

GMS-42 Geologic Map of the Ocean Floor Off Oregon and the Adjacent Continental Margin By Carolyn P. Peterson, LaVerne D. Kulm, and Jerry J. Gray Funded by the U.S. Department of the Interior-Minerals Management Service through Cooperative Agreement 14-12-0001-30223 TIME ROCK CHART **ROCK — STRATIGRAPHIC UN'ITS ONSHOP** ONTINENTAL SH tore units are delived on the basis of toe metric of and are delined on basis of rock-stratigraphic mileria "dele Eccene line and der Arm trout (1981). In Niem and Niem (1985): middle Eccene through Mesozoic line acaie from Palmer (1983). absolute scale on this chart is schematic ne-Pleistocene boundary after Palmer (1983) cur offshore on cross section. It Jairs defined on the basis of seismic reflection data and may correlate to part of unit JKs onshore **EXPLANATIO Nye Mudstone (middle-lower Miocene)** — Laminated to massive mudstone and siltstone; locally concretionary (Snavely and others, 1976b) OFFSHORE TIME STRATIGRAPHIC UNITS Juan de Fuca Ridge — Blanco Fracture Zone — Gorda Ridge — Abyssal Plain Manganese-enriched clayey silts (Holocene-late Pleistocene?) - Light- and orthrup Creek formation (informal) (lower Miocene-upper Oligocene?) rk-banded brown clayey silts with all layers composed of variable proportions of h Vell-bedded laminated micaceous and carbonaceous mudstone and arkosic turbidite drothermal precipitates, hydrogenous precipitates, volcanic ash, biogenous debris, sandstone; minor thick-bedded feldspathic sandstone and grit beds (informal unit of and minor terrigenous debris. Dark-colored layers indicate increases in manganese liem and Niem, 1985) rich hydrothermal activity (Selk, 1978 Yaquina Formation (lower Miocene-upper Oligocene) - Tuffaceous and Abyssal plain turbidites (Holocene-late Pleistocene) — Thin silt and sand turbi-dites intercalated with hemipelagic muds. Turbidite sequences composed of very finefeldspathic sandstone, cross-bedded in part; minor conglomerate and coal (Snavely and others, 1976b) grained sand or coarse silt layers that grade upward to hemipelagic clay or silty clay. Silt and sand layers range from a few millimeters to 150 centimeters (cm) thick. Sed-**Granophyric gabbro (upper Oligocene)** — Inclined sheets, sills, and dikes of massive gabbro (Snavely and others, 1976c) iments of late Pleistocene age generally have higher percentages of sand and silt tur-bidites than Holocene abyssal plain sediments (Duncan, 1968; Horn and others, 1971; Kulm and others, 1973a) Camptonite intrusive rocks (Oligocene) — Dikes and sills of commonly porphyritic but in part aphyric camptonite (Snavely and others, 1976c) Astoria Fan (Holocene-early Pleistocene) — Subdivided into three physiographic provinces: upper fan, middle fan, and lower fan. Thick- to thin-bedded, medium- to very fine-grained turbidite sands with thin interbedded olive-gray muds. Sand beds Nepheline syenite (Oligocene) — Sills, dikes, and small stocks of very fine- to finegenerally range from 50 to 100 cm in thickness. Individual beds grade upward into grained nepheline syenite or phonolite (Snavely and others, 1976a) silts and silty clays and have sharp basal contacts. Thin, graded silt turbidites are also present in minor proportions (Nelson, 1968; Kulm and others, 1973a) Alsea Formation (Oligocene) — Massive tuffaceous siltstone (Snavely and others, 1976a; Johnson and others, 1984) Hemipelagic mud (Holocene-Pleistocene) — Homogeneous, poorly sorted, olivegray and gray clay and silty clay. Radiolarians dominate Holocene strata, while plan-Smuggler Cove formation (informal) (lower Miocene-upper Eocene) — Thickktonic foraminifers dominate deposits of late Pleistocene age. This unit is restricted to regions topographically isolated from turbidity currents (Duncan, 1968) bedded bioturbated tuffaceous claystone and siltstone; minor thin-bedded micaceous sandstone and glauconitic sandstone (informal unit of Niem and Niem, 1985) Pelagic ooze and clay (Holocene-Pleistocene) --- Foraminiferal ooze and clay (Duncan, 1968) Sager Creek formation (informal) (upper Eocene) — Well-laminated micaceous and carbonaceous mudstone rhythmically interbedded with thin feldspathic sandstone turbidites (informal unit of Niem and Niem, 1985) Qc Cascadia Channel fill (Holocene-Pleistocene) — Rhythmically interbedded thick silt and sand turbidites and thin heminologic alour. Channel fill the second secon silt and sand turbidites and thin hemipelagic clays. Sharp basal contacts, commonly Marine sedimentary rocks, undifferentiated (middle Miocene-upper Eocene) with sole marks, are succeeded by laminated and graded sand or silt. The coarse basal - Massive tuffaceous mudstone, thin-bedded micaceous sandstone, and tuffaceous zone is overlain by normally graded hemipelagic sediment. Holocene sediments are mudstone (Johnson and others, 1984) finer grained, more poorly sorted, and have a higher organic carbon content than their counterparts of late Pleistocene age. Local pebbly claystones and moderately Pittsburg Bluff Formation (lower Oligocene-upper Eocene) — Fossiliferous, sorted gravels of late Pleistocene age were deposited by ice rafting and turbidity curthick-bedded, bioturbated tuffaceous and feldspathic sandstone; glauconitic in lower rents caused by catastrophic glacial flooding, respectively (Griggs and Kulm, 1970; ___ part (Niem and Niem, 1985) Griggs and others, 1970) Unyamecl basaltic sandstone (lower Oligocene) — Massive to thick-bedded, fos-Abyssal plain silt turbidites and interbedded clays (late Pleistocene-Pliocene) siliferous, medium- to coarse-grained basaltic sandstone (Snavely and others, 1976a) QTp (shown only on cross section) — pelagic clays and foraminiferal ooze becoming more predominant with increasing depth in section; unit overlies volcanic basement (Kulm Yachts Basait (lower Oligocene-upper Eocene) — Aphanitic to porphyritic sub-aerial basalt nows and breccias, with minor pillow lavas, alkalic basalt flows, and reand others, 1973a) Mid-ocean ridge basalts (Holocene-late Miocene) — Tholeiitic pillow lavas and ---lated intrusive rocks (Snavely and others, 1976a) sheet and lobate flows erupted along the axes of the Juan de Fuca and Gorda Ridges. Modern Juan de Fuca axial valley is floored predominantly by sheet flows; valley Nestucca Formation (upper Eocene) -- Thin- to medium-bedded siltstone with walls are composed chiefly of pillow lavas (Lichtman and others, 1983). On the cross minor sandstone and tuff beds (Snavely and others, 1976a) section, unit QTv represents oceanic crust (whose upper few hundred meters consist of the volcanic rocks described above) which may grade downward into feeder dike Nestucca volcanic rocks of the Nestucca Formation (upper Eocene) swarms, isotropic gabbros, and layered ultramafic rocks. Ridge basalts increase in age Aphanitic to porphyritic subaerial basalt flows, breccias, alkalic basalt flows; minor with distance from the ridge axis due to seafloor spreading. Reversals in the earth's pillow lavas and related intrusive rocks; flow rocks intertongue with Nestucca Formagnetic polarity produce the striped pattern of magnetic anomalies in the oceanic mation sediments (Snavely and others, 1976a; Wells and others, 1983) crust (see magnetic anomaly map in text accompanying this map). Several hydrothermal vent sites with associated benthic communities are located in **Keasey Formation** (upper Eocene) — Laminated to thin-bedded tuffaceous the axial valley of the Juan de Fuca Ridge. Massive sulfide deposits rich in zinc and iron occur at these vent sites (Koski and others, 1982, 1984). Deposits along the northmudstones and thin-bedded micaceous sandstone and tuff beds (Niem and Niem, ern Gorda Ridge include hydrothermal clay and manganese oxide crusts (Clague and others. 1984) Cole Mountain basalt (informal) (upper Eocene) — Basalt sills, dikes, and irregular bodies intruded into the Hamlet formation and Cowlitz Formation and along Abyssal plain silt turbidites (early Pleistocene-late Miocene) (shown only on Leasey/Hamlet contact; includes some minor submarine pillow lavas (Niem and OTpt cross section) — Silty turbidites and interbedded clays. Individual beds generally consist of a thin basal silt interval with a sharp lower contact and grade upward into olive-gray silty clay that in turn grades into calcareous silty clay. Basal silts are Bastendorff Formation (upper Eocene) — Massive tuffaceous mudstone and planar and micro-cross-laminated. Beds generally range in thickness from 10 to 20 minor thin-bedded micaceous sandstone and tuffaceous mudstone (Baldwin and cm. With increasing depth in the section, the basal silt proportion decreases or may be completely absent, while calcareous silty clays of hemipelagic to pelagic origin become more prevalent (Kulm and others, 1973a) Cowlitz Formation (upper Eocene) — Micaceous, cross-bedded to thick-bedded arkosic sandstone (Niem and Niem, 1985) Continental Slope Accretionary basin fill (Holocene-Pliocene?) - Intercalated hemipelagic clays and Hemiet formation (informal) (upper Eocene) — Massive, carbonaceous and micawell-bedded turbidites that consist of well-sorted, fine-grained sand to coarse silt and DTab bearing mudstone; few thin interbeds of graded, rhythmic, fine-grained, arkosic, that have sharp upper and lower contacts. Hemipelagic sediments predominate where micaceous, carbonaceous sandstone and/or medium- to coarse-grained basaltic topographic barriers prevent turbidite deposition (Kulm and others, 1973b; Kulm and sandstone (informal unit of Niem and Niem, 1985) Fowler, 1974; Kulm and Scheidegger, 1979) Igneous intrusions, undifferentiated (middle Miocene-middle Eocene) — Gab-Accretionary complex (Holocene-Pliocene?) — Abyssal plain and fan sediments bro, diabase, and basalt dikes and sills in the Coast Range; diorite, gabbro, and sye-nite dikes and dacitic and rhyolitic dikes and sills in the Klamath Mountains QTac that have been accreted to the lower continental slope and subsequently uplifted. Fan and plain sediments include graded sand and silt turbidites and hemipelagic muds. (Baldwin and others, 1973; Ramp and Peterson, 1979; Johnson and others, 1984) Lower slope accretionary basin sediments are also incorporated into the accretionary prism. The semiconsolidated to indurated strata have been disrupted by folding and Coaledo Formation (upper-middle Eocene) --- Feldspathic, micaceous, cross-bedfaulting as a result of convergence het use the quan de Fuca and North American ded to thick-bedded sandstone; minor conglomerate and coal (Johnson and others, Paleobathymetry, indicated by benthic foraminifers, shows that general uplift of the entire Oregon continental margin has occurred during the late Cenozoic. The up-Tillamook Volcanics (upper-middle Eocene) — Aphanitic to porphyritic subaelift rate has been highest on the lower continental slope (1,000 meters per million rial basalt flows, breccias, pillow lavas, alkalic basalt and dacite flows, and related in-trusive rocks (Johnson and others, 1984) years [m/my]) and lowest on the outer continental shelf (100 m/my) (Kulm and Bateman Formation (middle Eocene) — Feldspathic, micaceous, cross-bedded to Inferred mélange and broken formation (Miocene?-late Oligocene?) — May be thick-bedded lithic sandstone; minor coal (Baldwin and others, 1973) -Tac uplifted, sheared siltstone with large infolds of interbedded sandstone and siltstone; similar to terrain mapped by Rau (1975) in coastal area of the Olympic Peninsula, Yamhill Formation (middle Eocene) — Massive to thin-bedded concretionary Washington (Snavely and others, 1980) siltstone with thin interbeds of arkosic, glauconitic, and basaltic sandstone; localized interbedded basalt flows (Wells and others, 1983) Marine sedimentary rocks, undifferentiated (Oligocene-late Eocene) (shown Toe only on cross section) — Tuffaceous marine siltstone and mudstone (Snavely and yee Formation (middle Eocene) — Thick to thin, rhythmically bedded, graded, others, 1980) eldspathic, micaceous sandstone and siltstone (Johnson and others, 1984) Continental Shelf QTpm Siltstone (Pleistocene-late Miocene) — Poorly indurated siltstone and minor sandstone. This basinal deposit also blankets upper slope accretionary complex rocks Tes Elkton Siltstone Member of the Tyee Formation (middle Eocene) — Thin-bed-ded sandstone and siltstone; massive concretionary siltstone (Johnson and others, Siliceous claystone (Pliocene-late Miocene) ---- Light-gray to olive-gray, well-contoly Flournoy Formation (middle-lower Eocene) — Fine- to medium-grained lithic west of Coos Bay. Correlates to strata onshore south of Coquille Point (Fowler and others. 1971) Lookingglass Formation (lower Eocene) — Alternating thin- to thick-bedded Tpm Mudstone (Pliocene-Miocene) — Mudstone and siltstone with minor fine-grained sandstone. Miocene rocks have a greater percent sand, while Pliocene rocks have a greater percent clay lithic sandstone and mudstone with subordinate massive sandstone, conglomerate, and mudstone (Johnson and others, 1984) **Roseburg Formation (lower Eocene-upper Paleocene)** — Thin- to thick-bedded lithic sandstone interbedded with mudstone; subordinate massive sandstone, conglomerate, and mudstone (Johnson and others, 1984) Tsu Mudstones, sandstones, and claystones (pre-late Miocene?) — Undifferentiated marine sedimentary rocks with some interbedded volcanic and volcaniclastic rocks Tr (Clarke and others, 1985) Siletz River Volcanics (lower Eocene-upper Paleocene) — Aphanitic to por-**Sedimentary rocks (late Jurassic?)** — Sheared assemblage of sedimentary rocks. May correlate to Otter Point Formation **JKs**, as inferred from onshore geology and seismic reflection (Mackay, 1969) phyritic pillow basalt, breccias, tuffs, and related intrusive rocks; minor siltstone in-terbeds (Johnson and others, 1984). Includes Roseburg volcanic rocks of Baldwin (1974). On cross section, the top of the stipple pattern represents lower limit to which surface geology can be projected **QNSHORE ROCK STRATIGRAPHIC UNITS** Sedimentary rocks (Cretaceous-Upper Jurassic) — Rhythmically interbedded Coastal Region — Western Coast Range — Klamath Mountains sandstone and mudstone of the Hunters Cove and Rocky Point Formations; massive to thick-bedded, cross-bedded sandstone and minor conglomerate of the Cape Sebastian Alluvium (Holocene) — Unconsolidated stream clay, silt, sand, and gravel; beach Sandstone; conglomerate of the Myrtle Group; sheared assemblage of graywacke, siltstone, limestone, and chert of the Otter Point Formation; massive to thick-bedded Qal sand and gravel; dune sand (Niem and Niem, 1985) sandstone and minor intercalated siltstone and shale of the Dothan Formation; rhyth-Terraces (Pleistocene) — Elevated marine terraces of semiconsolidated silt, sand, mically interbedded sandstone and siltstone of the Galice Formation (Ramp and others, 1977; Ramp and Peterson, 1979) Qt and gravel locally; elevated alluvial terraces of semiconsolidated silt, sand, and gravel (Baldwin and others, 1973; Niem and Niem, 1985) **Volcanic rocks (Upper Jurassic)** Basaltic pillow lavas, breccia flows, flows, and pyroclastic rocks of the Otter Point, Dothan, and Galice Formations (Ramp and others, 1977; Ramp and Peterson, 1979) Empire Formation (Pliocene?-upper Miocene) — Fossiliferous massive sandstone and minor interbeds of siltstone; includes a fossiliferous conglomerate lens (Baldwin and others, 1973) Igneous intrusions (Upper Jurassic) — Diorite and gabbro stocks, dikes, and sills Gnat Creek formation (informal) (middle Miocene) — Marine and nonmarine, (Ramp and others, 1977; Ramp and Peterson, 1979) thick, cross-bedded to massive feldspathic sandstone and laminated siltstone; minor conglomerate and coal (informal unit of Niem and Niem, 1985) **FJU** Ultramafic rocks (Jurassic-Upper Triassic?) — Serpentinite and altered perido-Columbia River Basalt Group tites and minor dunites; concordant sheets and tectonically emplaced dikes (Ramp Frenchman Springs Member of the Wanapum Basalt (middle Miocene) and others, 1977; Ramp and Peterson, 1979) Subaerial basalts and submarine pillow lavas and breccias and associated dikes and **Metamorphic rocks (Jurassic-Triassic?)** — Metasedimentary and metavolcanic rocks of the Galice and Rogue Formations, Colebrook Schist, and Applegate Group; includes amphibolite and metagabbro (Ramp and others, 1977; Ramp and Peterson, 1977) sills of the Columbia River Basalt Group. Equivalent to Cape Foulweather Basalt of Snavely and others (1973) (Niem and Niem, 1985) Grande Ronde Basalt (middle Miocene) - Subaerial basalts and submarine pillow lavas and breccias and associated dikes and sills of the Columbia River Basalt Group. Equivalent to Depoe Bay Basalt of Snavely and others (1973) (Niem and -----See accompanying text for the list of references and a discussion Astoria Formation (middle-lower Miocene) — Thick, laminated to cross-bedded of the regional geologic setting. Ta feldspathic and volcanic fine- to coarse-grained sandstone; minor coal; rhythmically bedded turbidite sandstone and siltstone; thick laminated mudstone; massive sandstone; quartzo-feldspathic sandstone and minor tuff in Newport area (Johnson and others, 1984; Niem and Niem, 1985) MAP SYMBOLS _____ Contact — Approximately located; dashed where inferred offshore **Fault** — Approximately located; dashed where probable; dotted where concealed. Ball and bar on downthrown side. Arrows indicate separation. A/T on cross section: A indicates lateral movement along fault away from reader; T indicates movement toward reader **Thrust fault** — Saw teeth on upper plate; dashed where approximately located **Base of defs, mation front of subduction zone** Approximately located; saw teeth on upper plate; bathymetric boundary between continental slope and abyssal $\cdots \wedge \cdots \qquad C_{\text{incr}^2 \mathbf{q}_{c} \mathbf{d}} \mathbf{t}_{\mathbf{n}}$ rust boundary between the accretion complex to the west $\mathbf{a}_{\mathbf{q}}$ basinal rocks to the east Saw teeth on upper plate Approximate time boundary between the Holocene to Pliocene portion of the accretionary complex (QTac) to the west and the accretionary complex of Miocene to late Oligocene age (Tac) to the east — In some localities and in the cross section, this boundary may be a fault \blacktriangleright Syncline — Approximately located offshore; arrows show direction of plunge BASE MAP SOURCES Anticline — Approximately located offshore; arrows show direction of plunge . Bathymetry - Topography, 1984: Western North American Continental Margin and Adjacent Ocean Axis of extension within pull-apart depression — Located on the Blanco Fracture Floor Off Oregon and Washington, edited by L.D. Kulm and others. Ocean Margin Drilling Program: Modified from Juan de Fuca Plate, 1978; Relief compiled by Pacific Geoscience Centre, Surveys and Mapping Branch, Dept. of Energy, Mines and Resources, Ottawa, Canada. Central portion of pull-apart depression Offshore topography of the Western United States between 32° and 49° North Latitude, 1981: U.S. Geological Survey, Open-File Map 81-443. Location of spre_{iding}; center on ridge axis 4. Modified from #3 (above) by the Oregon Dept. of Geology and Mineral Industries, 1984. Zone adjacent to shore without sufficient information to map This map is not intended for navigational purposes Physiographic boundaries within the Astoria Fan separating upper, middle, and lower fan Map prepared by STATE OF OREGON

A' METERS Gravity, piston, and dart core sample site WESTERN OREGON

Sea level

△ Dredge sample site

174 Deep Sea Drilling Project drill site, Leg 18

Bathymetric boundary between the continental slope and shelf

 $-b^{\frac{1}{2}}$ Oil and gas exploration drill hole site on the continental shelf

Scale 1:500,000 at 46° North Latitude Mercator Projection

40 10 20 30 Bathymetric contour interval 100 meters Onshore contour interval 500 meters

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Cartography by Paul E. Staub