indicates easterly ice flow in the Stellwagen lobe and southerly flow in the Martha's Vineyard lobe.

HYDROCARBON DISTRIBUTIONS IN SEDIMENTS FROM THE HUDSON ESTUARY

KEENAN, Everly M., Department of Geology, University of Delaware, Newark, Delaware 19711

In July 1972 and October 1976, grab samples were collected in the Hudson Estuary from Poughkeepsie to the Verrazano-Narrows Bridge. Saturated, straight chain hydrocarbons were extracted from all samples and analyzed. Results indicate that New York Harbor is polluted by petroleum hydrocarbons. Characteristic features of contamination are present in the 1972 and 1976 samples from this area. They include low CPI (carbon preference index)(1.0-1.5), high Sat.HC/TOC (ratio of saturated hydrocarbons to total organic carbon)(.01-.06), and unresolved complex mixtures. Samples taken from the northern section of the study area produced conflicting results. The 1972 series was collected 3 weeks after Tropical Storm Agnes and indicated that terrestrial plants had supplied the saturated hydrocarbons to the sediments. This was confirmed by low Sat. HC/TOC(.0011-.0071) and high CPI(1.5-3.6). Samples collected in 1976 from the same area yielded Sat.HC/TOC and CPI values similar to those from New York Harbor, thus indicating petroleum contamination. It is believed that Tropical Storm Agnes exposed older, uncontaminated sediment in the northern portion of the study area by erosion of the polluted material, transportation downstream and deposition in New York Harbor. Redoposition of contaminated material after Tropical Storm Agnes in the northern area would lead to the saturated hydrocarbon content found in the 1976 samples.

TRANSPORT AND DEPOSITION OF FINE GRAINED SEDIMENT: INFERENCES FROM GRAIN SIZE DISTRIBUTIONS

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Size analyses were performed by sieve, pipette, and Coulter counter on more than 200 bottom and suspended sediment samples from inner continental shelf, beach, inlet, tidal channel, and lagoonal environments in southern New Jersey. Although SEM observations and comparison of dispersed and non-dispersed size distributions indicate a high degree of particle agglomeration in most environments, a regular decrease in dispersed mean phi (M_ϕ) size is observed on a regional scale from ocean toward mainland, and on a local scale within a single tidal channel. A plot of M_ϕ versus sorting indicates that hydraulic fractionation of discreet particles is effective only in the sizes coarser than 5 ϕ. Cumulative frequency plots on probability paper of the finer than 62 μm fraction of samples delineate three populations representing three modes of fine sediment transport. While particles coarser than 5 ϕ travel largely as discreet grains, those from 5 ϕ to 10 ϕ move as agglomerates on floccules of roughly equivalent size grains. Particles finer than 10 ϕ are transported as subordinate grains, electrostatically bound to larger particles of all sizes.

Deposition of floccules from suspension is controlled by floccule size in the manner described by Kranck (1975). Since the size distribution (dispersed) of grains in silt sized floccules is finer than in clay sized floccules, deposition of silt sized floccules results in an enrichment of clay sized material in the remaining suspension. Fractionation of grains by size in this manner in back barrier regions results in a reservoir of very fine suspended sediment offshore (greater than 70% of the inorganic fraction by weight is finer than 11 ϕ).

PRECAMBRIAN TECTONICS OF NOVA SCOTIA

KEPPIE, J. Duncan, Department of Mines, 1690 Hollis Street, Halifax, Nova Scotia, Canada.

The Precambrian rocks of the Avalon Zone in Nova Scotia occur north of the Glooscap Fault System and are divided into three subzones, each of which is subdivided into two domains. From east to west, they are - 1. Cape Breton Island Subzone; (a) Louisburg domain: calc-alkaline, cratonic island arc volcanics (Fourchu Group); (b) Ingonish domain metavolcanics and metasediments (Clyburn Succession and George River Group), unconformably overlying a pre-Hadrynian gneissic basement (Kelly Mountain Complex); 2. Antigonish Highlands Subzone; (a) Cheticamp domain: metavolcanics and metasediments overlying an ultramafic complex; (b) Antigonish domain: submarine volcanics, metasediments and volcaniclastic flysch (Georgeville Group), possibly underlain by ultramafic rocks; 3. Cobequid Highlands Subzone; (a) East Cobequid domain: gneiss, metasediments and metavolcanics (Mt. Thom and Bass River Complexes); (b) West Cobequid domain: volcanics and sediments (Jeffers and North River Successions). Amphibolite facies metamorphism is generally confined to the Ingonish and East Cobequid domains. Intermediate - basic plutonism is predominant in the Antigonish domain, whereas acidic-intermediate plutonism is typical of the Cape Breton Highlands Subzone. All of these late Precambrian rocks were deformed by one or more phases of the Late Hadrynian Wapnakian Orogeny. Tectonic interpretation of these subzones includes a northwesterly dipping subduction zone beneath a cratonic volcanic island arc (Cape Breton Island Subzone), a marginal basin (Antigonish Highlands Subzone) and a remnant cratonic arc (Cobequid Highlands Subzone). The Caledonian Highland Subzone in southern New Brunswick is correlated with the Cape Breton Island Subzone, displaced by later faulting. These subzones do not appear in the Avalon Zone in Newfoundland, but may occur offshore.

TWO "BLACK-GREEN" BOUNDARIES IN THE NORTHERN TACONIC ALLOCHTHON

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Detailed outcrop mapping in the western part of the Giddings Brook slice of the northern Taconic allochthon reveals that there are two "black-green" stratigraphic boundaries developed on a regional scale in the early to middle Cambrian part of the section. An exceptionally well-exposed (for the Taconics) and structurally undissected area, northwest of Granville, NY shows conclusively that this repetition is not due to tectonic causes. The change, from mostly green mudrocks below, to dark grey and black mudrocks above, has previously been thought to occur at a single horizon. Separation of the map units that define these boundaries leads to a much clearer understanding of the possible stratigraphic range of some distinctive lithologic members (Black Patch/Eddy Hill grit, Mudd Pond Quartzite, North Brittain conglomerate) previously used extensively in Taconic mapping. The latter two, in particular, occur at several different stratigraphic levels below the upper black-green boundary. A well-exposed undisrupted section from below the earliest fossiliferous Cambrian rocks up to the middle Ordovician flysch (Pawlet) is seen throughout this area, and the Pawlet here conformably overlies the other rocks. Given the generally poor exposure and/or structural complexity in other areas of the Taconics, this area contains a valuable reference section for Taconic Cambro-Ordovician stratigraphy. The present thickness of the intact Cambro-Ordovician sequence below the flysch is close to 700 meters. Allowing for tectonic thinning, this gives an average accumulation rate of about 1.3 cm/1000 yr, supporting the idea that the site of deposition was a "starved" environment, in this case the continental rise.

FOOTPRINT EVIDENCE FOR FLOCKING BEHAVIOR IN LATE TRIASSIC BIPEDAL REPTILES

KINGSTON , M.J., LAPIANA, V.J., PURDY, T.L., AND WEEMS, R.E., Department of Geology, the George Washington University, Washington, D.C. 20056

Quarrying operations by the Culpeper Stone Company near Culpeper, Virginia, exposed an Upper Triassic bedding plane of contact-metamorphosed mudstone over an area of several acres. Mudcracks and over 1000 footprints record the final stages of drying of this layer, probably involving at most a few days of time. During this interval, at least six different types of animals (five bipedal and one questionably quadrupedal) traversed this bedding plane, producing over thirty separate trackways ranging from deep and poorly defined (early drying stage) through well defined to shallow and poorly defined (late drying stage). One type of trackway, made by a tridactyl, bipedal, blunt-toed animal (ornithischian dinosaur?) occurs only in two discrete clusters. In each cluster, all trackways trend nearly in the same direction (compass bearing $125° \pm 4°$ in one group of four trackways, $134° \pm 4°$ for the other group of seven trackways). In the case of the larger cluster, there is a suggestion that most of the individuals near the center of the cluster had slightly shorter strides than those toward the flanks of the cluster. These patterns suggest that this type of trackmaker may have been gregarious and travelled in flocks.

SUCCESSION OF FAUNAS AND FRAMEWORKS IN MIDDLE DEVONIAN PINNACLE REEFS OF SOUTH-CENTRAL NEW YORK

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Five subsurface pinnacle reefs in Steuben and Cattaraugus Counties, New York were initiated as isolated mounds on extensive basin-margin platforms during early Onondaga transgression. Unlike the far smaller outcropping Onondaga bioherms confined to the basal Edgecliff Member, pinnacle reefs continued vertical growth throughout the duration of Onondaga deposition. They measure 36 to 63 m thick and 1200 to 3200 m diameter and display broadly domed final structures exposed subaqueously during deposition of onlapping Marcellus and Skaneateles Shales. Pinnacle reefs bear many similarities to outcropping bioherms, but contrast in absence of stromatoporoids, proponderance of Cylindrophyllum in spaceous central facies, dominance of Cladopora over favositids in relatively subordinate crinoid-rich flank facies, and overall greater complexity in faunal succession.

Although variable among reefs and cyclical on small scale, faunal succession in pinnacle reefs when simplified manifests a tripartite model that probably reflects temporal changes in bathymetry of growing reef surfaces determined by relative rates of vertical accretion and rates of subsidence or eustatic rise. (1) Initial rapid upward growth by dense Acinophyllum and Cladopora thickets in ostracode-rich carbonate mud matrix. Followed by (2) slower vertical accretion of relatively clean crinoid sands interspersed by profuse thickets and rubble of Cylindrophyllum, Cladopora, Acinophyllum and robust solitary corals, together comprising the major part of reefs. Capped by (3) delicate coral bafflestone in carbonate mud matrix, dominated by Cladopora and Cystiphylloides, lesser clusters of Acinophyllum, Syringopora and fenestrate bryozoans, and formed under gradual foundering that led to drowning and termination of reef growth.

STRUCTURAL GEOLOGY AND TECTONICS II—SOUTHERN NEW ENGLAND AND HUDSON RIVER

Suite E, 1330 hours

William M. Chappel and J. W. Skehan, S.J., Presiding

1 *Patrick J. Barosh:* Paleozoic Plate Boundary Conditions in Southeastern New England 1330
2 *J. W. Skehan, S.J.,* D. P. Murray:* Structural Domains within the Narragansett Basin, Southeastern New England 1350
3 *Robert P. Wintsch:* Recent Mapping in the Chester Area, Connecticut, and Its Bearing on the Chester Syncline 1410
4 *Charles Merguerian:* Dismembered Ophiolite along Cameron's Line, West Torrington, Connecticut 1430
5 *Douglas G. Mose, F. Donald Eckelmann,* Leo M. Hall:* Age-Determination and Zircon Morphology Studies of the Yonkers and Pound Ridge Granite Gneisses in the Manhattan Prong, Southeastern New York 1450
6 *Douglas G. Mose,* Leo M. Hall:* Rb-Sr Whole-Rock Age Determination of Member C of the Manhattan Schist and Its Bearing on Allochthony in the Manhattan Prong, Southeastern New York 1510

Recess 1530

7 *D. Rowley,* L. L. Delano:* Structural Variations in the Northern Part of the Lower Taconic Allochthon 1550
8 *W.S.F. Kidd,* L. L. Delano:* Two "Black-Green" Boundaries in the Northern Taconic Allochthon 1610
9 *Gary J. Mitch:* Preliminary Report on the Stratigraphy and Structure of the Newburgh Area, Newburgh 7½′ (SE ¼) and Cornwall 7½′ (NE ¼) Quadrangles, New York 1630
10 *Philip J. Murphy, Timothy Bruno,* Nicholas A. Lanney:* Decollement Structures in the Hudson River Valley 1650
11 *William P. Crowley:* The Appalachian Piedmont: A Cross Section near Baltimore 1710

POSTER SESSION II—STRUCTURAL GEOLOGY AND PETROLOGY

Lower Level Registration Area

Authors will be present from 1400 to 1700 hours

1 *Rodger T. Faill:* Deformation Pattern in the Pennsylvania Salient of the Central Appalachians .. Booth 1
2 *H. Robert Burger,* Ellen McLean, Paul L. Hancock:* Strain Analysis of Shear Zones in Upper Cretaceous and Paleocene Limestones, Esca Gorge, Spain ..... Booth 2
3 *Martin E. Ross:* Evidence of Partial Melting and Fractional Crystallization of Columbia River Basalt Magmas, Oregon and Washington ..... Booth 3
4 *Richard S. Naylor:* Characterization of the Phanerozoic Plutonic Rocks of Vermont ..... Booth 4
5 *Barry Voight, James Ewart*:* Thermal Stresses in Oceanic Lithosphere ..... Booth 5
6 *David S. Westerman:* Major Fault Systems in Central Washington County, Maine ..... Booth 6

PALEONTOLOGY I

Suite F, 1410 hours

David R. Kobluk and Steven M. Warshauer, Presiding

1 *Helen Farnstrom,* Lisa Poulsen, Robert M. Linsley:* Functional Significance of Shell Ornamentation in Prosobranch Gastropods 1410
2 *George R. McGhee, Jr.:* Geometric Analysis of Biconvex Brachiopod Shell Morphology: Ordinal Distributions and Stability Strategies 1430
3 *Howard R. Feldman:* Morphologic Variability and Adaptation in Middle Devonian Brachiopods from New York 1450
4 *David B. Cornue:* Gradient Analysis of Species Distribution: Theory and an Example from the Devonian of New York 1510
5 *Susan L. Duffield,* Steven M. Warshauer:* An Integrated Study of Mid-Appalachian Subsurface Shales (Upper Devonian)—Conodont Biostratigraphy and Ostracode Paleoecology 1530

Recess 1550

6 *Daniel B. Sass,* Robert A. Condrate, R. Snyder, Timothy R. Alderfer:* The Alfred Shale: Its Fauna, Mineralogy, and Trace-Element Chemistry 1610
7 *Patricia E. Videtich,* Ian G. MacIntyre:* Stable Isotopic Analyses of Serpulids from a Submarine Cave, Belizean Barrier Platform 1630
8 *Steven W. Markle, Roger J. Cuffey,* Shirley S. Fonda:* Modern Reefs and Bryozoans off Port Royal, Eastern Roatán, Honduras 1650
9 *David R. Kobluk:* Boring Algae: Rates of Infestation and Time to Initial Infestation of Calcite in Shallow Reef Environments, Discovery Bay, Jamaica 1710

*Speaker

PLEASE BRING THIS PROGRAM TO THE MEETING

abstracts with programs

Northeastern Section of The Geological Society of America 14th Annual Meeting

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