp	Rio de la Plata Sandstone
Ks	Sabana Grande Formation
Ksl	Granodiorite-quartz diorite of San Lorenzo batholith
Kslg	Mixed granodiorite-diorite of the San Lorenzo batholith
Kslq	Quartz diorite facies of Granodiorite of San Lorenzo
Kso	Santa Olaya Lava
Kt	Torrecilla Breccia
Kta	Tabonuco Formation
Kte	Tetuan Formation
Kto	Tortugas Andesite
Ku	Granodiorite-quartz diorite of the Utuado batholith
Kv	Vista Alegre Formation
Qa	Alluvium
Qb	Beach deposits
Ql	Landslide deposits
Qs	Swamp deposits
QTs	Blanket sand deposits

Ta	Aguada Limestone
Tay	Aymamon Limestone
Tc	Cuevas Limstone
Tca	Carreras Siltstone
Tcb	Cibao Formation
Tcbg	Guajataca Member of Cibao Formation
Tcbga	Almirante Sur Sand Lentil of Cibao Formation
Tcbm	Montebello Limestone Member of Cibao Formation
Tcbmi	Miranda Sand Member of Cibao Formation
Tcbq	Quebrada Arenas Limstone Member of Cibao Formation
Tcbr	Rio Indio Limstone Member of Cibao Fomation
Tcm	Camuy Formation
Tco	Corozal Limestone
Td	Porphyritic dacite
Tfb	Fault breccia
Tg	Guayo Formation
Tga	Gabbro
Tgua	Guanajibo Formation
Thp	Hornblende quartz diorite porphyry
Tj	Jicara Formation
Tjd	Juana Diaz Formation
Tjo	Jobos Formation
TKa	Anon Formation
TKahp	Augite-hornblende porphyry
TKal	Anon Formations and Lago Garzas, undivided
TKam	Anon and Maricao Formations, undivided
TKamo	Anon-Monserrate Formations, undivided
TKap	Augite andesite porphyry
TKas	Alkali syenite
TKat	Augite trachybasalt
TKay	Anon and Yauco Formations, undivided
Tkaym	Anon, Yauco, and Maricao Formations, undivided
TKci	Cibuco Formation
TKda	Amygdaloidal dacite
TKdi	Diorite
TKg	Diabasic gabbro
TKgm	Granodiorite quartz monzonite
TKgu	Guaracanal Formation
TKh	Porphyry Hornblende quartz-diorite
TKha	Hydrothermally altered rock
TKhda	Hornblende dacite
TKk	Quartz keratophyre
TKl	Lago Garzas Formation
TKlam	Lago Garzas, Anon, and Maricao Formations, undivided
TKly	Lago Garzas and Yauco Formations, undivided
TKm	Maricao Formation

TKmly	Maricao, Lago Garzas, and Yauco Formations, undivided
TKmv	Metavolcanic rock
TKmy	Maricao and Yauco Formations, undivided
TKn	Naranjito Formation
TKqd	Quartz diorite-granodiorite
TKy	Yauco Formation
Tl	Los Puertos Formation
Tla	Lares Limestone
Tm	Monserrate Formation
Tmu	Mucarabones Sand
Tor	Ortiz Formation
Tpa	Palmarejo Formation
Tpo	Ponce Limestone
Tr	Rio Culebrinas Formation
Tra	Raspaldo Formation
Trd	Rio Descalabrado Formation
Trhp	Rhyodacite porphyry
Trp	Rio Piedras Siltstone
Ts	San Sebastian Formation
Ty	Yunes Formation

Appendix A. Map Unit Descriptions

ii. Map unit descriptions

The following list, sorted alphabetically by mnemonic, provides a geologic description of each map unit.

af Artificial Fill (HOL0CENE)--Igneous, volcanic, and sedimentary rocks of various types

Kabcj Formations A, B, C, and J (LOWER ?-UPPER ? CRETACEOUS) (Berryhill and Glover, 1960; Pease and Briggs, 1960)--Non-pillowed lava flows, volcanic breccia, sandstone, conglomerate, and minor limestone, siltstone, and tuff. Estimated thickness exceeds 5,000 m. Exposed in the Cayey, Patillas, Caguas, Comerio, and Yabucoa quadrangles

Kac Achiote Conglomerate (MAESTRICHTIAN-SANTONIAN)(Mattson, 1967, 1968b; Krushensky and Monroe, 1975; Briggs, 1971; Glover, 1973)--Boulder and cobble conglomerate basalt and andesite clasts similar to the Jayuya, Vista Alegre, and Cotorra Formations. Lithologically similar sandstone and mudstone are interbedded. Maximum estimated thickness, l,800 m. Exposed in the Jayuya, Ponce, and Orocovis quadrangles

Kal Alonso Formation (UPPER ? CRETACEOUS)(Nelson and Monroe, 1966; Nelson, 1967b; Nelson and Tobisch, 1968)--Welded and non-welded ash-flow tuff. Minor coarse tuff, laharic breccia, volcanic sandstone, and thin andesitic lava flows interbedded locally with the ash-flow tuff sequence. Maximum estimated thickness, 2,000 m. Exposed in the Florida, Bayaney, and Utuado quadrangles

Kap Avispa and Perchas Formations undivided.

Kav Avispa Formation (UPPER ? CRETACEOUS)(Berryhill, 1965; Nelson, 1966, 1967a; Briggs, 1971; Nelson and Monroe, 1966; Mattson, 1968b)--Pillowed lava flows and interbedded tuffaceous sandstone, some volcanic breccia/conglomerate, and a local calcarenite. Maximum estimated thickness l,800 m. Exposed in the Ciales, Corozal, Orocovis, Jayuya, and Florida quadrangles

Kba Barrazas Formation (UPPER CENOMANIAN)(Seiders, 1971a, 1971c)--Volcanic sandstone and volcaniclastic breccia and mudstone. Maximum estimated thickness, l,l00 m. Exposed in the Gurabo quadrangle

Kbo Boqueron Basalt (UPPER CRETACEOUS ?)(Volckmann, 1984c, 1984d) Dark grayish-brown, locally amygdaloidal, nonpillowed, porphyritic basalt flows. Maximum estimated thickness, l50 m. Exposed in the Puerto Real quadrangle

Kca Cariblanco Formation (LOWEST CAMPANIAN-UPPER SANTONIAN)

(Berryhill and others, 1960; Glover, 1961, 1973; Briggs, 1971; Briggs and Gelabert, 1962; Briggs and Glover, 1960)--Volcaniclastic conglomerate, sandstone, siltstone, lava and limestone; composed dominantly of hornblende dacite welded ash-flow tuff, amygdaloidal plagioclase-pyroxene biotite andesite, and subordinate sandstone, siltstone, and limestone clasts. One pillowed basaltic lava flow. Maximum estimated thickness, 1,000 m. Exposed in the Rio Descalabrado, Orocovis, Coamo, Barranquitas, and Cayey quadrangles

Kcag Granodiorite of Caguas Pluton (POST MIDDLE ALBIAN) (Rogers, 1979; Pease, 1968b; Broedel, 1961; Seiders, 1971a)--Granodiorite, foliate near contacts, autoclastic intrusion breccia present near margins; hornblende-rich autoliths(?) or xenoliths(?) are locally common. Exposed in the Caguas, Aguas Buenas, Juncos, and Gurabo quadrangles

Kcam Camarones Sandstone (UPPER ? CRETACEOUS)(Pease, 1968a, 1968b, 1968c) Locally carbonaceous volcaniclastic siltstone interbedded with tuffaceous sandstone, and minor volcanic conglomerate, local lava flows. Maximum known thickness, 950 m. Exposed in the Aguas Buenas and Naranjito quadrangles

Kcan Cancel Breccia (UPPER ? CRETACEOUS)(Pease, 1968a, 1968c, 1967)-Andesitic tuff breccia, volcanic breccia, and lava. Maximum exposed thickness 2,000 m. Exposed in the Naranjito and Corozal quadrangles

Kcar Carraizo Breccia (LOWER TURONIAN-MIDDLE CENOMANIAN) (Pease, 1968a, 1968b)--Pumiceous volcanic breccia and subordinate volcanic sandstone and tuffaceous siltstone and tuff. Minimum estimated thickness, 1,400 m. Exposed in the northeastern Aguas Buenas quadrangle. Maximum estimated thickness, 90 m. Exposed in the Aguas Buenas quadrangle

Kcb Cambalache Formation (TURONIAN)(Seiders, 1971a, 1971b, 1971c)--Pumiceous volcanic breccia, sandstone, mudstone, and, locally, welded ash-flow tuff. Maximum known thickness, 600 m., typically, 350-450 m thick. Exposed in the Gurabo and El Yunque quadrangles

Kce Celada Formation (POST TURONIAN ? CRETACEOUS)(Seiders, 1971,a, 1971c)--Pillowed basaltic lava flows and hyaloclastite breccia, volcanic breccia, and pumiceous volcanic sandstone and mudstone. Flows are identical with the Infierno Formation. Maximum estimated thickness, 600 m. Exposed in the Gurabo quadrangle

Kcg Cerro Gordo Lava (LOWER ? CRETACEOUS)(Pease, 1968a, 1968c)--Basaltic andesite lava, flow-breccia, and minor tuff and tuff-breccia. Maximum estimated thickness, 1,100 m. Exposed in the Naranjito quadrangle

Kcn Canovanas Formation (LOWER SANTONIAN-UPPER TURONIAN) (Seiders, 1971a, 1971b, 1971c)--Basaltic, volcanic sandstone, mudstone. Maximum estimated thickness, 200 m. Exposed in the Gurabo and El Yunque quadrangles

Kco Concepcion Formation (MAESTRICHTIAN-CAMPANIAN)(McIntyre and others, 1970; McIntyre, 1974; Tobisch and Turner, 1971)--Massive, pillowed basaltic lava flows and volcanic breccia interbedded with tuff. Formation rarely includes thin foraminiferal limestone lenses. Thickness unknown. Exposed in the Maricao and San Sebastian quadrangles

Kcoa Coamo Formation (LOWER MAESTRICHTIAN-UPPER SANTONIAN) (Glover, 1961; Mattson, 1967, 1968b; Glover and Mattson, 1973; Berryhill and others, 1960; Briggs, 1971; Krushensky and Monroe, 1975)--Tuff, and volcanic breccia. Locally includes andesitic lava flows, and lenses of calcarenite. Maximum estimated thickness, 300 m. Exposed in the Coamo, Rio Descalabrado, Orocovis, Ponce, and Jayuya quadrangles

Kcot Cotui Limestone (LOWER MAESTRICHTIAN-UPPERMOST LOWER CAMPANIAN) (Mattson, 1960; Volckmann, 1984b, 1984c, 1984d)--Massive limestone, local basal conglomerate with clasts of lava of underlying Lajas Formation. Maximum thickness, 75 m. Exposed in the Puerto Real and San German quadrangles

Kctt Cotorra Tuff (UPPER ? CRETACEOUS)(Briggs, 1967, 1971; Briggs and Gelabert, 1962; Krushensky and Monroe, 1975; Mattson, 1968b)--Basaltic hyaloclastite-breccia. At base and top, consists of pillowed very basalt flows. Maximum estimated thickness, 500 m. Exposed in the Orocovis, Barranquitas, Ponce, and Jayuya quadrangles

Kd Daguao Formation (LOWER CRETACEOUS ?)(M'Gonigle, 1977, 1978, 1979)--Massive andesitic interbedded volcaniclastic breccia, lava, and subordinate sandstone and crystal tuff. Maximum estimated thickness, 1,000 m. Exposed in the Humacao, Naguabo, and Punta Puerca quadrangles

Kdh DIORITE-HORNBLENDITE-GABBRO (UPPER ? CRETACEOUS) (M'Gonigle, 1978; Rogers, 1977)--Hornblende diorite intermixed with hornblendite. Hornblende gabbro locally intrudes and is mapped with the diorite. Exposed in the Humacao and Punta Guayanes quadrangles

Kdi Diorite (CAMPANIAN ? ALBIAN ?)(Rogers, 1977, 1979; Glover, 1982; Rogers and others, 1979; Glover, 1961a; Berryhill, 1965; Mattson and Glover, 1973)--Locally porphyritic, hornblende-rich diorite. Autoclastic intrusion breccia present near margins and locally in interior of stocks. Widely altered. Autoliths and/or xenoliths are widely present. Exposed in the Punta Guayanes, Patillas, Yabucoa, Coamo, and Caguas quadrangles

Ke El Rayo Formation (UPPER TO MIDDLE MAESTRICHTIAN) (Volckmann, 1984b, 1984c; Krushensky and Monroe, 1979)--Massive, dark grayish-purple andesitic and basaltic lava with interbedded limestone. Thickness unknown. Exposed in the San German, Sabana Grande, and Punta Verraco quadrangles

Keo El Ocho Formation (CENOMANIAN ?)(Pease, 1968a, 1968b, 1968c; Nelson, 1967)--Volcaniclastic breccia and tuff, with interbedded andesitic lava flows near base. Maximum estimated thickness, 825 m. Exposed in the Corozal, Naranjito, and Aguas Buenas quadrangles

Kf Figuera Lava (LOWER CRETACEOUS ?)(Briggs, 1973; Briggs and Aguilar, 1980; M'Gonigle, 1979)--Massive andesitic lava, locally pillowed, interlayered with very minor autobrecciated lava, tuffaceous sandstone, siltstone, and hyaloclastite breccia. Includes one thin unit of non-welded ash-flow tuff. Maximum estimated thickness, 2,000 m. Exposed in the Fajardo, Cayo Icacos, Naguabo, and Punta Puerca quadrangles

Kfa Fajardo Formation (MIDDLE ? ALBIAN)(Briggs, 1973; Briggs and Aguilar, 1980; M'Gonigle, 1978, 1979; Seiders, 1971b)--Basal tuff breccia interbedded with tuff, and tuffaceous sandstone and black cherty siltstone. Maximum estimated thickness, 3,l50 m. Exposed in the Fajardo, Cayo Icacos, Naguabo, and Humacao quadrangles, and in the El Yunque quadrangle where it was mapped as unnamed volcaniclastic rocks

Kfd Figuera Lava and Daguao Formation Interbedded--Locally interbedded rocks characteristic of the Figuera Lava and Daguao Formations. Exposed in the Naguabo quadrangle

Kfr Friales Formation (CAMPANIAN)(Seiders, 1971a, 1971b, 1971c; Pease, 1968b, Pease and Briggs, 1972; Monroe, 1977)--Calcareous mudstone, volcaniclastic sandstone, conglomeratic sandstone, volcanic breccia, and locally, pillowed basaltic lava flows. Maximum estimated thickness,l,lOO m. Exposed in the Aquas Buenas, Carolina, Gurabo, Rio Grande, and El Yunque quadrangles

Kg Guynabo Formation (LOWER SANTONIAN-UPPER CENOMANIAN) (Pease, 1968a)--Interbedded volcanic sandstone and tuffaceous siltstone and volcanic conglomerate, pillowed andesitic lava flows at the base and middle of formation. Maximum thickness 1,600 m. Exposed in the Aguas Buenas quadrangle.

Kh Hato Puerco Formation (TURONIAN-LOWER CENOMANIAN) (Seiders, 1971a, 1971b, 1971c; Pessagno, 1976; Briggs and Aguilar, 1980)--Andesitic to basaltic volcaniclastic sandstone and breccia, mudstone, conglomerate, and lava. Maximum estimated thicknesses 2,600 m. Exposed in the Gurabo, El Yunque, Fajardo, and Cayo Icacos quadrangles; previously mapped as part of the Carraizo Breccia in the Aguas Buenas quadrangle to the west

Ki Infierno Formation (TURONIAN)(Seiders, 1971a, 1971b)--Pillowed, basaltic andesite lava, volcanic breccia, volcaniclastic sandstone, and mudstone. Maximum thickness known, 900 m. Exposed in the Gurabo quadrangle.

Kib Intrusive Daguao Breccia (LOWER? CRETACEOUS)(M'Gonigle, 1977,

1978, 1979)--Massive breccia like the Daguao Formation. Intrudes bedded tuff, breccia, and lava flows of the Daguao Formation. Exposed in the Naguabo quadrangle

Kja Jayuya Tuff (CRETACEOUS ?)(Mattson, 1967, 1968a, 1968b)--basaltic crystal-lithic tuff and fine-grained hyaloclastite; subordinate silicified mudstone and volcanic sandstone. Locally metamorphosed to feldspar hornblende hornfels, gneiss, and schist. Maximum estimated thickness, 900 m. Exposed in the Jayuya and Adjuntas quadrangles

KJa Amphibolite (CRETACEOUS ?-PRE-CRETACEOUS ?)(Mattson, 1960; Tobisch, 1968; Volckmann 1984a, 194b, 1984c; Krushensky and Monroe, 1979)--Dark- to light-gray-green, amphibolite. Present both as discrete massive outcrops and as blocks of various sizes in serpentinite. Exposed in the Cabo Rojo, Parguera, San German, Mayaguez, and Punta Verraco quadrangles

KJas Amphibolite-Serpentinite (CRETACEOUS ?-PRE-CRETACEOUS ?) (Volckmann, 1984a, 1984b)--Blocks of amphibolite held in a matrix of serpentinite. Exposed in the Parguera and San German quadrangles

KJb Spilitized Basalt (LOWER CRETACEOUS ?-PRE-UPPER KIMMERIDGIAN?)(Mattson, 1960; Curet, 1986)--Massive, locally vesicular, dark greenish-gray spilitized basalt. Exposed in the Mayaguez quadrangle

KJc Cajul Basalt (LOWER CRETACEOUS ?-UPPER JURASSIC ?) (Volckmann, 1984a, 1984b, 1984c)--Dark purplish-red amygdaloidal, pillowed, porphyritic basalt flows, with phenocrysts of plagioclase and olivine. Thickness unknown. Exposed in the San German, Cabo Rojo, Parguera, and Puerto Real quadrangles

KJm Mariquita Chert (MIDDLE TURONIAN ?-UPPER KIMMERIDGIAN-LOWER- TITHONIAN UNDIVIDED)(Mattson, 1973; Mattson and Pessagno, 1974, 1979; Volckmann, 1984a, 1984b, 1984c; Krushensky and Monroe, 1979)--Laminated, fine-grained, dark-gray chert. Contains abundant to sparse radiolaria, and locally, Foraminifera. Locally interbedded with recrystallized and largely silicified limestone(?), and with non-metamorphosed pillowed basalt. Maximum estimated thickness, 300 m. Exposed in the Cabo Rojo, Puerto Real, San German, Parguera, and Punta Verraco quadrangles

KJs Serpentinite (CRETACEOUS ?-PRE-CRETACEOUS ?)(Curet, 1986; McIntyre, 1975; Mattson, 1960, 1973; Krushensky and Monroe, 1978; Volckmann, 1984a, 1984b, 1984c)--Sheared light- to dark-green, serpentinite; chiefly altered harzburgite. Epiclastic serpentinite is poorly sorted, unsheared, and retains a characteristic epiclastic appearance in both clasts and matrix. Exposed in the Mayaguez, Rosario, Maricao, Sabana Grande, Yauco, Punta Verraco, Parguera, Cabo Rojo, San German, and Puerto Real quadrangles

Kl Lajas Formation (LOWER ? CAMPANIAN-PRE CAMPANIAN ?) (Volckmann, 1984b, 1984,c, 1984d)--Massive, non-pillowed, grayish-purple, basalt flows Minor basaltic tuff is lithologically similar to lava flows. Minimum estimated thickness, 1,000 m. Exposed in the Puerto Real and San German quadrangles

Klm La Muda Formation (MAESTRICHTIAN-CAMPANIAN ?)(Pease, 1968a, 1968b)--Calcareous sandstone that ranges to arenaceous limestone; interbedded with coarse conglomerate, locally, massive limestone. Maximum thickness, 90 m. Exposed in the Aguas Buenas quadrangle

Kln Los Negros Formation (LOWER ?-UPPER ? CRETACEOUS) (Berryhill, 1965; Nelson, 1966, 1967a; Pease, 1968a, 1968b, 1968c; Rogers, 1979; Broedel, 1961; Seiders, 1971)--Basaltic hyaloclastite-breccia, with stringers ofpillowed basaltic lava, subordinate volcanic sandstone, and minorsiltstone. Maximum estimated thickness, l,800 m. Exposed in the Ciales, Corozal, Naranjito, Aguas Buenas, Caguas, Gurabo, and Juncos quadrangles

Klo Lomas Formation (UPPER ? CRETACEOUS)(Seiders, 1971a, 1971b, 1971c)--Volcanic breccia, hyaloclastite breccia, conglomerate, volcanic sandstone, pillowed and non-pillowed lava flows, and rarely volcanicdithic mudstone. Maximum thickenss 1,500 m. Exposed in the Gurabo and El Yunque quadrangles

Km Melones Limestone (MIDDLE MAESTRICHTIAN-UPPER CAMPANIAN)(Mattson, 1960; Volckmann, 1984a, 1984d)- Volcanic sandstone interbedded with shaley limestone, calcareousmudstone, and carbonaceous limestone. Estimated thickness, 300 m. Exposed in the Cabo Rojo quadrangle

Kma Magueyes Formation (MIDDLE ALBIAN)(Berryhill, 1965; Nelson, 1966; Briggs and Gelabert, 1962)--Tuffaceous sandstone and siltstone intercalated with pillowed, basaltic lava flows and flowbreccia, and, near the top of the formation, a thick basaltic hyaloclastite breccia. At the base of the Magueyes is the Barrancas Limestone Member. Maximum estimated thickness, 1,400 m. Exposed in theCiales, Corozal, and Barranquitas quadrangles

Kmag Martin Gonzales Lava (UPPER CRETACEOUS) (Seiders, 1971a, 1971c; Pease, 1968)— Gray green, locallypillowed, basaltic andesite; commonly contains abundant plagioclase phenocrysts (2-5 mm long) that are generally more than 40 percent of the rock; locally, plagioclasephenocrysts makeup most of the rock. Clinopyroxene phenocrysts are sparse and present only locally; in one location orthopyroxene is present. Lava is commonlyamygdaloidal. Variation in thickness over short distances is common. Thickness varies from 50 m to 700 m. Exposed in theGurabo and El Yunque quadrangles.

Kmal Malo Breccia (UPPER ? CRETACEOUS)(Briggs, 1967, 1971; Briggs and Gelabert, 1962; Mattson, 1968b)--Andesitic to basaltic-andesite tuff interbedded with hyaloclastite breccia and pillowed lava, volcanic sandstone,siltstone, and conglomerate.

Maximum estimated thickness, 1,300 m. Exposed in the Orocovis, Jayuya, and Barranquitas quadrangles

Kmam Mameyes Formation (UPPER ? CRETACEOUS)(Nelson and Monroe, 1966; Nelson, 1967b)--Pillowed andesitic lava flows and intercalated volcanic sandstone and siltstone. Maximum estimated thickness, 1,100 m. Exposed in the Florida and Utuado quadrangles

Kman Manicaboa Formation (UPPER ? CRETACEOUS)(Berryhill, 1965)--Volcanic breccia and conglomerate interbedded with tuff. Maximum estimated thickness, 2,200 m. Exposed in the Ciales quadrangle, mapped as Avispa Formation in the adjacent Corozal quadrangle

Kmar Maravillas Formation (MIDDLE ? MAESTRICHTIAN-UPPER SANTONIAN)(Mattson, 1967, 1968b; Glover, 1971; Glover and Mattson, 1973; Briggs, 1971)-Tuffaceous sandstone, siltstone, volcanic breccia, limestone, and limestone conglomerate. Irregularly interbedded calcarenite and limestone conglomerate. Maximum thickness is estimated at about 1,100 m. Exposed in the Jayuya, Orocovis, Rio Descalabrado, and Coamo quadrangles

Kmc Granodiorite of Morovis and Ciales Stocks (POST MIDDLE ALBIAN)(Berryhill, 1965)--Granodiorite. Grades into quartz monzonite in Morovis stock. Autoclastic intrusion breccia near margins. Exposed in the Ciales quadrangle

Kmo Monacillo Formation (UPPER CRETACEOUS)(Kaye, 1959; Pease, 1968a, 1968b; Seiders, 1971a, 1971c; Pease and Monroe, 1977)--Conglomerate and mudstone interbedded with siltstone and sandstone, locally a limestone. Maximum thickness estimated as less than 400 m. Exposed in the Aguas Buenas, Gurabo, San Juan, and Carolina quadrangles

Kp Parguera Limestone (LOWER(?) MAESTRICHTIAN-LOWER CAMPANIAN-UPPERMOST SANTONIAN)(Mattson, 1960; Almy, 1965; Volckmann, 1984a;, 1984d; Monroe, 1972)--Basal conglomerate grades upward into a limestone. Upper member limestone composed of varied, coarse, skeletalclasts of fossils. Maximum estimated thickness, 1,000 m. Exposed in the Parguera, Cabo Rojo, and Guanica quadrangles

Kpa Pajaros Tuff (LOWER ? CRETACEOUS)(Pease, 1968a, 1968c)--Tuff, tuffaceous siltstone, and sandstone. Maximum exposed thickness, 580 m. Exposed in the Naranjito quadrangle

Kpe Penoñes Limestone (MAESTRICHTIAN)(Curet, 1986)--Limestone with minor volcanic lithic and mineralclasts like those in the Sabana Grande Formation. Locally metamorphosed to a coarse crystalline marble near intrusive contacts. Maximum estimated thickness 250 m. Exposed in the Rosario quadrangle

Kper Perchas Formation (UPPER ?-LOWER ? CRETACEOUS) (Berryhill, 1967; Nelson, 1966, 1967a; Pease, 1968a, 1968b; Briggs and Gelabert, 1962; Pease and Briggs, 1960)-Pillowed basaltic lava interbedded with basaltic tuff, volcanic sandstone, and minor hyaloclastite breccia. Lithologically the Perchas is indistinguishable from the Magueyes. Maximum estimated thickness, 1,500 m. Exposed in the Ciales, Corozal, Aguas Buenas, Naranjito, Barranquitas, and Comerio quadrangles

Kpgg GRANODIORITE OF THE PLUTONIC COMPLEX OF PUNTA GUAYANES (MAESTRICHTIAN-CAMPANIAN)(M'Gonigle, 1978; Rogers, 1977; Glover, 1982; and Rogers and others, 1979)--Granodiorite grades into quartz monzonite. Exposed in the Humacao, Punta Guayanes, Patillas, Punta Tuna, and Yabucoa quadrangles

Kpgq QUARTZ DIORITE OF PLUTONIC COMPLEX OF PUNTA GUAYANES (MAESTRICHTIAN-CAMPANIAN)(Rogres and others, 1979; Glover, 1982; Rogers, 1977)--Quartz diorite, local porphyritic quartz dacite. Exposed in the Yabucoa, Punta Tuna, Patillas, Guayama, and Punta Guayanes quadrangles

Kpgqm QUARTZ MONZONITE OF PLUTONIC COMPLEX OF PUNTA GUAYANES (MAESTRICHTIAN)(Rogers and others, 1979)--Quartz monzonite. Exposed in the Yabucoa quadrangle

Kpi Pitahaya Formation (LOWER CRETACEOUS ?)(M'Gonigle, 1977, 1978)--Pillowed lava, hyaloclastite breccia, flow-breccia, tuff, and tuff-breccia. locally with limestone lenses, which may be metamorphosed to marble and replaced by metasomatic magnetite. Tuff facies are locally metamorphosed to aphyllite, and most rocks are epidotized or chloritized. Maximum estimated thickness, 2,000 m. Exposed in the Humacao and Juncos quadrangles; mapped in the Juncos quadrangle as undivided volcanic rocks and metamorphosed equivalents

Kpo Pozas Formation (LOWER MAESTRICHTIAN-UPPER SANTONIAN) (Berryhill, 1965; Nelson and Monroe, 1966; Briggs, 1971; Briggs and Gelabert, 1962)--Volcanic breccia, conglomerate, tuff, volcanic sandstone and siltstone, interbedded locally with ash-flow tuff, lava, and limestone lenses. Also includes limestone lenses. Minimum estimated thickness, 2,000 m. Exposed in the Florida, Ciales, Orocovis, and Barranquitas quadrangles

Kpob TWO PYROXENE OLIVINE BASALT (LOWER ? MAESTRICHTIAN-CAMPANIAN)(Krushensky and Monroe, 1979; Monroe, 1972; Volckmann, 1984a, 1984b; Curet, 1986; and McIntyre, 1975)--Porphyritic augite hypersthene-olivine basalt. Exposed in the Yauco, Sabana Grande, Guanica, Parguera, San German, Cabo Rojo, Mayaguez, Rosario, and Maricao quadrangles

Kpsg GRANODIORITE OF THE PLUTONIC COMPLEX OF PUNTA GUAYANES AND GRANODIORITE OF SAN LORENZO UNDIVIDED (UPPER CRETACEOUS)(Glover, 1982; Rogers and others, 1979)--See Individual rock

descriptions. Exposed in the Patillas, Punta Guayanes, and Yabucoa quadrangles

Kpsq QUARTZ DIORITE OF PLUTONIC COMPLEX OF PUNTA GUAYANES AND OF THE GRANODIORITE OF SAN LORENZO (UPPER CRETACEOUS)(Rogers, 1977; M'Gonigle, 1978)--Quartz diorite of the Punta Guayanes plutonic complex and quartz diorite facies of the granodiorite of San Lorenzo, minor quartz diorite porphyry, and quartz monzonite of the Punta Guayanes plutonic complex. See individual rock types for descriptions. Exposed in the Punta Guayanes and Humacao quadrangles

Kr Robles Formation (CENOMANIAN-LOWER ALBIAN)(Pease and Briggs, 1960; Berryhill and Glover, 1960; Mattson, 1968a, 1968b; Nelson and Tobisch, 1968; Nelson, 1967b; Glover, 1961a, Broedell, 1961; Briggs, 1971; and Rogers, 1979)--Chiefly volcaniclastic sandstone and siltstone, subordinate lava and minor limestone, conglomerate and breccia; includes at the base, in the Cayey quadrangle, a calcarenite. Two pillowed basaltic andesite flows are enclosed in sandstone-siltstone sequence. Estimated thickness of the Robles exceeds 1,200 m. The Robles occurs in the Coamo, Juncos, Cayey, Caguas, Orocovis, and Comerio quadrangles. In the Barranquitas quadrangle rock lithologically and stratigraphically equivalent to the Robles is mapped as the Magueyes Formation.

Kra Río Abajo Formation (LOWER CRETACEOUS ?)(M'Gonigle, 1977, 1978)--Crystal-lithic tuff and interbedded volcaniclastic sandstone and breccia; clasts of embayed quartz and bipyramidal quartz crystals are abundant. The tuff facies is locally metamorphosed to phyllite, or hornblende and mica schist near contacts with the San Lorenzo batholith. Maximum estimated thickness, 600 m. Exposed in the Humacao quadrangle

Krp Río de la Plata Sandstone (UPPER ? CRETACEOUS)(Pease, 1968a)--Volcaniclastic epiclastic sandstone and siltstone interbedded with conglomerate and, locally, andesitic lava flows. Maximum estimated thickness, 1,000 m. Exposed in the Naranjito, Aguas Buenas, and Corozal quadrangles

Ks Sabana Grande Formation (LOWER MAESTRICHTIAN-TURONIAN) (Slodowski, 1956; Mattson, 1960; Volckmann, 1984a, 1984b, 1984c, 1984d)--Volcanic breccia, conglomerate, sandstone and siltstone, and minor basalt flows and limestone lenses. Minimum estimated thickness 1,000 m. Exposed in the Sabana Grande, San German, Puerto Real, Mayaguez, and Rosario quadrangles

Ksl Granodiorite-Quartz Diorite of San Lorenzo (POST CENOMANIAN ?) (Rogers, 1979; Broedel, 1961; M'Gonigle, 1977; Glover, 1962; Rogers and others, 1979)--Massive hornblende-bearing granodiorite, grades into quartz diorite and locally into quartz monzonite. Autoliths(?) and xenoliths of metavolcanic rock are scattered throughout plutonic complex. Exposed in the Caguas, Juncos, Humacao, Patillas, Yabucoa, and Punta Guayanes quadrangles

Kslg MIXED GRANODIORITE-DIORITE OF SAN LORENZO COMPLEX AND DIORITE HORNBLENDITE-HORNBLENDE GABBRO (CRETACEOUS) (M'Gonigle, 1978; Rogers, 1977)--Intermixed granodiorite of the San Lorenzo complex and diorite, hornblendite, and hornblende gabbro. Exposed in the Humacao and Punta Guayanes quadrangles

Kslq Quartz Diorite Facies of Granodiorite of San Lorenzo (UPPER ? LOWER ? CRETACEOUS) (Rogers, 1979)--Quartz diorite, shows faint foliation near intrusive contacts, locally includes autoliths or xenoliths of quartz diorite and diorite. Grades into granodiorite but is largely quartz diorite. Exposed in the Caquas quadrangle

Kso Santa Olaya Lava (UPPER ? CRETACEOUS)(Pease, 1968a, 1968b, 1968c; Seiders, 1971a; Lidiak, 1965)--Basal pillowed, basaltic and andesitic lava flows, hyaloclastite-breccia, tuff, and volcaniclastic sandstone. Maximum estimated thickness, 2,600 m. Exposed in the Aguas Buenas and Naranjito quadrangles; equivalent continuous rocks in the Gurabo quadrangle to the east have been mapped by Seiders (1971a) as the Celada Formation

Kt Torrecilla Breccia (LOWER ALBIAN)(Briggs, 1969, 1971; Pease, 1968b; Pease and Briggs, 1960; Berryhill and Glover, 1960; Briggs and Gelabert, 1962)--Hyaloclastite breccia and associated lava flows, subordinate volcanic sandstone, conglomerate, and siltstone, minor limestone (Aguas Buenas Limestone). Maximum estimated thickness, 2,000 m. Mapped in part or in whole as Robles in central Puerto Rico. Exposed in the Barranquitas, Orocovis, Comerio, Aguas Buenas, and Cayey quadrangles

Kta Tabonuco Formation (MIDDLE OR LOWER CENOMANIAN-ALBIAN AND ? APTIAN) (Seiders, 1971b, 1971c; Briggs and Aguilar, 1980)--Volcaniclastic sandstone, mudstone, minor volcanic breccia, and conglomerate. Approximate thickness, 1,000 m. Exposed in the El Yunque, Fajardo, and Cayo Icacos quadrangles

Kte Tetuan Formation (CAMPANIAN-SANTONIAN)(Nelson and Monroe, 1966; Mattson, 1968b)--Pumiceous tuff, volcanic breccia, and pillowed andesitic lava flows. Maximum estimated thickness, 1500 m. Exposed in the Florida, Utuado, and Jayuya quadrangles

Kto Tortugas Andesite (UPPER ? CRETACEOUS)(Kaye, 1959; Pease, 1968a, 1968b)--Volcanic breccia, subordinate lava, volcanic sandstone, and conglomerate. Maximum estimated thickness, 700 m. Exposed in Aguas Buenas quadrangle

Ku GRANODIORITE-QUARTZ DIORITE OF THE UTUADO BATHOLITH (POST UPPER PALEOCENE- SANTONIAN ?)(Mattson, 1968b; Nelson and Tobisch, 1968; Nelson, 1967b; Mattson, 1968a)--Granodiorite, locally porphyritic, and subordinate quartz diorite, quartz monazite, and diorite. Exposed in the Jayuya, Bayaney, Utuado, and Adjuntas quadrangles

Kv Vista Alegre Formation (UPPER ? CRETACEOUS)(Nelson and Monroe, 1966; Mattson, 1968a, 1968b; Nelson, 1967b; Briggs, 1971)--Graded volcanic sandstone; crystal and lithic tuff, siltstone, volcanic breccia, pillowed andesitic and basaltic lava, and basaltic tuff. Estimated maximum thickness, 1700 m. Exposed in the Florida, Jayuya, Utuado, Adjuntas, and Orocovis quadrangles

Qa Alluvium (QUATERNARY)--Unconsolidated sand and gravel, some silt and clay; locally includes fluvial terrace deposits

Qb Beach Deposits (QUATERNARY)--Poorly consolidated beach sands. locally, sand dune deposits. Mapped chiefly on the north coast of Puerto Rico

Ql Landslide Deposits (HOLOCENE-PLEISTOCENE ?)--Non consolidated rock and soil.

Qs Swamp Deposits (HOLOCENE-PLEISTOCENE ?)--Sandy and silty clay, locally ranges to peat or peaty muck

QTs Blanket Sand Deposits (QUATERNARY ? LATE TERTIARY ?)--Friable quartz-rich sand. Estimated thickness as great as 30 m., commonly 4 to 5 m. thick. Exposed in a discontinuous belt along the north, west and southwest coasts of Puerto Rico

Ta Aguada Limestone (L0WER MIOCENE)(Zapp and others, 1948; Monroe, 1968)--Hard granular calcarenite overlain by alternating beds of chalky marl and rubbly limestone. Maximum estimated thickness, 150 m. Exposed from the San Juan quadrangle to the Aguadilla quadrangle and in the Utuado quadrangle

Tay Aymamon Limestone (LOWER MIOCENE)(Zapp and others, 1948; Monroe, 1963, 1967)--Dense limestone and chalk. Maximum estimated thickness, 200 m. Exposed along the north coast of Puerto Rico from the Vega Alta quadrangle to the Aguadilla quadrangle

Tc Cuevas Formation (LOWER MIDDLE EOCENE)(Pessagno, 1960; Krushensky and Monroe, 1975; Mattson, 1968b; Glover, 1961a, 1961b, 1971; Glover and Mattson 1973)-Calcarenite algae clasts. Maximum estimated thickness, 35 m. Exposed in the Coamo, Salinas, Rio Descalabrado, Ponce, and Jayuya quadrangles

Tca Carreras Siltstone (EARLY ? PALEOCENE ?)(Berryhill, 1965; Nelson, 1967a)--Tuffaceous siltstone, minor volcanic sandstone, and tuff; limestone, limestone breccia, and calcareous sandstone. Grades downward into arkosic conglomerate. Maximum estimated thickness, 600 m. Exposed in the Corozal and Ciales quadrangles

Tcb Cibao Formation (LOWER MIOCENE-UPPER OLIGOCENE)(Monroe, 1980)--Calcareous clay, marl, and chalky limestone.

Tcbg Guajataca Member (Zapp and others, 1948)--Calcareous clay, chalky limestone, and marl with massive lenses of sand and gravel.

Tcbga Almirante Sur Sand Lentil (Monroe, 1962)--Pebbly quartz sand and sandstone, locally grades into glauconitic calcarenite.

Tcbm Montebello Limestone Member (Nelson and Monroe, 1966)--Chalky limestone, clay, and marl.

Tcbmi Miranda Sand Member--Channel sand, locally with pebbles and cobbles. Formation thickness ranges, from l70 m. to 260 m. Formation exposed along north coast from San Juan quadrangle to the Aguadilla quadrangle

Tcbq Quebrada Arenas Member (Monroe, 1962)--Dense limestone alternating with chalky limestone.

Tcbr Río Indio Limestone Member (Monroe, 1962)--Limestone lenses ofmarly clay or beds of chalky limestone, grades intoMucarbones Sand laterally

Tcm Camuy Formation (LOWER PLIOCENE-UPPER MIOCENE)(Monroe, 1963, 1967, 1969, 1971, 1980; Briggs, 1965, 1968;)--Foraminiferal biomicrite with clay lenses, ferruginous calcarenite interbedded with chalky breccia, and upper chalky sandstone, sandstone, sandy limestone, and limestone. Estimated maximum thickness, l70 m. Exposed in the Manati, Barceloneta, Arecibo, Camuy, Quebradillas, and Moca quadrangles

Tco Corozal Limestone (LOWER EOCENE ?-PALEOCENE)(Berkey, 1915; Nelson, 1966; 1967a; Kaye, 1956)--Limestone and limestone breccia. Minimum thickness l50 m. Exposed in the Corozal quadrangle

Td DACITE (TERTIARY)(Mattson, 1968a, 1968b; Krushensky and Monroe, 1975)--Porphyritic dacite. Locally, border zones show autoclastic intrusion breccia. Exposed in the Adjuntas, Jayuya, and Ponce quadrangles

Tfb Fault Breccia (MIDDLE EOCENE ?-POST MIDDLE EOCENE ?) (Mattson, 1968b; Krushensky and Monroe, 1975; Krushensky, 1978; Glover, 1971; Glover and Mattson, 1973)--Varies lithologically with the underlying, and to a lesser extent, with the overlying fault plates. Blocks of various formations to 1OO m+ in a clay-rich, arenaceous, slickenside-riddled matrix. Maximum thickness estimated as 35 m. Exposed in the Jayuya, Ponce, and Rio Descalabrado quadrangles

Tg Guayo Formation (MIDDLE EOCENE ? -POST MIDDLE EOCENE ?)(Glover and Mattson, 1967; Krushensky and Monroe, 1975)--Conglomerate, and subordinate sandstone and siltstone. Boulders are abundant; lithologically like volcanic rocks in the Coamo, Maravillas, Lago Garzas, and Anon Formations, and limestone like the Cuevas Limestone in a lithic matrix. The Guayo fills channels in the Cuevas and Rio

Descalabrado Formations. Maximum estimated thickness, 200 m. Exposed in the Rio Descalabrado and Ponce quadrangles

Tga GABBRO (UPPER ?-MIDDLE EOCENE)(McIntyre, 1975)--Gabbro. Exposed in the Maricao quadrangle

Tgua Guanajibo Formation (UPPER MIOCENE)(McGinnis, 1948; Volckmann, 1984)--Calcarenite and calcirudite. Local interbedded lithic sandstone and conglomerate. Estimated maximum thickness, 30 m. Exposed in the Puerto Real and San German quadrangles

Thp HORNBLENDE QUARTZ-DIORITE (TERTIARY ?)-UPPER CRETACEOUS ?) (Seiders, 1971a; Nelson, 1966; Monroe and Pease, 1962; Briggs and Gelabert, 1962; Glover, 1961a, 1971; Pease, 1968, 1968b; Mattson, 1968b; Nelson and Monroe, 1966; Briggs, 1971; Mattson, 1968a; Volckmann, 1984a; Seiders, 1971b; Volckmann, 1984B; Broedel, 1961; Rogers, 1979; M'Gonigle, 1978; Briggs and Aguillar C., 1980; Nelson, 1968; Berryhill and Glover, 1960)--Porphyritic hornblende quartz-diorite. Exposed in the Gurabo, Corozal, Bayamon, Barranquitas, Coamo, Naranjito, Aquas Buenas, Jayuya, Florida, Orocovis, Adjuntas, Cabo Rojo, El Yunque, San German, Juncos, Caguas, Humacao, Fajardo, Bayaney, and Cayey quadrangles

Tj Jicara Formation (LOWER EOCENE-UPPER PALEOCENE) (Slodowski, 1956; Mattson, 1960; Volckmann, 1984b; Monroe, 1972)--Laminated tuff with a conchoidal fracture. Composed of pale-green glass shards, quartz crystal fragments, and rare, pyroxene and plagioclase crystal fragments. Maximum estimated thickness, 1,OOO m. Exposed in the San German, Sabana Grande, and Guanica quadrangles

Tjd Juana Diaz Formation (MIDDLE MIOCENE-LOWER OLIGOCENE) (Seiglie and Bermudez, 1969; Zapp, Bergquist, and Thomas, 1948; Bermudez and Seiglie, 1970; Moussa and Seiglie, 1970; and Monroe, 1973, 1980; Krushensky and Monroe, 1975; 1978, 1978a, Glover and Mattson, 1973)--Basal gravel to conglomerate overlain by limestone. Maximum estimated thickness is 850 m. Exposed in the Ponce, Rio Descalabrado, Penuelas, Punta Cuchara, Yauco, Punta Verraco, Guanica, and Sabana Grande quadrangles

Tjo Jobos Formation (OLIGOCENE ?-PRE-OLIGOCENE?)(Nelson, 1967b)--Volcanic breccia, includes some volcanic conglomerate, sandstone, and andesitic lava flows. Estimated thickness, l,700 m. Exposed in the Utuado quadrangle

TKa Anon Formation (EOCENE-MIDDLE CAMPANIAN)(Pessagno, 1960; Mattson, 1967; McIntyre, 1971; Nelson and Tobisch, 1967, 1968; Tobisch and Turner, 1971; Krushensky and Curet, 1984, Krushensky and Monroe, 1975)--Volcanic breccia and lava, subordinate tuff, tuffaceous sandstone, siltstone, and mudstone. Pillow structure is absent. Maximum estimated thickness of the Anon, 2,000 m. Anon Formation without discernable interbeds with other formations crops out in the Ponce, Jayuya, and Adjuntas quadrangles; interbedded Anon and Lago Garzas, Anon and Yauco,

Anon and Maricao, and Anon and Monserrate crop out in the Rincon, Central La Plata, San Sebastian, Monte Guilarte, Bayaney, and Ponce quadrangles

TKahp AUGITE-HORNBLENDE PORPHYRY (TERTIARY ?-UPPER CRETACEOUS) (Mattson, 1968b; Curet, 1986; Mattson, 1968a; Volckmann, 1984b; Krushensky, unpub. data; Krushensky and Monroe, 1979, 1978a)--Porphyritic augite hornblende andesite, locally grades into diorite, locally mapped with basalt and dacite. Exposed in the Jayuya, Mayaguez, Rosario, Adjuntas, San German, Sabana Grande, Yauco, and Penuelas quadrangles

TKal Lago Garzas-Anon Formations Interbedded (UPPER EOCENE(?)-UPPER CAMPANIAN)(Krushensky and Curet, 1984; Nelson and Tobisch, 1968, McIntyre, 1971, 1975; Mattson, 1968a; Krushensky and Monroe, 1978)--Dark-red, non-pillowed andesite lava flows and volcanic breccia of the Lago Garzas Formation are irregularly interbedded with hornblende-dacite-rhyodacite lava flows, sandstone-siltstone, and tuff characteristic of the Anon Formation. Maximum thickness of the interbedded Lago Grazas and Anon estimated in excess of 3,500 m. Exposed in the Penuelas, Adjuntas, Monte Guilarte, Maricao, Bayaney, San Sebastian, and Central La Plata quadrangles

TKam Anon and Maricao Formations Interbedded (PALEOGENE ?-LATE CRETACEOUS ?)(Krushensky and Curet, 1984)--Characteristic Maricao Breccia interbedded with dacitic volcanic breccia, tuffaceous sandstone, tuff, and lava, characteristic of the Anon Formation. Maximum estimated thickness, 600 m. Exposed in the Monte Guilarte and Bayaney quadrangles

TKamo Anon and Monserrate Formations Interbedded (MIDDLE EOCENE)(Krushensky and Monroe, 1975)--Interbedded volcaniclastic sandstone and siltstone of the Anon and Monserrate Formations. Thickness not estimated. Exposed in the Ponce quadrangle

TKap AUGITE ANDESITE PORPHYRY (TERTIARY ?-UPPER CRETACEOUS ?)(Pease and Briggs, 1972; Seiders, 1971b; Pease, 1968; Krushensky and Monroe, 1979, 1987a; and Seiders, 1971a) --Augite andesite porphyry. Exposed in the Rio Grande, El Yunque, Naranjito, Yauco, Penuelas and Gurabo quadrangles

TKas ALKALI SYENITE (TERTIARY ?-UPPER CRETACEOUS ?)(Berryhill, 1965)--Potash feldspar and augite in a chloritized matrix. Exposed in the Ciales quadrangle

TKat AUGITE TRACHYBASALT (TERTIARY ?-UPPER CRETACEOUS) (Curet, 1986; McIntyre, 1975; Krushensky and Curet, 1984; Krushensky, unpub. data; and Krushensky and Monroe, 1978a)--Porphyritic augite trachybasalt, characteristically with abundant, conspicuous, and large (l-3 cm long), augite phenocrysts. Exposed in the Mayaguez, Rosario, Maricao, Monte Guilarte, Sabana Grande, Yauco, and Penuelas quadrangles

TKay Anon and Yauco Formations Interbedded (UPPER MAESTRICHTIAN-MIDDLE CAMPANIAN)(Krushensky and Curet, 1984)--Calcareous and foraminiferal mudstone, siltstone, and claystone of the Yauco Formation interbedded with tuff, tuffaceous sandstone-mudstone and rarely conglomerate, of the Anon Formation. Exposed in the Monte Guilarte quadrangle

TKaym Anon, Yauco, and Maricao Formations Interbedded (LOWER PALEOGENE ?-CAMPANIAN ?)(Krushensky and Curet, 1984)--Dacitic tuff, tuffaceous sandstone, and breccia of the Anon Formation; irregularlyinterbedded with Yauco; and subordinate interbedded trachybasalt of the Maricao Formation. Thickness unknown. Exposed in the Monte Guilarte quadrangle

TKci Cibuco Formation (UPPER CRETACEOUS ?-PALEOGENE ?) (Nelson, 1966, 1968a)--Conglomerate with interbedded volcanic sandstone, siltstone, and tuff. Maximum known thickness, 2,000 m. Exposed in theCorozal quadrangle

TKda DACITE (TERTIARY-UPPER CRETACEOUS ?)(Krushensky and Monroe, 1978a, 1975)--Aphyric vesicular andamygdaloidal dacite. Exposed in the Penuelas and Ponce quadrangles

TKdi DIORITE (TERTIARY ?-UPPER CRETACEOUS ?)(Briggs and Aguillar C., 1980; M'Gonigle, 1979; Nelson, 1966; Glover, 1961a, 1971; Glover and Mattson, 1973; Curet, 1986; Pease and Briggs, 1960; Pease, 1968b; Berryhill, 1965; McIntyre, 1971; Briggs, 1971; Volckmann, 1984c)– Porphyritic diorite. Exposed in the Fajardo, Naguabo, Corozal, Coamo, Rio Descalabrado, Rosario, Comerio, Aquas Buenas, Ciales, Central La Plata, Orocovis, Mayaguez, and Puerto Real quadrangles

TKg GABBRO (TERTIARY-UPPER ? CRETACEOUS)(Seiders, 1971a; Monroe, 1977; Seiders, 1971b)--Diabasic gabbro and porphyritic gabbro, locally includes hornblende porphyry. Exposed in the Gurabo, Carolina, and El Yunque quadrangles

TKgm GRANODIORITE QUARTZ MONZONITE (TERTIARY-UPPER CRETACEOUS ?)(Curet, 1986; McIntrye, 1975)--Granodiorite grades into quartz monzonite. Exposed in the Rosario and Maricao quadrangles

TKgu Guaracanal Formation (LOWER PALEOGENE-UPPER CRETACEOUS) (Pease, 1968a, Seiders, 1971c)--Volcanic breccia integrades with lava or tuff. Locally includes limestone at base of formation. Maximum estimated thickness l25 m. Exposed in the Carolina, San Juan, Aguas Buenas, and Gurabo quadrangles

TKh HORNBLENDE QUARTZ-DIORITE PORPHYRY (EOCENE)(Tobisch and Turner, 1971; Nelson, 1968; Krushensky and Curet, 1984; Mattson, 1968a; Berryhill and Glover, 1960; Glover, 1961a, 1971; McIntyre, 1975; Krushensky and Monroe, 1975; and Nelson, 1966)--Porphyritic hornblende quartz diorite, minor hornblende-granodiorite, quartz monzonite, and quartz diorite; locally pyritized, molybdenite-bearing, and/or includes disseminatedchalcopyrite in the groundmass. Exposed in the San Sebastian,

Bayaney, Monte Guilarte, Adjuntas, Cayey, Coamo, Maricao, Ponce, and Corozal quadrangles

TKha HYDROTHERMALLY ALTERED ROCK (TERTIARY ?-CRETACEOUS?) (M'Gonigle, 1978; Broedel, 1961; Briggs and Gelabert, 1962; Berryhill and Glover, 1960; Pease, 1968, 1968b; Rogers, 1979; Curet, 1986; Volckmann, 1984b; Seiders, 1971a; Glover, 1982; Rogres and others, 1979)--Mixture of clay, sericite, albite, and pyrophyllite. Locally pyrite-bearing. Majority of areas mapped as hydrothermally altered are intrusive rocks. Exposed in the umacao, Juncos, Barranquitas, Cayey, Naranjito, Aquas Buenas, Comerio, Caquas, Cailes, Rosario, San German, Gurabo, Patillas, Naguabo, Guayama, and Punta Tuna quadrangles

TKhda HORNBLENDE DACITE (TERTIARY-LATE CRETACEOUS)(McIntyre, 1975; Krushensky and Monroe, 1979; Krushensky and Curet, 1984; Mattson, 1968a; and Krushensky and Monroe, 1978a)--Porphyritic hornblende dacite. Exposed in the Maricao, Yauco, Monte Guilarte, Adjuntas, and Penuelas quadrangles

TKk QUARTZ KERATOPHYRE (TERTIARY ?-UPPER CRETACEOUS ?)(Briggs and Aguillar C., 1980; M'Gonigle, 1979)--Quartz keratophyre. Exposed in the Fajardo and Naguabo quadrangles

TKl Lago Garzas Formation (MIDDLE EOCENE-CAMPANIAN)(Pessagno, 1962; Mattson, 1967, 1968a, 1968b; Krushensky and Monroe, 1975, 1978, 1979; McIntyre, 1971, 1975; Krushensky and Curet, 1984; Curet, 1986; Tobisch and Turner, 1971)--Dark-red volcanic breccia, lava, and subordinate volcanic sandstone, claystone, calcirudite, and pillowed basalt flows are interbedded. Locally interbedded with Anon Formation of Middle Eocene age. Maximum estimated thickness, in excess of 1,000 m. Exposed in the Ponce, Yauco, Penuelas, Jayuya, Adjuntas, Monte Guilarte, Maricao, Rosario, San Sebastian, and Central La Plata quadrangles

TKlam Lago Garzas, Anon, and Maricao Formations Interbedded (TERTIARY ? - MAESTRICHTIAN ?-CAMPANIAN ?)(Krushensky and Monroe, 1979)--Irregularly interbedded breccia characteristic of the Maricao, the Lago Garzas, and hornblende dacite volcanic breccia, tuffaceous sandstone and siltstone characteristic of the Anon. Thickness not estimated. Exposed in the Yauco quadrangle

TKly Lago Garzas and Yauco Formations Interbedded (TERTIARY ? - MAESTRICHTIAN ?-CAMPANIAN ?)(Krushensky and Monroe, 1975, 1979)--Characteristic Yauco Formation irregularly interbedded with volcanic sandstone characteristic of the Lago Garzas Formation. Exposed in the Ponce and Penuelas quadrangles

TKm Maricao Formation (TERTIARY ? -MAESTRICHTIAN-CAMPANIAN)(Mattson, 1960; McIntyre and others, 1970; Krushensky and Curet, 1984; Curet, 1986; McIntyre, 1971)--Volcanic trachybasalt breccia, tuffaceous sandstone and

mudstone, tuff, and subordinate lava and limestone; characteristically contains large (l-3 cm long) augite phenocrysts. Estimated minimum thickness, 2,000 m. Exposed in the Maricao, Rosario, Central La Plata, Mayaguez, Yauco, Penuelas, Adjuntas, and Monte Guilarte quadrangles

TKmly Maricao, Lago Garzas, and Yauco Formations Interbedded (LOWER PALEOGENE ?-CAMPANIAN ?)(Krushensky and Curet, 1984)--Interbedded lava flows and volcanic sandstone of the Lago Garzas, tuffaceous sandstone and volcanic breccia of the Maricao, and calcareous claystone of the Yauco Formation. Thickness not known. Crops out in the Monte Guilarte quadrangle

TKmv Metavolcanic Rocks (UPPER CRETACEOUS ?-PALEOGENE ?)--Hornblende hornfels. Textures of original lava flows, volcanic breccia, tuff, and volcanic sandstone are preserved. Exposed in the Punta Tuna, Patillas, and Yabucoa quadrangles

TKmy Maricao and Yauco Formations Interbedded (TERTIARY ?-MAESTRICHTIAN ?-CAMPANIAN ?)(Krushensky and Curet, 1984; McIntyre, 1875)--Volcanic sandstone, siltstone, and claystone irregularly interbedded with dark-green, coarse grained sandstone and subordinate conglomerate. Maximum estimated thickness, 300 m. Exposed in the Monte Guilarte and Maricao quadrangles

TKn Naranjito Formation (LOWER PALEOGENE ? UPPER CRETACEOUS ?) (Pease, 1968a, 1968c; Nelson, 1967a)--Crystal-tuff, tuffaceous breccia and conglomerate, volcanic sandstone, and, locally, lava flows. Maximum thickness 450 m. Exposed in Naranjito and Corozal quadrangles

TKqd QUARTZ DIORITE-GRANODIORITE (TERTIARY ?-UPPER CRETACEOUS ?)(M'Gonigle, 1978, 1979; Nelson, 1966; Mattson, 1968b; Aaron, unpub. data; McIntyre, 1971; Nelson, 1967b; Nelson and Monroe, 1966; McIntyre, 1975; Krushensky and Curet, 1984; Krushensky and Monroe, 1979, 1978a, 1975; and Volckmann, 1984a)--Quartz diorite grades into granodiorite, locally proportions are reversed. Locally porphyritic. Exposed in the Fajardo, Humacao, Naguabo, Punta Puerca, Corozal, Jayuya, Rincon, Central La Plata, Utuado, Florida, Maricao, Monte Guilarte, Yauco, Penuelas, Parguera, and Ponce quadrangles

TKy Yauco Formation (TERTIARY ?-MIDDLE ?-LOWER ? MAESTRICHTIAN-CENOMANIAN)(Mitchell, 1922; Hubbard, 1923; Mattson, 1960; Krushensky and Monroe, 1978, 1979; Krushensky and Curet, 1984; Curet, 1986; Mattson, 1968; McIntyre, 1971, 1975; Volckmann, 1984b, 1984c)--Siltstone, claystone; sandstone, limestone, and conglomerate. Interbedding of the Yauco with the Maricao, Anon, and Lago Garzas, which have fossils of Tertiary age, may indicate an age spread from Tertiary to Upper Cretaceous, for the Yauco, but fossils of Tertiary age from the Yauco are not known. Estimate thickness in excess of 1,200 m. Exposed in the Yauco, Ponce, Penuelas, Adjuntas, Monte Guilarte, Maricao, San German, Sabana Grande, Rosario, Mayaguez, Puerto Real, Central La Plata, and Rincon quadrangles

Tl Los Puertos Formation (LOWER PALEOCENE)(Glover and Mattson, 1967, 1973)--Andesitic volcaniclastic breccia. Distinguished from Coamo Formation by presence of locally interbedded quartz-bearing dacitic tuff. Maximum estimated thickness, 350 m. Exposed in the Rio Descalabrado quadrangle

Tla Lares Limestone (UPPER ? OLIGOCENE)(Hubbard, 1923; Zapp and others, 1948; Nelson and Monroe, 1966; Monroe, 1969, 1980; McIntyre, 1971; Tobisch and Turner, 1971; Nelson and Tobisch, 1968; Nelson, 1967a, 1967b; Berryhill, 1965)--Calcilutite, locally, hard calcilutite interbedded with chalky limestone and calcareous clay. Estimated maximum thickness about 270 m. Exposed in the Florida, Moca, Central La Plata, San Sebastian, Bayaney, Utuado, Ciales, and Corozal quadrangles

Tm Monserrate Formation (MIDDLE EOCENE)(Pessagno, 1960,; Mattson, 1967; Krushensky and Monroe, 1975, 1978)--Volcaniclastic siltstone and sandstone interbedded with tuff, subordinate conglomerate, calcarenite, and chert, conglomerate composed of augite andesite characteristic of the Lago Garzas Formation. Maximum estimated thickness, 2,000 m. Exposed in the Ponce, Penuelas, Jayuya, and Adjuntas quadrangles

Tmu Mucarbones Sand (LOWER MIOCENE ? UPPER OLIGOCENE) (Monroe and Pease, 1962; Nelson, 1966, 1967a; Berryhill, 1965; Pease, 1968)--Quartz sand, interbedded with glauconitic, calcareous sand and thin-bedded calcareous clay. Maximum known thickness, l20 m. Exposed in the Corozal, Ciales, Naranjito, Bayamon, and San Juan quadrangles

Tor Ortiz Formation (PALEOGENE ? -NEOGENE ?)(Berkey, 1915; Nelson, 1966, 1967a)--Volcanic sandstone, siltstone, and tuff, basal conglomerate. Maximum thickness, 600 m. Exposed in the Corozal quadrangle

Tpa Palmarejo Formation (EOCENE-PALEOCENE)(Nelson, 1966, 1967a; Pease 1968c)--Volcanic sandstone interbedded with siltstone. Maximum thickness, 370 m. Exposed in the Corozal and Naranjito quadrangles

Tpo Ponce Limestone (UPPER MIOCENE-PLIOCENE)(Monroe, 1973b, Krushensky and Monroe, 1975, 1978, 1979; Monroe, 1972; Volckmann, 1984a, 1984b; Mattson and Glover, 1973)--Limestone with locally includes beds of brown clay. Maximum estimated thickness, 850 m. Exposed in the Ponce, Río Descalabrado, Punta Cuchara, Yauco, Punta Verraco, Guanica, Parguera, San German, and Cabo Rojo quadrangles

Tr Río Culebrinas Formation (MIDDLE EOCENE)(McIntyre, 1975; McIntyre and others, 1970; Tobisch and Turner, 1971)-Basal mudstone and limestone, breccia, tuff, and volcanic sandstone and mudstone. Maximum estimated thickness, 3,000 m. Exposed in the Central La Plata, Rincon, Aguadilla, San Sebastian, and Maricao quadrangles

Tra Raspaldo Formation (LOWER EOCENE-UPPER PALEOCENE) (Glover and Mattson, 1967, 1973; Glover, 1961, 1971) Graded, tuffaceous mudstone, and tuff. Minimum estimated thickness, 600 m. Exposed in the Coamo and Rio Descalabrado quadrangles

Trd Río Descalabrado Formation (LOWER MIDDLE EOCENE)(Glover and Mattson, 1967; Glover, 1971)--Dacitic tuff and subordinate mudstone and tuffaceous mudstone. The Río Descalabrado is lithologically equivalent to the Monserrate Formation. Maximum estimated thickness, more than 500 m. Exposed in the Río Descalabrado and Coamo quadrangles

Trhp RHYODACITE PORPHYRY (TERTIARY)(McIntyre, 1971)--Rhyodacite porphyry. Exposed in the Central La Plata and San Sebastian quadrangles

Trp Río Piedras Siltstone (UPPER PALEOCENE)(Pease, 1968a)--Volcanic sandstone, siltstone, and basal conglomerate. Maximum thickness, 1400 m. Exposed in the Aguas Buenas, Naranjito and San Juan quadrangles

Ts San Sebastian Formation (MIDDLE ?-UPPER OLIGOCENE) (Hubbard, 1923; Zapp and others, 1948; Monroe, 1980, 1969; McIntyre, 1971; Nelson and Tobisch, 1968; Nelson, 1967; Nelson and Monroe, 1966; Berryhill, 1965; Pease, 1968; Monroe and Pease, 1962; Pease and Monroe, 1977; Tobisch and Turner, 1971)--Shaley clay, sandstone, and conglomerate. Estimated maximum thickness, 100 m. in outcrop, about 328 m. in the subsurface. Exposed in the San Sebastian, Moca, Central La Plata, Bayaney, Utuado, Florida, Ciales, Corozal, Naranjito, Bayamon, and San Juan quadrangles

Ty Yunes Formation (MIDDLE EOCENE-UPPER PALEOCENE)(Nelson and Monroe, 1966; Nelson, 1967b)--Quartz-bearing vitric and crystal vitric tuff, volcanic sandstone, in places graded, and siltstone; some volcanic breccia, conglomerate, calcarenite, and lava. Maximum estimated thickness is 3,000 m. Exposed in the Florida and Utuado quadrangles

KJa Amphibolite (CRETACEOUS ?-PRE-CRETACEOUS ?)(Mattson, 1960; Tobisch, 1968; Krushensky and Monroe, 1979; Volckmann 1984a, 1984b, 1984c)--Generally non-foliate to weakly foliate, moderately lineate, fine- to medium crystalline, dark-gray, dark- to light-gray-green, amphibolite. Composed of generally poikilitic to inclusion-free hornblende, and generally prehnitized plagioclase, minor inclusion-free clinopyroxene, and accessory quartz, magnetite, apatite, sphene, and zircon. Accessory minerals are commonly present as inclusions in the hornblende. Present both as discrete massive outcrops and as blocks of various sizes in serpentinite. Exposed in the Cabo Rojo, Parguera, San German, Mayaguez, and Punta Verraco quadrangles

KJas Amphibolite-Serpentinite (CRETACEOUS ?-PRE-CRETACEOUS ?) (Volckmann, 1984a, 1984b)--Blocks of amphibolite held in a matrix of serpentinite. Exposed in the Parguera and San German quadrangles

KJs Serpentinite (CRETACEOUS ?-PRE-CRETACEOUS ?)(Mattson, 1960; McIntyre, 1975; Krushensky and Monroe, 1978; Volckmann, 1984a, 1984b, 1984c; Curet, 1986;)--Massive, but pervasively sheared and internally slickensided, light- to dark-green, bluish-green, gray-green, and black, serpentinite; chiefly altered harzburgite and lerhzolite with minor bastite after orthopyroxene and sparse clinopyroxene. Commonly, even in intensely sheared serpentinite, with irregularly faceted, slickensided knobs or cores of unsheared bastite-bearing serpentinite. Locally, massive serpentinite may show concentrations of bastite in bands to l cm wide. Associated and probably younger, are generally thin lenses, but locally thick beds (to l5 m), of epiclastic serpentinite (not mapped separately) that

consist of angular to well-rounded clasts with a greater range in color and texture than nearby or adjacent non-epiclastic serpentinite. Locally, these epiclastic serpentinite beds or lenses include discrete beds of volcaniclastic rocks. Epiclastic serpentinite is moderately to poorly sorted, unsheared, and retains a characteristic epiclastic appearance in both clasts and matrix as contrasted to a tectonoclastic texture. Thickness of epiclastic serpentinite is unknown. Exposed in the Mayaguez, Rosario, Maricao, Sabana Grande, Yauco, Punta Verraco, Parguera, Cabo Rojo, San German, and Puerto Real quadrangles

KJb Spilitized Basalt (LOWER CRETACEOUS ?-PRE-UPPER KIMMERIDGIAN ?)(Mattson, 1960; Curet, 1986)--Massive, commonly sheared and fine-crystalline near known contacts with serpentinite, less sheared and medium- to fine-crystalline away from contacts with serpentinite, locally vesicular, dark greenish-gray spilitized basalt, composed chiefly of abundant anhedral to subhedral plagioclase almost completely replaced by sodic albite and subordinate calcite; sericite, kaolinite, and chlorite; and abundant, anhedral to subhedral clinopyroxene that is largely replaced by epidote, chlorite, and green hornblende. Subordinate groundmass consists of chlorite and accessory magnetite. Exposed in the Mayaguez quadrangle

KJc Cajul Basalt (LOWER CRETACEOUS ?-UPPER JURASSIC ?) (Volckmann, 1984a, 1984b, 1984c)--Very dark purplish-red and dark reddish-brown, amygdaloidal, pillowed, porphyritic basalt flows, with phenocrysts of plagioclase and rare olivine in a devitrified very fine-crystalline matrix. Locally, reddened chert lies between pillows. Maximum thickness unknown. Exposed in the San German, Cabo Rojo, Parguera, and Puerto Real quadrangles

KJm Mariquita Chert (MIDDLE TURONIAN ?-UPPER KIMMERIDGIAN-LOWER-TITHONIAN UNDIVIDED)(Mattson, 1973; Mattson and Pessagno, 1974, 1979; Krushensky and Monroe, 1979; Volckmann, 1984a, 1984b, 1984c)--Thin- to medium-bedded, locally internally laminated, fine-grained, dark-gray to black, greenish-gray, and pale-gray; red and reddish-green weathering chert; intensely brecciated over wide areas, angular breccia clasts range from <1 mm to over 6 cm across, are healed by silica or, uncommonly, by calcite. Weathers to predominantly red, slabby masses. Commonly contains abundant to sparse non-recrystallized radiolaria, and locally, Foraminifera. Fine-crystalline pseudomorphs of silica after very fine-grained, angular lithic tuff clasts are locally preserved. Pseudomorphs after glass shards have not been identified. Radiolarians identified include: Hsuum maxwelli, Parvicingula procera, P. turrita, P. altissima, Saitoum pagei, Paronaella casmaliaensis, Crucella corallitosensis, Acanthocircus variabilis, Tripocyclina jonesi, T. trigonum, and Emiluvina chica of lower Tithonian age; Thanarla conica, T. brouweri, Archaeodictyomitra sp. and Holocryptocanium sp. of Hauterivian to upper Aptian age; and Archaeodictyomitra sp. cf. A. sliteri, Mita sp., Zifondium ? sp., Z. pauperum, Pseudodictyomitra pentacolaensis, Thanarla conica, Ultranapora sp. aff. U. dumitricai, and Pantanellium sp. of upper Aptian age (Mattson and Pessagno, 1979). Widespread presence of non-recrystallized radiolaria indicates that chert is not recrystallized. Locally shows slump-folding. Locally interbedded with recrystallized and largely silicified limestone(?), and non-metamorphosed pillowed basalt. Basal sandstone-conglomerate of detrital serpentinite, locally present, grades upward into typical fine-crystalline chert in the Punta Verraco quadrangle. Maximum estimated thickness, 300 m. Exposed in the Cabo Rojo, Puerto Real, San German, Parguera, and Punta Verraco quadrangles

TKy Yauco Formation (TERTIARY ?-MIDDLE ?-LOWER ? MAESTRICHTIAN-CENOMANIAN)(Mitchell, 1922; Hubbard, 1923; Mattson, 1960, 1968; McIntyre, 1971, 1975; Krushensky and Monroe, 1978, 1979; Krushensky and Curet, 1984; Volckmann, 1984b, 1984c; Curet, 1986)--Predominantly siltstone, claystone; subordinate sandstone, minor limestone, and rare conglomerate. Thick and widespread sequences of irregularly interbedded, well-sorted, Foraminifera-rich, dark bluish-gray, typically pale-yellowish-gray weathering, calcareous siltstone, claystone and fine-grained sandstone. Small-scale crossbedding in sandstone and flaser-bedding in siltstone and claystone are common. Sandstone and conglomeratic sandstone, especially west of town of Yauco show well-graded sequences. Sandstone and siltstone units chiefly of rounded- to subrounded lithic clasts in an abundant or even predominant calcareous matrix. Microscopic Foraminifera range from sparse to abundant. Some beds contain highly angular fragments of plagioclase and pyroxene crystals and are tuffaceous. Claystone and siltstone characteristically weather into tabular polyhedral chips with conchoidal fracture surfaces. Minor limestone is dark- to medium brownish-gray calcarenite composed chiefly of rounded clasts of algae, coral, and rudists, and large Foraminifera in an argillaceous or tuffaceous, dark-brown micritic, or pale-gray sparry matrix. Foraminifera include Sulcorbitoides pardoi Bronnimann, Sulcoperculina dickersoni (Palmer), Pseudoorbitoides sp., P. israelskyi Vaughan and Cole, Kathina jamaicensis, Parastroma guitarti, Durania nicholasi (Whitfield), and Globotruncana navarronensis. Globotruncana stuarti, G. lapparenti lapparenti Boli, G. ventricosa (Krushensky and Monroe, 1975), and G. fornicata, as well as G. sp. cf. G. repanda of the Globotruncana fornicata-lapperenti-stuarti zone (Pessagno, 1960a, 1960b; Krushensky

and Monroe, 1979). Interbedding of the Yauco with the Maricao, Anon, and Lago Garzas, which have fossils of Tertiary age, may indicate an age spread from Tertiary to Upper Cretaceous, for the Yauco, but fossils of Tertiary age from the Yauco are not known. Rarely present conglomerate is intraformational and composed of rounded tabular clasts of claystone-siltstone in a matrix of the same rock type. Local estimated thickness exceeds l,200 m. Exposed in the Yauco, Ponce, Penuelas, Adjuntas, Monte Guilarte, Maricao, San German, Sabana Grande, Rosario, Mayaguez, Puerto Real, Central La Plata, and Rincon quadrangles

Ks Sabana Grande Formation (LOWER MAESTRICHTIAN-TURONIAN) (Slodowski, 1956; Mattson, 1960; Volckmann, 1984a, 1984b, 1984c, 1984d)--Predominantly volcanic breccia, subordinate conglomerate, volcanic sandstone and siltstone, and minor basalt flows and limestone lenses. Massive to very thick-bedded, polymict, light- to dark-gray, reddish-brown, and purplish-gray tuffaceous volcanic breccia composed of generally coarse-grained, subangular to subrounded and locally well-rounded lithic clasts of clinopyroxene andesite, subordinate to minor hornblende-andesite, and basalt in a tuffaceous matrix composed of lithic clasts like those described, crystals and crystal fragments of clinopyroxene, plagioclase, hornblende, and rare quartz, as well as glass shards and pumice. Widely interbedded, but areally restricted conglomerate lenses, are composed of rounded lithic clasts like those described in a matrix of generally well-rounded sand-size lithic and mineral clasts. Clinopyroxene-olivine-bearing basalt flows are rarely present. Massive, lenticular, light-to dark-gray calcarenite and calcirudite composed of angular to subrounded clasts of fossil rudists, other mollusk shells, fecal pellets, and echinoid spines in a micritic to sparry matrix are sparsely scattered. Foraminifera range from Turonian through early Maestrichtian.

The rudist Barrettia gigas has been reported from the Sabana Grande (Volckmann, 1984d). Minimum estimated thickness I,000 m. Exposed in the Sabana Grande, San German, Puerto Real, Mayaguez, and Rosario quadrangles

Kbo Boqueron Basalt (UPPER CRETACEOUS ?)(Volckmann, 1984c, 1984d)--Dark grayish-brown to very dark-gray, locally amygdaloidal, non-pillowed, porphyritic basalt flows, with phenocrysts of plagioclase, clinopyroxene, olivine, and rarely oxyhornblende in a fine-crystalline matrix. Flow banding is locally developed. Local, discontinuous, dark-gray limestone lenses at top of unit. Basaltic tuff at top of formation interbeds with grayish-red amphibole-rich tuff identical with the overlying Lajas Formation. Diagnostic fossils have not been recovered from the Boqueron. Maximum estimated thickness, l50 m. Exposed in the Puerto Real quadrangle

Kl Lajas Formation (LOWER ? CAMPANIAN-PRE CAMPANIAN ?) (Volckmann, 1984b, 1984,c, 1984d)--Generally massive, locally flow-banded, non-pillowed, grayish-purple, light- to dark reddish-brown, rarely gray-green, porphyritic basalt flows with phenocrysts of plagioclase and oxyhornblende; locally also with pseudomorphs after phenocrystic olivine, orthopyroxene, and clinopyroxene in a fine-crystalline to glassy groundmass. Minor basaltic tuff is lithologically similar to lava flows. Local zones of flow-breccia between or associated with lava flows. Diagnostic fossils identified in the Lajas include Barrettia rusae from the lower and B. gigas from the upper part of the formation (Volckmann, 1984d). Minimum estimated thickness, 1,000 m. Exposed in the Puerto Real and San German quadrangles

Kp Parguera Limestone (LOWER(?) MAESTRICHTIAN-LOWER CAMPANIAN-UPPERMOST SANTONIAN)(Mattson, 1960; Almy, 1965; Monroe, 1972; Volckmann, 1984a;, 1984d)--Lower member (not mapped separately) shows a local basal conglomerate of volcanic lithic clasts, chert, serpentinite, and amphibolite or a calcareous volcaniclastic sandstone which grades upward into a sequence of medium-grained, well-sorted, well-rounded, light-brown, glauconitic calcarenite and coarse-grained bioclastic limestone, and an overlying calcareous foraminiferal mudstone with prominent flaser bedding. The upper member (not mapped separately) is a coarse-grained, light-gray bioclastic limestone composed of varied, coarse, skeletal clasts of fossils; marked at the base by a conglomerate of rounded andesitic pebbles and cobbles and minor calcite cement. Sparse pebbles, cobbles, and sand-size volcanic lithic clasts are present throughout the upper member. An extensive foraminiferal fauna has been identified which indicates that the Parguera lies in the Globotruncana fornicata and Globotruncana contusa zones (Almy, 1965). In addition, Barrettia coatesi, B. ruseae, B. monilifera, and B. gigas of late Santonian to early Maestrichtian age have been identified (Volckmann, 1984d). Maximum estimated thickness, l,000 m. Exposed in the Parguera, Cabo Rojo, and Guanica quadrangles

TKl Lago Garzas Formation (MIDDLE EOCENE-CAMPANIAN)(Pessagno, 1962; Mattson, 1967, 1968a, 1968b; McIntyre, 1971; Tobisch and Turner, 1971; Krushensky and Monroe, 1975, 1978, 1979; Krushensky and Curet, 1984; Curet, 1986)--Volcanic breccia, lava, and subordinate volcanic sandstone-claystone, and calcirudite. Typically dark-red, dark purplish-red, and red-brown, uncommonly dark-green, augite-andesite lava and breccia clasts composed of abundant small (<5 mm) plagioclase and smaller (<lmm), subordinate, augite phenocrysts in a locally vesicular or

amygdaloidal, fine-crystalline, commonly trachytic groundmass. Angular to subrounded, dense to vesicular, unsorted, and nongraded breccia clasts are suspended in a nonsorted, generally coarse-grained volcanic lithic sandstone matrix like the coarse clasts described. Although clast color, texture, and phenocryst composition vary widely in any one breccia sequence, all appear to be andesitic. Generally subordinate very thin-to thick-bedded, fine- to coarse-grained dark red-brown tuffaceous sandstone and siltstone, and hematite-red claystone are interbedded throughout the breccia-lava sequence, and locally constitute thick sequences.

They consist of lithic clasts like those in the breccias and lavas as well as angular fragments of plagioclase and augite crystals. Volcanic breccias described appear in part to marine or sub-aerial debris flow deposits. The sandstone-siltstone facies are tuffaceous and locally tuff. Locally includes very subordinate, but thick beds of very coarse-grained, dark-gray, commonly fetid, calcirudite composed chiefly of closely appressed and drilled valves of Crassostrea sp., and subordinate turriculate gastropods in a black, carbonaceous mud matrix; interbedded with breccia and sandstone beds. Sporadic and local, dark gray-brown hypersthene- and olivine-bearing locally pillowed basalt flows are interbedded with breccias and lava flows characteristic of the Lago Garzas. Thin- to medium-bedded, generally fine-grained, pale green hornblende dacite and hornblende-quartz dacite tuff and very locally breccia conglomerate of welded ash-flow tuff clasts in a tuffaceous sandstone matrix characteristic of the Anon Formation locally are interbedded with otherwise typical Lago Garzas Formation. Interbedded lithofacies of the Lago Garzas and the Anon Formations include Globorotalia sp. (keeled), G. aragonesis Nuttall, G. densa (Cushman), and Globigerina sp. and indicate that the Lago Garzas is as young as Middle Eocene (McIntyre and others, 1970; McIntyre, 1975). In the Yauco quadrangle, the Lago Garzas includes

Sulcoperculina dickersoni (Palmer), Vaughania cubensis (Palmer), Lockhartia susuanesis Pessagno, Pseudobitoides israelskyi Vaughan and Cole, P. sp. aff. P. trechmanni (Doubilli), Parastroma sp., and Durania nicholasi (Whitfield) of early Campanian to late Maestrichtian age (Krushensky and Monroe, 1979). Maximum estimated thickness, in excess of l,000 m. Exposed in the Ponce, Yauco, Penuelas, Jayuya, Adjuntas, Monte Guilarte, Maricao, Rosario, San Sebastian, and Central La Plata quadrangles

TKa Anon Formation (EOCENE-MIDDLE CAMPANIAN)(Pessagno, 1960; Mattson, 1967; Nelson and Tobisch, 1967, 1968; McIntyre, 1971; Tobisch and Turner, 1971; Krushensky and Monroe, 1975; Krushensky and Curet, 1984)--Predominantly volcaniclastic breccia and lava, subordinate tuff, tuffaceous sandstone, siltstone, and mudstone. Breccia commonly predominant in many areas of exposure, thick-bedded to massive, generally unsorted and nongraded, pale-gray, pale greenish-gray, and locally pale reddish-brown, polymict, and composed of abundant, angular, pale-gray, pale-green, pale-brown, or pale reddish-brown lithic clasts of hornblende-dacite, quartz-dacite, quartz-latite, and rhyodacite in an unsorted matrix of lithic clasts like those described, and hornblende, plagioclase, and quartz crystal fragments. Interbedded, slightly amygdaloidal and vesicular, pale-green to pale greenish-gray generally dacitic lava flows, with sparse to abundant phenocrysts of hornblende, plagioclase, and corroded quartz in a fine-crystalline to glassy groundmass. Pillow structure has not been described for lava flows of the Anon Formation. Breccia units described may be sub-aerial lahar deposits. Subordinate, thin- to medium-bedded, generally well-sorted, light-green to pale-gray, tuffaceous sandstone and siltstone composed of angular lithic and mineral clasts, like those described in the breccia

facies, are locally predominant in westernmost areas of the Anon and commonly where the Anon interbeds with other formations. Fossils identified in the interbedded Anon and Lago Garzas are noted in the description of the Lago Garzas. Fossils identified from the Anon Formation in central Puerto Rico include Globigerina sp., Globorotalia sp.(keeled), G. densa (Cushman) of late Paleocene to middle Eocene age. Fossils from interbedded Anon and Yauco Formations where the internbeds underlie the Maricao Formation include Heterohelix sp., Globigerinelloides sp., and Globotruncana cf. G. elevata and suggest a middle Campanian to late Maestrichtian age (Krushensky and Monroe, 1984). Interbedded Anon and Lago Garzas lithofacies in western Puerto Rico include Globorotalia sp (keeled), G. aragonesis (Nuttall), G. densa (Cushman), and Globigerina sp. of early middle Eocene age (McIntyre and others, 1970). Maximum estimated thickness of the Anon, 2,000 m. Anon Formation without discernable interbeds with other formations crops out in the Ponce, Jayuya, and Adjuntas quadrangles; interbedded Anon and Lago Garzas, Anon and Yauco, Anon and Maricao, and Anon and Monserrate crop out in the Rincon, Central La Plata, San Sebastian, Monte Guilarte, Bayaney, and Ponce quadrangles

TKal Lago Garzas-Anon Formations Interbedded (UPPER EOCENE(?)-UPPER CAMPANIAN)(Mattson, 1968a; Nelson and Tobisch, 1968; Monroe, 1969; McIntyre and others, 1970; McIntyre, 1971, 1974, 1975; Krushensky and Monroe, 1978 Krushensky and Curet, 1984)--Characteristic, dark-red, dark-purple, and dark purplish-red, or red-brown, generally non-pillowed plagioclase augite-andesite lava flows and similarly colored, mineralogically-identical volcanic breccia of the Lago Garzas Formation are irregularly interbedded with massive, unsorted, pale-gray, pale gray-green, and pale yellowish-brown, hornblende dacite

to rhyodacite volcanic breccia and generally non-pillowed, similarly colored, hornblende-dacite-rhyodacite lava flows, sandstone-siltstone, and tuff characteristic of the Anon Formation. Locally fine-grained sandstone and siltstone of the Anon are interbedded with volcanic breccia and pillowed lava flows of the Lago Garzas. Eastward the same apparently water-laid sequence includes progressively greater quantities of breccia and non-pillowed lava flows of both formations. Facies characteristic of the Anon and Lago Garzas Formations are interbedded eastward into the original type area of the Lago Garzas and beyond into the northern Penuelas quadrangle. Interbedded Anon and Lago Garzas lithofacies in western Puerto Rico include Globorotalia sp (keeled), G. aragonesis (Nuttall), G. densa (Cushman), and Globigerina of early middle Eocene age (McIntyre, 1975; McIntyre and others, 1970. Areas mapped in the Bayaney quadrangle as the Milagros and Matilde Formations are lithologically identical to interbedded lithofacies of the Anon and Lago Garzas Formations, and contain Globigerina sp., Globorotalia s.s.sp.(keeled forms), and Stylospongia s.s. sp., of late Paleocene and Eocene age (Nelson and Tobish, 1967). Similarly, areas in the Central La Plata, Mariaco, Aguadilla, and Rincon, as the Mal Paso and Palma Escrita Formations are interbedded lithofacies of the Anon and Lago Grazas Formations. The presence of Globorotalia s.s.sp. (keeled), G. aragonensis, G. densa, and Globigerina sp. suggests a lower middle Eocene age (McIntyre and others, 1970) for the stratigraphic level from which the single fossil bearing sample was collected. Maximum thickness of the interbedded Lago Grazas and Anon estimated in excess of 3,500 m. Exposed in the Penuelas, Adjuntas, Monte Guilarte, Maricao, Bayaney, San Sebastian, Aguadilla, Rincon and Central La Plata quadrangles

TKm Maricao Formation (TERTIARY ? -MAESTRICHTIAN-CAMPANIAN)(Mattson, 1960; McIntyre and others, 1970; McIntyre, 1971; Krushensky and Curet, 1984; Curet, 1986)--Volcanic breccia, tuffaceous sandstone and mudstone, tuff, and subordinate lava and limestone. Chiefly thick-bedded to massive, coarse-grained (clasts 3-l5 cm across, uncommonly to 3 m across), dark-green to dark brownish-green, trachybasalt breccia; clasts characteristically contain abundant (to 40 percent) conspicuous, and large (l-3 cm long) augite phenocrysts, and relatively inconspicuous and smaller (.2-.5 cm long) plagioclase phenocrysts in an abundant fine-crystalline, trachytic groundmass of augite and plagioclase microphenocrysts and microlites in a magnetite-rich chloritized glass. Breccia matrix is unsorted and mineralogically like subordinate interbedded medium- to thick-bedded, coarse-to fine-grained, generally poorly sorted tuffaceous volcanic sandstone and tuff; composed chiefly of angular to subangular lithic clasts and augite and plagioclase crystal fragments. Interbedded with breccia-tuffaceous sandstone-tuff sequence are areally restricted, massive, non-pillowed, 7-lO m thick, sparsely vesicular, finely- to coarsely-porphyritic augite trachybasalt lava flows like the breccia clasts described. Weathered surfaces of lava and breccia are typically studded with abundant, large, limonite-coated augite phenocrysts weathered into positive relief. Restricted lenses of light brownish-gray biosparite are composed of angular clasts of rudists, other mollusks, algae, and large foraminifers held in a sparry matrix. Fossils from the Maricao have been identified as Sulcoperculina dickersoni (Palmer), Parastroma guitari (Palmer), Omphalocyclus (Torreina) torrei, Pseudorbitoides israelskyi Vuaghan and Cole, and Vaughania cubensis (Palmer) of early Campanian to late Maestrichtian age (Krushensky and Monroe, 1979), but interbedding of the Maricao and the Anon may indicate that the Mariaco is in part Tertiary

in age. Estimated minimum thickness, 2,000 m. Exposed in the Maricao, Rosario, Central La Plata, Mayaguez, Yauco, Penuelas, Adjuntas, and Monte Guilarte quadrangles

Kco Concepcion Formation (MAESTRICHTIAN-CAMPANIAN)(McIntyre and others, 1970; Tobisch and Turner, 1971; McIntyre, 1974;)--Massive, locally pillowed, amygdaloidal, dark-gray and dark greenish-gray porphyritic basaltic lava flows and volcanic breccia; phenocrysts of plagioclase and clinopyroxene, locally olivine and orthopyroxene in a fine-crystalline, generally altered groundmass. Interbedded tuff consists of abundant crystal and crystal fragments of plagioclase, clinopyroxene, hornblende, and dense volcanic lithic clasts, scoria or pumice. Formation rarely includes thin foraminiferal limestone lenses from which Pseudoorbitoides sp. cf. P. israelskyi Vaughan and Cole of Maestrichtian and Campanian age (McIntyre and others, 1970) have been described. Thickness unknown, unit fault-bounded at upper and lower contacts. Exposed in the Maricao and San Sebastian quadrangles

Kcot Cotui Limestone (LOWER MAESTRICHTIAN-UPPERMOST LOWER CAMPANIAN)(Mattson, 1960; Volckmann, 1984b, 1984c, 1984d)--Massive to thick-bedded, dense medium-gray to brownish-gray bioclastic limestone, composed chiefly of rudistid fragments in a micritic to sparry cement. Locally includes concentrations of well preserved rudists and gastropods, locally abundant fecal pellets, large Foraminefera, rare oolites, and sparse glauconite. Local, basal conglomerate with clasts of lava of underlying Lajas Formation. Barrettia ruseae, B. monilifera, and B. gigas (Sohl, 1985) and Pseudovaccinites sp., Durania sp., Radiolitidae, and the gastropod Trochocteon sp. (Volckmann, 1984d) of lower Maestrichtian to lower Campanian age have been identified from the

Cotui. Maximum thickness, 75 m. Exposed in the Puerto Real and San German quadrangles

TKly Lago Garzas and Yauco Formations Interbedded (TERTIARY ? - MAESTRICHTIAN ?-CAMPANIAN ?)(Krushensky and Monroe, 1975, 1979)--Characteristic, thin-bedded, dark gray-brown, light yellowish-brown weathering, calcareous siltstone and claystone of the Yauco Formation irregularly interbedded with coarse-grained, dark red-brown and dark purplish-red, augite-bearing sandstone and tuffaceous sandstone characteristic of the Lago Garzas Formation. See description of the Yauco and Lago Garzas Formations for names of fossils identified in the two formations and see descriptions of the interbedded Anon and Lago Garzas. Thickness not estimated. Exposed in the Ponce and Penuelas quadrangles

TKam Anon and Maricao Formations Interbedded (PALEOGENE ?-LATE CRETACEOUS ?)(Krushensky and Curet, 1984)--Massive breccia with conspicuous, abundant, and large (1-2 cm long) clinopyroxene phenocrysts, characteristic of the Maricao Formation in clasts, interbedded with very pale-blue, pale blue-gray, pale-gray, and pale brownish-gray dacitic volcanic breccia, tuffaceous sandstone, tuff, and lava, characteristic of the Anon Formation. Maximum estimated thickness, 600 m. Mapped in the Bayaney quadrangle as Robles Formation. Exposed in the Monte Guilarte and Bayaney quadrangles

TKmy Maricao and Yauco Formations Interbedded (TERTIARY ?-MAESTRICHTIAN ?-CAMPANIAN ?)(McIntyre, 1975; Krushensky and Curet, 1984)--Predominantly dark-gray, calcareous and locally carbonaceous volcanic sandstone, siltstone, and claystone. The latter

weathers into pale yellowish-brown polyhedral tabular chips with conchoidal fracture surfaces, characteristic of the Yauco; irregularly interbedded with dark-green, coarse grained sandstone and subordinate conglomerate with abundant and very coarse clinopyroxene crystal fragments, in the Monte Guilarte quadrangle, interbedded with angular, coarse-grained, dark-green augite trachybasalt breccia, characteristic of the Maricao Formation. The Maricao is known to be Tertiary in age where interebebed with the Anon. Maximum estimated thickness, 300 m. Exposed in the Monte Guilarte and Maricao quadrangles

Km Melones Limestone (MIDDLE MAESTRICHTIAN-UPPER CAMPANIAN)(Mattson, 1960; Volckmann, 1984a, 1984d)-Thin-to medium-bedded, medium- to coarse-grained, locally cross-bedded, reddish-brown, greenish-brown, and light-brown volcanic sandstone composed chiefly of plagioclase and volcanic lithic clasts in a calcite or hematite cement; commonly interbedded with gray, shaley limestone, dark-brown, calcareous mudstone, and, locally, carbonaceous shaley-limestone with flaser bedding. Higher in the sequence is a massive to thick-bedded, light- to dark-gray calcarenite composed chiefly of clasts of mollusks, Foraminifera, and fecal pellets in a sparry or micritic cement; and massive, rarely thick-bedded, cherty calcarenite containing zones of abundant actionellid gastropods. Barrettia gigas, Parastroma guitarti, and Titanosarcolites sp., of late Campanian to early middle Maestrichtian

age (Volckmann, 1984d), have been identified in the Melones Limestone. Estimated thickness, 300 m. Exposed in the Cabo Rojo quadrangle

Kpe Penoñes Limestone (MAESTRICHTIAN)(Curet, 1986)--Massive to thick-bedded, fine-to coarse-grained, light gray-brown biomicrite composed predominantly of angular to subrounded, abraded, unsorted to moderately sorted fragments of large Foraminifera, pelecypod shells, algae, echinodern plates and spines, rare fragments of rudists, and carbonate intraclasts in a predominantly micritic matrix. Globigerinelloides sp., cf. G. multispina (Lalicker), Pseudotextularia elegans (Rzehak), Rugoglobigerina rotundata Bronnimann, R. rugosa (Plummer), and Globotruncana arca (Cushman) indicate a Maestrichtian age for the Penoñes (Curet, 1986). The formation also contains minor volcanic lithic and mineral clasts like those in the Sabana Grande Formation. Locally metamorphosed to a coarse crystalline marble near intrusive contacts. Maximum estimated thickness 250 m. Exposed in the Rosario quadrangle

TKay Anon and Yauco Formations Interbedded (UPPER MAESTRICHTIAN-MIDDLE CAMPANIAN)(Krushensky and Curet, 1984)--Thin-bedded to massive, light- to medium-gray, calcareous and foraminiferal mudstone, siltstone, and claystone that weather into polyhedral chips with conchoidal fracture surfaces, characteristic of the Yauco Formation; interbedded with pale greenish-gray and pale-gray hornblende- and quartz bearing tuff, tuffaceous sandstone-mudstone and rarely conglomerate, characteristic of the Anon Formation. Fossils from interbedded Anon and Yauco Formation include Heterohelix sp., Globigerinelloides sp., and Globotruncana cf. G. elevata and suggest a late Maestrichtian to middle Campanian age, but interbedded Anon and

Maricao and Anon and Lago Garzas in other areas contain fossils of Tertiary age. Exposed in the Monte Guilarte quadrangle

TKlam Lago Garzas, Anon, and Maricao Formations Interbedded (TERTIARY ? -MAESTRICHTIAN ?-CAMPANIAN ?)(Krushensky and Monroe, 1979)--Irregularly interbedded dark gray-green, augite-trachybasalt breccia characteristic of the Maricao; dark purplish-red, and dark-red plagioclase-augite andesite volcanic breccia characteristic of the Lago Garzas, very dark-gray to black, augite-orthopyroxene-olivine basalt flows not characteristic of but locally present elsewhere in the Lago Garzas, and dark- to light-gray-green, hornblende dacite volcanic breccia, tuffaceous sandstone and siltstone characteristic of the Anon. Thickness not estimated. Exposed in the Yauco quadrangle

TKaym Anon, Yauco, and Maricao Formations Interbedded (LOWER PALEOGENE ?-CAMPANIAN ?)(Krushensky and Curet, 1984)--Thin- to very thick-bedded, pale-green and pale-gray weathering, hornblende-bearing, tuff, tuffaceous sandstone, and breccia composed of hornblende dacite characteristic of the Anon Formation; irregularly interbedded with pale yellowish-brown weathering mudstone and claystone in which weathered polyhedral chips show conchoidal fracture surfaces, characteristic of the Yauco; and subordinate interbedded massive, unsorted and nongraded, generally dark-green breccia composed of angular clasts of trachybasalt in which augite phenocrysts are conspicuous, abundant, and large (l-2.5 m long), characteristic of the

Maricao Formation. Although fossils have not been reported from this sequence, interbedding of the Anon with the Lago Garzas and with the Yauco in other areas suggests that this sequence could also be as young as early Paleogene. Thickness unknown. Exposed in the Monte Guilarte quadrangle

TKmly Maricao, Lago Garzas, and Yauco Formations Interbedded (LOWER PALEOGENE ?-CAMPANIAN ?)(Krushensky and Curet, 1984)--Characteristic, massive, dark-red and dark purplish-red plagioclase-augite andesite lava flows and volcanic sandstone of the Lago Garzas; very dark-green, coarse-grained tuffaceous sandstone and volcanic breccia with large and abundant augite phenocrysts, characteristic of the Maricao; and interbedded, thin-bedded to laminated, dark-gray, pale yellow-brown weathering, calcareous claystone characteristic of the Yauco Formation. Although fossils have not been identified from this sequence, interbedding of the Anon with the Yauco and Lago Garzas suggests that the sequence may be as young as the early Tertiary. Thickness not known. Crops out in the Monte Guilarte quadrangle

Ke El Rayo Formation (UPPER TO MIDDLE MAESTRICHTIAN) (Krushensky and Monroe, 1979; Volckmann, 1984b, 1984c)--Massive, dark grayish-purple to black, locally dark reddish-brown, porphyritic andesitic and basaltic lava, with abundant phenocrysts of plagioclase, green hornblende, clinopyroxene, olivine, and, rarely, oxyhornblende in a fine-crystalline matrix. Interbedded massive to thin-bedded, light- to dark-gray, fetid, locally argillaceous, bioclastic limestone which consists of rudistid fragments in a sparry or micritic matrix. Titanosarcolites sp., Distefanella sp., Parastroma sp., and Chiopasella sp., are identified from the El Rayo; Titanosarcolites sp. is diagnostic of a middle to late

Maestrichtian age for the formation (Sohl, 1985; Volckmann, 1984d). Local, unsorted, nongraded, breccia-conglomerate lenses are derived from lava of the El Rayo. Thickness unknown. Exposed in the San German, Sabana Grande, and Punta Verraco quadrangles

Tj Jicara Formation (LOWER EOCENE-UPPER PALEOCENE) (Slodowski, 1956; Mattson, 1960; Monroe, 1972; Volckmann, 1984b)--Predominantly thinly laminated, thin-to very thick-bedded, very fine-grained, yellowish-green, gray-green, and reddish-brown, tuff with a siliceous or calcareous cement; commonly very dense with conchoidal fracture. Composed of pale-green more or less devitrified glass shards, minor, angular quartz crystal fragments and rare, angular pyroxene and plagioclase crystal fragments. Foraminifera were identified as Globigerina stainforthi, G. soldadoensis crassata, G. trinoculinoides, G. compressa, Textularia sp., G. pseudobulloides cf. Globorotalia wilcoxensis var. acuta of late Paleocene age (Slodowski, 1956). The formation has been assigned to the Globorotalia rex zone (Mattson and others, 1972). Maximum estimated thickness,1,000 m. Exposed in the San German, Sabana Grande, and Guanica quadrangles

Tc Cuevas Formation (LOWER MIDDLE EOCENE)(Pessagno, 1960; Glover, 1961a, 1961b, 1971; Mattson, 1968b; Glover and Mattson 1973; Krushensky and Monroe, 1975)--Generally massive, but locally medium-bedded, white to locally pale-pink, algal calcarenite. Composed of 80 percent or more of well-rounded to subangular, white to pale-brown or pale-gray clasts of algae in a predominantly micritic but locally sparry matrix. The base of the formation is in all areas of outcrop a gravity glide fault. Near the structural base of the formation the matrix is pale-pink from included hematite-red clay. Upper part of formation, where

overlain by the Monserrate Formation, is medium-bedded and includes abundant large Foraminifera and yellowish-green vitric volcanic clasts, like those of the Monserrate. The Cuevas locally includes rare fossilized clasts of pelecypods, corals, and gastropods. Foraminifera identified include Operculinoides sp. aff. O. wilcoxensis, Gyrodina sp., Globigerina sp. aff. G. turgida boweri/linaperta, Globorotalia sp., and Discocyclina sp. of early middle Eocene age (Pessagno, 1960). Maximum estimated thickness, 35 m. Exposed in the Coamo, Salinas, Rio Descalabrado, Ponce, and Jayuya quadrangles

Tm Monserrate Formation (MIDDLE EOCENE)(Pessagno, 1960,; Mattson, 1967; Krushensky and Monroe, 1975, 1978)--Predominantly volcaniclastic siltstone and sandstone interbedded with tuff, subordinate conglomerate, and minor calcarenite and chert. Thin- to medium-bedded, internally thinly laminated, very fine-grained, well sorted, light-green to light blue-green, and dark greenish-gray or brownish-green, volcanic siltstone composed chiefly of green lithic clasts, and hornblende, quartz, plagioclase, and pyroxene crystal fragments in a generally calcareous cement; interbedded with generally thin-bedded, internally laminated, fine- to medium-grained, dark greenish-brown, volcanic sandstone, composed chiefly of volcanic lithic clasts and mineral fragments as in siltstone described; and subordinate interbedded rounded, tabular clasts of the siltstone and fine-grained sandstone described, in intraformational conglomerate; or with interformational conglomerate composed of generally rounded clasts of various volcanic rock types, but especially common are dark-red or dark purplish-red plagioclase-augite andesite characteristic of the Lago Garzas Formation. Matrices in both types of conglomerate are poorly sorted volcanic lithic sandstone. Locally a massive to very thick-bedded,

dark-green, very dense tuff composed chiefly of devitrified shards interbedded with volcanic sandstone. Locally, unit includes lenses of pale-brown calcarenite composed of well-rounded clasts of algae, large Foraminifera, coral, and minor volcanic lithic clasts in a fine-crystalline sparry to micritic matrix. Bedded, pale-purple, and opaque white chert are rarely present. Basal zone of angular yellowish-green, lithic clasts overlies and grades into underlying Cuevas Limestone. Foraminifera identified from the Monserrate include Siphogerinoides sp., Gyroidina sp., Hastingerina boweri/linaperta turgida, Globigerapsis index, Globorotalia spinulosa, G. densa (Cushman), G. broedermanni, G. spinuloflata, Cibicides sp., and Discocyclina sp. (Pessagno, 1960) of early middle Eocene age (Pessagno, 1960; Mattson, 1967). Maximum estimated thickness, 2,000 m. Exposed in the Ponce, Penuelas, Jayuya, and Adjuntas quadrangles

TKam Anon and Monserrate Formations Interbedded (MIDDLE EOCENE)(Krushensky and Monroe, 1975)--Locally interbedded volcaniclastic sandstone and siltstone characteristic of the Anon and Monserrate Formations. Thickness not estimated. Exposed in the Ponce quadrangle

Tr Río Culebrinas Formation (MIDDLE EOCENE)(McIntyre and others, 1970; McIntyre, 1975; Tobisch and Turner, 1971)-Basal mudstone and limestone, overlain successively by tuff breccia, crystal lithic tuff, and volcanic sandstone and mudstone. Basal, thin-bedded to laminated, abundantly foraminiferal, calcareous, dark greenish-gray to light-gray mudstone and muddy limestone, interbedded upward with thin-bedded, dark greenish-gray volcanic sandstone and mudstone composed of

rounded to subrounded lithic clasts and fragments of plagioclase, hornblende, clinopyroxene, and quartz; overlain in turn by a thick- to very thick-bedded, coarse-grained, very dark greenish-gray and dark-gray lithic-crystal tuff and superjacent very thick-bedded, poorly sorted, subangular to rounded, greenish-gray volcanic breccia composed of blocks (3 cm to l m) of plagioclase-hornblende dacite and plagioclase-clinopyroxene andesite, and abundant crystal clasts. Commonly volcanic breccia facies is interbedded with thick bedded coarse-grained tuff. Foraminifera identified in the formation include Nummulites wilcoxi (Heilprin), Amphistegina sp., Discocyclina (Discocyclina) marginata (Cushman), Asterocyclina habanensis Cole and Bermudez, Lepidocyclina antillea Cushman, Sphaerogypsina sp., and Eorupertia sp. cf. E. bermudezi Ansigard of middle Eocene age (McIntyre and others, 1970). Maximum estimated thickness, 3,000 m. Exposed in the Central La Plata, Rincon, Aguadilla, San Sebastian, and Maricao quadrangles

Trd Río Descalabrado Formation (LOWER MIDDLE EOCENE)(Glover and Mattson, 1967; Glover, 1971)--Tuff and subordinate mudstone and tuffaceous mudstone. Thin to medium-bedded, generally well-sorted, fine-grained, pale- to dark-greenish-gray, blue-gray, and yellowish gray-green, dacitic crystal-vitric, vitric-crystal, and vitric tuff; commonly with plagioclase, bipyramidal quartz, and magnetite that vary in quantity by as much as 30 percent. Sanidine, clinopyroxene, and biotite are primary but rare components. Glass shards are abundant and devitrified. Felsitic and porphyritic lithic clasts and red scoria are common in crystal-vitric tuff. Carbonate and fossil clasts are subordinate. Numerous species of Foraminifera indicate that the formation is in the Hantkenina aragonensis zone of middle Eocene age (Pessagno, 1961). The Río Descalabrado is the lithologic equivalent of the Monserrate Formation.

Maximum estimated thickness, more than 500 m. Exposed in the Río Descalabrado and Coamo quadrangles

Tg Guayo Formation (MIDDLE EOCENE ? -POST MIDDLE EOCENE ?)(Glover and Mattson, 1967; Krushensky and Monroe, 1975)--Massive to very thick-bedded, very coarse-grained, poorly-sorted, moderate-green, blue-green, and dark yellowish-gray-green, conglomerate, and subordinate sandstone and siltstone. Larger clasts, boulders (to l m across) to pebbles are abundant; lithologically like volcanic porphyries in the Coamo, Maravillas, Lago Garzas, and Anon Formations, and calcarenite like the Cuevas Limestone; all enclosed in a poorly-sorted, predominantly lithic matrix, in which lithic clasts are more angular but otherwise like the coarse lithic clasts described above, together with subordinate plagioclase, hornblende, clinopyroxene, and sparse quartz clasts, calcite, and clay. Although shard structures are commonly seen in lithic clasts, shards are not present in the matrix. The Guayo fills channels in the Cuevas and Rio Descalabrado Formations, and is not known to be fossiliferous. Maximum estimated thickness, 200 m. Exposed in the Rio Descalabrado and Ponce quadrangles

Tfb Fault Breccia (MIDDLE EOCENE ?-POST MIDDLE EOCENE ?) (Mattson, 1968b; Glover, 1971; Glover and Mattson, 1973; Krushensky and Monroe, 1975; Krushensky, 1978)--Brecciated rock related to gravity gliding, varies lithologically with the underlying, and to a lesser extent, with the overlying fault plates. Commonly dark hematite-red, fine- to

very coarse-grained (blocks to 1OO m+) lithic clasts in a clay-rich, arenaceous, slickenside-riddled matrix. Clasts over wide areas resemble rock in the underlying Achiote conglomerate, and the Coamo or Maravillas Formations. In the southern Jayuya and northern Ponce quadrangles, clasts show rounded surfaces cut by fractures at high angles; clast lithologies there are characteristic of pebbles and cobbles in the underlying Achiote; farther west, the fault breccia consists of angular rhomb-shaped clasts of siltstone and fine-grained volcanic sandstone characteristic of the underlying Maravillas. To the east, in the Río Descalabrado quadrangle, although clasts characteristic of the Robles through the Rio Descalabrado sequence are present, most clasts appear to be derived from the Coamo and Maravillas Formations. Maximum thickness estimated as 35 m. Exposed in the Jayuya, Ponce, and Rio Descalabrado quadrangles

Central Puerto Rico

Kabcj Formations A, B, C, J (LOWER ?-UPPER ? CRETACEOUS) (Berryhill and Glover, 1960; Pease and Briggs, 1960)--Lava flows, associated

autoclastic breccia, subordinate volcaniclastic breccia, sandstone, conglomerate, and minor limestone, siltstone, and tuff. Predominantly massive, non-pillowed, porphyritic, very dark greenish-gray, reddish-brown to reddish-gray weathering, andesitic and basaltic andesite lava flows and associated autoclastic flow breccia, with abundant to common plagioclase phenocrysts, and subordinate phenocrysts of hornblende and augite. Flows are irregularly interbedded with massive, angular to subrounded (clasts to 40 cm across) dark greenish-gray, generally vesicular volcaniclastic breccia like the flows described, and autoclastic breccia which includes clasts that appear to have been volcanic bombs. Volcaniclastic breccia locally grades into volcanic conglomerate. Unit includes thin, lenticular beds of calcarenite with well preserved corals and rudists, and some beds of sandstone and siltstone composed of lithic clasts like the flows and breccias described. Estimated thickness exceeds 5,000 m. Exposed in the Cayey, Patillas, Caguas, Comerio, and Yabucoa quadrangles

Kra Río Abajo Formation (LOWER CRETACEOUS ?)(M'Gonigle, 1977, 1978)--Tuff, volcaniclastic sandstone and breccia. Predominantly massive, to medium-bedded and graded, coarse- to fine-grained, medium-gray to brownish-gray crystal- and crystal-lithic tuff; composed of crystals and crystal fragments of plagioclase and quartz, and lithic clasts of tuff; and porphyritic lava, in a matrix of fragments of plagioclase, quartz, hornblende, and minor clinopyroxene. Abundant plagioclase and quartz crystals and crystal fragments give rock a characteristic speckled appearance. Subordinate sandstone is thin- to thick-bedded and lithologically similar to the tuff described. Thick-bedded to massive, subrounded to subangular, purple and medium-gray to light yellowish-gray-green polymict volcanic breccia is irregularly interbedded with tuff.

Breccia clasts include tuff, porphyritic plagioclase-andesite, hornblende- and pyroxene-andesite in a tuffaceous matrix like the tuff described, clasts of embayed quartz and bipyramidal quartz crystals are abundant. Uncommonly, conglomerate consists of rounded clasts like those described in the volcanic breccia in a matrix like the tuff described. The tuff facies is metamorphosed to phyllite, or locally to hornblende and mica schist near contacts of major intrusive bodies. Maximum estimated thickness, 600 m. Exposed in the Humacao quadrangle

Kpi Pitahaya Formation (LOWER CRETACEOUS ?)(M'Gonigle, 1977, 1978)-Lava, hyaloclastite breccia, flow-breccia, tuff, and tuff-breccia. Thick- to massive, pillowed, amygdaloidal, fine-crystalline, dark greenish-gray, dark yellowish-gray-green, to dark brownish-gray andesite interlayered with massive pyroxene-rich hyaloclastite breccia. Interbedded clinopyroxene-plagioclase crystal-tuff is graded, thin- to medium-bedded, medium- to brownish-gray. Tuff units grade into fine-grained breccia and tuffaceous breccia of the same composition as the tuff described. Areally restricted limestone lenses are metamorphosed to marble, and are locally replaced by metasomatic magnetite. Tuff units are in part phyllitic, and most rocks are epidotized or chloritized. Maximum estimated thickness, 2,000 m. Exposed in the Humacao and Juncos quadrangles, but mapped in the Juncos quadrangle as undivided volcanic rocks and their metamorphosed equivalents

Kt Torrecilla Breccia (LOWER ALBIAN)(Berryhill and Glover, 1960; Pease and Briggs, 1960; Briggs and Gelabert, 1962; Pease, 1968b; Briggs,

1969, 1971;)--Volcanic breccia, lava, subordinate volcanic sandstone, conglomerate, and siltstone; minor limestone. Predominantly thick- to very thick-layered medium- to dark-grayish-green andesitic to basaltic hyaloclastite breccia and associated lava flows; interbedded sporadically with lenticular, medium-bedded, coarse-grained, calcareous, volcanic sandstone; locally, volcanic conglomerate. Basal, lenticular (to 60 m thick, commonly about l5 m thick), thick-bedded, fine grained, dark- to yellowish-gray calcarenite (Aguas Buenas Limestone, not mapped separately); locally split into two or more beds by interlayered thin- to medium-bedded calcareous sandstone and siltstone. The Aguas Buenas Limestone as defined in the central eastern Comerio quadrangle, and the type section of the Rio Maton Limestone Member of the Robles Formation in the Cayey quadrangle contain the same fauna. Both sequences include Orbitolina occulata Douglass (Douglass, 1961), Coalcomana cf. C. ramosa Boehm , Monopleura sp., Toucasia sp., Chondrodonta sp., and the gastropods Plesioplocus sp., and Acteonella (Acteonella) sp. of lower Albian age (Sohl, 1976). Maximum estimated thickness, 2,000 m. Mapped in part or in whole as Robles in central Puerto Rico. Exposed in the Barranquitas, Orocovis, Comerio, Aguas Buenas, and Cayey quadrangles

KJa Jayuya Tuff (CRETACEOUS ?)(Mattson, 1967, 1968a, 1968b)--Predominantly massive, coarse-grained, dark grayish-green, basaltic crystal-lithic tuff and fine-grained hyaloclastite; both commonly with abundant euhedral clinopyroxene and subordinate plagioclase euhedral crystals and crystal fragments as clasts, rarely with predominant plagioclase crystal and crystal fragments as clasts. Subordinate medium-bedded, fine-grained, grayish-green, silicified mudstone and thin-bedded tuffaceous, graded, volcanic sandstone. Locally

metamorphosed to feldspar hornblende hornfels, gneiss, and schist. Fossils have not been reported from the Jayuya. Maximum estimated thickness, 900 m. Exposed in the Jayuya and Adjuntas quadrangles

Kr .. Robles Formation (CENOMANIAN-LOWER ALBIAN)(Berryhill and Glover, 1960; Pease and Briggs, 1960; Broedell, 1961; Glover, 1961a; Nelson, 1967b; Mattson, 1968a, 1968b; Nelson and Tobisch, 1968; Briggs, 1971; and Rogers, 1979)--The type section of the Robles in the Comerio quadrangle and elsewhere, consists chiefly of volcaniclastic sandstone and siltstone, subordinate lava and minor limestone, conglomerate and breccia. Chiefly thin- to thick-bedded, medium- to coarse-grained, medium-gray to medium bluish-gray, pale-brown and pale reddish-brown weathering, volcaniclastic sandstone and siltstone; commonly cemented by calcite, locally interbedded with coarse-grained volcanic breccia. The Robles as mapped in the Comerio quadrangle includes at the base a fine-grained, medium dark-gray, lenticular calcarenite defined by Berryhill and Glover, 1960 in the Cayey quadrangle as the Rio Maton Limestone Member; here not mapped separately. The type Rio Maton contains the bivalves Coalcomana cf. C. ramosa Boehm, Monopleuria sp., Toucasia sp., Chondrodonta sp., and the gastropods Pleisoplocus sp., and Acteonella (Acteonella) sp. and is of lower Albian age. The same fauna is also present in the Aguas Buenas Limestone of the Torrecilla Breccia (Sohl, 1976) in the Comerio quadrangle (Pease and Briggs, 1960). The basal limestone in the type area of the Robles in the Comerio quadrangle and elsewhere, but not the Rio Maton type section in Cayey quadrangle includes abundant Caprinuloidea and the ammonite Oxytropidoceras sp. of Middle Albian age. The type Robles basal limestone locally contains common, angular, volcanic lithic clasts of pebble size, or locally is composed of

highly arenaceous limestone. Locally interbedded with calcareous sandstone. Enclosed in sandstone-siltstone sequence are two prominent and commonly associated pillowed basaltic andesite flows; upper flow characterized by abundant clinopyroxene phenocrysts (to 5 mm long) and the absence of plagioclase phenocrysts; lower flow characterized by abundant, commonly clustered plagioclase phenocrysts and smaller, commonly discrete clinopyroxene phenocrysts in a fine-crystalline, dark-gray groundmass. The Las Tetas Lava Member, here not mapped separately, lies near top of formation. Rocks mapped as Robles in the Cayey, Barranquitas, and Coamo quadrangles, including the type section of the Rio Maton Limestone Member defined and mapped as basal Robles in the Cayey quadrangle, consist in part or are completely equivalent to the Torrecilla Breccia and its basal Aguas Buenas Limestone Member. Pessagno (1976) has identified Rotalipora appenninica, Hedbergella delrioensis, H. planispira (Tappan), and Loeblichella sp. of Cenomanian age from limestone included in rock mapped as Robles north of Aibonito in the Barranquitas quadrangle. The sequence originally mapped as Robles in the Barranquitas quadrangle is equivalent to the type area Torrecilla Breccia. The limestone at the base of the sequence mapped as Robles in the Barranquitas, Coamo, and Cayey quadrangles, including the type Rio Maton in the Cayey quadrangle, and the type Aguas Buenas Limestone of the Torrecilla Breccia, characteristically include fossils of Lower Albian age. Estimated thickness of the Robles as mapped exceeds 1,200 m. The Robles occurs in the Coamo, Juncos, Cayey, Caguas, Orocovis, and Comerio quadrangles. In the Barranquitas quadrangle rock equivalent to the Robles was mapped as the Magueyes Formation. The Robles as originally mapped in the Jayuya, Utuado, Adjuntas, and Bayaney quadrangles is lithologically the interbedded Anon and Maricao

Formations, and is here so mapped

Kma Magueyes Formation (MIDDLE ALBIAN)(Briggs and Gelabert, 1962; Berryhill, 1965; Nelson, 1966)--Massive- to thin-bedded, laminated, fine- to coarse-grained, locally graded, dark greenish-gray tuffaceous sandstone and thin-bedded, very fine-grained, dark-gray tuffaceous siltstone, both characterized by crystals and crystal fragments of dark-green clinopyroxene; intercalated with amygdaloidal, thick (50 m+) to thin, pillowed, dark greenish-gray, chiefly basaltic and some andesitic lava flows and flow breccia, and, near the top of the formation, a thick, unsorted, basaltic hyaloclastite breccia. At the base of the Magueyes is a medium- to dark-gray, massive, fine-crystalline limestone, the Barrancas Limestone Member (Briggs, 1969), here not mapped separately, which includes Cassiope sp., Cerithiopsis sp., Falsifusus ? cf. F. gainsvillensis, Nerinea cf. N. pecosensis, Pleisoplocus sp., and Caprinuloidea gigantia of middle Albian age (Sohl and Kollmann,1976). The Barrancas Limestone Member is the equivalent of the Rio Maton Limestone in the type section of the Robles Formation in the Comerio quadrangle, but not that of the Rio Maton type section in the Cayey quadrangle. Maximum estimated thickness, 1,400 m. Exposed in the Ciales, Corozal, and Barranquitas quadrangles

Kper Perchas Formation (UPPER ?-LOWER ? CRETACEOUS) (Pease and Briggs, 1960; Briggs and Gelabert, 1962; Nelson, 1966; Berryhill, 1967; 1967a; Pease, 1968a, 1968b;)--Massive, amygdaloidal, commonly pillowed, dark-gray to very dark greenish-gray basaltic lava; characteristically with larger and predominant clinopyroxene phenocrysts and subordinate and smaller plagioclase phenocrysts, thickness of individual flows ranges from l5 to 50 m. Interbedded with minor, thin-

bedded, fine- to coarse-grained pyroxene-bearing basaltic tuff, volcanic sandstone, and minor hyaloclastite breccia. Some minor lava with plagioclase phenocrysts. Lithologically the Perchas is indistinguishable from the lava sequence of the Magueyes (Berryhill, 1965). Maximum estimated thickness, l,500 m. Exposed in the Ciales, Corozal, Aguas Buenas, Naranjito, Barranquitas, and Comerio quadrangles

Kap Avispa and Perchas Formations undivided. See individual formation descriptions.

Kav Avispa Formation (UPPER ? CRETACEOUS)(Berryhill, 1965; Nelson, 1966, 1967a; Nelson and Monroe, 1966; Mattson, 1968b; Briggs, 1971)--Massive, generally pillowed, dark greenish-gray, andesitic(?) lava; characteristically with abundant, and locally clustered, plagioclase phenocrysts; and subordinate, locally absent, smaller clinopyroxene phenocrysts in a fine-crystalline to almost glassy groundmass. Interbedded throughout the formation is dark grayish-green tuffaceous sandstone as much as 30 m thick, some volcanic breccia/conglomerate, and a local, thin (5m) algal rudist-bearing calcarenite, but fossils have not been identified. Maximum estimated thickness l,800 m. Exposed in the Ciales, Corozal, Orocovis, Jayuya, and Florida quadrangles

Kln. Los Negros Formation (LOWER ?-UPPER ? CRETACEOUS) (Broedel, 1961; Berryhill, 1965; Nelson, 1966, 1967a; Pease, 1968a, 1968b, 1968c; Seiders, 1971; Rogers, 1979;)--Massive unsorted, highly angular, locally scoriaceous, dark- to very dark grayish-green weathering, light gray-green, pyroxene-bearing basaltic hyaloclastite-breccia, with pillows and stringers of basaltic lava, lithologically similar to the breccia; irregularly distributed throughout the hyaloclastite-breccia sequence, but increasing quantitatively in the eastern

areas of exposure are subordinate lenses of thick- to very thick-bedded coarse volcanic sandstone, and minor siltstone. Maximum estimated thickness, l,800 m. Interbeds with the Magueyes, Perchas, and Avispa Formations. Exposed in the Ciales, Corozal, Naranjito, Aguas Buenas, Caguas, Gurabo, and Juncos quadrangles

Kv.. Vista Alegre Formation (UPPER ? CRETACEOUS)(Nelson and Monroe, 1966; Nelson, 1967b; Mattson, 1968a, 1968b; Briggs, 1971)--Volcanic sandstone; subordinate crystal and lithic tuff, siltstone, volcanic breccia, andesitic and rarely basaltic lava, and basaltic tuff. Predominantly thin-bedded to massive, fine- to medium-grained, characteristically pyroxene-bearing, with subordinate plagioclase grains, generally graded, dark- to pale greenish-gray sandstone, and thin-bedded, locally calcareous, dark bluish-gray siltstone. Includes dark- to pale greenish-gray tuff, typically with abundant larger pyroxene and subordinate, smaller plagioclase crystal fragments, and pumice clasts in a very fine-grained partly vitric matrix; massive, light-greenish-gray volcanic breccia composed chiefly of lava clasts and minor clasts of siltstone and sandstone in a very fine--grained matrix; locally pillowed, bluish-gray to greenish-gray andesitic lava which contains clustered plagioclase and smaller discrete clinopyroxene phenocrysts in a fine-crystalline groundmass. Rare basaltic lava flows associated with the andesitic flows are commonly pillowed, amygdaloidal, dark greenish-gray, and characteristically contain clinopyroxene phenocrysts in a fine-crystalline groundmass. Plagioclase phenocrysts in these basaltic flows are rare. Estimated maximum thickness, l,700 m. Exposed in the Florida, Jayuya, Utuado, Adjuntas, and Orocovis quadrangles

Kmam Mameyes Formation (UPPER ? CRETACEOUS)(Nelson and Monroe, 1966; Nelson, 1967b)--Lava flows and subordinate intercalated volcanic sandstone and siltstone. Pillowed, characteristically with clusters of plagioclase phenocrysts, grayish-green, andesitic lava flows; intercalated with thin-bedded to massive, fine-to medium-grained dark- to pale greenish-gray, volcaniclastic sandstone, typically with abundant clinopyroxene grains; and with thin-bedded, dark bluish-gray siltstone. Maximum estimated thickness, l,l00 m. Exposed in the Florida and Utuado quadrangles

Kte Tetuan Formation (CAMPANIAN-SANTONIAN)(Nelson and Monroe, 1966; Mattson, 1968b)--Tuff and subordinate volcanic breccia and lava flows. Thin-bedded to locally massive, generally fine-grained but locally coarse-grained, pale- to dark greenish-gray, locally graded, commonly devitrified crystal vitric-, crystal-, and lithic-crystal tuff; composed of pyroxene and plagioclase crystal fragments, and pumice clasts in a very fine-grained vitric-lithic matrix. Pillowed, bluish-gray to greenish-gray, andesite lava flows with clustered phenocrysts, and rarely basaltic lava flows, and massive, light greenish-gray volcanic breccia are sparse but interbedded throughout the formation. In southernmost outcrop area, formation includes thin-to medium-bedded volcanic sandstone and sandstone. One specimen of ammonite has been identified as either Kossmaticeras sp. or Kitchenites sp. (Nelson and Monroe, 1966) with a possible Santonian to Campanian age designation. Maximum estimated thickness, l,500 m. Exposed in the Florida, Utuado, and Jayuya quadrangles

Kmal Malo Breccia (UPPER ? CRETACEOUS)(Briggs and Gelabert, 1962; Briggs, 1967, 1971; Mattson, 1968b)--Hyaloclastite breccia and subordinate to minor lava, volcanic sandstone, siltstone, and conglomerate. Predominantly massive (beds to 200 m thick, commonly lO-30 m thick), fine-grained, dark reddish-brown, dark-gray, and bluish-gray, andesitic to basaltic-andesite volcanic breccia; with clasts commonly to l5 cm across, subangular to subrounded, of plagioclase-, plagioclase-clinopyroxene, and clinopyroxene-porphyry; suspended in a sparse to abundant matrix of plagioclase crystals and crystal fragments, subordinate clinopyroxene crystals and crystal fragments, and lithic clasts like the large lithic clasts described. Some andesitic to basaltic andesite pillowed lava flows and hyaloclastite breccia. Both breccia and lava interbedded with thick-to very thick-bedded andesitic to basaltic andesite, crystal and crystal-lithic tuff. Maximum estimated thickness, l,300 m. Exposed in the Orocovis and Jayuya quadrangles, and in the Barranquitas quadrangle where it was mapped as Robles (Briggs, 1962)

Kctt Cotorra Tuff (UPPER ? CRETACEOUS)(Briggs and Gelabert, 1962; Briggs, 1967, 1971; Mattson, 1968b; Krushensky and Monroe, 1975;)--Massive, coarse- to fine-grained, dark yellowish-gray-green, to very dark bluish gray, basaltic hyaloclastite-breccia. Commonly consists of abundant large (to 6 mm long), clinopyroxene crystals and crystal fragments and partially to completely chloritized glassy basalt clasts. Pillows and larger fragments of pillows (to 50 cm across) comprise as

much as 50 percent of the unit. Locally, at base and top, formation consists of pillowed very dark-bluish gray basalt flows. Rare laminated, fine-grained, clinopyroxene crystal tuff. Grades downward into Malo Breccia. Maximum estimated thickness, 500 m. Exposed in the Orocovis, Barranquitas, Ponce, and Jayuya quadrangles

Kman Manicaboa Formation (UPPER ? CRETACEOUS)(Berryhill, 1965)-- Massive, coarse-grained, dark greenish-gray, volcanic breccia, thick-bedded (l-30 m) to massive, coarse-grained volcanic breccia and conglomerate, interbedded with massive to thick-bedded (l-25 m), fine- to coarse-grained, dark greenish-gray tuff. Breccia and tuff matrices commonly include glass shards, pumice clasts, vitric clasts, and abundant jagged-edged feldspar phenocrysts; subordinate clinopyroxene phenocrysts are present throughout the formation. Maximum estimated thickness, 2,200 m. Exposed in the Ciales quadrangle, and mapped as Avispa Formation in the adjacent Corozal quadrangle (Nelson, 1967a) to the east

Kac Achiote Conglomerate (MAESTRICHTIAN-SANTONIAN)(Mattson, 1967, 1968b; Briggs, 1971; Glover, 1973; Krushensky and Monroe, 1975)-- Massive, very well-rounded, very coarse-grained (clasts to l50 cm across, commonly lO-20 cm across) boulder and cobble conglomerate; composed chiefly of red or green porphyritic basalt and andesite clasts similar to rocks in the Jayuya, Vista Alegre, and Cotorra Formations, minor feldspar-hornblende-, feldspar-pyroxene-biotite porphyries, tuff, siltstone, limestone, and chert. Matrix composed of plagioclase crystal fragments, chloritized lithic clasts, minor pyroxene and hornblende crystal fragments, and hematite-rich clay (in the red phase of the Achiote) or chlorite (in the green phase of the Achiote). Lithologically

similar but subordinate beds of sandstone and mudstone are interbedded in the formation. Fossils from the upper part of the Fossils reported from the Achiote include the pelecypods Cymella bella Conrad, Cardium (Granocardium) sp., Veniella sp., and the gastropods Pugnellus sp., Cantharulus sp. of Maestrichtian to Santonian age (Sohl in Mattson, 1967). Maximum estimated thickness, l,800 m. Exposed in the Jayuya, Ponce, and Orocovis quadrangles

Kca Cariblanco Formation (LOWEST CAMPANIAN-UPPER SANTONIAN) (Berryhill and others, 1960; Briggs and Glover, 1960; Glover, 1961, 1973; Briggs and Gelabert, 1962; Briggs, 1971)--Volcaniclastic conglomerate, sandstone, siltstone, lava and limestone. Predominantly medium-bedded to massive, very well-rounded, dark reddish-brown, dark yellowish-gray-green to dark grayish-green weathering, coarse-(clasts to 3 m across) boulder- to fine (3-6 cm across) pebble-conglomerate composed of hornblende dacite welded ash-flow tuff, amygdaloidal plagioclase-pyroxene biotite andesite, and subordinate sandstone, siltstone, and limestone clasts, in a moderately well-sorted, tuffaceous, sand-size matrix of lithic clasts, like those described, pumice, devitrified glass, and crystal fragments of plagioclase, and minor hornblende, clinopyroxene, biotite, sanidine, and rarely, quartz. Interbedded thin to medium-bedded sandstone and siltstone of same composition as conglomerate matrix. One pillowed, highly amygdaloidal, dark grayish-green to dark yellowish-gray-green basaltic lava flow (La Guaba Lava Member, not here mapped separately) commonly with abundant clustered clinopyroxene phenocrysts; and two medium- to thick-bedded medium-gray to greenish-gray, calcarenite units (the Jobo Dulce and Pio Juan Limestone Members, here not mapped separately). Foraminifera from the limestone units includes Robulus cf. R. münsteri, Heterohelix sp. cf. H. navarroensis, H. striata, Gyroidina globosa, Eponides sp.,

Globotruncana (G) truncana, G. lapparenti lapparenti, G. bulloides, G. coronata, G. fornicata, G. conica, G. inornata, Planoglobulina glabrata, and Lenticulina nuda of Santonian to early Campanian age (Pessagno, 1962). Macrofossils include the rudist Barrettia monilifera, corals Dendrogyra n. sp., and Meandrophyllia n. sp., and a sponge Callepgerna sp. cf. C. acaule Zittel (Pessagno, 1962). Maximum estimated thickness, l,000 m. Exposed in the Rio Descalabrado, Orocovis, Coamo, Barranquitas, and Cayey quadrangles

Kal Alonso Formation (UPPER ? CRETACEOUS)(Nelson and Monroe, 1966; Nelson, 1967b; Nelson and Tobisch, 1968)--Predominantly massive, generally unsorted, brownish-red, purplish-red, and gray, welded and non-welded ash-flow tuff; characterized by purplish-red weathered color, and crudely developed columnar jointing. Consists of pumice clasts, plagioclase and quartz crystals and crystal fragments and minor fine-crystalline andesitic lithic clasts in generally devitrified glass-shard matrix. Pumice clasts range from flattened in most densely welded zones to angular and only slightly flattened in least welded or non-welded ash-flow tuff units. Minor coarse tuff, laharic breccia, volcanic sandstone, and thin andesitic lava flows interbedded locally with the ash-flow tuff sequence. Maximum estimated thickness, 2,000 m. Exposed in the Florida, Bayaney, and Utuado quadrangles

Kcoa Coamo Formation (LOWER MAESTRICHTIAN-UPPER SANTONIAN) (Berryhill and others, 1960; Glover, 1961; Mattson, 1967, 1968b; Briggs, 1971; Glover and Mattson, 1973; Krushensky and Monroe, 1975)--Crystal-lithic tuff, volcanic breccia, and lithic-tuff. Characteristically massive, locally thick-bedded, coarse-grained, speckled- appearing (green and white, or black and white), crystal-lithic tuff and fine-grained,

dark reddish-purple, volcanic breccia, containing clasts of feldspathic andesite, hornblende- and pyroxene-bearing andesite, in a matrix of common to abundant crystal fragments of plagioclase, subordinate hornblende, rare quartz, and biotite(?); coarse-grained, medium-green lithic tuff contains subordinate plagioclase, minor hornblende, and rare clinopyroxene clasts in an abundant (to 40 percent) very poorly-sorted, chloritic matrix. Locally includes dark bluish-gray pyroxene andesite lava flows, and lenses of calcarenite. Microfauna at one location includes Globotruncana fornicata, Globotruncana ex. gr. lapparenti, Planomalina messinea messinae, Gyroidina sp., and Robulus (?) of late Santonian to early Maestrichtian age (Pessagno, 1962). Maximum estimated thickness, 300 m. Exposed in the Coamo, Rio Descalabrado, Orocovis, Ponce, and Jayuya quadrangles

Kmar Maravillas Formation (MIDDLE ? MAESTRICHTIAN-UPPER SANTONIAN)(Mattson, 1967, 1968b; Briggs, 1971; Glover, 1971; Glover and Mattson, 1973;)-Volcanic breccia, tuffaceous sandstone, limestone, and limestone conglomerate. Locally, in eastern areas of exposure, basal, massive to thick-bedded, poorly-sorted, greenish- to brownish-gray, fine-grained volcanic breccia (San Diego Member, here not mapped separately), with abundant gray, green, and brown, fine-crystalline hornblende-andesite, and subordinate hornblende-augite andesite, and augite-andesite lithic clasts. Locally includes conglomerate like that in Cariblanco Formation. Locally the base of the formation is a medium- to thick-bedded, gray to greenish-gray, biomicrite (Sabana Hoyos Limestone Member, here not mapped separately) that ranges from fine-grained calcarenite to limestone boulder conglomerate, calcareous mudstone, tuffaceous calcarenite, and calcareous, tuffaceous sandstone, and includes Barrettia torreites sanchezi and

Ortiga sp. of early Maestrichtian age (Sohl, personal communication, 1989). The Maravillas is predominantly thick- to thin-bedded, laminated, brownish-gray, yellowish-gray-green to dark-gray, tuffaceous, locally graded, volcaniclastic sandstone and siltstone. Includes fine-crystalline lithic clasts, chiefly hornblende andesite and crystal fragments of plagioclase, hornblende, and augite. Irregularly interbedded are massive to thick-bedded, fine- to coarse-grained, medium gray- brown, calcarenite (Santa Ana Limestone Member, here not mapped separately) and subordinate rudist-bearing limestone conglomerate, with abundant clasts of fossil algae, mollusk shells, Foraminifera and locally, in the limestone conglomerate, rudists. The Santa Ana Limestone includes Barrettia sp., Titanosarcolites sp., and Vaccinites sp. of late Campanian and Maestrichtian age (Sohl, personal communication, 1989). Limestone beds commonly contain quartz-bearing hornblende andesite lithic clasts. Maximum thickness of the Maravillas is estimated at about l,l00 m. Exposed in the Jayuya, Orocovis, Rio Descalabrado, and Coamo quadrangles

Kpo Pozas Formation (LOWER MAESTRICHTIAN-UPPER SANTONIAN) (Briggs and Gelabert, 1962; Berryhill, 1965; Nelson and Monroe, 1966; Briggs, 1971)--Volcanic breccia, subordinate conglomerate, crystal tuff, volcanic sandstone and siltstone, interbedded locally with ash-flow tuff, lava, and various discrete limestone lenses. Predominantly massive, tuffaceous breccia composed of angular to subrounded, dense, porphyritic andesite clasts in a matrix of smaller pumice clasts, plagioclase, and pyroxene crystals and crystal fragments; grades locally into conglomerate of same composition. Fine-grained, dark reddish-brown crystal-vitric tuff is composed of plagioclase and minor pyroxene crystals, and crystal fragments in a vitric matrix; ranges locally to welded or non-welded ash-

flow tuff (Blacho Tuff Member, here not mapped separately). Local, basal, dark-red to greenish-gray, porphyritic andesite lava flows and associated flow breccia (Minguillo Lava Member, here not mapped separately), composed of phenocrystic flows that range from plagioclase- and plagioclase-pyroxene-bearing to pyroxene-bearing. Local, thin-bedded to massive, light-gray, generally crystalline limestone (Flor de Alba Limestone Lentil, here not mapped separately), includes Barrettia monilifera (Sohl and Kollmann, 1985). Southeastern areas of exposure include: thin-bedded, light-brown sandstone and dark-gray limestone conglomerate composed of fossil and crystalline limestone granules (Reves Member, here not mapped separately), which includes Barrettia sp. C, and B. sp. D, Praebarrettia sparcilirata, and Titanosarcolites spp. (Sohl and Kollmann, 1985). The Pozas also includes a massive- to thick-bedded medium- to dark-gray crystalline limestone and thick-bedded to massive, medium- gray calcarenite (Botijas Limestone Member, here not mapped separately), which includes Barrettia sp. C, Praebarrettia sparcilirata, and Titanosarcolites spp (Sohl and Kollmann, 1985). Locally the base of the Pozas is composed of dark-gray, bluish-gray, and grayish-brown thin-to medium-bedded calcareous volcanic sandstone, siltstone, and mudstone, dark-gray limestone lenses which include Barrettia coatesi (Sohl, personal communication, 1989). Minimum estimated thickness, 2,000 m. Exposed in the Florida, Ciales, Orocovis, and Barranquitas quadrangles

Tl Los Puertos Formation (LOWER PALEOCENE)(Glover and Mattson, 1967, 1973)-Massive to thick-bedded, generally fine-grained, predominantly reddish-purple volcaniclastic breccia composed of plagioclase, pyroxene-, and hornblende-bearing andesite in a fine-grained matrix of lithic clasts like those described and hematite-red clay

and silt. Limestone clasts are rare. Distinguished from Coamo Formation only by presence of locally interbedded, reworked, quartz-bearing dacitic tuff. Subordinate conglomerate composed of andesitic lithic clasts like those described. Fossils present are identified as Globogerina daubjergensis triloculinoides, and Globorotalia pseudobulloides compressa of the Globorotalia trindadensis zone of early Paleocene age (Glover, 1971). Locally includes well-rounded clasts of rudistids. Maximum estimated thickness, 350 m. Exposed in the Rio Descalabrado quadrangle

Tra Raspaldo Formation (LOWER EOCENE-UPPER PALEOCENE) (Glover, 1961, 1971; Glover and Mattson, 1967, 1973;) Thin- to medium-bedded, generally fine-grained, locally as coarse as fine breccia, dark blue-gray weathering, light yellowish-gray- green, and yellowish-brown, graded and crossbedded tuffaceous mudstone, and tuff. Tuff is commonly reworked, ranges from fine-grained ash to fine-grained breccia; contains abundant to common plagioclase and quartz crystals and crystal fragments. Tuffaceous conglomerate contains dacite, andesite, and rudist-bearing limestone pebbles in a tuffaceous matrix like the tuff described. Foraminifera described include Globigerina triloculinoides soladadoenis, Globigerinoides daubjergensis, Globorotalia aequa, G. velascoensis apanthesma, G. aequa wilcoxensis elongata, G. compressa, G. pseudobulloides, Cibicides praecursorius, Anomalina praespissiformis, Bulimina petroleana, Eponides bronnimanni, of latest Paleocene to early Eocene age (Reiskind in Glover, 1971). Minimum estimated thickness, 600 m. Exposed in the Coamo and Rio Descalabrado quadrangles

TKci Cibuco Formation (UPPER CRETACEOUS ?-PALEOGENE ?) (Nelson, 1966, 1967a)--Massive, dark-gray, medium-red weathering, conglomerate composed of rounded pebbles and some angular clasts of porphyritic lava, tuff-breccia, tuff, and diorite in an epiclastic, fine-grained quartz- and plagioclase-bearing matrix. Grades upward into thinner-bedded conglomerate and interbedded volcanic sandstone, siltstone, and tuff. Fine-grained rocks predominate upward in the section. Maximum known thickness, 2,000 m. Exposed in the Corozal quadrangle

Tca Carreras Siltstone (EARLY ? PALEOCENE ?)(Berryhill, 1965; Nelson, 1967a)--Siltstone, minor volcanic sandstone, and tuff. Thin- to medium-bedded, very fine-grained, medium dark-gray to very dark greenish-gray, grayish-orange weathering, mixture of tuff and epiclastic siltstone. Chiefly limestone, limestone breccia, and calcareous sandstone, and grades downward into conglomerate characterized by granodiorite debris in the Corozal quadrangle. Characteristically weathers into small rectangular blocks. Maximum estimated thickness, 600 m. Exposed in the Corozal and Ciales quadrangles

Ty Yunes Formation (MIDDLE EOCENE-UPPER PALEOCENE)(Nelson and Monroe, 1966; Nelson, 1967b)--Tuff, sandstone, siltstone, and locally volcanic breccia, conglomerate, calcarenite, and lava. Chiefly, thin-bedded, fine-grained, characteristically pale-green to pale blue-green crystal-vitric and vitric tuff; composed of plagioclase crystals and crystal

fragments and rare lithic clasts in an abundant, largely devitrified glass. Thin-to thick-bedded, fine- to coarse-grained, generally dark-gray to brownish-gray sandstone and thin-bedded dark-gray to brownish-gray siltstone, both with abundant quartz grains. Some sandstone beds are graded. Conglomerate, volcanic breccia and calcarenite are local and commonly massive. Foraminifera identified from the Yunes are Globigerina sp. and Globorotalia sp., (keeled forms) and radiolaria (spumellinid) (Pessagno in Nelson and Monroe, 1966). Maximum estimated thickness is 3,000 m. Exposed in the Florida and Utuado quadrangles

Tjo Jobos Formation (OLIGOCENE ?-PRE-OLIGOCENE?)(Nelson, 1967b)--Massive, medium- to dark grayish-brown volcanic breccia; includes some volcanic conglomerate, sandstone, and andesitic lava flows. Estimated thickness, l,700 m. Exposed in the Utuado quadrangle

Northeast Puerto Rico

Kd Daguao Formation (LOWER CRETACEOUS ?)(M'Gonigle, 1977, 1978, 1979)--Interbedded volcaniclastic breccia, lava, and subordinate sandstone and crystal tuff. Massive breccia contains subangular to subrounded, dark-gray, andesitic clasts in a coarse-grained, dark-gray, plagioclase- and clinopyroxene-rich crystal tuff matrix. Dark-gray, pilotaxitic, locally amygdaloidal andesitic lava with plagioclase and clinopyroxene phenocrysts; ranges to autobrecciated lava of same lithic type. Laminated to thin-bedded, graded, dark- to medium-gray volcaniclastic sandstone and tuff. Sandstone composed of plagioclase and some clinopyroxene grains; tuff locally includes abundant

hornblende crystal fragments. Maximum estimated thickness, l,000 m. Exposed in the Humacao, Naguabo, and Punta Puerca quadrangles

Kf Figuera Lava (LOWER CRETACEOUS ?)(Briggs, 1973; M'Gonigle, 1979; Briggs and Aguilar, 1980)--Massive, medium- to dark-gray, reddish-brown weathering, porphyritic, andesitic lava; locally but not characteristically pillowed. Interlayered with very minor autobrecciated lava, thin- to medium-bedded, tuffaceous sandstone, siltstone, and hyaloclastite breccia. Sparse plagioclase and augite phenocrysts are held in a dense, generally altered groundmass. Lava is locally amygdaloidal. Contains one thin bed of non-welded ash-flow tuff. Maximum estimated thickness, 2,000 m. Exposed in the Fajardo, Cayo Icacos, Naguabo, and Punta Puerca quadrangles

Kfd Figuera Lava and Daguao Formation Interbedded--Locally interbedded rocks characteristic of the Figuera Lava and Daguao Formations. Exposed in the Naguabo quadrangle

Kfa Fajardo Formation (MIDDLE ? ALBIAN)(Seiders, 1971b; Briggs, 1973; M'Gonigle, 1978, 1979; Briggs and Aguilar, 1980;)--Basal thick to very thick-bedded tuff breccia, in which larger clasts are andesite (to lO cm across); interbedded with thick-bedded, coarse-grained, dark- to light bluish-gray and dark greenish-gray tuff, and subordinate thin- to thick-bedded tuffaceous sandstone and black cherty siltstone. Crystal-vitric tuff predominant, but lithic clasts are common. Includes some pumice and scoria. Overlain by cherty thin-bedded bluish-gray to black, tuffaceous sandstone and siltstone and thick-bedded, coarse-grained,

vitric-crystal tuff. Four stratigraphic units, in which units 1 and 2 are lithologically like units 3 and 4 respectively are mapped, but all are fault bounded and may be a doubling of the sequence because of faulting. An ammonite described by Cobban as Manuaniceras cf. M. carbonarium (Gabb) of late middle Albian age was collected from the middle part of the formation (Sol, 1976). Maximum estimated thickness, 3,l50 m. Exposed in the Fajardo, Cayo Icacos, Naguabo, Humacao quadrangles, and in the El Yunque quadrangle where it was mapped as unnamed volcaniclastic rocks

Kpa Pajaros Tuff (LOWER ? CRETACEOUS)(Pease, 1968a, 1968c)--Predominantly tuff, tuffaceous siltstone, and sandstone. Thin-bedded, fine-grained tuff with interbedded tuffaceous volcanic sandstone and coarse-grained tuff. Widely silicified and pyritized. Crystal-vitric tuff composed of plagioclase and pyroxene crystals and crystal fragments, and pumice in a chloritic matrix. Maximum exposed thickness, 580 m. Exposed in the Naranjito quadrangle

Kta Tabonuco Formation (MIDDLE OR LOWER CENOMANIAN-ALBIAN AND ? APTIAN) (Seiders, 1971b, 1971c; Briggs and Aguilar, 1980)--Volcaniclastic sandstone, subordinate mudstone and minor volcanic breccia and conglomerate. Medium- to thick-bedded, fine- to coarse-grained, moderately-sorted, medium-gray, generally calcareous volcanic sandstone composed of angular, fine-crystalline, vesicular to non-vesicular, andesitic(?) volcanic lithic clasts and subordinate plagioclase, clinopyroxene and rarely, quartz grains. Medium-, but ranging to thin- and thick-bedded, laminated, highly calcareous, dark-gray mudstone with abundant Foraminifera and Radiolaria. Coarser grained sandstone grades into fine- to coarse-grained breccia conglomerate. Larger clasts of angular mudstone and angular to well-rounded lava are to l m.

Foraminifera identified by Pessagno (in Seiders, 1971c) include Globigerinelloides sp. possibly of Aptian to middle Cenomanian age, Heldbergella delrioensis possibly of Aptian to late Cenomanian age, Planomalina buxtorfi of Albian to middle or late Cenomanian age, Praeglobotruncana delrioensis of probable Albian age, and Globigerinelloides barri (Bolli) of upper Aptian age (Pessagno, 1976). Cobban (in Seiders, 1971c) tentatively identified Mortinoceras s.l. sp., Hypacanthoplites sp., Flickia sp., and Lechites gaudini of probable Albian age. Approximate thickness, 1,000 m. Exposed in the El Yunque, Fajardo, and Cayo Icacos quadrangles

Kcg Cerro Gordo Lava (LOWER ? CRETACEOUS)(Pease, 1968a, 1968c)--Lava, flow-breccia, and minor tuff and tuff-breccia. Massive, porphyritic, bluish gray to greenish-gray basaltic andesite with randomly oriented and abundant plagioclase and pyroxene phenocrysts in a fine-crystalline groundmass; locally interbedded with flow-breccia and massive tuff. Maximum estimated thickness, l,l00 m. Exposed in the Naranjito quadrangle

Kh Hato Puerco Formation (TURONIAN-LOWER CENOMANIAN) (Seiders, 1971a, 1971b, 1971c; Pessagno, 1976; Briggs and Aguilar, 1980)--Andesitic to basaltic volcaniclastic sandstone and breccia, subordinate mudstone, conglomerate, and lava. Generally very thick-bedded but includes subordinate medium- to thick-bedded, moderately-sorted, generally angular, grayish-green to dark-green volcanic sandstone, composed of dense to somewhat vesicular volcanic lithic clasts, plagioclase, clinopyroxene, and minor hornblende grains. Basal breccia composed of fine- to coarse-grained, moderately- to poorly-sorted, grayish-green, angular- to subrounded, and dense to vesicular andesite

and basalt clasts in a finer matrix of the same lithic types; sparse to locally abundant (to 30 percent) angular to rounded clasts of fossiliferous calcarenite. Rarely, beds of conglomerate are present in the breccia. Uncommonly, breccia and sandstone are highly pumiceous; generally in the northeast areas of exposure. Thin-bedded, medium- to dark-gray calcareous mudstone and andesitic to basaltic porphyritic lava are present in minor amounts. Assignment of age (Pessagno in Seiders, 1971c) is based on the presence of foraminifera; those from the presumed middle part of the formation include Globigerinelloides sp., Shackoina sp. Hedbergella delrioensis, Praeglobotruncana stephani, Rotalipora appenninica, R. cushamani, R. evoluta, and R. appenninica of early Cenomanian age; R. greenhornensis of middle to late Cenomanian age; Clavihedbergella simplex of late Cenomanian age is reported from the upper part of the formation; and Marginotruncana sp. (double keeled) M. helvitica and M. sigali of Turonian age are also reported from near the top of the formation (Seiders, 1971c). Maximum estimated thicknesses 2,600 m. Exposed in the Gurabo, El Yunque, Fajardo, and Cayo Icacos quadrangles; previously mapped (Pease, 1986) as part of the Carraizo Breccia in the Aguas Buenas quadrangle

Keo El Ocho Formation (CENOMANIAN ?)(Nelson, 1967; Pease, 1968a, 1968b, 1968c)--Massive- to thick-bedded volcaniclastic breccia and coarse-grained tuff, with andesitic lava flows near base. Massive- to thick-bedded volcanic breccia and coarse-grained tuff interbedded with andesitic lava flows and flow-breccia near the base. Lava flows and clasts in flow breccia are reddish-gray, and consist of plagioclase and pyroxene phenocrysts in a fine-crystalline groundmass. Basal siltstone member (Piña Siltstone Member, here not mapped separately), thin-bedded to laminated, calcareous siltstone interbedded with fine-grained

volcaniclastic sandstone. Locally, siltstone grades into dark-gray carbonaceous limestone. Fossils have not been reported from the El Ocho. Maximum estimated thickness, 825 m. Exposed in the Corozal, Naranjito, and Aguas Buenas quadrangles

Kba Barrazas Formation (UPPER CENOMANIAN)(Seiders, 1971a, 1971c)--Chiefly volcanic sandstone, subordinate volcaniclastic breccia and mudstone. Thin- to very thick-bedded, fine- to coarse-grained, generally moderately sorted, medium-to dark-gray volcanic sandstone; commonly with small-scale crossbedding in thinner beds. Very thick-bedded, fine- to medium-grained, volcaniclastic breccia composed of angular lithic clasts and sparse light-gray calcarenite. Thin- to medium-bedded, medium- to dark-gray, calcareous and carbonaceous mudstone composed of tuff, calcite, planktonic Foraminifera and Radiolaria. Fossils reported have been identified as Hedbergella sp., H. delrioensis, Clavihedbergella simplex, Praegbotruncana stephani Loeblichella hessi, and Rotalipora appenninica of late Cenomanian age (Seiders, 1971c). Maximum estimated thickness, l,l00 m. Exposed in the Gurabo quadrangle

Kg Guynabo Formation (LOWER SANTONIAN-UPPER CENOMANIAN) (Pease, 1968a)--Predominantly thin-bedded volcanic sandstone and tuffaceous siltstone interbedded with volcanic conglomerate. Oldest rocks in formation are greenish-gray, scoriaceous, pillowed, andesitic lava flows. These are overlain by interbedded tuffaceous, calcareous siltstone, and conglomerate composed of abundant volcanic clasts, and minor limestone clasts. Greenish-gray, porphyritic, locally pillowed, andesitic lava flows (Martin Gonzales Lava, here not mapped

separately) occur in about the middle of formation. Conglomerate beds decrease in number upward and calcareous siltstone becomes more abundant upward in the formation. The upper part of the Guynabo is a sequence of thin-bedded to laminated, dark-gray, calcareous and tuffaceous siltstone and fine-grained sandstone that includes small lenses of massive dark-gray limestone (the Leprocomio Siltstone Member, here not mapped separately). Locations cited by Pease from the Gurabo quadrangle of rocks assumed to be equivalent to the Guynabo in the type area in the Aguas Buenas quadrangle included fossils identified as Hedbergella sp., H. delrioensis, Clavihedbergella simplex, Praeglobotruncana stephani, Whiteinella archeocretacea, W. inornata, Marginotruncana sp. (double keeled), M. carenata, M. concavata, and Loblichella hessi. Maximum thickness l,600 m. Exposed in the Aguas Buenas quadrangle. Seiders (1971a, 1971b) subsequently mapped rocks in the Gurabo quadrangle which are shown with identical contacts and continuations of the Guynabo Formation but he used new formational names in the Gurabo and El Yunque quadrangles

Kcan Cancel Breccia (UPPER ? CRETACEOUS)(Pease, 1967, 1968a, 1968c,)--Tuff breccia, volcanic breccia, with flow-breccia and lava. Massive, reddish-gray to purplish-gray lava and breccia clasts of porphyritic andesite with abundant small plagioclase, and sparse pyroxene phenocrysts in a fine-crystalline, amygdaloidal groundmass. Tuff and tuffaceous matrices of breccias are purplish-gray-green and composed of weathered clasts of lava and pumice with grains of plagioclase and pyroxene. Banded reddish-purple ash flow tuff is

present in one area. Maximum exposed thickness 2,000 m. Exposed in the Naranjito and Corozal quadrangles

Krp Río de la Plata Sandstone (UPPER ? CRETACEOUS)(Pease, 1968a)--Thin-bedded to laminated, calcareous, greenish-gray volcaniclastic sandstone and siltstone interbedded with thick-bedded, coarse-grained, volcaniclastic sandstone and conglomerate and, locally, andesitic lava flows. Sandstone composed of subangular, andesitic lava clasts, feldspar and pyroxene grains, and weathered pumice clasts in a calcareous matrix. Conglomerate consists chiefly of porphyritic andesite lithic clasts like those in sandstone. Lithic clasts typically show clustered phenocrysts. Dark greenish-gray andesitic lava flows contain sparse phenocrysts of plagioclase and pyroxene. Fossils have not been reported from the Río de la Plata. Maximum estimated thickness, 1,000 m. Exposed in the Naranjito, Aguas Buenas, and Corozal quadrangles

Kso Santa Olaya Lava (UPPER ? CRETACEOUS)(Lidiak, 1965; Pease, 1968a, 1968b, 1968c; Seiders, 1971a)--Massive, pillowed, basaltic and andesitic lava flows, hyaloclastite-breccia, tuff, and volcaniclastic sandstone. Basal, amygdaloidal, pillowed, dark-gray to greenish-gray, porphyritic and generally chloritized lava flows with sparse to abundant plagioclase and subordinate pyroxene phenocrysts. Dark-gray,

aphanitic, thin flows higher in the formation are generally non-pillowed, and contain sparse plagioclase and pyroxene phenocrysts. Unsorted hyaloclastite-breccia composed of scoriaceous and angular lithic clasts of lava in a fine-grained but otherwise lithologically identical matrix. In eastern outcrop areas, hyaloclastite breccia and fine- to coarse-grained tuff and tuffaceous sandstone predominate. Fossils have not been reported from the Santa Olaya. Maximum estimated thickness, 2,600 m. Exposed in the Aguas Buenas and Naranjito quadrangles; equivalent continuous rocks in the Gurabo quadrangle to the east have been mapped by Seiders (1971a) as the Celada Formation

Kcam Camarones Sandstone (UPPER ? CRETACEOUS)(Pease, 1968a, 1968b, 1968c) -Thin- bedded, dark-gray, calcareous and locally carbonaceous, volcaniclastic siltstone interbedded with thick-bedded, fine- to coarse-grained, dark-gray, tuffaceous sandstone, and minor volcanic conglomerate. Locally (Mamey Lava Member, here not mapped separately) massive, dark-gray lava containing abundant plagioclase and clinopyroxene phenocrysts and interstitial pseudomorphs of chlorite after orthopyroxene, in a fine-crystalline generally chloritized groundmass. Maximum known thickness, 950 m. Exposed in the Aguas Buenas and Naranjito quadrangles

Kcb Cambalache Formation (TURONIAN)(Seiders, 1971a, 1971b, 1971c)-- Volcaniclastic breccia, sandstone, mudstone, and, locally, vitrophyre. Thin- to very thick-bedded, generally non-graded, fine-grained, pale-- green, grayish-blue-green, and greenish-gray volcaniclastic breccia characteristically composed of abundant pumice and perlite clasts and

variable but generally subordinate fine-crystalline volcanic lithic clasts. Thin to very-thick-bedded, grayish-blue-green to dark-blue-green fine- to coarse-grained, locally graded volcaniclastic sandstone of the same general composition as breccia. Volcaniclastic mudstone is interbedded with breccia and sandstone throughout formation. Breccia and sandstone contain discoidal mudstone clasts from l to 4 m across, and sparse to abundant scattered blocks of devitrified vitrophyre member to 2 m across. Black vitrophyre, a welded ash-flow tuff (Toma de Agua Vitrophyre Member, here not mapped separately) with platy and locally columnar jointing at top of formation, is composed of light-brown glass with plagioclase and augite microlites. Commonly devitrified. Pessagno (in Seiders 1971c) reports Whiteinella inornata and Marginotruncana helvetica of Turonian age from one location in the Cambalache. Maximum known thickness, 600 m., typically, 350-450 m thick. Maximum thickness of Toma de Agua Vitrophyre Member, 50 m. Exposed in the Gurabo and El Yunque quadrangles

Ki Infierno Formation (TURONIAN)(Seiders, 1971a, 1971b)--Gray to green, generally pillowed, basaltic andesite lava, volcanic breccia, volcaniclastic sandstone, and mudstone. Flows characteristically contain abundant plagioclase, and in a few flows, sparse clinopyroxene phenocrysts, in a fine-crystalline groundmass. Thin-to very thick-bedded, green, moderately to poorly sorted volcaniclastic sandstone and volcanic breccia which contains abundant altered pumice, scoria, perlite, volcanic lithic clasts, plagioclase and clinopyroxene grains. Foraminifera identified consist of Heterohelix sp., H. reussi, Hedbergella sp., H. delrioensis, Marginotruncana helvetica, M. marginata, and Whiteinella cf. W. archeocretacea of Turonian age (Pessagno in Seiders, 1971c). Maximum thickness known, 900 m. Exposed in the

Gurabo quadrangle. Previously mapped as part of the Carraizo Breccia in the Aguas Buenas quadrangle to the west (Pease, 1968b)

Klo Lomas Formation (UPPER ? CRETACEOUS)(Seiders, 1971a, 1971b, 1971c)--Very thick bedded, gray-green, very poorly sorted, fine- to medium-grained volcanic breccia, subordinate, coarse-grained hyaloclastite breccia, conglomerate, volcanic sandstone, pillowed lava, and rare volcanic lithic mudstone. Breccia clasts are commonly augite- and/or plagioclase-bearing andesite and basalt, abundant pumice, and vesicular lava. Lava flows are both pillowed and non-pillowed. Pillowed flows are abundantly vesicular. Maximum thickness, 1,500 m. Exposed in the Gurabo and El Yunque quadrangles

Kcar Carraizo Breccia (LOWER TURONIAN-MIDDLE CENOMANIAN) (Pease, 1968a, 1968b)--Predominantly massive, coarse- to fine-grained, greenish-gray and reddish-gray volcanic breccia and subordinate massive to thick-bedded, coarse-grained, volcanic-lithic sandstone and thin-bedded, tuffaceous siltstone and tuff. Breccia characteristically contains greenish-gray and reddish-gray lithic clasts with plagioclase and augite phenocrysts and pumice clasts in a fine-grained matrix of the same lithic types, plagioclase and augite crystal fragments, chlorite, and clay. Minimum estimated thickness, l,400 m. Exposed in the northeastern Aguas Buenas quadrangle. Continuous with the subsequently mapped (Seiders, 1971a) Hato Puerco Formation in the Gurabo quadrangle. Fossil localities cited by Pease (1968a) for the Carraizo lie in the Gurabo quadrangle, and are cited in the description of the Hato Puerco Formation. Maximum estimated thickness, 90 m. Exposed in the Aguas Buenas quadrangle

Kto Tortugas Andesite (UPPER ? CRETACEOUS)(Kaye, 1959; Pease, 1968a, 1968b)--Predominantly massive, medium-gray to brownish-gray volcanic breccia and subordinate lava, volcanic sandstone, and conglomerate. Greenish-gray and reddish-gray augite andesite breccia clasts and lava contain abundant augite and plagioclase phenocrysts; breccia clasts held in a matrix of same lithic type, some reddish-gray pumice, and crystal fragments of plagioclase and augite. Lava flows are non-pillowed, areally highly limited, and generally enclosed in massive, coarse-grained volcanic breccia (flow-breccia or hyaloclastite breccia?). Locally, formation includes thin lenses of tuffaceous sandstone, very fine-grained tuff, and reddish-brown conglomerate. Fossils have not been reported from the Tortugas Andesite. Maximum estimated thickness, 700 m. Exposed in the Aguas Buenas quadrangle

Kcn Canovanas Formation (LOWER SANTONIAN-UPPER TURONIAN) (Seiders, 1971a, 1971b, 1971c)--Chiefly basaltic, volcaniclastic sandstone, subordinate calcareous mudstone near the top of the formation and, rarely, andesitic volcaniclastic sandstone. Thick-bedded to locally thin-bedded, medium- to dark-gray, medium- to coarse-grained, volcaniclastic sandstone composed of angular basaltic lithic clasts, some of which are pumiceous, zeolitized plagioclase grains, fresh clinopyroxene, and mudstone clasts; all in a calcareous matrix. Thin- to medium-bedded, uncommonly thick-bedded, medium-gray to dark-gray, calcareous mudstone ranges to fine grained sandstone and siltstone; interbedded throughout the formation, but more abundant nearer top of formation. Foraminifera identified include Clavhedbergella simplex, Praeglobotruncana stephani, Whiteinella archeocretacea, W. inornata, Marginotruncana sigali, M. coronata, and M. canaliculata of late Turonian age; Marginotruncana sp. (double keeled), Loeblichella hessi of late Turonian to early Santonian age; Globotruncana bulloides,

Marginotruncana pseudolinneiana Heterohelix reussi, Marginotruncana angusticarenata, M. concavata, M. renzi, and Heterohelix sp., cf. H. reussi of Coniacian to early Santonian age (Pessagno in Seiders, 1971c). Maximum estimated thickness, 200 m. Exposed in the Gurabo and El Yunque quadrangles

Kmag Martin Gonzales Lava (EARLY CAMPANIAN-SANTONIAN)(Pease, 1968; Seiders, 1971c; 1971a)--Gray green, locally pillowed, basaltic andesite; commonly with abundant plagioclase phenocrysts (2-5 mm long) generally more than 40 percent of the rock, locally plagioclase phenocrysts comprise most of the rock. Clinopyroxene phenocrysts are sparse and only locally present; in one location orthopyroxene is present. Lava is commonly amygdaloidal. Variation in thickness over short distances is common. Thickness varies from 50 m to 700 m. Exposed in the Gurabo and El Yunque quadrangles

Kce Celada Formation (POST TURONIAN ? CRETACEOUS)(Seiders, 1971,a, 1971c)--Grayish-green, commonly pillowed, basaltic lava, fine- to coarse-grained volcanic breccia, and subordinate volcaniclastic sandstone and siliceous mudstone; characteristically with abundant clinopyroxene. Clinopyroxene phenocrysts are common, rarely plagioclase phenocrysts are dominant, but they are present only in a few flows; in these, the flows are lithologically identical with the Infierno Formation. Locally lava grades into hyaloclastite breccia. Poorly sorted volcanic lithic sandstone consists of abundant round-bubble pumice or scoria, amygdaloidal, and dense angular lava clasts, clinopyroxene, and locally plagioclase grains. Previously mapped (Pease, 1968b) and continuous with the Santa Olaya Lava in the Aguas Buenas quadrangle adjacent to the west. Maximum estimated thickness, 600 m. Exposed in

the Gurabo quadrangle

Kfr Friales Formation (CAMPANIAN)(Pease, 1968b; Seiders, 1971a, 1971b, 1971c; Pease and Briggs, 1972; Monroe, 1977)--Predominantly calcareous mudstone, volcaniclastic sandstone, conglomeratic sandstone, volcanic breccia, and locally, lava flows. Basal, thin, poorly-sorted, grayish-green volcaniclastic breccia composed of sparsely vesicular volcanic lithic clasts, mudstone and sandstone clasts in a calcareous matrix; overlain by thin- to medium-bedded, dark-gray, calcareous mudstone. Thick-to very thick-bedded, grayish-green, clinopyroxene-bearing andesitic to dacite volcanic lithic sandstone, conglomeratic sandstone, fine-grained breccia, and subordinate thin- to medium-bedded sandstone and mudstone comprise the middle part of the formation. Plagioclase phenocrysts in lithic clasts and clinopyroxene phenocrysts are uncommon, quartz phenocrysts sparse but present in most outcrops. Grains of epiclastic epidote and epidotized rocks are sparse. Pillowed, blue-gray to dark greenish-gray, basaltic lava flows occur locally. The lower flow contains abundant clinopyroxene phenocrysts and sparse pseudomorphs after olivine or orthopyroxene in a fine-crystalline groundmass; the upper flow contains abundant albitic plagioclase phenocrysts in a fine-crystalline groundmass. Thin- to medium-bedded light- to dark-gray calcareous mudstone and minor pale-green volcaniclastic mudstone and gray-green volcaniclastic sandstone comprise the upper part of the formation (the Leprocomio Mudstone Member, here not mapped separately). Mollusks identified from the lower part of the Friales type section consist of Parastroma sp. and Actaeonella sp.; foraminifera identified from the lower mudstone facies of the Friales include Heterohelix sp., Archaeoglobigerina blowi, Globotruncana arca, G. linneiana, G. rosetta, G. stuartiformis, G.

ventricosa, G. austinensis, G. bulloides, G. fornicata, and G. lapparenti s.s. of early Campanian age. Foraminifera from the Leprocomio Mudstone Member include Heterohelix sp., H. globulosa, Globigerinelloides sp., G. cf. yarocensis, Pseudotextularia elegans, Globitruncana bulloides, G. elevata, G. fornicata, G, lapparenti s.s., G. linneiana, G. plummerae, G. rosetta, G. stephensoni, G. stuartiformis, G. ventricosa, Pseudorbitoides sp., and Rugoglobigerina sp. of late Campanian to early Maestrichtian age (Seiders, 1971c). Maximum estimated thickness, l,lOO m. Exposed in the Aquas Buenas, Carolina, Gurabo, Rio Grande, and El Yunque quadrangles

Klm La Muda Formation (MAESTRICHTIAN-CAMPANIAN ?)(Pease, 1968a, 1968b)--Dark gray where least weathered, dark yellow to brownish-gray where weathered, calcareous sandstone that ranges to arenaceous limestone; interbedded with coarse conglomerate, and locally, massive limestone. Predominant sandstone composed of detrital feldspar and subordinate quartz and biotite grains in a calcareous cement. Conglomerate pebbles and cobbles generally composed of lava, but locally of limestone. Formation locally consists of massive dark-gray, rudist-containing limestone. Local reddish-gray basal conglomerate contains clasts derived from the underlying Tortugas Andesite. The rudists Vaccinites sp. and Antillocaprina sp. from one location are of Maestrichtian age; the other location in which only Vaccinites sp. was described may be Campanian in age (Sohl, personal communication, 1990). Maximum thickness, 90 m. Exposed in the Aguas Buenas quadrangle

Kmo Monacillo Formation (UPPER CRETACEOUS)(Kaye, 1959; Pease, 1968a, 1968b; Seiders, 1971a, 1971c; Pease and Monroe, 1977)-- Massive to thick-bedded, reddish-gray, poorly consolidated conglomerate and dark grayish-purple mudstone interbedded with greenish-gray or yellowish-green, thin-bedded siltstone and sandstone. Predominant clasts in conglomerate are porphyritic lava characteristic of the Tortugas Andesite, pumiceous lava characteristic of the Santa Olaya Lava, quartz, chert, diorite(?), and welded ash-flow tuff. Mudstone contains epiclastic quartz and biotite. The Trujillo Alto Limestone Member of the type area in the Aguas Buenas quadrangle (here not mapped separately) consists of dark-gray calcarenite with abundant fragments of algae, echinoids, and shells. Maximum thickness estimated as less than 400 m where it was measured but probably subject to repetition by faulting. The Trujillo Alto Limestone Member is known to be as much as 60 m thick. The Monacillo is exposed in the Aguas Buenas, Gurabo, San Juan, and Carolina quadrangles

TKn Naranjito Formation (LOWER PALEOGENE ? UPPER CRETACEOUS ?) (Nelson, 1967a; Pease, 1968a, 1968c) - Massive to thick-bedded, reddish-brown to grayish-purple, hornblende crystal-tuff, unsorted and massive tuffaceous breccia and conglomerate, volcanic sandstone, and, locally, lava flows. Abundant black hornblende as phenocrysts or as crystal fragments is characteristic of lava flows, tuff, and breccia facies. Lava and lithic clasts in breccia also contain abundant plagioclase phenocrysts. Fossils have not been reported from the Naranjitto, but the formation is overlain by volcanic sandstone-siltstone which contains fossils of Paleocene-Eocene age. Maximum thickness 450 m. Exposed in Naranjito quadrangle and mapped as hornblende tuff in the Corozal

quadrangle (Nelson 1967a)

TKgu Guaracanal Formation (LOWER PALEOGENE-UPPER CRETACEOUS) (Pease, 1968a; Seiders, 1971c)--Massive, coarse-grained, characteristically purplish-gray volcanic breccia that integrades (both laterally and vertically) with lava or tuff, characterized by abundant and conspicuous, black hornblende phenocrysts or crystal fragments. White plagioclase and black hornblende give a distinctive spotted appearance to breccia clasts and lava. Locally includes lenticular limestone in tuff sequence at or near base of formation. Locally, in the Carolina quadrangle, consists of waterlaid, tuffaceous, volcanic lithic sandstone and conglomerate that retain characteristic color and abundant hornblende. Maximum estimated thickness l25 m. Exposed in the Carolina, San Juan, Aguas Buenas, and Gurabo quadrangles

TKmv Metavolcanic Rocks (UPPER CRETACEOUS ?-PALEOGENE ?)(Rogers and others, 1979; Glover, 1982)--Dark green to dark greenish-gray, generally fine-crystalline, uncommonly phyllitic or schistose hornblende hornfels composed of hornblende, plagioclase, and subordinate quartz, magnetite, ilmenite, and hematite. Textures of original lava flows, volcanic breccia, tuff, and volcanic sandstone are generally preserved. Present in the Patillas, Yabucoa, and Punta Tuna quadrangles

Tpa Palmarejo Formation (EOCENE-PALEOCENE)(Nelson, 1966, 1967a; Pease 1968c)-Thin-bedded, fine- to medium-grained, gray to dark-gray volcanic sandstone interbedded with thin-bedded, dark-gray siltstone. Pseudophragmina sp. of Paleocene and Eocene age has been identified by Pessagno (in Nelson, 1966). Maximum thickness, 370 m. Exposed in

the Corozal and Naranjito quadrangles

Trp Río Piedras Siltstone (UPPER PALEOCENE)(Pease, 1968a)--Predominantly thin-bedded, dark-gray volcanic sandstone, siltstone, and conglomerate. Base laminated to thin-bedded, dark-gray, generally calcareous, and locally carbonaceous siltstone with a local basal conglomerate. Overlain by thin-bedded, medium-gray, tuffaceous limestone that weathers to a distinctive bright-red soil, an overlying thin-bedded, greenish-gray conglomerate composed of volcanic lithic clasts and interlayered thick-bedded coarse-grained volcanic sandstone and siltstone, and an upper and predominant sequence of laminated to thin-bedded, dark-gray volcanic sandstone and conglomerate. Although names of species were not noted, Reiskind (in Pease, 1968a) tentatively identified foraminifera present in the Río Piedras as of "upper but not uppermost Paleocene" age. Maximum thickness, l,400 m. Exposed in the Aguas Buenas, Naranjito and San Juan quadrangles

Tco Corozal Limestone (LOWER EOCENE ?-PALEOCENE)(Berkey, 1915; Kaye, 1956; Nelson, 1966, 1967a;)--Predominantly lenticular and massive, light-gray limestone and grayish-red limestone breccia. Basal limestone overlain by interbedded limestone lenses and thin-bedded, fine-grained calcareous sandstone, siltstone, and bentonitic clay. Breccia consists of limestone clasts and minor volcanic lithic clasts in a calcareous, grayish-red, arenaceous clay. Limestone breccia also contains thin beds of shale and non-brecciated limestone. The Corozal contains an extensive foraminiferal assemblage of Paleocene age (Applin in Kaye, 1956). The presence of Valvulammina cubensis Cushman and Bermudez,

Quinqueloculina spp., and Discorbis sp. may indicate, according to Todd (in Kaye, 1956), a range as young as early or middle Eocene. Minimum thickness l50 m. Exposed in the Corozal quadrangle

Tor Ortiz Formation (PALEOGENE ? -NEOGENE ?)(Berkey, 1915; Nelson, 1966, 1967a)--Medium- to thin-bedded, irregularly interbedded, red, green, and dark-gray volcanic sandstone, siltstone, and pale-green tuff. Thin conglomerate with abundant limestone pebbles underlain by interbedded, calcareous, thick-bedded, coarse-grained sandstone and dark-red shale at base of formation. Thin-bedded, gray limestone lens locally present in upper part of formation west of Ortiz. Fossils have not been reported from the Ortiz. Maximum thickness, 600 m. Exposed in the Corozal quadrangle

Middle Tertiary Deposits

North Coast

Ts San Sebastian Formation (MIDDLE ?-UPPER OLIGOCENE) (Hubbard, 1923; Zapp and others, 1948; Monroe and Pease, 1962; Berryhill, 1965; Nelson and Monroe, 1966; Nelson, 1967; Nelson and Tobisch, 1968; Pease, 1968; McIntyre, 1971; Tobisch and Turner, 1971; Pease and Monroe, 1977; Monroe, 1980, 1969)--Type section (Monroe, 1980) gray shaley clay, sandstone, and conglomerate. Basal beds contain local lenses of pebbles and cobbles of volcanic rocks in red and yellow mottled clay. Overlying beds are mottled gray, blue-gray, or green clay and silty clay interlayered with thin-bedded silt, argillaceous limestone lenses are locally present. West of Utuado quadrangle, predominantly lenticular, massive to thin-bedded, fine-to medium-grained, dark yellowish-gray-green and dark yellow-gray sandstone, gravel, and thin-bedded, red and greenish-gray, locally lignitic or carbonaceous sandy clay and clay. Basal cobble and boulder gravel with clasts to l m across. Some local limestone beds near top of formation. Utuado quadrangle eastward, predominantly dark yellowish-gray-green to pale-red, locally carbonaceous or lignitic sandy clay and clay with subordinate, locally crossbedded, medium-to coarse-grained sandstone which includes scattered pebbles of older volcanic rocks. Hubbard (1923) and Zapp and others (1948) assigned the San Sebastian to the middle Oligocene

based on contained mollusks and echinoids. Larger Foraminifera described from the formation include Operculina dia (Cole and Ponton), Heterostegina antillea Cushman, Lepidocyclina (Lepidocyclina asterodisca Nuttall, L. (L.) cannellei Lemione and R. Douvillé, L. (L.) giraudi R. Douvillé, L. (Eulepidina) undosa Cushman, Miogypsina (Miogypsina) antillea (Cushman), M. (M.) gunteri Cole, and M. (Miolepidocylina) panamensis (Cushman) of upper Oligocene age (Sachs, 1959). Hubbard (1920) noted the presence of various new species of Pecten, and Amusium papyraceum, A. (Propeamusium) hollicki Maury, Spondylus bostrychites ?, S. gumanomocon Brown and Pilsbry, Ostrea collazica Maury, Arca dariensis, A. (Scapharca) collazica Maury, various new species of Lucina, new species of Glycimeris, Phacoides, and Clementia dariena Conrad, Pitaria (Hyphantosoma) carbases Guppy, Corbula collazica Maury, Dentalium sp., Turritella planigyrata Guppy, Cassis sp., and Turbinella sp., of middle Oligocene age. Estimated maximum thickness, l00 m. in outcrop, about 328 m. in the subsurface. Exposed in the San Sebastian, Moca, Central La Plata, Bayaney, Utuado, Florida, Ciales, Corozal, Naranjito, Bayamon, and San Juan quadrangles

Tla Lares Limestone (UPPER ? OLIGOCENE)(Hubbard, 1923; Zapp and others, 1948; Berryhill, 1965; Nelson and Monroe, 1966; Nelson, 1967a, 1967b; Nelson and Tobisch, 1968; Monroe, 1969, 1980; McIntyre, 1971; Tobisch and Turner, 1971)--Upper third: medium-bedded, fine- crystalline calcilutite, locally, hard calcilutite is interbedded with soft chalky limestone and calcareous clay. Lower two thirds: commonly thick-bedded, but also flaky, thin-bedded, and poorly consolidated, medium-grained, where least weathered, light-to dark-gray calcarenite; includes thin lenses of marl, calcareous sandstone, gravel and locally, thick beds of very calcareous clay.

Abundantly fossiliferous with calcareous algae, large Foraminifera, and coral heads. Basal beds commonly include calcareous sandstone or sandy limestone in which non-limestone grains are volcanic lithic clasts, uncommonly, quartz. Corals in the Lares are also known from the late Oligocene-early Miocene in the Lesser Antilles, and the presence of abundant Lepidocyclina (Eulepidina) undosa, L. yurnagunensis, and Heterostegina sp. probably H. antillea suggests that the Lares is late Oligocene in age (Monroe, 1980). The Lares is about 270 m. thick. Exposed in the Florida, Moca, Central La Plata, San Sebastian, Bayaney, Utuado, Ciales, and Corozal quadrangles

Tmu Mucarbones Sand (LOWER MIOCENE ? UPPER OLIGOCENE) (Monroe and Pease, 1962; Berryhill, 1965; Nelson, 1966, 1967a; Pease, 1968)--Characteristically (Monroe and Pease, 1962; Pease and Monroe, 1977) crossbedded, predominantly medium- to fine-grained, yellow to grayish-orange quartz sand, interbedded with glauconitic, calcareous sand and thin-bedded calcareous clay. Sand is coarser near base of unit, and includes subangular to subrounded cobbles and pebbles and grayish-green glauconitic sandy clay. Scattered throughout formation are abundantly fossiliferous, hard lenses of sandy limestone and sandy clay, with abundant oysters, echinoids, pelecypods, Foraminifera, Lepidocyclina undosa is abundant and characteristic of the Oligocene. The lack of Lepidocyclina in the upper part of the Mucarbones may suggest that the top part of the formation is of Miocene age (Monroe, 1980). Maximum known thickness, l20 m. Exposed in the Corozal, Ciales, Naranjito, Bayamon, and San Juan quadrangles

Tcb Cibao Formation (LOWER MIOCENE-UPPER OLIGOCENE)(Monroe, 1980)--Laterally and vertically intergrading, massive to thick-bedded, light

bluish-gray where least weathered, generally pale yellowish-orange or grayish-orange, calcareous clay, marl, and soft chalky limestone. Local thick-bedded, fine-grained, hard limestone, thick-bedded quartz sand, and sandy clay beds, and gravel.

Tcbg — Guajataca Member (Zapp and others, 1948)--Light-yellow and light-gray, calcareous clay and soft chalky limestone and marl with massive lenses of sand and gravel composed of silicified older volcanic rocks. Fossils described from the Guajataca include Ostrea rugifera, Turritella sp., Pecten sp., P. vaun, P. crocus, Metis chipolana, Kuphus incrassatus, Echinolampus semiorbis, and Globularia anguillana (Monroe, 1980).

Tcbm — Montebellow Limestone Member (Nelson and Monroe, 1966)--Medium- to thick-bedded, or massive, locally thin-bedded and crossbedded, white to pale-yellow, chalky limestone with local calcareous clay and marl. "Ostrea' haitensis is both abundant and forms a 5 m. thick bed at the base of the Montebello above the contact with the Lares (Monroe, 1980). Fossils described include Lepidocyclina asterodisca, L. undosa, L. canellei?, Nummulites dia, and Heterostegina sp. (Monroe, 1980).

Tcbr — Río Indio Limestone Member (Monroe, 1962)--Thick-bedded, pale- to dark yellowish-orange limestone composed of dark-orange micrite intraclasts, locally with lenses of marly clay or beds of chalky limestone, scattered quartz grains and some glauconite

grains. Contains Lepidocyclina sp. Basal limestone is locally brecciated, contains layers of large fossil oysters like those at the base of the Mucarbones, grades into Mucarbones Sand laterally

Tcbga Almirante Sur Sand Lentil (Monroe, 1962)--Within the Rio Indio Limestone, a fine- to coarse-grained, subrounded to subangular, crossbedded, calcareous and fossiliferous, pebbly sand and sandstone composed of quartz and volcanic lithic grains, locally grades into glauconitic calcarenite. Contains very large and abundant Pectin sp.

Tcbq Quebrada Arenas Member (Monroe, 1962)--Thick- to very thick-bedded, fine-to medium-crystalline, pale-orange to pale grayish-orange, dense limestone alternating with thick-to very thick-bedded, similarly-colored, soft chalky limestone. Locally includes abundant Lepidocyclina undosa, sparse quartz grains, some marl, and rubbly limestone.

Tcbmi Miranda Sand Member - Coarse-grained, angular to subangular, clayey and silty sand, locally with pebbles and cobbles of quartz and volcanic rocks. Noncalcareous and nonfossiliferous. Occupies channels cut into underlying Quebrada Arenas Limestone Member. Thickness of the formation ranges, from l70 to 260 m. Formation exposed along north coast from San Juan quadrangle in the east to the Aguadilla quadrangle in the west

Ta Aguada Limestone (L0WER MIOCENE)(Zapp and others, 1948; Monroe, 1968)-Generally thick-bedded, pale-orange, pale grayish-orange, and pale-pink, hard, granular calcarenite at the base, overlain by alternating

beds of chalk or chalky marl, and rubbly limestone; commonly with discontinuous lenses of fine- to medium-grained fossiliferous calcarenite. Typically with crossbedded calcarenite at or near top of formation. Chiefly micrite with sparse intraclasts and non-limestone grains, contains Marginopora sp. and Archaias angulatus. Orthaulax aguadillensis is conspicuous but ubiquitous throughout the Miocene-Oligocene of northern Puerto Rico (Monroe, 1980). Maximum estimated thickness, l50 m., commonly 90 m. thick. Exposed from the San Juan quadrangle in the east to the Aguadilla quadrangle along the north coast, and in the Utuado quadrangle

Tay Aymamon Limestone (LOWER MIOCENE)(Zapp and others, 1948; Monroe, 1963, 1967)--Generally white to pale-orange, or pale grayish-orange, dense, fine-crystalline intrasparite, locally coarse-grained limestone collapse-breccia; includes thin-bedded granular limestone and chalk; overlain by white to pale-orange chalk or interbedded chalk and dense limestone like that in the lower part of the formation. Upper chalky part of unit locally includes beds of the oyster Ostrea lathensis Gabb. Fossils from western outcrops of the Aymamon include "Ostrea" haitensis, Pecten gabbi, P. portoricoensis reticulatus, Clyperaster cubensis, Montastrea limbata pennyi, Psammocora gasparillensis, Porites sp., and Amusium sp. Identifiable Foraminifers include Marginopora sp., Archaias, and Gypsina. The Aymamon is of Miocene and probably early Miocene age (Monroe, 1980). Formation is locally dolomitized in outcrops near the sea. Maximum estimated thickness, 200 m. Exposed along the north coast of Puerto Rico from the Vega Alta quadrangle to the Aguadilla quadrangle

Tcm Camuy Formation (LOWER PLIOCENE-UPPER MIOCENE)(Monroe,

1963, 1967, 1969, 1971, 1980; Briggs, 1965, 1968;)--Basal, thin- to thick-bedded, friable, pale yellowish-orange, foraminiferal biomicrite, locally crossbedded and contains clay lenses. Middle part of unit, pale-orange, ferruginous calcarenite interbedded with chalky breccia, both are foraminiferal biomicrite. Superjacent sequence of chalky sandstone, sandstone, sandy limestone, and limestone; grades eastward in Arecibo and Barceloneta quadrangles into chalk, clayey chalk, and marl. Identified macro fossils include Nummulites cojimarensis "Osterea haitensis Sowerby, Spondylus bostrychites Guppy, and Chalmys (Aequipectin) cf. pleurinominis moranfesis Woodring. Studies of planktonic foraminifera suggest that the formation is of late Miocene and early Pliocene age (Seigle and Moussa, 1975). Estimated maximum thickness, l70 m. Exposed in the Manati, Barceloneta, Arecibo, Camuy, Quebradillas, and Moca quadrangles

Tgua Guanajibo Formation (UPPER MIOCENE)(McGinnis, 1948; Volckmann, 1984)--Pale-yellow to yellowish-orange, friable, poorly cemented calcarenite and calcirudite composed chiefly of clasts of fossil oysters, corals and gastropods. Finer calcarenite includes abundant fossil ostracods and foraminifera. Locally interbedded, reddish-brown and reddish-orange, poorly cemented, lithic sandstone and conglomerate; clasts are chiefly of volcanic rock, silicified mudstone, and minor limestone. Fossil ostracods in addition to 12 forms also present in the Ponce Formation, include Loxoconcha cubensis, and Acuticythereis elongata, and indicate a late Miocene, slightly older late Miocene than the Ponce Formation (Bold, 1969). The presence of Cyprideis subquadraregularis and Perissocytheridea matsoni suggests a brackish water environment. Estimated maximum thickness, 30 m. Exposed in the Puerto Real quadrangle and in the San German quadrangle north of

Lago Cartagena, where it was mapped as the Ponce Formation

South Coast

Tjd Juana Diaz Formation (MIDDLE MIOCENE-LOWER OLIGOCENE) (Seiglie and Bermudez, 1969; Zapp and others, 1948; Bermudez and Seiglie, 1970; Moussa and Seiglie, 1970; Glover and Mattson, 1973; Monroe, 1973, 1980; Krushensky and Monroe, 1975; 1978, 1978a)--Characteristically consists of a detrital basal unit overlain by limestone. Basal, very coarse gravel composed of well-rounded boulders, cobbles, and pebbles of volcanic and intrusive rock, and locally of serpentinite, held in a poorly-sorted but generally coarse-grained very poorly cemented sand matrix overlain by interbedded, thin- to medium-bedded, light bluish-gray, calcareous mudstone and sandstone. Lepidocyclina undosa and Clypeaster oxybaphon are common throughout all but the uppermost part of the formation. Overlying is a lenticular, thin- to thick-bedded, locally very thick-bedded, white to pale-orange, argillaceous chalk and chalky limestone, which locally becomes massive biosparite limestone. Locally the upper limestone is overlain by fine- to coarse-

grained, crossbedded, carbonaceous, light-brown sand and gravel composed of angular clasts of limestone in a sand matrix, a few beds of light-gray limestone, and pebbly limestone, all in channels cut into the Juana Diaz limestone. Oysters and Foraminifera are abundant in this channel deposit. The lower part of the formation is in the Globeigerina ampliapertura zone, and the upper detrital channel fill is in the Globigerinatella insueta zone (Mousa and Seiglie, 1970); the formation is of middle Miocene to lower Oligocene age. Because the formation was eroded prior to deposition of the overlying Ponce Limestone, thickness of the formation is highly variable, but maximum estimated thickness is about 850 m. Exposed in the Ponce, Rio Descalabrado, Penuelas, Punta Cuchara, Yauco, Punta Verraco, Guanica, and Sabana Grande quadrangles

Tpo Ponce Limestone (UPPER MIOCENE-PLIOCENE)(Monroe, 1972; Mattson and Glover, 1973; Monroe, 1973b, Krushensky and Monroe, 1975, 1978, 1979; Volckmann, 1984a, 1984b;)--Very thin-bedded, rubbly, light grayish-orange, dark yellowish-orange, light-gray to white, biomicrite containing abundant specimens and clasts of fossil mollusks, algae, echnioderms, and Foraminifera in a generally micritic matrix. Recrystallized over wide areas. Locally includes beds of brown clay and, in one area, rounded to angular clasts of dense biomicrite in a clayey matrix. Locally, rubbly limestone contains abundant voids lined with crystalline calcite. Contains Marginopora vertebralis, Archaias angulatus, A. floridanus, Clypeaster cubensis, Flabellum sp. and belongs in the lower part of the Mutilus confragosus zone (Bold, 1969) of late Miocene and Pliocene age. Maximum estimated thickness, 850 m. Exposed in the Ponce, Río Descalabrado, Punta Cuchara, Yauco, Punta Verraco, Guanica, Parguera, San German, and Cabo Rojo quadrangles

QTs Blanket Sand Deposits (QUATERNARY ? LATE TERTIARY ?) - predominantly massive, but locally, near the top of deposits, laminated, friable, generally very poorly consolidated, mottled reddish-orange, orange-brown, dark reddish-brown, light-gray, and white quartz-rich sand. Composed chiefly (70 to 95 percent) of fine- to coarse-grained, angular to subangular, anhedral quartz grains suspended in a limonite-stained clay. Quartz grains commonly include abundant randomly-arranged or lineate fluid inclusions, and show undulose extinction. Deposits include sparse, but locally abundant, limonite-manganese oxide(?) concretions of irregular shape, which commonly enclose quartz grains. These concretions (perdigones) are locally concentrated on present topographic surfaces. Upper parts of deposits show locally poor- to well-developed stratification in which laminae are defined by different size quartz grains; deposits are commonly massive downward away from this superficially laminated zone. Blanket sand deposits overlie various rock types including serpentinite, but most commonly they overlie non quartz-bearing limestone. Estimated thickness may be as great as 30 m., but more commonly 4-5 m. thick. Exposed in a discontinuous belt along the north, and locally on the west and southwest coasts of Puerto Rico

Qb Beach Deposits (QUATERNARY) - Predominantly rounded, generally fine- to medium-grained, volcanic lithic clasts, quartz grains, and shell fragments; includes friable, poorly consolidated beach sands "(beach rock") and, locally, sand dune deposits. Mapped chiefly on the north coast of Puerto Rico

Qa Alluvium (QUATERNARY)--Very poorly sorted, massive to thin-bedded, unconsolidated sand and gravel, subordinate silt and clay; locally includes

fluvial terrace deposits

Ql Landslide Deposits (HOLOCENE-PLEISTOCENE ?)-- Characteristically sited in deeply weathered or hydrothermally altered rocks or in massive rocks overlying such rocks. Widely present in late Tertiary formations along the northern coast and in hydrothermally altered intrusive rocks, locally elsewhere

Qs Swamp Deposits (HOLOCENE-PLEISTOCENE ?)--Dark-gray, black, and bluish-gray sandy and silty clay, locally ranges to peat or peaty muck

af Artificial Fill (HOL0CENE)--Igneous, volcanic, and sedimentary rocks of various types, unconsolidated sand and gravel

IGNEOUS ROCKS

Ksl Granodiorite-Quartz Diorite of San Lorenzo (POST CENOMANIAN ?) (Broedel, 1961; Glover, 1962; M'Gonigle, 1977; Rogers, 1979; Rogers and others, 1979)--Medium- to dark-gray, granitic-textured, medium-crystalline, generally massive granodiorite which grades into quartz diorite and locally into quartz monzonite. Composed generally of plagioclase, potassium feldspar, quartz, hornblende, minor biotite and accessory magnetite, sphene, apatite and zircon. Sparse hornblende-rich autoliths(?) and xenoliths of metavolcanic rock are scattered throughout plutonic complex. Locally, near contacts with metavolcanic rocks, biotite and hornblende are foliate. Exposed in the Caguas, Juncos, Humacao, Patillas, Yabucoa, and Punta Guayanes quadrangles

Kmc Granodiorite of Morovis and Ciales Stocks (POST MIDDLE ALBIAN) (Berryhill, 1965)--Medium gray, granitic textured, coarse-crystalline, granodiorite; locally fine-crystalline, generally massive except for flow foliation developed in hornblende near intrusive margins, shows autoclastic intrusion breccia near margins. Composed of plagioclase, hornblende, orthoclase biotite and quartz with accessory magnetite, apatite, and sphene. Granodiorite in Morovis stock locally grades into quartz monzonite. Exposed in the Ciales quadrangle

Kcag Granodiorite of Caguas Pluton (POST MIDDLE ALBIAN) (Broedel, 1961; Pease, 1968b; Seiders, 1971a; Rogers, 1979;)--Medium- to dark-gray, granitic textured, medium-crystalline, granodiorite; generally massive except near intrusive margins where hornblende is locally foliate and autoclastic intrusion breccia may be present; hornblende-rich autoliths(?) or xenoliths(?) are locally common. Granodiorite is composed chiefly of plagioclase, potassium feldspar, quartz, and hornblende, minor biotite, and accessory magnetite, sphene, apatite, and zircon. Exposed in the Caguas, Aguas Buenas, Juncos, and Gurabo quadrangles

Kdi Diorite (CAMPANIAN ? ALBIAN ?)(Glover, 1961a; Berryhill, 1965; Mattson and Glover, 1973; Rogers, 1977, 1979; Rogers and others, 1979; Glover, 1982)--Medium- to dark-gray, locally light-gray, fine- to medium-crystalline, generally granitic textured, equigranular, locally porphyritic, hornblende-rich diorite. Composed chiefly of plagiocalse and hornblende with minor clinopyroxene and minor to rare biotite and quartz. Autoclastic intrusion breccia present near margins and locally in interior of stocks. Widely altered, plagiocalse is albitized or converted to sericite and clay, hornblende is altered to chlorite, epidote and calcite.

Autoliths and/or xenoliths are widely present. Exposed in the Punta Guayanes, Patillas, Yabucoa, Coamo, and Caguas quadrangles

Kslq Quartz Diorite Facies of Granodiorite of San Lorenzo (UPPER ? LOWER ? CRETACEOUS) (Rogers, 1979)--Light- to dark-gray, granitic textured, medium-crystalline, generally massive quartz diorite; shows faint foliation near intrusive contacts and locally includes subrounded autoliths or xenoliths of quartz diorite and diorite to l m. across Composed of abundant plagiocalse and quartz, subordinate hornblende, biotite, and potassium feldspar; accessory magnetite, sphene, apatite, and zircon. Grades into granodiorite but is largely quartz diorite. Exposed in the Caquas quadrangle

Kib Intrusive Daguao Breccia (LOWER? CRETACEOUS)(M'Gonigle, 1977, 1978, 1979)--Massive breccia like the volcaniclastic breccia which comprises the Daguao Formation. Consists generally of dark-gray, angular, andesitic clasts in a finer-grained plagioclase- and clinopyroxene-rich clastic matrix which appears to intrude bedded tuff, breccia, and lava flows of the Daguao Formation. Mapped in the Naguabo quadrangle.

Kslg MIXED GRANODIORITE-DIORITE OF SAN LORENZO COMPLEX AND DIORITE HORNBLENDITE-HORNBLENDE GABBRO (CRETACEOUS) (Rogers, 1977; M'Gonigle, 1978)--Intermixed granodiorite of the San Lorenzo complex and diorite hornblendite and hornblende gabbro. See individual rock types, for descriptions. Mapped in the Humacao and Punta Guayanes quadrangles

Kdh DIORITE-HORNBLENDITE-GABBRO (UPPER ? CRETACEOUS) (Rogers, 1977; M'Gonigle, 1978)--Medium- to light-gray, medium-grained

hornblende diorite intermixed with dark-gray to dark-greenish-gray, medium- to very coarse-grained hornblendite. Hornblende is abundant, locally lineate, and conspicuous because of generally large (to l6 cm long) size. Magnetite occurs as grains to 2mm within hornblende crystals and in bands to l0 cm wide in the hornblendite. Hornblende gabbro locally intrudes and is mapped with the diorite. Exposed in the Humacao and Punta Guayanes quadrangles

Ku GRANODIORITE-QUARTZ DIORITE OF THE UTUADO BATHOLITH (POST UPPER PALEOCENE- SANTONIAN ?)(Nelson, 1967b; Mattson,1968a, 1968b; Nelson and Tobisch, 1968)--Generally pale gray-brown to pale pink, weathers to very pale yellow-brown sandy saprolite, massive, granitic textured, but locally porphyritic, medium- to fine-crystalline, granodiorite and subordinate quartz diorite, quartz monazite, and diorite (not mapped separately). Composition variable, chiefly abundant plagioclase, hornblende, and quartz; subordinate potassium feldspar and biotite; accessory magnetite, sphene, apatite, and zircon. Batholith is widely and deeply saprolitized. Exposed in the Jayuya, Bayaney, Utuado, and Adjuntas quadrangles

Kpob TWO PYROXENE OLIVINE BASALT (LOWER ? MAESTRICHTIAN-CAMPANIAN)(McIntyre, 1975; Monroe, 1972; Krushensky and Monroe, 1979; Volckmann, 1984a, 1984b; Curet, 1986)--Generally massive, dense, very dark-gray to black, dark purplish-gray to light-brown weathering, porphyritic augite hypersthene-olivine basalt. Composed of abundant, large, locally poikilitic, generally unaltered augite, abundant poikilitic and embayed hypersthene, abundant, generally sericitized plagioclase and pseudomorphs of iddingsite after olivine phenocrysts in an abundant hyalopilitic to pilotaxitic groundmass of plagioclase

microlites in generally chloritized glass. Exposed in the Yauco, Sabana Grande, Guanica, Parguera, San German, Cabo Rojo, Mayaguez, Rosario, and Maricao quadrangles

Kpsg GRANODIORITE OF THE PLUTONIC COMPLEX OF PUNTA GUAYANES AND GRANODIORITE OF SAN LORENZO UNDIVIDED (UPPER CRETACEOUS)(Rogers and others, 1979; Glover, 1982)--See Individual rock descriptions. Exposed in the Patillas, Punta Guayanes, and Yabucoa quadrangles

Kpsq QUARTZ DIORITE OF PLUTONIC COMPLEX OF PUNTA GUAYANES AND OF THE GRANODIORITE OF SAN LORENZO (UPPER CRETACEOUS)(Rogers, 1977; M'Gonigle, 1978)--Mixture of quartz diorite of the plutonic complex of Punta Guayanes and the quartz diorite facies of the granodiorite of San Lorenzo together with minor quartz diorite porphyry, and quartz monzonite of the plutonic complex of Punta Guayanes. See individual rock types for descriptions. Exposed in the Punta Guayanes and Humacao quadrangles

Kpgg GRANODIORITE OF THE PLUTONIC COMPLEX OF PUNTA GUAYANES (MAESTRICHTIAN-CAMPANIAN)(Rogers, 1977; M'Gonigle, 1978; Rogers and others, 1979; Glover, 1982)-- Light-gray, to light-red or pink saprolite, granitic textured, medium crystalline, massive granodiorite that grades locally into quartz monzonite. Composed of abundant plagioclase, orthoclase, and quartz, minor hornblende and biotite and accessory magnetite, sphene, apatite, and zircon. Exposed in the Humacao, Punta Guayanes, Patillas, Punta Tuna, and Yabucoa quadrangles

Kpsq QUARTZ DIORITE OF PLUTONIC COMPLEX OF PUNTA GUAYANES (MAESTRICHTIAN-CAMPANIAN)(Rogres and others, 1979; Rogers, 1977; Glover, 1982)--Generally light-gray to light pinkish-gray, widely and deeply saprolitized, granitic textured, fine- to coarse-crystalline quartz diorite; composed of abundant plagioclase (oligoclase-albite) and quartz, subordinate biotite, and minor hornblende, potassium feldspar, and accessory magnetite, sphene, apatite, and zircon. Locally includes porphyritic quartz dacite. Exposed in the Yabucoa, Punta Tuna, Patillas, Guayama, and Punta Guayanes quadrangles

Kpgqm QUARTZ MONZONITE OF PLUTONIC COMPLEX OF PUNTA GUAYANES (MAESTRICHTIAN)(Rogers and others, 1979)--Light- to pale-gray, weathers to pink or pale-red, granitic-textured, medium crystalline quartz monzonite. Composed of abundant plagioclase, potassium feldspar, and quartz, subordinate hornblende, minor biotite, and accessory magnetite, sphene, apatite, and zircon. Plagioclase and hornblende commonly altered. Exposed in the Yabucoa quadrangle

TKgm GRANODIORITE QUARTZ MONZONITE (TERTIARY-UPPER CRETACEOUS ?)(McIntrye, 1975; Curet, 1986)--Fine- to medium-crystalline, granitic- to aplitic textured, massive, non-porphyritic granodiorite grading locally to quartz monzonite. Composed of plagiocalse, quartz, potassium feldspar, and hornblende with accessory sphene, apatite, and magnetite. Widely and deeply weathered. Exposed in the Rosario and Maricao quadrangles

TKh HORNBLENDE QUARTZ-DIORITE (TERTIARY ?)-UPPER CRETACEOUS ?) (Berryhill and Glover, 1960; Glover, 1961a, 1971; Broedel, 1961; Briggs and Gelabert, 1962; Monroe and Pease, 1962; Nelson, 1966; Nelson and Monroe, 1966; Nelson, 1968; Mattson, 1968a, 1968b; Pease, 1968, 1968b; Briggs, 1971; Seiders, 1971a, 1971b; M'Gonigle, 1978; Rogers, 1979; Briggs and Aguillar C., 1980; Volckmann, 1984a, 1984b)--Medium- to light greenish-gray, to dark-gray, massive, porphyritic hornblende quartz-diorite. Commonly includes abundant plagioclase, and common to abundant hornblende phenocrysts, some quartz, and minor biotite in a fine- to medium crystalline groundmass of quartz, hornblende, orthoclase, and plagioclase, with accessory magnetite, apatite, and zircon. Plagioclase ranges from fresh and clear to sericitized; hornblende is commonly altered to chlorite, calcite, and epidote; biotite is commonly fresh, but is also altered to chlorite and epidote. Exposed in the Gurabo, Corozal, Bayamon, Barranquitas, Coamo, Naranjito, Aquas Buenas, Jayuya, Florida, Orocovis, Adjuntas, Cabo Rojo, El Yunque, San German, Juncos, Caguas, Humacao, Fajardo, Bayaney, and Cayey quadrangles

TKat AUGITE TRACHYBASALT (TERTIARY ?-UPPER CRETACEOUS) (McIntyre, 1975; Krushensky and Monroe, 1978a; Krushensky and Curet, 1984; Curet, 1986; Krushensky, unpub. data)--Dark-green or dark blue-green, abundantly porphyritic augite trachybasalt; characteristically with abundant, conspicuous, and large (l-3 cm long), deep-green augite phenocrysts, and sparse, small (<5 cm long), tabular labradorite-andesine phenocrysts held in a sparse to common fine-crystalline matrix

of plagioclase microphenocrysts and microlites, sparse augite, and magnetite in a largely chloritized glass. Prominent pseudomorphs of limonite after augite aid in identifying widely saprolitized rock. Exposed in the Mayaguez, Rosario, Maricao, Monte Guilarte, Sabana Grande, Yauco, and Penuelas quadrangles

TKqd QUARTZ DIORITE-GRANODIORITE (TERTIARY ?-UPPER CRETACEOUS ?)(Nelson, 1966; Nelson and Monroe, 1966; Nelson, 1967b; Mattson, 1968b; McIntyre, 1971; McIntyre, 1975; Krushensky and Monroe, 1975, 1979, 1978a; M'Gonigle, 1978, 1979; Krushensky and Curet, 1984; and Volckmann, 1984a; Aaron, unpub. data)--Generally equigranular and massive but locally porphyritic near intrusive contacts, light- to pale-gray or pale blue-gray, quartz diorite grading into granodiorite (proportions vary, locally predominance may be reversed); shows flow-foliation and autoclastic intrusion breccia. Hornblende plagioclase, and quartz commonly predominant, orthoclase and biotite are minor constituents; accessory magnetite, apatite, sphene, and zircon. Exposed in the Fajardo, Humacao, Naguabo, Punta Puerca, Corozal, Jayuya, Rincon, Central La Plata, Utuado, Florida, Maricao, Monte Guilarte, Yauco, Penuelas, Parguera, and Ponce quadrangles

TKap AUGITE ANDESITE PORPHYRY (TERTIARY ?-UPPER CRETACEOUS ?)(Pease, 1968; Pease and Briggs, 1972; Seiders, 1971a, 1971b; Krushensky and Monroe, 1979, 1987a) --Dark-to medium bluish-gray, ranging to dark yellow-green and dark-red, light-gray to yellowish-brown weathering, augite andesite porphyry; phenocrysts include abundant, generally albitized, lath-like plagioclase, and conspicuous, sparse to

common augite in a sparse to abundant groundmass of plagioclase microphenocrysts and microlites, abundant, well crystallized magnetite, and chloritized glass. Plagioclase is uncommonly replaced by chlorite, epidote and calcite. Augite is commonly fresh and contains inclusions of apatite. Exposed in the Rio Grande, El Yunque, Naranjito, Yauco, Penuelas and Gurabo quadrangles

TKda DACITE (TERTIARY-UPPER CRETACEOUS ?)(Krushensky and Monroe, 1975, 1978a)--Aphyric, rarely porphyritic, abundantly vesicular and amygdaloidal, medium gray-green hyalopilitic dacite. Predominantly plagioclase microlites in random arrangement in glass, rare small plagioclase phenocrysts and very rare, augite phenocrysts. Vesicles and amygdules are small (<l mm across) and spherical. Largely replaced by chlorite and locally by calcite. Microlites in one small stock show trachytic texture. Exposed in the Penuelas and Ponce quadrangles

TKdi DIORITE (TERTIARY ?-UPPER CRETACEOUS ?)(Pease and Briggs, 1960; Glover, 1961a, 1971;; Berryhill, 1965; Nelson, 1966; Pease, 1968b; Briggs, 1971; McIntyre, 1971; Glover and Mattson, 1973; M'Gonigle, 1979; Briggs and Aguillar, 1980; Volckmann, 1984c; Curet, 1986)-- Generally light- to dark-gray, massive, porphyritic diorite. Fine-crystalline groundmass contains abundant plagioclase and hornblende phenocrysts. Sparse augite occurs only as inclusions or cores in hornblende. Locally, in Aguas Buenas quadrangle, hornblende to 6 cm long. Accessories include apatite and magnetite. Hornblende is commonly altered to chlorite, epidote, and calcite, plagioclase is altered to sericite. Exposed in the Fajardo, Naguabo, Corozal, Coamo, Rio Descalabrado, Rosario, Comerio, Aquas Buenas, Ciales, Central La

Plata, Orocovis, Mayaguez, and Puerto Real quadrangles

TKhda HORNBLENDE DACITE (TERTIARY-LATE CRETACEOUS)(Mattson, 1968a; McIntyre, 1975; Krushensky and Monroe, 1978a, 1979; Krushensky and Curet, 1984)--Generally light- to pale greenish-gray, uncommonly pale bluish-green, weathers to pale-gray, pale-pink, to pale-yellow saprolite, porphyritic hornblende dacite; commonly with abundant phenocrysts of plagioclase, hornblende, quartz and rarely biotite, in a fine-crystalline, microgranitic groundmass of high-soda plagioclase, orthoclase, quartz, and microlites of hornblende. Local granitic facies shows coarse-crystalline anhedral plagioclase, sanidinite, quartz and hornblende. Chilled margins locally show autoclastic intrusion breccia, and range from very fine-crystalline to glassy. Phenocrystic hornblende ranges from fresh and unaltered to completely replaced by chlorite and calcite, quartz is commonly corroded and deeply embayed. Exposed in the Maricao, Yauco, Monte Guilarte, Adjuntas, and Penuelas quadrangles

TKas ALKALI SYENITE (TERTIARY ?-UPPER CRETACEOUS ?)(Berryhill, 1965)--Composed of potash feldspar (orthoclase?) and sparse augite in a subordinate chloritized matrix. Exposed in the Ciales quadrangle

TKg GABBRO (TERTIARY-UPPER ? CRETACEOUS)(Seiders, 1971a, 1971b; Monroe, 1977)--Fine- to coarse crystalline diabasic gabbro and porphyritic gabbro, locally includes hornblende porphyry. Exposed in the Gurabo, Carolina, and El Yunque quadrangles

TKk QUARTZ KERATOPHYRE (TERTIARY ?-UPPER CRETACEOUS ?) (M'Gonigle, 1979; Briggs and Aguillar, 1980)--Medium- to dark-gray, medium bluish-gray, quartz keratophyre; weathers to grayish- or dark--yellow and light-brown. Phenocrysts of oligoclase and bipyramidal quartz in a fine-crystalline groundmass of quartz, sodic plagioclase, and potassium feldspar. Exposed in the Fajardo and Naguabo quadrangles

TKahp AUGITE-HORNBLENDE PORPHYRY (TERTIARY ?-UPPER CRETACEOUS)(Mattson, 1968a, 1968b; Krushensky and Monroe, 1978a, 1979; Volckmann, 1984b; Curet, 1986; Krushensky, unpub. data)--Light-gray to light purplish- or bluish-gray, greenish-gray, massive porphyritic augite hornblende andesite that locally grades into diorite; weathers to light purplish-gray saprolite. In the Jayuya and Adjuntas quadrangles, map unit includes basalt and dacite. Contains abundant to common plagioclase, subordinate augite and hornblende phenocrysts in an abundant felted to intersertal groundmass. Augite and hornblende are commonly replaced by chlorite, epidote, and calcite. Olivine present in trace amounts. Accessory magnetite may comprise as much as 1O percent of the rock. Exposed in the Jayuya, Mayaguez, Rosario, Adjuntas, San German, Sabana Grande, Yauco, and Penuelas quadrangles

TKha HYDROTHERMALLY ALTERED ROCK (TERTIARY ?-CRETACEOUS?) (Berryhill and Glover, 1960; Broedel, 1961; Briggs and Gelabert, 1962; Pease, 1968; Seiders, 1971a; M'Gonigle, 1978; 1968b; Rogers, 1979; Rogres and others, 1979; Glover, 1982; Volckmann, 1984b; Curet,

1986)--Generally greenish-gray, pale yellow, brown, or reddish-brown, rock is generally converted to a mixture of clay, sericite, albite, and pyrophyllite. Constituent alteration materials commonly include secondary quartz, autinite, pyrophyllite, kaolinite, sericite, chlorite, calcite, and epidote. Locally, areas mapped as hydrothermally altered, are also pyrite bearing. Majority of areas mapped as hydrothermally altered are intrusive rocks; only locally the original stratigraphic or intrusive unit identified on individual geologic maps. Hydrothermally altered rocks are exposed in the Humacao, Juncos, Barranquitas, Cayey, Naranjito, Aquas Buenas, Comerio, Caquas, Ciales, Rosario, San German, Gurabo, Patillas, Naguabo, Guayama, and Punta Tuna quadrangles

Td DACITE (TERTIARY)(Mattson, 1968a, 1968b; Krushensky and Monroe, 1975)--Commonly light- to medium bluish-green or greenish-gray porphyritic dacite with phenocrysts of plagioclase, hornblende, very sparse clinopyroxene, and rare quartz in a groundmass of quartz and chlorite (after glass?). Locally, border zones show autoclastic intrusion breccia. Exposed in the Adjuntas, Jayuya, and Ponce quadrangles

Trhp RHYODACITE PORPHYRY (TERTIARY)(McIntyre, 1971)--Light- to medium-gray and light gray-green rhyodacite porphyry with phenocrysts of plagioclase and clinopyroxene in a fine-crystalline groundmass. Plagioclase phenocrysts are pale pink and zeolitized. Chemically equivalent to granodiorite. Exposed in the Central La Plata and San Sebastian quadrangles

Tga GABBRO (UPPER ?-MIDDLE EOCENE)(McIntyre, 1975)--Dark greenish-gray gabbro; weathers to reddish-orange saprolite or brown grus, ranges from

equigranular to porphyritic and consists of plagioclase and clinopyroxene and accessory magnetite. Ranges from high alumina gabbro to alkalic gabbro. Exposed in the Maricao quadrangle

Thp HORNBLENDE QUARTZ-DIORITE PORPHYRY (EOCENE)(Berryhill and Glover, 1960; Glover, 1961a; Nelson, 1966; Mattson, 1968a; 1971; Nelson, 1968; Tobisch and Turner, 1971; Krushensky and Monroe, 1975; McIntyre, 1975; Krushensky and Curet, 1984)--Generally light- to pale-green, light greenish-gray, equigranular to porphyritic hornblende quartz diorite, minor hornblende- granodiorite, and quartz monzonite and quartz diorite. Composed of abundant plagioclase and subordinate quartz and hornblende held in a microgranitic groundmass of quartz, orthoclase, and plagioclase. Hornblende is commonly replaced by chlorite, calcite and epidote. Plagioclase phenocrysts range from fresh to altered. Rock is locally pyritized, and in some areas includes disseminated chalcopyrite in the groundmass. Locally the stocks are molybdenite-bearing. Exposed in the San Sebastian, Bayaney, Monte Guilarte, Adjuntas, Cayey, Coamo, Maricao, Ponce, and Corozal quadrangles

Puerto Rico geologic map units by geologic terranes
[Stratigraphic units listed alphabetically within terrane]

Map unit symbol	Map unit
NONVOLCANICLASTIC TERRANES	
Quaternary:	
Qa	Alluvium
Qb	Beach deposits
QTs	Blanket sand deposits
Ql	Landslide deposits
Qs	Swamp deposits
af	Artificial fill
Pliocene through Oligocene:	
Tcbga	Almirante Sur Sand Lentil of Cibao Formation
Ta	Aguada Limestone
Tay	Aymamon Limestone
Tcm	Camuy Formation
Tcb	Cibao Formation
Tcbg	Guajataca Member of Cibao Formation
Tgua	Guanajibo Formation
Tjd	Juana Diaz Formation
Tla	Lares Limestone
Tcbmi	Miranda Sand Member of Cibao Formation
Tcbm	Montebello Limestone Member of Cibao Formation
Tmu	Mucarabones Sand
Tpo	Ponce Limestone
Tcbq	Quebrada Arenas Limstone Member of Cibao Formation
Tcbr	Rio Indio Limstone Member of Cibao Fomation
Ts	San Sebastian Formation
Tfb	Fault breccia
Eocene through Cretaceous:	
Tco	Corozal Limestone
Kcot	Cotui Limestone
Tc	Cuevas Limstone
Tg	Guayo Formation
Klm	La Muda Formation
Kp	Parguera Limestone
Kpe	Penones Limestone

INTRUSIVE TERRANES

Tertiary through Cretaceous:

TKas	Alkali syenite
TKap	Augite andesite porphyry
TKahp	Augite-hornblende porphyry
TKat	Augite trachybasalt
Td	Porphyritic dacite
TKda	Amygdaloidal dacite
TKg	Diabasic gabbro
Tga	Gabbro
TKgm	Granodiorite quartz monzonite
TKhda	Hornblende dacite
TKh	Porphyry Hornblende quartz-diorite
Thp	Hornblende quartz diorite porphyry
TKdi	Diorite
TKqd	Quartz diorite-granodiorite
TKk	Quartz keratophyre
Trhp	Rhyodacite porphyry

Cretaceous:

Kdi	Diorite
Kdh	Diorite-hornblende gabbro
Kcag	Granodiorite of the Caguas pluton
Kmc	Granodiorite of Morovis and Ciales stocks
Kpgq	Quartz diorite - plutonic complex of Punta Guayanes
Kpsg	Granodiorite of the plutonic complex of Punta Guayanes and the granodiorite of San Lorenzo batholith, undivided
Ksl	Granodiorite-quartz diorite of San Lorenzo batholith
Ku	Granodiorite-quartz diorite of the Utuado batholith
Kib	Intrusive breccia of the Daguao Formation
Kslg	Mixed granodiorite-diorite of the San Lorenzo batholith
Kpgg	Granodiorite of plutonic complex of Punta Guayanes
Kpsq	Quartz diorite of plutonic complex of Punta Guayanes and of the Granodiorite of San Lorenzo batholith
Kslq	Quartz diorite facies of Granodiorite of San Lorenzo batholith and diorite-hornblende gabbro
Kpgqm	Quartz monzonite of plutonic complex of Punta Guayanes
Kpob	Two pyroxene olivine basalt

VOLCANICLASTIC TERRANES

SUBAERIAL:

Kcb	Cambalache Formation
Kpo	Pozas Formation

MARINE:

Tertiary

Tca	Carreras Siltstone
Tj	Jicara Formation
Tjo	Jobos Formation
Tl	Los Puertos Formation
Tm	Monserrate Formation
Tor	Ortiz Formation
Tpa	Palmarejo Formation
Tra	Raspaldo Formation
Tr	Rio Culebrinas Formation
Trd	Rio Descalabrado Formation
Trp	Rio Piedras Siltstone
Ty	Yunes Formation

Tertiary and Cretaceous:

TKa	Anon Formation
TKamo	Anon-Monserrate Formations, undivided
TKay	Anon and Yauco Formations, undivided
TKam	Anon and Maricao Formations, undivided
TKci	Cibuco Formation
TKgu	Guaracanal Formation
TKl	Lago Garzas Formation
TKaym	Anon, Yauco, and Maricao Formations, undivided
TKlam	Lago Garzas, Anon, and Maricao Formations, undivided
TKly	Lago Garzas and Yauco Formations, undivided
TKal	Anon Formations and Lago Garzas, undivided
TKm	Maricao Formation
TKmy	Maricao and Yauco Formations, undivided
TKmly	Maricao, Lago Garzas, and Yauco Formations, undivided
TKn	Naranjito Formation
TKy	Yauco Formation

Cretaceous:

Kac	Achiote Conglomerate
Kal	Alonso Formation
Kba	Barrazas Formation
Kcam	Camarones Sandstone
Kcn	Canovanas Formation
Kca	Cariblanco Formation
Kcan	Cancel Breccia
Kcar	Carraizo Breccia
Kcoa	Coamo Formation
Keo	El Ocho Formation
Kfa	Fajardo Formation
Kfr	Frailes Formation
Kg	Guaynabo Formation
Kh	Hato Puerco Formation
Kja	Jayuya Tuff
Kln	Los Negros Formation
Kma	Magueyes Formation
Kmal	Malo Breccia
Kman	Manicaboa Formation
Kmar	Maravillas Formation
Kmag	Martin Gonzalez Lava
Km	Melones Limestone
Kmo	Monacillo Formation
Kpa	Pajaros Tuff
Kpi	Pitahaya Formation
Kra	Rio Abajo Formation
Krp	Rio de la Plata Sandstone
Kr	Robles Formation
Ks	Sabana Grande Formation
Kta	Tabonuco Formation
Kte	Tetuan Formation
Kt	Torrecilla Breccia
Kto	Tortugas Andesite
Kv	Vista Alegre Formation

ALTERATION TERRANE

TKmv	Metavolcanic rock
TKha	Hydrothermally altered rock

SUBMARINE BASALT AND CHERT TERRANE

Kabcj	Formations A, B, C, & J
Kav	Avispa Formation
Kap	Avispa and Perchas Formations, undivided
Kbo	Boqueron Basalt
KJc	Cajul Basalt
Kce	Celada Formation
Kcg	Cerro Gordo Lava
Kco	Concepcion Formation
Kctt	Cotorra Tuff
Kd	Daguao Formation
Ke	El Rayo Formation
Kf	Figuera Lava
Kfd	Figuera and Daguao Formations, undivided
Ki	Infierno Formation
Kl	Lajas Formation
Klo	Lomas Formation
Kmam	Mameyes Formation
KJm	Mariquita Chert
Kper	Perchas Formation
Kso	Santa Olaya Lava

ULTRAMAFIC ROCK AND AMPHIBOLITE TERRANE

KJa	Amphibolite
KJas	Amphibolite-Serpentinite
KJs	Serpentinite
KJb	Spillitized Basalt

Metallic Mineral Occurrences

Appendix B. Selected Mineral Resources Data Systems (MRDS) data fields of metallic mines and mineral occurrences for Puerto Rico. For complete record retrievals, see Appendix E.

Site number is a unique identification number for each site found on the mineral occurrence maps.

Record numbers are unique and assigned to each record in the MRDS data base. A single record represents a site or groups of adjacent properties. Complete MRDS records for each site are found in appendix B.

The site name is extracted from the referenced literature describing that deposit, prospect, or occurrence. In cases where the site is unnamed, it is referred to by quadrangle and sequence number as listed in Cox and Briggs, 1973.

The quadrangle name refers to the 1:20,000 scale quadrangle map series for the Commonwealth of Puerto Rico, in which the site is located.

The Latitude and longitude provide the location in degrees, minutes, and seconds (DMS) for that specific site.

The Commodities present are those known to occur at the site. Not all metallic commodities are mentioned, only those considered most significant. At some sites, significant industrial commodities have also been noted.

The deposit type is the mineral deposit type thought to be present at the site. Assignment to a mineral deposit type is dependent upon the quantity and quality of geologic information available. When sufficient information is not available to decide upon a specific model type, it remains unclassified and is cited as unknown.

The Host rock type is determined from geologic descriptions of the site from either personal observation or from geologic literature in cases where direct observations were not possible. (SEE NEXT PAGE)

Site Number	Record Number	Site Name	Quadrangle Name	Latitude DMS	Longitude DMS	Commodities Present	Deposit Type	Host Rock Type
1	W701144	UNNAMED 48-2	RIO DESCALABRADO	18-04-50N	066-27-40W	Mn Cu	VEINS OR SHEAR ZONES	CARBONATES
2	W701145	JUANA DIAZ MINE	RIO DESCALABRADO	18-04-15N	066-27-55W	Mn	FISSURE FILLINGS	LIMESTONE
4	W701146	UNNAMED 48-4	RIO DESCALABRADO	18-03-09N	066-27-44W	Cu	VEINS OR SHEAR ZONES	CARBONATES
6	W701147	UNNAMED 48-5	RIO DESCALABRADO	18-03-15N	066-27-10W	Mn Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
8	W701148	GUAVABAL C U	RIO DESCALABRADO	18-03-22N	066-26-45W	Cu	VEIN(?)	VOLCANIC-WACKE, CONGLOMERATE, DACITE TUFF
10	W701149	UNNAMED 48-7	RIO DESCALABRADO	18-03-40N	066-26-03W	Mn	VEINS OR SHEAR ZONES	CARBONATES
12	W701020	UNNAMED 20-1	CIALES	18-20-18N	066-28-31W	Cu	UNKNOWN Cu	QUARTZ MONZONITE
13	W701021	UNNAMED 20-2	CIALES	18-19-40N	066-25-15W	Cu	UNKNOWN Cu	QUARTZ MONZONITE
14	W701022	UNNAMED 20-3	CIALES	18-18-57N	066-29-40W	Pb Zn Ag Ba	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
15	W701023	UNNAMED 20-4	CIALES	18-18-34N	066-29-35W	Cu Ag	Cu MANTO	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
16	W701024	UNNAMED 20-5	CIALES	18-17-50N	066-28-38W	Cu Ag	Cu MANTO	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
17	W701025	UNNAMED 20-6	CIALES	18-17-22N	066-28-19W	Cu	Cu MANTO	LAVA OR LAVA BRECCIA
18	W701060	UNNAMED 31-2	MONTE GUILARTE	18-13-22N	066-51-20W	Mn	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
19	W701026	UNNAMED 20-7	CIALES	18-16-48N	066-28-27W	Cu	MORE OR LESS STRARABOUND	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
20	W701061	UNNAMED 31-3	MONTE GUILARTE	18-12-40N	066-51-00W	Mn	VEINS OR SHEAR ZONES	WEATHERED ANDESITE
21	W701027	UNNAMED 20-8	CIALES	18-18-36N	066-27-12W	Cu	UNKNOWN Cu	AUGITE ANDESITE
22	W701062	UNNAMED 31-4	MONTE GUILARTE	18-10-47N	066-50-32W	Mn	VEINS OR SHEAR ZONES	
23	W701028	UNNAMED 20-9	CIALES	18-18-00N	066-26-15W	Cu	UNKNOWN Cu	BASALT LAVA
24	W701063	MONTE GUILARTE	MONTE GUILARTE	18-10-10N	066-46-20W	Mn	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA

25	W701029	BARRIO PASTO DEPOSITS	CIALES	18-17-20N	066-26-03W	Cu Ag	BRECCIA-FILLING	PORPHYRITIC AND BRECCIATED ANDESITE
26	W701064	UNNAMED 32-1	ADJUNTAS	18-14-45N	066-44-50W	Au Cu	VEIN	LAVA OR LAVA BRECCIA; THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
27	W701065	UNNAMED 32-2	ADJUNTAS	18-14-20N	066-43-25W	Au	VEIN	QUARTZ MONZONITE
28	W701066	UNNAMED 32-3	ADJUNTAS	18-13-55N	066-43-00W	Cu	VEIN	QUARTZ DIORITE
29	W701067	UNNAMED 32-4	ADJUNTAS	18-13-40N	066-43-25W	Cu	VEIN	QUARTZ DIORITE
30	W701068	UNNAMED 32-5	ADJUNTAS	18-12-10N	066-41-15W	Cu	UNKNOWN Cu	QUARTZ DIORITE
31	W701069	UNNAMED 32-6	ADJUNTAS	18-11-55N	066-42-30W	Cu	VEIN	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
32	W701110	UNNAMED 35-10	BARRANQUITAS	18-10-27N	066-17-22W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
34	W701112	RIO HONDO 36-2	COMERIO	18-13-15N	066-14-45W	Cu	VEINS OR SHEAR ZONES	CARBONATES
35	W701113	CIDRA	COMERIO	18-11-40N	066-10-16W	Cu Zn Pb Au?	VOLCANIC HOSTED EPITHERMAL	DIORITIC PORPHYRY
36	W701114	BEATRIZ	CAGUAS	18-11-00N	066-03-45W	Zn Fe Cu	BASEMETAL SULFIDE VEIN	VOLCANICS, TONALITE
37	W701115	ESCUELA PROSPECT	JUNCOS	18-14-28N	065-57-55W	Fe Cu	SKARN	TUFFS AND LIMY TUFFS
38	W701150	UNNAMED 48-8	RIO DESCALABRADO	18-03-11N	066-26-31W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
39	W701116	AGUAYO PROSPECT	JUNCOS	18-14-25N	065-57-40W	Fe Cu	SKARN	CARBONATES
41	W701117	CANE FIELD & PASTOR PROSPECTS	JUNCOS	18-14-15N	065-57-50W	Fe	SKARN	CARBONATES
42	W701152	UNNAMED 48-10	RIO DESCALABRADO	18-02-56N	066-24-15W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
43	W701118	SANTIAGO & PASTOR PROSPECTS	JUNCOS	18-14-00N	065-57-38W	Fe Cu	SKARN	CARBONATES
44	W701153	CUATRO CALLES	RIO DESCALABRADO	18-02-50N	066-27-15W	Cu	VEIN(?)	LIMESTONE FAULT BRECCIA
45	W701119	SUIZA PROSPECT	JUNCOS	18-14-18N	065-57-24W	Fe Cu	SKARN	CARBONATES
46	W701154	UNNAMED 48-12	RIO DESCALABRADO	18-02-28N	066-27-30W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE

47	W701155	UNNAMED 48-13	RIO DESCALABRADO	18-02-25N	066-25-37W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
48	W701156	SANTIAGO	RIO DESCALABRADO	18-02-13N	066-25-05W	Mn	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
49	W701157	UNNAMED 48-15	RIO DESCALABRADO	18-01-53N	066-27-12W	Cu	VOLCANIC HOSTED VEIN	MARINE VOLCANICS
51	GEM1111	BORINQUEN	CAGUAS	18-10-00N	066-02-00W	Cu	SKARN	VOLCANICS, CALCAREOUS FINE-GRAINED WATER LAIN TUFFS, LAPILLI TUFFS, TUFF BRECIAS
52	W701159	RIO CUYON	CAYEY	18-06-40N	066-14-45W	Cu	PORPHYRY COPPER	QUARTZ DIORITE PORPHYRY
53	GEM1112	CABO ROJO	SAN GERMAN	18-03-00N	067-08-00W	Cu Au	CU OCCURRENCE	SAN GERMAN
54	GEM1113	ROSARIO	SAN GEMAN	18-08-00N	067-05-00W	Cu Au	CU OCCURRENCE	SABANA GRANDE ANDESITES AND FLOWS
58	GEM1117	RIO JAJOME	CAYEY	18-05-05N	066-08-15W	Cu Au An	VEIN	VOLCANIC FLOWS
62	W701030	UNNAMED 20-11	CIALES	18-17-42N	066-24-03W	Cu	UNKNOWN Cu	GRANODIORITE
63	W701031	UNNAMED 20-12	CIALES	18-16-21N	066-23-54W	Cu	VEINS OR SHEAR ZONES	BASALTIC PILLOW LAVA
64	W701032	UNNAMED 20-13	CIALES	18-15-45N	066-24-00W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA; THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
65	W701033	MAYAGUEZ	COROZAL	18-20-08N	066-19-41W	Mn	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
66	W701034	CONSTANCIA MINE	COROZAL	18-20-07N	066-19-46W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
67	W701035	COROZAL	COROZAL	18-19-14N	066-18-15W	Mn Fe	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
68	W701036	UNNAMED 21-4	COROZAL	18-17-45N	066-20-17W		VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
69	W701070	PELLEJAS	ADJUNTAS	18-11-52N	066-41-50W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE

70	W701037	COLL CUCHI, SAYRE	COROZAL	18-17-38N	066-20-20W	Au	VEINS	VEINS OCCUR IN "SLATE-LIKE-STRUCTURE" ALTERED TUFFS
71	W701071	PIEDRA HUECA DEPOSIT	ADJUNTAS	18-11-50N	066-41-12W	Cu	PORPHYRY COPPER	QUARTZ DIORITE PORPHYRY STOCK
72	W701038	PALOS BLANCOS	COROZAL	18-17-16N	066-17-25W	Au	PLACER	PLACER
73	W701072	SAPO ALEGRE PROSPECT	ADJUNTAS	18-11-50N	066-40-45W	Cu Mo	PORPHYRY COPPER	QUARTZ DIORITE PORPHYRY
74	W701039	UNNAMED 21-7	COROZAL	18-16-56N	066-18-05W	Au	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
75	W701073	CALA ABAJO DEPOSIT	ADJUNTAS	18-11-20N	066-40-50W	Cu	PORPHYRY COPPER	QUARTZ DIORITE PORPHYRY STOCK
76	W701074	UNNAMED 32-11	ADJUNTAS	18-11-45N	066-44-25W	Zn	VEINSAND SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
77	W701075	UNNAMED 32-12	ADJUNTAS	18-11-20N	066-44-55W	Zn	VEINS AND SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
78	W701076	UNNAMED 32-13	ADJUNTAS	18-11-10N	066-40-05W	Cu	VEINS AND SHEAR ZONES	QUARTZ DIORITE
79	W701077	UNNAMED 32-14	ADJUNTAS	18-11-28N	066-38-07W	Zn	VEINS AND SHEAR ZONES	QUARTZ DIORITE
80	W701078	UNNAMED 32-15	ADJUNTAS	18-11-05N	066-37-35W	Cu	VEINS AND SHEAR ZONES	QUARTZ DIORITE
81	W701079	UNNAMED 32-16	ADJUNTAS	18-11-02N	066-38-19W	Cu	VEINS AND SHEAR ZONES	QUARTZ DIORITE
82	W701120	UNNAMED 38-6	JUNCOS	18-14-36N	065-57-14W	Fe Cu Au	SKARN	CARBONATES
83	W701121	BUEN SUCESO	JUNCOS	18-14-14N	065-56-59W	Fe Cu	SKARN	CARBONATES
84	W701122	LA CARIDAD PROSPECT	JUNCOS	18-14-16N	065-56-40W	Fe Cu	SKARN	CARBONATES
85	W701123	KEYSTONE MINE	JUNCOS	18-14-00N	065-53-54W	Fe Cu	SKARN	THIN TUFFACEOUS MARBLE
86	W701124	UNNAMED 39-1	HUMACAO	18-13-59N	065-51-34W	Ba	VEINS AND SHEAR ZONES	SHEAR ZONES
87	W701125	DEPOSIT NO. 5	HUMACAO	18-12-17N	065-49-45W	Fe	SKARN	LIMESTONE
88	W701160	CERRO AVISPA	CAYEY	18-04-35N	066-11-50W	Au Ag	VEIN	LAVA OR LAVA BRECCIA
89	W701126	DEPOSIT NO. 2	HUMACAO	18-11-57N	065-50-54W	Fe	SKARN	METAMORPHOSED CALCAREOUS ANDESITE TUFF(?)
90	W701161	CARMEN 50-3	CAYEY	18-02-14N	066-09-45W	Pb	VEINS AND SHEAR ZONES	LAVA OR LAVA BRECCIA
91	W701127	DEPOSIT NO. 3	HUMACAO	18-11-42N	065-50-32W	Fe LST2	SKARN	METAMORPHOSED LIMESTONE

92	W701128	ISLAND QUEEN MINE	HUMACAO	18-11-23N	065-50-02W	Fe Cu	COPPER IRON SKARN	CARBONATES,SILTSTONES, SANDSTONES, TUFFS, BASALT FLOWS
93	W701162	CARMEN 50-4	CAYEY	18-02-07N	066-10-22W	Pb	VEINS AND SHEAR ZONES	LAVA OR LAVA BRECCIA
94	W701129	DEPOSIT NO. 4	HUMACAO	18-11-17N	065-49-28W	Fe	SKARN	CARBONATES
95	W701163	CARMEN 50-5	CAYEY	18-01-40N	066-10-15W	Au Ag Pb Cu Zn	VEINS	CONGLOMERATE, AUGITE ANDESITE
96	W701164	YAUREL	PATILLAS	18-01-59N	066-03-17W	Fe Zn Cu Au	SKARN	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
97	W701165	EMAJAGUA	PATILLAS	18-01-34N	066-02-57W	Fe	SKARN	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
98	W701166	CACAO	PATILLAS	18-00-47N	066-02-20W	Cu	Cu OCCURRENCE	VOLCANIC TUFF BRECCIA, FLOWS, INTERLAYERD SILTS
100	GEM1120	LUQUILLO MOUNTAINS GOLD PLACERS	E YUNQUE	18-15-00N	065-45-00W	Au	PLACER-GOLD	GRAVELS
105	W701003	HATILLO	CAMUY	18-29-22N	066-50-20W	Fe	PLACER	SAND
106	W701004	LA MARINA	ARECIBO	18-28-29N	066-42-38W	Fe	PLACER	SAND
107	W701005	LA BOCA	BARCELONETA	18-29-09N	066-32-36W	Fe TIO2	PLACER BEACHSAND	SAND
110	W701041	UNNAMED 22-2	NARANJITO	18-17-18N	066-08-29W	Cu Ba	VEINS AND SHEAR ZONES	LAVA OR LAVA BRECCIA
111	W701007	RIO COCAL	BAYAMON	18-28-10N	066-13-41W	Fe	PLACER	SAND
112	W701042	UNNAMED 23-1	AGUAS BUENAS	18-20-34N	066-03-30W	Cu	UNKNOWN Cu	DIORITE OR GABBRO
114	W701043	LA MUDA 23-2	AGUAS BUENAS	18-20-18N	066-06-51W	Cu Mo	PORPHYRY COPPER	VOLCANIC FLOWS
115	W701009	AGUADA	RINCON	18-21-45N	067-10-20W	Mn CLY1	VOLCANIC ASH BENTONITE	ANDESITE PORPHYRY
116	W701044	LA MUDA 23-3	AGUAS BUENAS	18-19-55N	066-05-58W	Cu Mo	PORPHYRY COPPER	QUARTZ DIORITE
117	W701045	LA MUDA 23-4	AGUAS BUENAS	18-19-28N	066-05-10W	Cu Mo	PORPHYRY COPPER	QUARTZ DIORITE
118	W701080	UNNAMED 32-17	ADJUNTAS	18-10-43N	066-38-53W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA; THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
119	W701046	LA MUDA 23-5	AGUAS BUENAS	18-19-40N	066-04-35W	Cu Mo	VEINS OR SHEAR ZONES	QUARTZE DIORITE
121	W701081	UNNAMED 32-18	ADJUNTAS	18-10-10N	066-37-38W	Cu	UNKNOWN Cu	CARBONATES
122	W701047	UNNAMED 23-6	AGUAS BUENAS	18-18-30N	066-02-45W	Cu	VEINS OR SHEAR ZONES	QUARTZ DIORITE

123	W701082	UNNAMED 32-19	ADJUNTAS	18-08-21N	066-41-14W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
124	W701048	UNNAMED 23-7	AGUAS BUENAS	18-15-57N	066-05-30W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
125	W701083	UNNAMED 32-20	ADJUNTAS	18-07-58N	066-40-21W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
126	W701049	EL YUNQUE	EL YUNQUE	18-18-25N	065-46-22W	Au Cu	SKARN	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
127	W701084	UNNAMED 32-21	ADJUNTAS	18-08-03N	066-43-45W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
128	W701085	GATTI PROSPECT	ADJUNTAS	18-07-49N	066-44-04W	Mn	VEIN	TUFF, LAVA
129	WALT001	MONTE EL GATO	CAYEY	18-05-00N	066-11-00W	Au Fe Cu	LOW SULFIDE QUARTZ VEINS	PYROCLASTIC ASSEMBLAGE OF POORLY SORTED LAPILLI TUFF AND BRECCIA
130	W701086	UNNAMED 33-1	JAYUYA	18-14-00N	066-35-47W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
131	W701087	UNNAMED 33-2	JAYUYA	18-12-15N	066-33-28W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
132	W701088	UNNAMED 33-3	JAYUYA	18-12-03N	066-34-40W	Cu	VEINS OR SHEAR ZONES	QUARTZ MONZONITE
133	W701089	UNNAMED 33-4	JAYUYA	18-11-59N	066-33-30W	Cu	UNKNOWN Cu	QUARTZ MONZONITE
134	W701130	UNNAMED 39-7	HUMACAO	18-07-43N	065-50-00W	Fe-Ti	UNKNOWN Fe-Ti	QUARTZ MONZONITE
139	W701133	PALMAREJO	SAN GERMAN	18-02-53N	067-04-56W	GYP Cu Au Hg	VEINs	SERPENTINITES
140	W701134	UNNAMED 43-4	SAN GERMAN	18-00-16N	067-05-30W	Au Ag	UNKNOWN Au-Ag	CHERT
141	W701135	MINILLAS, SAN GERMAN	SABANA GRANDE	18-03-35N	066-59-50W	Au Cu Ag Pb Zn	VEINS	PORPHYRITIC ANDESITE, CARBONATES
143	W701136	TIBES	SABANA GRANDE	18-04-05N	066-57-20W	Pb Fe Au	MAGNETITE SKARN	LAVA OR LAVA BRECCIA, LIMESTONE
145	W701137	UNNAMED 44-3	SABANA GRANDE	18-03-10N	066-57-10W	Mo	UNKNOWN Mo	LAVA OR LAVA BRECCIA
146	W701172	UNNAMED 65-1	ISLAND OF VIEQUES	18-07-08N	065-28-26W	Cu	Cu-Au OCCURENCE	QUARTZ MONZONITE
147	W701138	BARRIO TIBES, RIO PORTUGUES	PENUELAS	18-05-00N	066-38-00W	Fe Cu	SKARN	LIMESTONE

149	W701139	UNNAMED 46-2	PENUELAS	18-02-58N	066-39-50W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA; VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
156	W701010	UNNAMED 14-2	RINCON	18-21-20N	067-10-35W	Cu	VEINLETS	AMYGDALOIDAL AUGITE-ANDESITE FLOWS
157	W701011	UNNAMED 15-1	CENTRAL LA PLATA	18-17-05N	067-04-20W	Au Pb Zn	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA; VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
158	W701012	LAUNDRY CREEK PROSPECT	BAYANEY	18-17-20N	066-50-20W	Cu	PORPHYRY COPPER	TONALITE PORPHYRY STOCK
159	W701013	COPPER CREEK PROSPECT	BAYANEY	18-16-15N	066-49-15W	Cu	PORPHYRY COPPER	TONALITE PORPHYRY
160	D002191	CERRO LA TIZA	PUERTO RICO	18-14-37N	066-11-05W	Al K Cu Au	HYDROTHERMAL ALTERATION	BASALTIC - ANDESITIC VOLCANIC ROCKS
161	W701014	TANAMA DEPOSIT	BAYANEY	18-15-30N	066-47-29W	Cu Au	PORPHYRY COPPER	FAULTED TONALITE PORPHYRY STOCK
162	W701015	UNNAMED 17-4	BAYANEY	18-15-45N	066-52-05W	Cu	UNKNOWN Cu	LAVA OR LAVA BRECCIA; THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
163	W701016	UNNAMED 18-1	UTUADO	18-15-08N	066-44-11W	Cu Zn	VEINS OR SHEAR ZONES	QUARTZ MONZONITE
164	W701050	LA MINA, RIO BLANCA	EL YUNQUE	18-15-40N	065-48-36W	Cu Fe Au Ag	SKARN	CARBONATES
166	W701051	PUNTA GUANAJIBO DEPOSITS 1 & 2	MAYAGUEZ	18-09-50N	067-10-37W	Ni Fe Co Cr	LATERITE	PERIDOTITE (SERPENTINITE)
169	W701053	LAS MESAS DEPOSIT	ROSARIO	18-11-10N	067-06-15W	Ni Fe Co Cr	LATERITE	PERIDOTITE (SERPENTINITE)
171	W701054	ROSARIO NORTH DEPOSIT	ROSARIO	18-09-45N	067-01-45W	Ni Fe Co Cr	LATERITE	LATERITE, SERPENTINITE
172	W701055	ROSARIO SOUTH DEPOSIT	ROSARIO	18-08-55N	067-01-08W	Ni Fe Co Cr	LATRITE	LATERITE, SERPENTINITE
173	W701056	UNNAMED 30-1	MARICAO	18-12-30N	066-55-00W	Mn	VEINS OR SHEAR ZONES	
174	W701090	UNNAMED 33-5	JAYUYA	18-12-01N	066-33-09W	Cu	UNKNOWN Cu	QUARTZ MONZONITE
175	W701057	MARICAO WEST AND LAS TETAS DE CERRO GORDO WEST	MARICAO	18-08-50N	066-58-50W	Ni Fe Co Cr	LATERITE	PERIDOTITE (SERPENTINITE)
176	W701091	UNNAMED 33-6	JAYUYA	18-11-39N	066-31-45W	Cu Mo	LATERITE	
177	W701058	MARICAO EAST AND LAS TETAS DE CERRO GORDO EAST	MARICAO	18-08-15N	066-57-56W	Ni Fe Co Cr	VEINS OR SHEAR ZONES	PERIDOTITE (SERPENTINITE)

178	W701092	UNNAMED 33-7	JAYUYA	18-11-09N	066-36-43W	Cu	PORPHYRY COPPER	QUARTZ MONZONITE
179	W701059	HELECHO DEPOSIT	MONTE GUILARTE	18-14-38N	066-48-00W	Cu Au Ag	VEINS OR SHEAR ZONES	BASALTS, FELSIC VOLCANICS
180	W701093	UNNAMED 33-8	JAYUYA	18-11-04N	066-36-02W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
181	W701094	UNNAMED 33-9	JAYUYA	18-10-46N	066-30-54W	Zn	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
182	W701095	UNNAMED 33-10	JAYUYA	18-10-17N	066-34-56W	Cu Zn	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
183	W701096	UNNAMED 33-11	JAYUYA	18-09-53N	066-36-30W	Cu	UNKNOWN Cu	
184	W701097	UNNAMED 33-12	JAYUYA	18-08-57N	066-34-37W	Cu Zn Au	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
185	W701098	UNNAMED 33-13	JAYUYA	18-09-00N	066-33-33W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
186	W701099	UNNAMED 33-14	JAYUYA	18-07-46N	066-32-35W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE
187	WALT002	RIO ANASCO	MARICAO	18-15-00N	066-56-00W	Fe Cu	COPPER SULFIDE VEINS	ANDESITIC VOLCANIC ROCKS
188	WALT003	RIO SANTIAGO COPPER PROSPECT	HUMACAO	18-12-00N	065-44-00W	Fe Cu Mo	DISSEMINATED BLEBS	GRANITIC INTRUSIVE ROCKS
189	WALT004	HUMACAO COPPER PROSPECT	HUMACAO	18-11-00N	065-52-00W	Cu Fe Mo	CHALCOPYRITE, BORNIT E	GRANODIORITE
190	W701100	UNNAMED 34-1	OROCOVIS	18-10-13N	066-27-56W	Cu	VEINS OR SHEAR ZONES	VERY THICK BEDDED TUFF, TUFF BRECCIA, OR CONGLOMERATE
191	W701101	RIO HONDO 35-1	BARRANQUITAS	18-13-14N	066-16-25W	Cu Au Ag	SKARN OR PORPHYRY Cu	LAVA OR LAVA BRECCIA
192	W701102	RIO HONDO 35-2		18-13-23N	066-16-12W	Cu	VEINS OR SHEAR ZONES	CARBONATES
193	W701103	RIO HONDO 35-3	BARRANQUITAS	18-13-11N	066-15-55W	Cu	VEINS OR SHEAR ZONES	CARBONATES
194	W701104	RIO HONDO 35-4	BARRANQUITAS	18-13-10N	066-15-34W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
195	W701105	RIO HONDO 35-5	BARRANQUITAS	18-13-23N	066-15-06W	Cu	VEINS OR SHEAR ZONES	CARBONATES
196	W701106	RIO HONDO 35-6	BARRANQUITAS	18-13-03N	066-15-05W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
197	W701140	UNNAMED 47-1	PONCE	18-04-30N	066-37-15W	Fe	SKARN	

198	W701107	UNNAMED 35-7	BARRANQUITAS	18-12-46N	066-20-22W	Cu	VEINS OR SHEAR ZONES	LAVA OR LAVA BRECCIA
200	W701108	RIO CALIENTE	BARRANQUITAS	18-12-45N	066-17-55W	Au	PLACER	PLACER
201	W701052	GUANAJIBO DEPOSIT	MAYAGUEZ	18-08-02N	067-09-43W	Ni Fe Co Cr	LATERITE	PERIDOTITE (SERPENTINITE)
203	W701109	BARRANQUITAS PROSPECT	BARRANQUITAS	18-12-05N	066-18-34W	Au Cu	QUARTZ VEINS	ALTERED TUFFACEOUS VOLCANIC ROCKS
204	W701143	UNNAMED 48-1	RIO DESCALABRADO	18-04-27N	066-29-49W	Cu	VEINS OR SHEAR ZONES	THIN TO THICK BEDDED TUFF, TUFFACEOUS SANDSTONE, OR MUDSTONE

Industrial Mineral Occurrences

Appendix C. Selected Mineral Resources Data System (MRDS) data fields of industrial mines and minerals occurrences for Puerto Rico. A retrieval with more complete records can be made in Appendix E.

Commodities Include those of primary economic interest, coproducts, and byproducts, which have not been exploited but which are present in sufficient amount to be suspected of possible economic interest, and occurrences of geologic interest. A question mark following the acronym indicates uncertainty in commodity assignment.

MRDS Abbreviations	Commodity
BA	Barite
CLY1	Bentonite
DOL	Dolomite
GAR	Garnet
GYP	Gypsum, Anhydrite
LST	Limestone
LST1	Limestone, Ultra Pure limestone ($CaCO_3$ > 97%)
LST2	Limestone, High calcium limestone ($CaCO_3$ > 95%)
MBL	Marble
P	Phosphate
SDG	Sand and gravel
SIL	Silica
STN	Stone
STN1	Stone, crushed or broken stone
STN2	Stone, Dimension
VOL	Volcanic materials (ash, cinders)
SLA	Slate

Site Number	Record Number	Quadrangle Name	Latitude DMS	Longitude DMS	Commodities Present	Host Rock Type
1	TC01031	PATILLAS	18-00-30N	066-03-39W	STN1	HORNBLENDE DIORITE
2	TC00712	NARANJITO	18-20-00N	066-07-50W	STN1	
3	TC01027	ARECIBO	18-26-56N	066-38-08W	LST	LIMESTONE
4	TC01039	COMERIO	18-12-27N	066-08-17W	STN1 STN2	LIMESTONE
5	TC01160	HUMACAO	18-09-05N	065-47-16W	STN1	TUFF, VOLCANIC SANDS
6	TC00716	NARANJITO	18-22-00N	066-14-35W	SDG	
7	TC01035	GUAYAMA	17-59-06N	066-05-20W	STN1	PORPHYRITIC QUARTZ DIORITE
8	TC01164	PONCE	18-01-46N	066-36-56W	LST	CALCAREOUS SANDY CLAY
9	TC01023	ARECIBO	18-26-15N	066-41-42W	LST	LIMESTONE
10	TC00718	BAYAMON	18-25-05N	066-14-35W	LST	
11	TC01260	BAYAMON	18-24-41N	066-10-35W	STN1	LIMESTONE
12	TC01166	PONCE	18-01-25N	066-35-13W	LST	CALCAREOUS SANDSTONE
13	TC00710	NARANJITO	18-17-45N	066-12-50W	VOL	
14	TC01025	ARECIBO	18-26-27N	066-41-10W	LST	LIMESTONE
15	TC01037	CAYEY	18-07-14N	066-09-23W	STN1	LIMESTONE
16	TC01264	PUERTO REAL	18-05-12N	067-08-30W	LST	LIMESTONE
17	TC01033	PATILLAS	18-00-51N	066-03-35W	STN1	HORNBLENDE DIORITE
18	TC01021	ARECIBO	18-26-56N	066-38-08W	LST	LIMESTONE
19	TC01029	PATILLAS	18-00-11N	066-02-19W	STN1	ANDESITIC LAVA
20	TC00714	NARANJITO	18-20-30N	066-08-10W	STN	
21	TC01162	HUMACAO	18-10-29N	065-48-48W	STN1	TUFF, VOLCANIC SANDS
22	TC00717	BAYAMON	18-22-40N	066-14-45W	SDG	
23	TC01028	ARECIBO	18-25-49N	066-38-07W	LST	LIMESTONE
24	TC01032	PATILLAS	18-00-39N	066-03-38W	STN1	HORNBLENDE DIORITE
25	TC01165	PONCE	18-03-10N	066-31-35W	LST	CALCAREOUS SANDY CLAY
26	TC01020	ARECIBO	18-27-38N	066-38-13W	LST	LIMESTONE
27	TC01263	PUERTO REAL	18-04-52N	067-07-34W	LST	LIMESTONE
28	TC01161	HUMACAO	18-08-47N	065-48-24W	STN1	TUFF, VOLCANIC SANDS
29	TC00713	NARANJITO	18-18-20N	066-08-00W	SDG	
30	TC01024	ARECIBO	18-26-31N	066-41-11W	LST	LIMESTONE
31	TC01169	PONCE	18-01-09N	066-35-07W	LST	FOSSILIFEROUS CALCARENITE
32	TC01036	CAYEY	18-06-06N	066-11-33W	STN1	LIMESTONE
33	TC01265	PUERTO REAL	18-00-03N	067-09-23W	STN1	SERPENTINITE, AMPHIBOLITE
34	TC01030	PATILLAS	18-01-56N	066-01-50W	STN1	ANDESITIC LAVA
35	TC01026	ARECIBO	18-26-24N	066-40-51W	LST	LIMESTONE
36	TC00715	NARANJITO	18-21-50N	066-13-25W	VOL	
37	TC01038	COMERIO	18-08-59N	066-14-47W	STN1	SANDSTONE, SILTSTONE

38	TC01163	PONCE	18-02-49N	066-35-58W	LST	CALCAREOUS SANDY CLAY
39	TC00711	NARANJITO	18-21-10N	066-08-20W	STN1	
40	TC01034	GUAYAMA	17-58-56N	066-05-48W	STN1	PORPHYRITIC QUARTZ DIORITE
41	TC01261	BAYAMON	18-24-47N	066-10-25W	STN1	LIMESTONE
42	TC01167	PONCE	18-01-47N	066-30-18W	LST	CALCAREOUS SANDSTONE
43	TC00719	BAYAMON	18-27-00N	066-09-35W	SDG	
44	TC01022	ARECIBO	18-26-54N	066-39-24W	LST	LIMESTONE
45	TC00958	AGUADILLA	18-27-42N	067-08-21W	STN1	CHALK
46	TC00950	PENUELAS	18-01-32N	066-38-19W	STN1	CLAYEY CHALK, CHALKY LIMESTONE
47	TC01044	AGUAS BUENAS	18-22-20N	066-07-28W	STN1?	SILTSTONE
48	TC01095	CAROLINA	18-24-08N	065-53-25W	STN1	LIMESTONE
49	TC01091	CAROLINA	18-23-40N	065-57-47W	SDG	ALLUVIAL SAND AND GRAVEL
50	TC01040	COMERIO	18-12-36N	066-08-05W	STN1 STN2	LIMESTONE
51	TC01048	AGUAS BUENAS	18-22-06N	066-01-57W	LST	LIMESTONE
52	TC00954	BARRANQUITAS	18-13-59N	066-19-20W	LST1	LIMESTONE
53	TC01099	GURABO	18-21-37N	065-59-51W	SDG	ALLUVIAL SAND, GRAVEL
54	TC00956	AGUADILLA	18-28-53N	067-08-05W	STN1	CHALK
55	TC01093	CAROLINA	18-22-41N	065-53-29W	STN1	PORPHYRITIC ANDESITIC BASALT
56	TC01042	COMERIO	18-07-40N	066-09-55W	STN1 STN2	LIMESTONE
57	TC00952	BARRANQUITAS	18-12-07N	066-15-48W	STN1	BASALT TO ANDESITE F LOWS
58	TC01046	AGUAS BUENAS	18-22-13N	066-03-03W	STN1?	SILTSTONE
60	TC01096	CAROLINA	18-24-16N	065-56-52W	STN1	LIMESTONE
61	TC01041	COMERIO	18-07-42N	066-09-58W	STN1 STN2	LIMESTONE
62	TC01049	AGUAS BUENAS	18-22-04N	066-01-38W	LST	LIMESTONE
63	TC00955	BARRANQUITAS	18-07-41N	066-17-05W	STN1	BASALT TO ANDESITE
64	TC00951	CAMUY	18-27-52N	066-45-06W	SIL	QUARTZ SAND
65	TC01045	AGUAS BUENAS	18-22-24N	066-07-16W	STN1?	SILTSTONE
66	TC01092	CAROLINA	18-25-22N	065-53-36W	SDG	ALLUVIAL SAND AND GRAVEL
67	TC00959	AGUADILLA	18-27-48N	067-09-20W	STN1	CHALK
68	TC00953	BARRANQUITAS	18-13-50N	066-19-24W	LST1	LIMESTONE
69	TC01047	AGUAS BUENAS	18-22-11N	066-02-04W	LST	LIMESTONE
70	TC01094	CAROLINA	18-22-37N	065-54-31W	STN1	CALCAREOUS MUDSTONE
71	TC01090	CAROLINA	18-23-13N	065-54-17W	SDG	ALLUVIAL SAND AND GRAVEL
72	TC00957	AGUADILLA	18-28-12N	067-07-42W	STN1	CHALK
73	TC01098	GURABO	18-21-29N	065-59-59W	SDG	ALLUVIAL SAND, GRAVEL
74	TC00724	AGUAS BUENAS	18-15-20N	066-01-00W	SDG	
75	TC01132	MANATI	18-26-16N	066-26-60W	LST2	LIMESTONE
77	TC00728	AGUAS BUENAS	18-18-20N	066-04-00W	SDG	
78	TC01202	RIO DESCALABRADO	18-03-37N	066-29-47W	STN1	CONGLOMERATIC SANDSTONE
79	TC01136	MANATI	18-25-45N	066-28-53W	LST2	LIMESTONE

80	TC00720	BAYAMON	18-25-00N	066-11-50W	LST	
81	TC00722	CAGUAS	18-14-50N	066-03-20W	SDG	
82	TC01204	RIO DESCALABRADO	18-00-59N	066-22-41W	STN1	LIMESTONE
83	TC01130	MANATI	18-26-16N	066-23-24W	LST2	LIMESTONE
84	TC00726	AGUAS BUENAS	18-20-00N	066-01-00W	STN1	
85	TC01208	UTUADO	18-17-02N	066-42-14W	SDG	RIVER GRAVEL, TERRACE GRAVEL
86	TC01134	MANATI	18-25-42N	066-28-52W	LST2	LIMESTONE
87	TC01200	RIO DESCALABRADO	18-01-55N	066-29-27W	SDG	ALLUVIUM, STREAM GRAVEL
88	TC00729	AGUAS BUENAS	18-22-10N	066-03-15W	LST	
89	TC01203	RIO DESCALABRADO	18-00-04N	066-24-01W	SDG	ALLUVIUM, STREAM GRAVEL
90	TC01137	MANATI	18-26-21N	066-23-20W	STN1	LIMESTONE
91	TC00721	CAGUAS,	18-13-30N	066-00-50W	SDG	
92	TC01207	UTUADO	18-15-15N	066-43-23W	SDG	RIVER GRAVEL, TERRACE GRAVEL
93	TC00725	AGUAS BUENAS	18-19-00N	066-05-15W	LST	
94	TC01133	MANATI	18-25-43N	066-28-48W	LST2	LIMESTONE
95	TC00727	AGUAS BUENAS	18-20-10N	066-07-00W	STN1	
96	TC01209	UTUADO	18-18-13N	066-41-45W	SDG	RIVER GRAVEL, TERRACE GRAVEL
97	TC01135	MANATI	18-25-48N	066-28-49W	LST2	LIMESTONE
98	TC01201	RIO DESCALABRADO	18-04-28N	066-27-31W	STN1	LIMESTONE
99	TC01205	RIO DESCALABRADO	18-01-01N	066-22-39W	STN1	LIMESTONE
100	TC01139	MANATI	18-26-31N	066-25-10W	STN1	LIMESTONE
101	TC00792	GUANICA	17-58-20N	066-53-10W	SDG	
102	TC00773	SAN GERMAN	18-04-25N	067-00-10W	SDG	
103	TC01255	PUNTA GUAYANES	18-02-33N	065-50-54W	STN1	TONALITE
104	TC00962	AGUADILLA	18-26-35N	067-08-48W	LST1	LIMESTONE
105	TC01016	ARECIBO	18-26-48N	066-43-46W	LST	LIMESTONE
106	TC00974	AGUADILLA	18-22-33N	067-11-21W	STN1	CHALK, CALCARENITE
107	TC00745	PENUELAS	18-00-40N	066-39-10W	LST	
108	TC01153	VEGA ALTA	18-28-52N	066-19-58W	STN1	LIMESTONE
109	TC00741	GURABO	18-21-45N	065-57-00W	LST	
110	TC01259	BAYAMON	18-24-53N	066-11-51W	STN1	CALCARENITE, CLAYEY LIMESTONE
111	TC00966	AGUADILLA	18-23-56N	067-09-28W	STN1	CHALK
112	TC00981	CAGUAS	18-12-10N	066-03- W	STN1	VOLCANIC, DIORITE DIKE
113	TC00796	CAMUY	18-26-45N	066-45-58W	SLA	
114	TC00777	CENTRAL LA PLATA	18-17-50N	067-02-00W	STN1	
115	TC00970	AGUADILLA	18-23-07N	067-12-37W	STN1	CHALK, CALCARENITE
116	TC01251	PUNTA GUAYANES	18-02-03N	065-49-58W	STN1	TONALITE
117	TC00978	AGUADILLA	18-22-40N	067-13-19W	STN1	CALCAREOUS CLAY, CHALK, CALCARENITE
118	TC01157	HUMACAO	18-09-12N	065-46-22W	STN1	TUFF, VOLCANIC SANDS
119	TC00749	BARCELONETA	18-28-00N	066-32-00W	SDG	
120	TC00989	BARCELONETA	18-26-28N	066-33-50W	LST	LIMESTONE

121	TC01012	ARECIBO	18-28-16N	066-43-32W	LST	LIMESTONE
122	TC01145	MANATI	18-25-44N	066-28-55W	STN1	LIMESTONE
123	TC00968	AGUADILLA	18-23-34N	067-10-01W	STN1	CHALK, CALCARENITE
124	TC01147	ROSARIO	18-09-22N	067-07-05W	STN1	MIXED SEDIMENTARY AND VOLCANICLASTIC ROCKS
125	TC00798	CAMUY	18-25-45N	066-45-40W	LST	
126	TC00779	MOCA	18-27-10N	067-02-55W	LST	
127	TC00831	ROSARIO	18-08-30N	067-05-15W	SDG	
128	TC01253	PUNTA GUAYANES	18-01-35N	065-50-47W	STN1	DIORITE
129	TC01151	MAYAGUEZ	18-11-26N	067-08-17W	STN1 (?)	MIXED SEDIMENTARY AND VOLCANICLASTIC ROCKS
130	TC00743	YABUCOA	18-00-30N	065-56-30W	LST	
131	TC00960	AGUADILLA	18-27-20N	067-07-37W	STN1	CHALK
132	TC00983	CAGUAS	18-13-20N	066-04-30W	STN1 LST	LIMESTONE
133	TC01014	ARECIBO	18-29-08N	066-39-34W	LST	LIMESTONE
134	TC01159	HUMACAO	18-09-02N	065-47-00W	STN1	TUFF, VOLCANIC SANDS
135	TC00790	QUEBRADILLAS	18-27-58N	066-58-50W	SDG	
136	TC00771	SAN GERMAN	18-05-00N	067-06-20W	LST	
137	TC00972	AGUADILLA	18-24-48N	067-08-59W	STN1	CALCARENITE, LIMESTONE
138	TC01257	BAYAMON	18-25-19N	066-10-42W	STN1	CLAYEY AND CHALKY LIMESTONE
139	TC01155	VEGA ALTA	18-27-17N	066-19-35W	SIL	BEACH SAND DUNES
140	TC01010	ARECIBO	18-27-31N	066-44-21W	LST	LIMESTONE
141	TC00794	SABANA GRANDE	18-05-45N	066-56-30W	STN1	
142	TC00775	CENTRAL LA PLATA	18-17-00N	067-06-50W	SDG	
143	TC00976	AGUADILLA	18-22-59N	067-10-09W	STN1	TUFFACEOUS SANDSTONE
144	TC01018	ARECIBO	18-28-48N	066-37-47W	LST	LIMESTONE
145	TC01143	MANATI	18-25-47N	066-28-51W	STN1	LIMESTONE
146	TC00747	ARECIBO	18-27-10N	066-39-40W	STN	
147	TC00964	AGUADILLA	18-24-21N	067-08-49W	STN1	CHALK, CALCARENITE
148	TC00987	BARCELONETA	18-29-09N	066-36-59W	LST	LIMESTONE
149	TC00746	ARECIBO	18-27-10N	066-37-45W	LST	
150	TC00967	AGUADILLA	18-23-52N	067-09-47W	STN1	CHALK, CALCARENITE
151	TC00986	BARCELONETA	18-29-10N	066-36-12W	LST	LIMESTONE
152	TC00774	CENTRAL LA PLATA	18-17-20N	067-02-10W	SDG	
153	TC00797	CAMUY	18-26-50N	066-47-10W	LST	
154	TC00971	AGUADILLA	18-26-42N	067-08-29W	SDG	BLANKET SAND DEPOSIT
155	TC01142	MANATI	18-25-44N	066-28-47W	STN1	LIMESTONE
156	TC01256	BAYAMON	18-24-34N	066-12-13W	STN1	CALCARENITE, CLAYEY AND CHALKY LIMESTONE
157	TC00979	CAGUAS	18-13-30N	066-00-50W	SIL? SDG	SAND, GRAVEL
158	TC01154	VEGA ALTA	18-22-44N	066-15-04W	SDG	SAND, GRAVEL, CLAY, BOULDERS
159	TC01013	ARECIBO	18-28-28N	066-44-29W	LST	LIMESTONE

160	TC00975	AGUADILLA	18-24-31N	067-08-21W	STN1?	LANDSLIDE DEPOSITS
161	TC01146	MANATI	18-26-03N	066-29-39W	STN1	LIMESTONE
162	TC00778	CENTRAL LA PLATA	18-17-00N	067-05-50W	SDG	
163	TC00830	PUNTA GUAYANES	18-04-45N	065-50-45W		
164	TC01252	PUNTA GUAYANES	18-02-02N	065-50-44W	STN1	GRANODIORITE
165	TC01150	MAYAGUEZ	18-13-30N	067-09-55W	STN1 (?)	MIXED SEDIMENTARY AND VOLCANICLASTIC ROCKS
166	TC00742	YABUCOA	18-03-15N	065-54-50W	SDG	
167	TC00963	AGUADILLA	18-24-34N	067-09-10W	STN1	CHALK, CALCARENITE
169	TC01017	ARECIBO	18-26-50N	066-43-40W	LST	LIMESTONE
170	TC01158	HUMACAO	18-09-12N	065-46-39W	STN1	TUFF, VOLCANIC SANDS
171	TC00770	SAN GERMAN	18-04-00N	067-00-45W	STN	
172	TC00793	SABANA GRANDE	18-04-00N	066-58-35W	SDG	
173	TC00772	SAN GERMAN	18-04-50N	067-00-50W	SDG	
174	TC01254	PUNTA GUAYANES	18-01-30N	065-50-38W	STN1	TONALITE
175	TC01148	ROSARIO	18-12-50N	067-05-18W	STN1 (?)	MIXED SEDIMENTARY AND VOLCANICLASTIC ROCKS
176	TC01011	ARECIBO	18-27-51N	066-44-27W	LST	LIMESTONE
177	TC00795	CAMUY	18-26-50N	066-46-05W	LST	
178	TC00977	AGUADILLA	18-23-34N	067-10-01W	STN1	CHALK, CALCARENITE
179	TC01019	ARECIBO	18-27-19N	066-39-59W	LST	LIMESTONE
180	TC01140	MANATI	18-26-27N	066-26-21W	STN1	LIMESTONE
181	TC00832	MOCA	18-27-45N	067-01-00W	LST	
182	TC00744	UTUADO	18-18-30N	066-41-00W	SDG	
183	TC00965	AGUADILLA	18-24-16N	067-08-52W	STN1	CHALK, CALCARENITE
184	TC00984	CAGUAS	18-13-30N	066-04-50W	STN1 LST	LIMESTONE
185	TC01152	VEGA ALTA	18-28-38N	066-15-53W	STN1	LIMESTONE
186	TC00740	JUNCOS	18-08-20N	065-58-30W	SDG	
187	TC01258	BAYAMON	18-25-02N	066-14-58W	STN1	CALCARENITE, CLAYEY LIMESTONE
188	TC00961	AGUADILLA	18-26-39N	067-08-45W	LST1	LIMESTONE
189	TC00980	CAGUAS	18-11-15N	066-03-00W	SIL SDG	SAND, GRAVEL
190	TC01015	ARECIBO	18-27-07N	066-44-17W	LST	LIMESTONE
191	TC00791	QUEBRADILLAS	18-27-25N	066-53-10W	STN1	
192	TC00776	CENTRAL LA PLATA	18-17-25N	067-02-00W	SDG	
193	TC00973	AGUADILLA	18-25-44N	067-06-49W	STN1	CALCARENITE, LIMESTONE
194	TC00799	CAMUY	18-29-35N	066-52-05W	SDG	
195	TC01250	PUNTA GUAYANES	18-02-41N	065-51-14W	STN1	DIORITE
196	TC01003	ARECIBO	18-29-02N	066-41-50W	SDG	DUNE SAND
197	TC01156	HUMACAO	18-09-47N	065-50-51W	STN1	HORNBLENDE-BIOTITE GRANODIORITE
198	TC00748	ARECIBO	18-26-45N	066-44-50W	STN	
199	TC00824	CAROLINA; GURABO	18-22-30N	065-57-10W	SDG	

200	TC01246	PUNTA GUAYANES	18-05-54N	065-50-20W	STN1	GRANODIORITE
201	TC00969	AGUADILLA	18-23-31N	067-10-08W	STN1	CHALK, CALCARENITE
202	TC00988	BARCELONETA	18-29-02N	066-36-53W	LST	LIMESTONE
203	TC01144	MANATI	18-25-44N	066-28-51W	STN1	LIMESTONE
204	TC00700		18-07-30N	065-30-00W	SDG	
205	TC01218	SAN JUAN	18-22-56N	066-01-39W	STN1	SILTSTONE
206	TC00933	CENTRAL AGUIRRE	17-58-47N	066-14-07W	STN1 LST	LIMESTONE
207	TC00736	JUNCOS	18-12-30N	065-56-30W	SDG	
208	TC01210	UTUADO	18-18-19N	066-41-55W	STN1	VOLCANIC TUFF
209	TC01116	FAJARDO	18-20-16N	065-38-29W	STN1	BEDDED TUFF AND BRECCIA
210	TC00929	SANTA ISABEL	17-59-33N	066-24-34W	SDG	ALLUVIAL GRAVEL
211	TC00708	VEGA ALTA;NARANJITO; BAYAMON; CORROYAL	18-22-35N	066-15-10W	SDG	
212	TC01104	GURABO	18-21-50N	065-58-54W	STN1	BASALTIC VOLCANIC SANDSTONE
213	TC00937	OROCOVIS	18-12-46N	066-28-58W	STN1	ANDESITE, BASALTIC ANDESITE BRECCIA
214	TC01100	GURABO	18-21-34N	065-59-39W	SDG	ALLUVIAL SAND, GRAVEL
215	TC00925	PLAYA DE PONCE	17-58-16N	066-33-42W	SDG	BEACH DEPOSITS
216	TC00704	VEGA ALTA	18-23-10N	066-17-00W	SDG	
217	TC01112	FAJARDO	18-22-17N	065-42-49W	STN1	BEDDED TUFF AND BRECCIA
218	TC00732	JUNCOS	18-13-15N	065-55-30W	SDG	
219	TC01214	SAN JUAN	18-22-48N	066-02-21W	STN1	SILTSTONE
220	TC01108	GURABO	18-21-36N	065-59-58W	SDG	ALLUVIAL SAND, GRAVEL
221	TC00939	OROCOVIS	18-11-43N	066-24-26W	STN1	BASALT TO BASALTIC ANDESITE
222	TC01216	SAN JUAN	18-22-42N	066-01-57W	STN1	SILTSTONE
223	TC01114	FAJARDO	18-21-31N	065-38-35W	STN1	BEDDED TUFF AND BRECCIA
224	TC00931	CENTRAL AGUIRRE	17-59-02N	066-14-27W	STN1 LST	LIMESTONE
225	TC00734	JUNCOS	18-11-30N	065-56-45W	VOL	
226	TC01102	GURABO	18-22-26N	065-57-52W	SDG	ALLUVIAL SAND, GRAVEL
227	TC00927	SANTA ISABEL	17-58-43N	066-24-53W	SDG	ALLUVIAL GRAVEL
228	TC00706	VEGA ALTA	18-25-40N	066-15-35W	SDG	
229	TC00702	SALINAS	17-58-20N	066-18-20W	SDG	
230	TC01118	FAJARDO	18-22-06N	065-41-11W	STN1	TUFFACEOUS SILTSTONE
231	TC00730	CAROLINA	18-23-00N	066-53-45W	SDG	
232	TC00738	JUNCOS	18-14-15N	065-54-30W	STN	
233	TC01212	SAN JUAN	18-22-50N	066-07-11W	STN1	SILTSTONE
234	TC01110	GURABO	18-21-51N	065-58-38W	SDG	ALLUVIAL SAND, GRAVEL
235	TC00935	CENTRAL AGUIRRE	17-59-09N	066-11-27W	STN1	ANDESITE
236	TC00934	CENTRAL AGUIRRE	17-58-02N	066-13-53W	STN1	SANDSTONE, LIMESTONE
237	TC01101	GURABO	18-21-42N	065-58-54W	SDG	ALLUVIAL SAND, GRAVEL

238	TC00705	VEGA ALTA	18-25-35N	066-15-10W	LST	
239	TC01113	FAJARDO	18-20-48N	065-40-21W	STN1	BEDDED TUFF AND BRECCIA
240	TC00733	JUNCOS	18-10-45N	065-53-15W	SDG	
241	TC01215	SAN JUAN	18-22-42N	066-02-04W	STN1	SILTSTONE
242	TC01109	GURABO	18-21-42N	065-59-29W	SDG	ALLUVIAL SAND, GRAVEL
243	TC00938	OROCOVIS	18-11-29N	066-29-25W	STN1	DIORITE PORPHYRY, QUARTZ DIORITE PORPHYRY
244	TC01211	UTUADO	18-17-35N	066-44-24W	STN1	LIMESTONE
245	TC01117	FAJARDO	18-18-07N	065-37-41W	STN1	ANDESITE
246	TC00709	VEGA ALTA; NARANJITO; BAYAMON; COROZAL	18-22-32N	066-15-03W	SDG	
247	TC01105	GURABO	18-22-11N	065-58-03W	STN1	BASALTIC ANDESITE, VOLCANICLASTIC ROCKS
248	TC00930	SANTA ISABEL	17-59-57N	066-24-10W	SDG	ALLUVIAL GRAVEL
249	TC00737	JUNCOS	18-09-30N	065-58-00W	SDG	
250	TC00926	QUEBRADILLAS	18-26-59N	066-55-03W	STN1 LST	LIMESTONE
251	TC00701	FAJARDO	18-21-50N	065-42-30W	STN1	
252	TC01219	SAN JUAN	18-22-57N	066-01-17W	STN1	SILTSTONE
253	TC00703	SALINAS	17-58-20N	066-18-10W	SDG	
254	TC01119	FAJARDO	18-22-23N	065-42-30W	SDG	BEACH SAND
255	TC00932	CENTRAL AGUIRRE	17-58-52N	066-14-08W	STN1 LST	LIMESTONE
256	TC00731	CAROLINA; GURABO	18-22-45N	066-54-40W	VOL	
257	TC00739	JUNCOS	18-10-20N	065-58-15W	SDG	
258	TC01213	SAN JUAN	18-22-39N	066-07-22W	STN1	SILTSTONE
259	TC01111	FAJARDO	18-22-40N	065-45-00W	STN1	VOLCANIC BRECCIA, TUFFACEOUS BRECCIA
260	TC00928	SANTA ISABEL	17-58-06N	066-24-51W	SDG	ALLUVIAL GRAVEL
261	TC01107	GURABO	18-20-34N	065-57-26W	STN1	ANDESITIC TO BASALTIC CALCAREOUS VOLCANIC SANDSTONE
262	TC00936	OROCOVIS	18-12-51N	066-28-50W	STN1	CALCAREOUS TUFFACEOUS SANDSTONE-SILTSTONE
263	TC00735	JUNCOS	18-10-30N	065-58-00W	SDG	
264	TC01103	GURABO	18-22-23N	065-57-15W	SDG	ALLUVIAL SAND, GRAVEL
265	TC00707	VEGA ALTA	18-25-55N	066-20-25W	LST	
266	TC01217	SAN JUAN	18-22-48N	066-01-56W	STN1	SILTSTONE
267	TC01115	FAJARDO	18-21-07N	065-38-21W	STN1	BEDDED TUFF AND BRECCIA
268	TC00817	CIALES	18-20-25N	066-27-40W	SDG	
269	TC01060	AGUAS BUENAS	18-20-44N	066-00-05W	SDG	ALLUVIAL GRAVEL, SAND, SILT, CLAY
270	TC01083	CAROLINA	18-22-45N	065-58-13W	STN1	VOLCANIC SANDSTONE
271	TC01072	COAMO	18-02-39N	066-21-38W	STN1	TUFF-BRECCIA, TUFFACEOUS CONGLOMERATE, LAPILLI TUFF

272	TC00757	MANATI	18-27-00N	066-25-05W	SIL	
273	TC00997	BARCELONETA	18-26-01N	066-35-00W	SDG	CEMENTED DUNES
274	TC00946	ADJUNTAS	18-10-23N	066-42-41W	STN1	TUFF
275	TC01068	AGUAS BUENAS	18-19-09N	066-04-44W	STN1	GREEN-GRAY LAVA FLOWS
276	TC00942	MOCA	18-22-57N	067-06-20W	STN1	BLACK GLASSY IGNEOUS ROCK
277	TC01076	CAROLINA	18-23-15N	065-59-37W	STN1	TUFFACEOUS SILTSTONE
278	TC00753	RIO DESCALABRO	18-02-30N	066-28-30W	SDG	
279	TC00993	BARCELONETA	18-27-05N	066-32-21W	LST	LIMESTONE
280	TC01087	CAROLINA	18-23-05N	065-56-51W	SDG	ALLUVIAL SAND AND GRAVEL
281	TC00813	VEGA ALTA	18-27-15N	066-19-45W	STN	
282	TC00755	MANATI	18-26-30N	066-25-05W	LST	
283	TC00995	BARCELONETA	18-27-16N	066-32-52W	LST	LIMESTONE
284	TC01078	CAROLINA	18-23-20N	065-59-32W	STN1	TUFFACEOUS SILTSTONE
285	TC00944	YAUCO	18-06-13N	066-51-36W	STN1	CALCAREOUS SILTSTONE
286	TC01089	CAROLINA	18-23-09N	065-55-12W	SDG	ALLUVIAL SAND AND GRAVEL
288	TC01081	CAROLINA	18-23-31N	065-59-16W	STN1	TUFFACEOUS SILTSTONE
289	TC00759	MANATI	18-27-30N	066-29-30W	LST	
290	TC00811	MANATI	18-27-00N	066-26-50W	SIL	
291	TC00999	BARCELONETA	18-28-53N	066-33-07W	SDG	CEMENTED DUNES
293	TC00948	SAN GERMAN	18-05-03N	067-06-24W	LST	CALCAREOUS SILTSTONE
294	TC00751	SANTA ISABEL	17-59-50N	066-23-10W	SDG	
295	TC00991	BARCELONETA	18-27-46N	066-31-13W	LST	LIMESTONE
296	TC01085	CAROLINA	18-22-37N	065-57-38W	SDG	ALLUVIAL SAND AND GRAVEL
297	TC00940	MOCA	18-28-06N	067-01-05W	STN1	LIMESTONE
298	TC00819	CAGUAS	18-14-20N	066-04-45W	MBL	
299	TC01074	COAMO	18-02-27N	066-21-38W	STN1	TUFF-BRECCIA, TUFFACEOUS CONGLOMERATE
300	TC00943	YAUCO	18-00-25N	066-52-14W	LST STN1(?)	LIMESTONE
301	TC00818	VEGA ALTA	18-27-00N	066-19-30W	SDG	
302	TC01077	CAROLINA	18-23-20N	065-59-35W	STN1	TUFFACEOUS SILTSTONE
303	TC00750	PONCE	18-01-30N	066-35-30W	LST	
304	TC00990	BARCELONETA	18-27-43N	066-33-16W	LST	LIMESTONE
306	TC01084	CAROLINA	18-22-31N	065-57-42W	SDG	ALLUVIAL SAND AND GRAVEL
307	TC00758	MANATI	18-28-25N	066-24-50W	SIL	
308	TC00810	MANATI	18-27-00N	066-26-50W	SDG	
309	TC00998	BARCELONETA	18-29-03N	066-33-07W	SDG	CEMENTED DUNES
310	TC00754	MANATI	18-27-45N	066-25-10W	SDG	
311	TC00994	BARCELONETA	18-27-40N	066-36-24W	LST	LIMESTONE
312	TC00947	ADJUNTAS	18-13-07N	066-38-34W	STN1	VEINED DIORITE
313	TC01088	CAROLINA	18-23-10N	065-55-40W	SDG	ALLUVIAL SAND AND GRAVEL

314	TC01073	COAMO	18-00-50N	066-19-56W	STN1 STN2	LIMESTONE
316	TC01080	CAROLINA	18-23-29N	065-59-20W	STN1	TUFFACEOUS SILTSTONE
317	TC00816	MANATI	18-24-00N	066-25-50W	SDG	
318	TC01082	CAROLINA	18-23-31N	065-59-12W	STN1	TUFFACEOUS SILTSTONE
319	TC00949	CABO ROJO - PARGUERA	17-59-40N	067-06-30W	STN	LIMESTONE, CHERT, QUARTZ DIORITE PORPHYRY
320	TC00756	MANATI	18-26-45N	066-25-10W	LST	
321	TC00996	BARCELONETA	18-27-27N	066-35-56W	LST	LIMESTONE
322	TC00941	MOCA	18-28-11N	067-01-05W	STN1	LIMESTONE
323	TC01075	CAROLINA	18-23-10N	065-59-51W	STN1	TUFFACEOUS SILTSTONE
324	TC01071	AGUAS BUENAS	18-15-08N	066-00-31W	GAR	GREENSTONE, VOLCANIC ROCKS UNDIVIDED
325	TC00752	RIO DESCALABRADO	18-04-30N	066-27-30W	SDG	
326	TC00992	BARCELONETA	18-27-21N	066-30-08W	LST	LIMESTONE
327	TC01067	AGUAS BUENAS	18-16-26N	066-02-22W	STN1	
328	TC00812	VEGA ALTA	18-27-15N	066-19-45W	SIL	
329	TC00945	COROZAL	18-20-32N	066-19-20W	CLY1	GREEN TUFFS, VOLCANIC SANDSTONE AND SILTSTONE
330	TC01079	CAROLINA	18-23-24N	065-59-27W	STN1	TUFFACEOUS SILTSTONE
331	TC01222	SAN JUAN	18-23-28N	066-01-20W	STN1	SILTSTONE
332	TC01120	FAJARDO	18-21-49N	065-40-06W	SDG	BEACH SAND
333	TC01234	ISLA DE MONA	18-05-15N	067-56-22W	P	CAVERNOUS LIMESTONE
334	TC01128	MANATI	18-27-08N	066-23-06W	LST2	LIMESTONE
335	TC01056	AGUAS BUENAS	18-21-27N	066-00-11W	STN1	BASALT
336	TC01226	ISLA DE MONA	18-04-59N	067-51-02W	P	CAVERNOUS LIMESTONE
338	TC01124	MANATI	18-23-17N	066-25-20W	LST1	CHALKY LIMESTONE
339	TC01230	ISLA DE MONA	18-03-20N	067-53-32W	P	CAVERNOUS LIMESTONE
340	TC01238	ISLA DE MONA	18-06-20N	067-56-06W	P	CAVERNOUS LIMESTONE
341	TC01228	ISLA DE MONA	18-03-52N	067-52-06W	P	CAVERNOUS LIMESTONE
343	TC01220	SAN JUAN	18-23-19N	066-00-25W	STN1	SILTSTONE
344	TC01126	MANATI	18-25-00N	066-25-06W	LST2	LIMESTONE
345	TC01232	ISLA DE MONA	18-03-50N	067-54-21W	P	CAVERNOUS LIMESTONE
346	TC01058	AGUAS BUENAS	18-21-33N	066-00-19W	SDG	ALLUVIAL GRAVEL, SAND, SILT, CLAY
347	TC01122	JUNCOS	18-14-49N	065-58-30W	STN1	UNDIFFERENTIATED ANDESITIC VOLCANIC ROCKS
348	TC01236	ISLA DE MONA	18-05-47N	067-56-14W	P	CAVERNOUS LIMESTONE
349	TC01224	ISLA DE MONA	18-05-14N	067-50-41W	P	CAVERNOUS LIMESTONE
350	TC01050	AGUAS BUENAS	18-22-16N	066-01-02W	LST	LIMESTONE
351	TC01227	ISLA DE MONA	18-04-04N	067-51-02W	P	CAVERNOUS LIMESTONE
353	TC01125	MANATI	18-22-57N	066-27-24W	LST1	CHALKY LIMESTONE, MARL

354	TC01231	ISLA DE MONA	18-03-43N	067-54-12W	P	CAVERNOUS LIMESTONE
355	TC01239	ISLA DE MONA	18-06-46N	067-56-05W	P	CAVERNOUS LIMESTONE
356	TC01235	ISLA DE MONA	18-05-22N	067-56-19W	P	CAVERNOUS LIMESTONE
357	TC01129	MANATI	18-26-22N	066-23-20W	LST2	LIMESTONE
358	TC01057	AGUAS BUENAS	18-21-36N	066-00-09W	SDG	ALLUVIAL GRAVEL, SAND, SILT, CLAY
359	TC01223	ISLA DE MONA	18-05-36N	067-50-40W	P	CAVERNOUS LIMESTONE
360	TC01121	JUNCOS	18-14-00N	065-53-54W	STN1	UNDIFFERENTIATED ANDESITIC VOLCANIC ROCKS
361	TC01059	AGUAS BUENAS	18-21-30N	066-00-35W	SDG	ALLUVIAL GRAVEL, SAND, SILT,CLAY
362	TC01123	MANATI	18-27-52N	066-26-29W	SIL	SAND
363	TC01237	ISLA DE MONA	18-06-00N	067-56-10W	P	CAVERNOUS LIMESTONE
364	TC01225	ISLA DE MONA	18-05-04N	067-51-01W	P	CAVERNOUS LIMESTONE
365	TC01051	AGUAS BUENAS	18-22-25N	066-01-42W	STN1	BRECCIA, TUFF, CONGLOMERATE
366	TC01221	SAN JUAN	18-23-29N	066-00-59W	STN1	SILTSTONE
367	TC01127	MANATI	18-27-26N	066-23-48W	LST2	LIMESTONE
368	TC01233	ISLA DE MONA	18-04-58N	067-56-19W	P	CAVERNOUS LIMESTONE
369	TC01055	AGUAS BUENAS	18-21-28N	066-00-17W	STN1	BASALT
370	TC01229	ISLA DE MONA	18-03-32N	067-52-33W	P	CAVERNOUS LIMESTONE
371	TC00829	NARANJITO	18-15-15N	066-12-20W	SDG	
372	TC01004	ARECIBO	18-28-58N	066-41-38W	SDG	DUNE SAND
373	TC00780	ISABELA	18-30-30N	067-04-45W	SDG	
374	TC00761	MANATI	18-27-10N	066-28-10W	SDG	
375	TC00821	JUNCOS	18-10-30N	065-54-50W	SDG	
376	TC00788	RINCON	18-18-30N	067-11-30W	STN	
377	TC00769	ROSARIO	18-08-00N	067-06-00W	SDG	
378	TC01243	ISLA DE MONA	18-06-57N	067-52-43W	P	CAVERNOUS LIMESTONE
379	TC01184	NARANJITO	18-20-49N	066-11-55W	STN1	CALCAREOUS SILTSTONE
380	TC01196	RIO DESCALABRADO	18-05-12N	066-28-32W	P	LIMESTONE CAVES
381	TC01177	PUNTA PUERCA	18-13-53N	065-36-42W	STN1	VOLCANIC BRECCIA, LAVA
382	TC00784	AGUADILLA	18-22-30N	067-13-45W	STN	
383	TC00765	PUNTA GUAYANES	18-04-45N	065-50-20W	SDG	
384	TC01192	YABUCOA AND PUNTA TUNA	18-04-14N	065-53-19W	SDG	GRAVEL
385	TC01008	ARECIBO	18-27-07N	066-44-21W	LST	LIMESTONE
386	TC01173	PONCE	18-03-42N	066-34-43W	LST	CALCIRUDITE, CALCARENITE
387	TC01180	NARANJITO	18-20-40N	066-08-22W	STN1	TUFF AND TUFF BRECCIA
388	TC01188	NAGUABO	18-13-16N	065-39-08W	STN1	VOLCANIC BRECCIA, LAVA
389	TC01000	BARCELONETA	18-29-13N	066-32-45W	SDG	DUNE SAND
390	TC00825	AGUAS BUENAS	18-20-00N	066-07-10W	SDG	
391	TC01247	PUNTA GUAYANES	18-02-26N	065-52-20W	STN1	TONALITE

392	TC00827	VEGA ALTA	18-25-20N	066-16-00W	SDG	
393	TC01241	ISLA DE MONA	18-07-03N	067-55-18W	P	CAVERNOUS LIMESTONE
395	TC01002	ARECIBO	18-28-28N	066-44-42W	SDG	CEMENTED DUNES
396	TC01175	PONCE	18-02-57N	066-36-48W	CLY? STN1?	CALCAREOUS SILTSTONE
397	TC00786	AGUADILLA	18-26-20N	067-08-45W	LST	
398	TC00767	HUMACAO	18-12-50N	065-50-25W	VOL	
399	TC01249	PUNTA GUAYANES	18-02-35N	065-51-18W	STN1	DIORITE
400	TC01006	ARECIBO	18-29-04N	066-40-21W	SDG	CEMENTED DUNES
401	TC00782	PUERTO REAL	18-04-50N	067-07-45W	STN1	
402	TC00763	CIALES	18-20-00N	066-27-40W	SDG	
404	TC01245	ISLA DE MONA	18-06-48N	067-51-04W	P	CAVERNOUS LIMESTONE
405	TC01179	PUNTA PUERCA	18-14-28N	065-37-18W	STN1	VOLCANIC BRECCIA, LAVA
406	TC00823	CAMUY	18-26-50N	066-46-00W	LST	
407	TC01186	NARANJITO	18-21-18N	066-13-23W	STN1	CALCAREOUS SILTSTONE
408	TC01190	NAGUABO	18-13-37N	065-38-32W	STN1	DIORITE
409	TC01171	PONCE	18-03-35N	066-35-09W	LST	CALCIRUDITE, CALCARENITE
410	TC00785	AGUADILLA	18-27-25N	067-07-40W	STN	
411	TC01193	RIO DESCALABRADO	18-05-15N	066-29-55W	STN1 LST	LIMESTONE, TUFFACEOUS VOLCANICS
412	TC01009	ARECIBO	18-27-29N	066-44-18W	LST	LIMESTONE
413	TC01170	PONCE	18-03-38N	066-35-13W	LST	CALCIRUDITE, CALCARENITE
414	TC00822	PUNTA GUAYANES	18-06-10N	065-49-10W	SDG	
415	TC01189	NAGUABO	18-14-18N	065-38-02W	STN1	VOLCANIC BRECCIA, LAVA
416	TC01001	BARCELONETA	18-28-37N	066-30-15W	SDG	DUNE SAND
417	TC00762	MANATI	18-22-45N	066-29-40W	SDG	
418	TC01244	ISLA DE MONA	18-07-17N	067-51-35W	P	CAVERNOUS LIMESTONE
419	TC01178	PUNTA PUERCA	18-14-30N	065-36-57W	STN1	VOLCANIC BRECCIA, LAVA
420	TC00826	VEGA ALTA	18-25-20N	066-16-10W	SDG	
421	TC00789	RINCON	18-18-00N	067-12-20W	VOL	
422	TC01240	ISLA DE MONA	18-06-53N	067-55-54W	P	CAVERNOUS LIMESTONE
423	TC01185	NARANJITO	18-21-09N	066-12-42W	STN1	CALCAREOUS SILTSTONE
425	TC01174	PONCE	18-03-48N	066-34-12W	LST	CALCIRUDITE, CALCARENITE
426	TC00781	ISABELA	18-30-50N	067-02-35W	SDG	
427	TC00766	HUMACO	18-09-40N	065-52-10W	SDG	
428	TC01248	PUNTA GUAYANES	18-02-25N	065-52-12W	STN1	TONALITE
429	TC01005	ARECIBO	18-29-02N	066-40-44W	SDG	CEMENTED DUNES
430	TC00828	YABOCA	18-04-55N	065-53-50W	SDG	
431	TC01007	ARECIBO	18-28-25N	066-44-13W	SDG	CEMENTED DUNES
432	TC00760	MANATI	18-26-40N	066-27-10W	LST	
433	TC00783	PUERTO REAL	18-07-20N	067-08-00W	STN	

435	TC00820	HUMACO	18-09-45N	065-50-30W	LST	
436	TC00768	ROSARIO	18-11-50N	067-07-20W	STN	
437	TC01187	NAGUABO	18-13-10N	065-39-09W	STN1	VOLCANIC BRECCIA, LAVA
438	TC01242	ISLA DE MONA	18-06-50N	067-53-13W	P	CAVERNOUS LIMESTONE
439	TC01191	YABUCOA AND PUNTA TUNA	18-00-33N	065-55-09W	SDG	GRAVEL
440	TC01176	PUNTA PUERCA	18-13-48N	065-35-36W	STN1	VOLCANIC BRECCIA, LAVA
441	TC00787	CABO ROJO	17-58-50N	067-08-10W	VOL?	
442	TC00764	CIALES	18-22-00N	066-28-25W	LST	
443	TC01172	PONCE	18-03-39N	066-34-59W	LST	CALCIRUDITE, CALCARENITE
450	W701169	PARGUERA	17-59-35N	067-06-54W	BA	CHERT
451	W701180	ISLA MONA	18-05-05N	067-50-58W	DOL	CARBONATES
452	W701183	ISLA MONA	18-03-21N	067-53-55W	DOL	CARBONATES
453	W701184	ISLA DESECHEO	18-23-14N	067-29-11W	P	CARBONATES
454	W701151	RIO DESCALABRADO	18-03-14N	066-25-26W	BA	CARBONATES
455	W701158	COAMO	18-04-45N	066-22-24W	BA	VERY THICK BEDDED TUFF, TUFF BRECCIA
460	W701167	CABO ROJO	17-59-33N	067-09-45W	DOL	CARBONATES
461	W701168	PARGUERA	17-59-57N	067-06-24W	BA	CHERT
462	W701001	QUEBRADILLAS	18-29-05N	066-57-30W	DOL	CARBONATES
463	W701002	QUEBRADILLAS	18-28-56N	066-53-53W	DOL	CARBONATES
464	W701040	NARANJITO	18-17-14N	066-11-53W	BA	LAVA OR LAVA BRECCIA
465	W701006	MANATI	18-28-54N	066-26-11W	DOL	CARBONATES
466	W701008	CAROLINA	18-25-40N	065-52-56W	DOL	CARBONATES
467	W701131	SAN GERMAN	18-04-30N	067-05-00W	BA	LAVA OR LAVA BRECCIA
468	W701132	SAN GERMAN	18-02-50N	067-06-25W	BA	LAVA OR LAVA BRECCIA
469	W701170	GUANICA	17-59-43N	066-55-22W	GYP	
470	W701171	GUANICA	17-58-43N	066-56-12W	BA	LAVA OR LAVA BRECCIA
471	W701173	ISLA MONA	18-07-00N	067-54-02W	DOL	CARBONATES
472	W701175	ISLA MONA	18-06-10N	067-56-08W	DOL	CARBONATES
473	W701177	ISLA MONA	18-06-39N	067-51-00W	DOL	CARBONATES
474	W701178	ISLA MONA	18-05-22N	067-54-00W	DOL	CARBONATES
475	W701017	FLORIDA	18-18-35N	066-31-22W	BA	LAVA OR LAVA BRECCIA
476	W701018	FLORIDA	18-18-20N	066-30-28W	BA	LAVA OR LAVA BRECCIA
477	W701019	FLORIDA	18-18-06N	066-31-30W	BA	LAVA OR LAVA BRECCIA
478	W701141	PONCE	18-02-41N	066-31-19W	GYP	CARBONATES
479	W701142	PONCE	18-01-58N	066-36-54W	GYP	CARBONATES

Appendix D

Geochemical Sample Analysis

Because of the mix of file formats and type related to the geochemical data, it is necessary to present this information in a separate folder. Please proceed to folder ‘Appendix D’ for more information.

Appendix E

This folder contains a program called GSSTK, which can be used to retrieve and display MRDS mineral deposit and occurrence data for Puerto Rico. Included with the program are ‘HELP’ files to be used when executing the program and data files that contain the complete MRDS records for Puerto Rico.

Because of the mix of file formats and type related to the retrieval software, it is necessary to present this information in a separate folder. Please proceed to folder ‘Appendix E’ for more information.