Knowledge Base and Textbook Readings for Geology 2C, Historical Geology, Spring 2006 – Exam 3

13. Geologic History of NY – The Taconic Orogeny
Wicander (Ch.10)

Cambrian – Early Ordovician: passive margin (limestone deposition).
Middle – Upper Ordovician: active tectonic margin – collision of east coast with volcanic island arc – Taconic Orogeny
Evidence for Taconic Orogeny: rapid change from shallow water to deep water deposition (development of foreland basin – "bowling ball on the mattress effect")
Erosion of Taconian Mountains deposits clastic sediments westward across New York State – shales, siltstones, and greywackes.
Eastern New York – metamorphism of rocks beneath rising Taconian Mountains – schist, gneiss, and marble of the Manhattan Prong.
Folding and thrust faulting of Upper Ordovician and older rock layers towards the end of the Taconic Orogeny, uplift and erosion to form angular unconformity.
Metamorphism and movement of rock layers in the Taconic region east of the Hudson River – Taconic klippe or allochthon (a region of crust that has been pushed out of place)
After the Taconic Orogeny: erosion of the Taconian Mountains. Unconformity spanning most of the Silurian.
Late Silurian: sea level rise – shoreline moves westward across New York. Deposition of Shawangunk conglomerate, return of shallow water passive margin conditions and deposition of limestones.

14. Geologic History of NY – The Acadian Orogeny and the Late Paleozoic
Wicander (Ch.11)

Lower Devonian: passive margin conditions persist. Deposition of limestone in shallow seas covering New York. Abundant marine fossils – extensive coral reefs.
Middle Devonian: beginning of Acadian Orogeny – collision of eastern North America and Avalonia microcontinent (part of Europe).
Evidence for the Acadian Orogeny: rapid change from shallow water to deep water deposition as Middle Devonian begins (development of foreland basin – "bowling ball on the mattress effect")
Erosion of Acadian Mountains deposits clastic sediments westward across New York State – shales, siltstones, greywackes, sandstones, and conglomerates.
Deposition of enormous quantities of eroded sediment filling the foreland basin and spreading of river systems across New York into Pennsylvania and Ohio (the "Catskill Delta".
Devonian metamorphism and igneous intrusion in rocks of New England and Virginia.
"Exotic" fossils in sedimentary rocks of the Boston area and other parts of New England – remnants of Avalonia sutured to North America.

Gilboa forest – world's oldest known fossil forest preserved in the Upper Devonian sandstones of the Catskill Mountains.

Mississippian: return of passive margin conditions across eastern North America after erosion of Acadian mountains.

Pennsylvanian: Alleghenian Orogeny – collision of Africa and South America with North America – final stage in the assembly of Pangea.

Little evidence of Alleghenian Orogeny in New York – some folding of older rock layers in the eastern part of the state.

Most impact seen south of New York – belt of metamorphic rock between the coastal plain and Blue Ridge Mountains, bordered by belt of folded and thrust faulted sedimentary rock to the west. Foreland basin was farther west – filled with thick deposits of sandstone and shale covering Kentucky, West Virginia, and western Pennsylvania.

Pennsylvanian sedimentary rock shows evidence of high amplitude sea level cycles – widespread transgressions and regressions – caused by the waxing and waning of glaciers in the southern hemisphere (Gondwana). Flooding of the continental interior during sea level rise (transgression) created extensive swamp forests that led to the deposition of widespread coal formations.

Permian: no record exists in New York. All continents are joined as Pangea. Sea floor spreading stops, causing a global regression. Climates across most of Pangea are arid or seasonally wet. Seed plants and synapsids dominate terrestrial ecosystems.

End Permian mass extinction: up to 95% of all species go extinct in both terrestrial and marine ecosystems. Extinctions likely caused by combination of sea level fall, climate change, and climate disruption due to gases released by immense, long-term volcanic eruptions in Siberia.

15. Paleozoic Life

Wicander (Ch.13)

Vertebrates evolve along with other major marine animal groups in the Cambrian explosion. Evolutionary radiation of fishes in the Devonian – bony fish, sharks and rays, and lobe-finned fish. Lob-finned fish (sarcopterygians) evolve limbs, becoming tetrapods ("four-foots") in the Late Devonian.

Challenges of living on land: desiccation, lack of support against gravity, reproduction out of water, exposure to UV radiation, rapid temperature changes.

Land plants: evolve from green algae in the Early Paleozoic. Silurian- first fossils of vascular land plants, Devonian- first extensive forests, seed-producing plants evolve, Carboniferous- extensive coastal swamp-forests produce extensive deposits of coal.

Arthropods and insects evolve along with plants as they invade the land.

Tetrapods (four-legged vertebrates) evolve in the late Devonian from lobe-finned ancestors. Devonian tetrapods appear to have been fully aquatic (walking fish). Tetrapods radiate and invade the land in the Mississippian as amphibians (some becoming rather large – "frog-gators").

Amniotes (tetrapods that have embryos protected by an amniotic membrane) evolve in the Pennsylvanian. The rapidly radiate into two main lineages – reptiles and synapsids (mammal ancestors).

Synapsids become the dominant land animals in the Permian and evolve to become increasingly mammal-like.

16. Dinosaurs and Mesozoic Life
Wicander (Ch.15)

Permo-Triassic extinction event: >90% of marine and terrestrial animal species go extinct.
Triassic begins with only a few species of synapsids and reptiles.
Early Triassic – evolution of first Archosaurs – a group of reptiles that includes dinosaurs, birds, crocodiles, and pterosaurs (flying reptiles).
Middle Triassic – synapsids continue to dwindle in diversity while new groups of archosaurian reptiles evolve. Archosaurs split into two main groups defined by ankle structure – crocodile normal and crocodile reverse.
Late Triassic – synapsids evolve into first small, shrew-like mammals. Archosaurs evolve phytosaurs (crocodile-like animals) and first dinosaurs.
Earliest dinosaurs are small, carnivorous, and bipedal. Herbivorous dinosaurs evolve from carnivore ancestors.
Dinosaurs increase in number and diversity through the end of the Triassic.
Turtles and pterosaurs evolve in the Late Triassic.
Extinction at the end of the Triassic eliminates most archosaur reptile groups, leaving the dinosaurs as the dominant terrestrial animals.

17. Geologic History of NY – The Mesozoic Era
Wicander (Ch.14)

Mesozoic rift basins: regions of Late Triassic to Early Jurassic rock found along the eastern margin of North America. Formed during rifting and separation of Pangea. Normal fault forms as crust is pulled apart and blocks of crust sink, creating large, elongate valleys. Valleys fill with sediment as rivers and alluvial fans transport sediments eroded from the uplands bordering the valley. Lakes form as rivers flow into rift basins. Volcanic eruptions are common as magma rises along faults from the mantle.
Rift basin geology: alluvial fan conglomerates, braided river sandstones, red beds, lake shoreline siltstones (often showing dinosaur trackways), and deep lake black shales. Basalt lava flows and diabase dikes and sills (e.g. Palisades Cliffs).
Newark Lowlands and Connecticut Valley are Triassic-Jurassic rift basins.
Cretaceous: Expanding Atlantic Ocean basin leads to development of passive margin along eastern North America. High sea level in the Cretaceous floods the coastal plain and deposits marine sediments far inland of the present coastline. Cretaceous deposits are exposed along the inner New Jersey coastal plain and are present beneath Long Island.

Lab 9 Regional Geology of New York
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Atlantic Coastal Plain

Newark Basin
Manhattan Prong
Walkill Valley
Hudson Highlands
Taconic Klippe
Appalachian Fold Belt
Allegheny Plateau
Adirondack Dome
Tugg Hill Plateau
Ontario Lowlands, Hudson Mohawk Lowlands, Champlain Lowlands

Lab 10-11 Structural Geology and Geologic Maps

Strike and Dip of tilted rock layers
Synclines and Anticlines – how can you recognize them on a geologic map?
Domes and Basins – how can you recognize them on a geologic map?
Thrust Faults

20. Geologic History of NY – The Pleistocene Epoch
Wicander (Ch.17)

Pleistocene – epoch of Ice Ages – major advances of continental glaciers.
Most recent continental glaciation was the Wisconsinan – peak at 22,000 years ago.
New York completely ice covered, landscape modified by glacial erosion and deposition. Long Island formed by glacial deposition.
Landscape features of glacial erosion: striations and chatter marks carved in bedrock, u-shaped valleys, tunnel valleys.
Depositional glacial features: drumlins, erratic boulders, moraines (till), outwash, kettle holes and kame hills.
Extinct ice-age mammals: Mastodons, Wooly Mammoths, Saber-tooth Cats, Giant Ground Sloths. American Lion, Dire Wolf

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