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LOWER BARNEVELD (SHOREHAM) FAUNAL ASPECTS OF THE  
MARTINSBURG SHALE, NEW PALTZ-KINGSTON AREA, ULSTER COUNTY, NEW YORK

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Seven fossil localities in the Martinsburg Shale of the New Paltz-Kingston area have yielded a fauna resembling that reported from the Shoreham Limestone of north-central New York State. Although fossils are not generally common, the fauna is fairly diverse and consists of the following (in decreasing order of abundance): brachiopods (*Dalmanella rogata*, *Sowerbyella* sp., *Rafinesquina* sp.); "crinoid stems"; trilobites (*Cryptolithus tessellatus*, *Cryptolithus lorettensis*, *Flexicalymene senaria*, *Calliopus callicephala*, *Bumastoides milleri*, *Isotelus* sp.); gastropods; cephalopods (cf. *Spyroceras bilineatum*); conularids (*Metaconularia trentonensis*). Ostracods and a tabulate coral (*Paleoalveolites* sp.) are known from single occurrences. Fragmentary remains of eurypterids and graptolites have also been found.

Of the taxa identified thus far, ten of twelve have been reported from the Shoreham Limestone. None of the twelve appears to have stratigraphic range which excludes the Shoreham.

Differences in depositional environments between the Martinsburg and the Shoreham (i.e. shale and siltstone vs. limestone) may account for the apparent absence of some Shoreham faunal elements. *Trematis terminalis* and *Ceraurus dentatus* have yet to be found in the New Paltz area. Environmental differences may also account for the relatively smaller size of individual Martinsburg specimens compared with specimens of the same species from the Shoreham.

The near absence of graptolites in the Martinsburg Shale may be more apparent than real due to a slaty cleavage which rarely parallels the bedding planes. In addition, occurrences of some species of other fossils may also be masked to various degrees in a similar fashion.

PALEOCURRENT DIRECTION AND DEPOSITIONAL ENVIRONMENT OF A BINNEWATER  
SANDSTONE SECTION (UPPER SILURIAN) NEAR ROSENDALE, ULSTER COUNTY, NEW YORK.

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A complete 30.2 foot section of Binnewater Sandstone one mile south of Rosendale on State Highway 32 is disconformably overlain by the Rosendale

Member (dolostone) of the Rondout Formation and questionably gradational with the underlying High Falls Shale. Beds strike N40°E and dip 25°NW. The exposure trends N40°W.

Lithology consists predominately of buff, grey and white medium- to fine-grained quartz arenite but minor shale beds occur. Bedding ranges from 0.05 to 0.9 feet in thickness and averages 0.2 feet. Tabular, tangential cross-laminated beds comprise 20 percent of the total thickness. Remaining beds are either massive or laminate.

Paleocurrent directions from corner readings of cross-laminae (double azimuth) average N35°W (9 readings) with a reverse direction of S51°E (2 readings). This general trend is supported by single azimuth readings with an average direction of N36°W (64 readings) and a reverse trend averaging S31°E (22 readings). Fore-set inclinations of cross-laminae projected from corners average 19° with a maximum of 24°. Inclinations in single azimuth readings average 14° ranging up to 24°.

Environmental features are indicated by tabular, tangential cross-laminae, translation ripple marks, sand-filled mud cracks, rare salt casts, numerous shale partings and a general absence of fossils except in the top 4.4 feet of the section (silicified stromatoporoids, brachiopods and favositid corals). These features are tentatively interpreted as indicating frequently subaerial and occasionally arid tidal flat conditions with a net shift of sediment to the northwest.

#### PYRITIZATION IN FOSSILS FROM THE SILICA FORMATION,

##### MEDUSA QUARRY, OHIO

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Previous studies of the geochemistry of pyritization indicate that pyrite deposition takes place in neutral or alkaline reducing environments, that the activities of autotrophic sulfate-reducing and sulfide-oxidizing bacteria greatly increase the rate of pyrite deposition, and that the necessary sulfide and iron are probably derived respectively from dissolved sulfate and from the iron oxides associated with clay minerals. Methods of the present investigation of the pyritization of the Silica fossils include X-ray diffraction analysis and transmission photography, thin-section examination, bacteriological experimentation, and hopefully electron microprobe investigation. It seems possible that patterns of pyrite distribution in sediments and selectivity of pyritization among fossil groups may be related to amount and nature of original organic material, and that pyrite distribution within shell material may give an indication of whether or not the pyrite was introduced prior to the latest crystallization of the calcium carbonate in the shell.



STRUCTURAL AND GRAVIMETRIC ANALYSIS OF THE MIDDLEBURY  
SYNCLINORIUM NEAR ORWELL, VERMONT

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Structural and gravimetric data were collected along the southern termination of the west limb of the Middlebury Synclinorium between Shoreham and Orwell, Vermont. The Orwell Thrust dominates the western portion of this area, bringing Cambrian Danby quartzite in thrust contact with Upper Ordovician Stony Point Shale. Decreasing displacement along the thrust to its termination in Orwell indicate a possible structural hinge. The lower plate comprises steeply-dipping and folded rocks. The predominant fold pattern on the upper plate was developed in mid-Trenton time with the emplacement of the Taconic allochthon by gravity sliding. This recumbent, asymmetrical folding may have been refolded during the Acadian orogeny, but such deformation was not observed in the field area. The large-scale thrusting is the outstanding manifestation of the Acadian. Regional joints and fractures post-date the last orogenic phase. Most of the structures trend north-south and are concordant with the larger scale tectonic trends.

INTERRELATIONSHIPS OF SURFACE AND GROUND WATER AND SOME  
ENVIRONMENTAL IMPLICATIONS NEAR THE NATIONAL FISH HATCHERY,  
CORTLAND, NEW YORK

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A study is being undertaken with the cooperation of the United States Geological Survey and the Bureau of Sports Fisheries and Wildlife to ascertain the interrelationships between ground water and surface water recharge-discharge phases in the area of the Cortland National Fish Hatchery. Due to the availability of data, stream and ground water flow are being closely monitored, and recharge-discharge relationships studied.

A number of well water level recorders, staff and rain gauges were placed in the study area to measure these various geohydrologic parameters. Any variations or stress on the hydrologic environment are traceable to their source, thus allowing for the control and manipulation of these factors.

This area is believed to be typical of glaciated terrane with high water tables in Central New York, and thus the results of this study should prove useful in future hydrogeologic investigations in areas of this type.

ZONED ANDRADITE FROM CRIPPLE CREEK, COLORADO

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Anisotropic andradite from Cripple Creek, Colorado shows strong oscillatory zoning and cyclic twinning. Microprobe analyses reveal alternating zones that chemically vary between pure andradite and andradite<sub>50</sub>-grossularite<sub>50</sub>. The possibility of fluctuating hydrothermal solution and oxidation may explain the zoning. The specific cause of anisotropism and twinning is unresolved at this time.

THE PRECAMBRIAN PILLOW LAVAS OF THE TIBBIT HILL MEMBER,  
PINNACLE FORMATION, ENOSBURG FALLS, VERMONT

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The Tibbit Hill member of the Pinnacle Formation has been metamorphosed to the lowest temperature subfacies of the greenschist facies. Three principal rock types were recognized in the field and studied under the microscope: a "tuffaceous" schist, a vesicular schist, and pillowed lavas. Mineralogically similar, all three contain an albite-epidote-chlorite-actinolite-stilpnomelane-magnetite assemblage. The texture is very fine grained intersertal-divergent, with grains generally smaller than 0.5 mm.

In the tuffaceous schist, quartz and white mica are also present in variable amounts. Albite in the vesicular schist is slightly more sodic in the vesicles than in the matrix, indicating some soda migration. Detailed microscope and correlative x-ray work have shown the pillowed lavas to be composed of: pistacite with 20-30 mol%  $\text{OHCa}_2\text{Fe}_3\text{Si}_3\text{O}_{12}$  and minor amounts of the manganian epidote piemontite; a chlorite of rumpfitic or delessitic composition, indicating 30% iron over total Fe and Mg; ferrostilpnomelane having roughly 20-30%  $\text{Fe}^{3+}$  over total femics; actinolite with an Fe:Mg ratio of 2:3; and magnetite with occasional calcite and sphene.

Chlorite-quartz-actinolite phase relationships indicate a minimum metamorphic temperature of 400 to 425°C. Recalculation of the protolith, based on modes and composition, and assuming a semi-closed system, indicates a basaltic



rock composed of: augite, labradoritic plagioclase, and olivine.  $K_2O$  percentages are similar to those of Atlantic Series tholeiites. There are virtually no primary internal structures preserved in the pillows, such as mineralogical and textural zoning from core to margin, suggesting that they did not develop because of shallow marine emplacement or that they have been obliterated by metamorphism.

THE PRECAMBRIAN TIBBIT HILL MEMBER OF THE PINNACLE  
FORMATION IN BERKSHIRE TOWNSHIP, VERMONT

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The Tibbit Hill member of the Pinnacle Formation in Berkshire Township, north-central Vermont, is a metamorphosed series of basaltic lava flows and associated volcanic tuffs. The stratigraphically lower parts of each flow consist of pillows in strings up to 100 m. long; the individual pillows are no larger than 75 x 150 cm. Stratigraphically higher in a single flow sequence, the pillows become smaller and more scattered, with an increasing proportion of matrix material. Some of the smallest pillows are mineralogically zoned, with epidote-rich cores and albite-actinolite coronas. In the matrix above the pillows, crystal aggregates of epidote 1 cm. in diameter occur; these give way to similar albite clots still farther up.

The larger pillows consist of coarse-grained epidotes. Their matrix is a schist that contains epidotes, chlorite, actinolite, magnetite, and sphene. Two generations of quartz and albite occur also. The older generation are very small crystals in the matrix of the schist. The younger occurs in (dilation) veins and as filling for primary vacuoles. The veins occur both in the schist and the pillows. Hexagonal aggregates of quartz and epidote are interpreted as pseudomorphous replacement of labradoritic plagioclase.

The structure of the pillows indicates that the Tibbit Hill rests on the lower Pinnacle Formation, which was previously considered to be younger than the volcanic rocks in the area. This necessitates reinterpretation of the "synclines" as anticlines, and since the base of the formation is exposed, allows a determination of the thickness of the unit.

## LAKE ONTARIO - ROCHESTER MARINE GEOPHYSICAL SURVEY

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A marine geophysical survey was conducted in the near offshore waters of Lake Ontario - in the Rochester area. The geophysical survey consisted of a series of continuous seismic reflection lines in grid formation, lake bottom bathymetry, and a number of subbottom sediment cores. The geological question to be resolved by the survey was to establish the nature of the lake subbottom, whether it be hard rock or sediment. Thick deposits of sediments were found to exist immediately offshore of Rochester under Lake Ontario. The bedrock, where encountered, was relatively deep, and probably reflects the nature of the lake coastal bedrock topography. The sediments consist of sands, gravels and clays.

## TILL COLOR BOUNDARY IN ERIE COUNTY, NEW YORK

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Two till types, a red and a grey, are easily distinguished in Erie County. The boundary between the two types is linear in an east-west direction and is often as little as 50 feet in width. Red till lies to the north of this boundary and grey till to the south. Samples were taken in a pipeline trench 5 feet deep which crossed this boundary and subjected to sedimentological, heavy mineral, clay mineral, and iron and carbonate content analysis. Depth to bedrock data allowed the definition of a small subsurface scarp or rise of the more resistant Stafford limestone (Skaneateles Fm) which closely parallels the color boundary.

Investigation has shown that both tills are of Port Huron age and that the change of color is caused by the incorporation of dark brown Oatka Creek shale (Marcellus Fm) into the base of the predominately red glacial load. Apparently the basal load has been forced to override the small scarp of the Stafford limestone to produce the color boundary. Presumably overriding also resulted in admixture and dilution of the red till to a grey color in exposures of tills of the same age in the southern part of the area.

