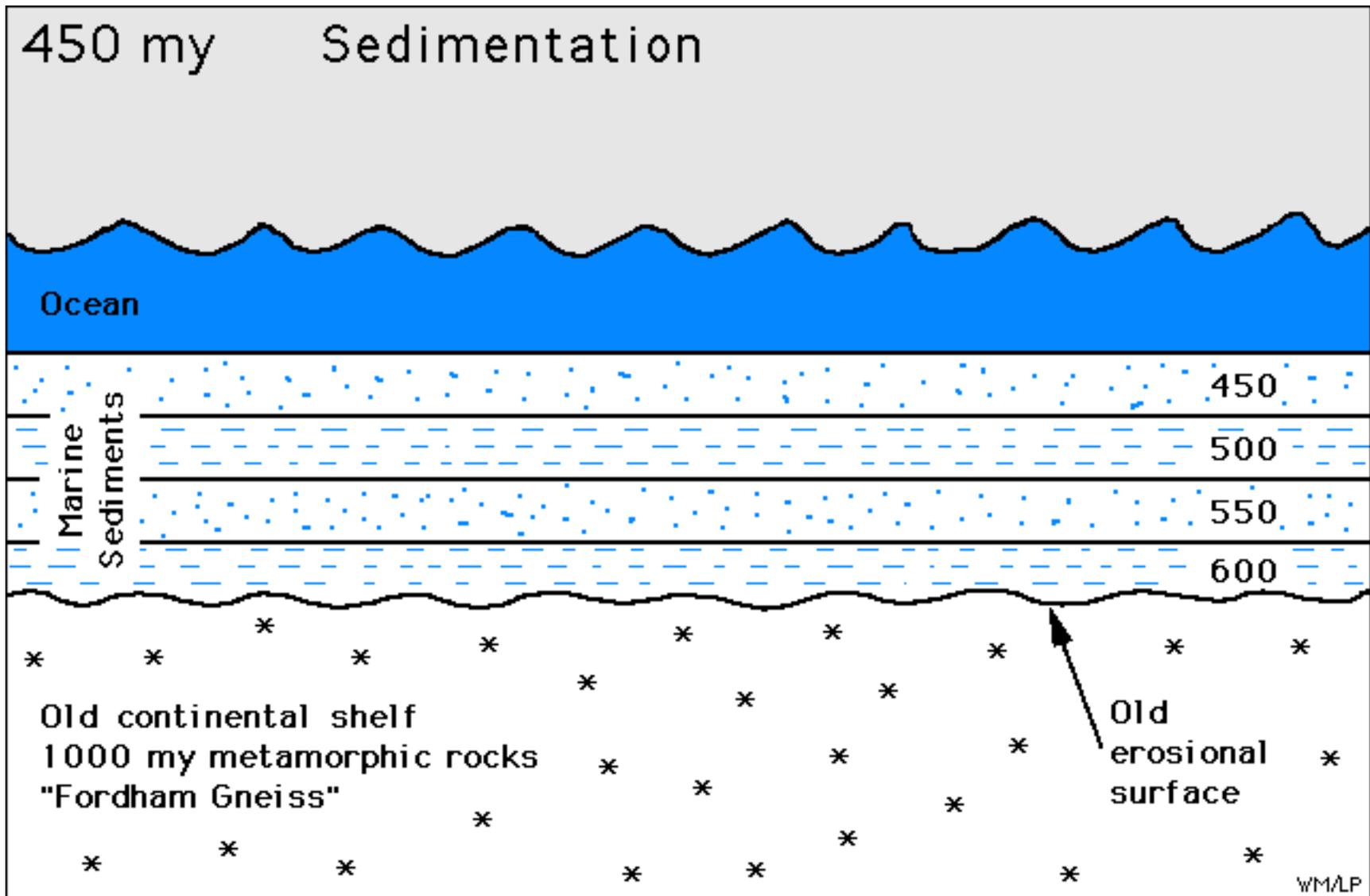
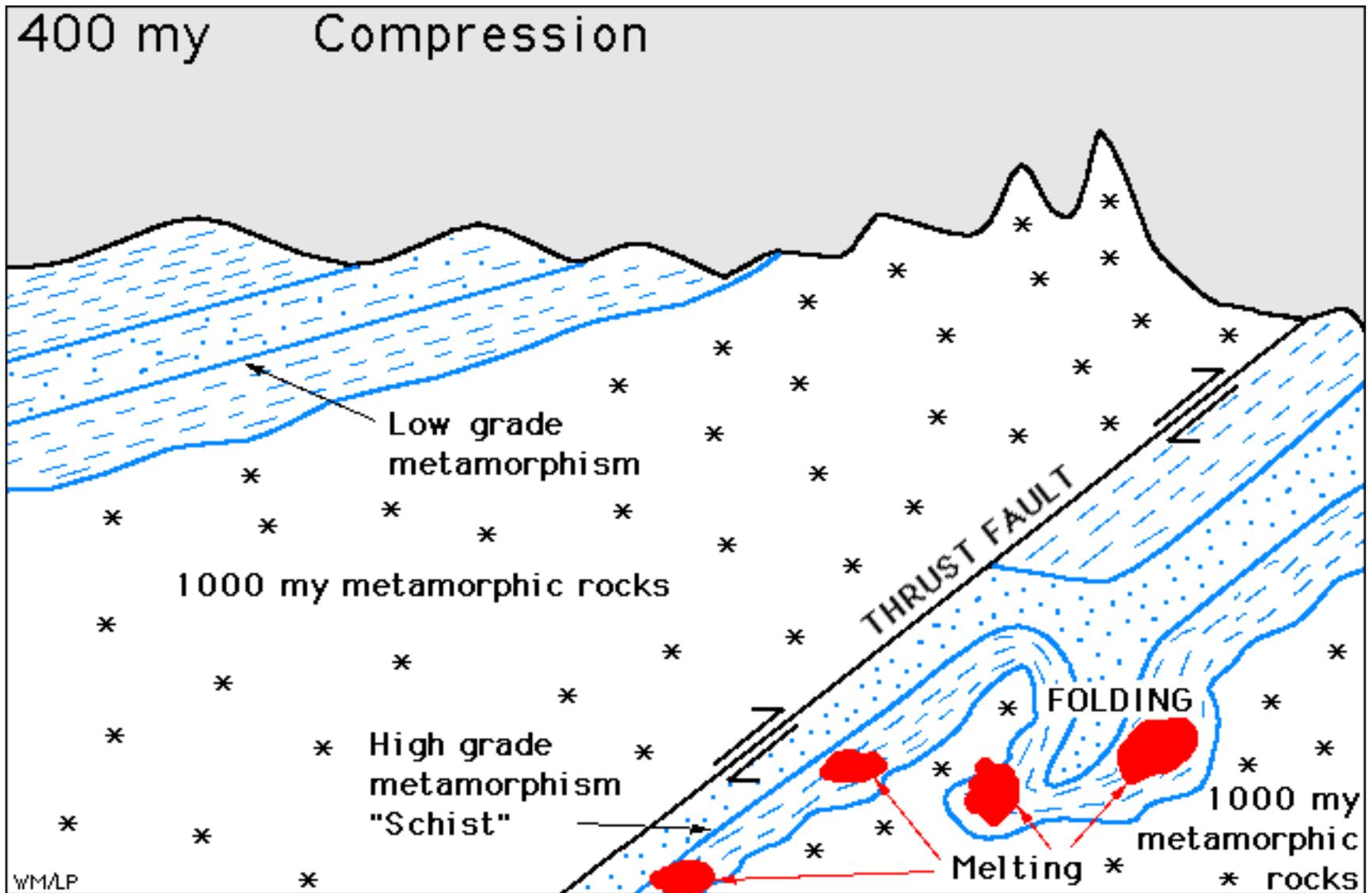


Sequence of events in the geological history of the New York metropolitan area

View is looking towards the north

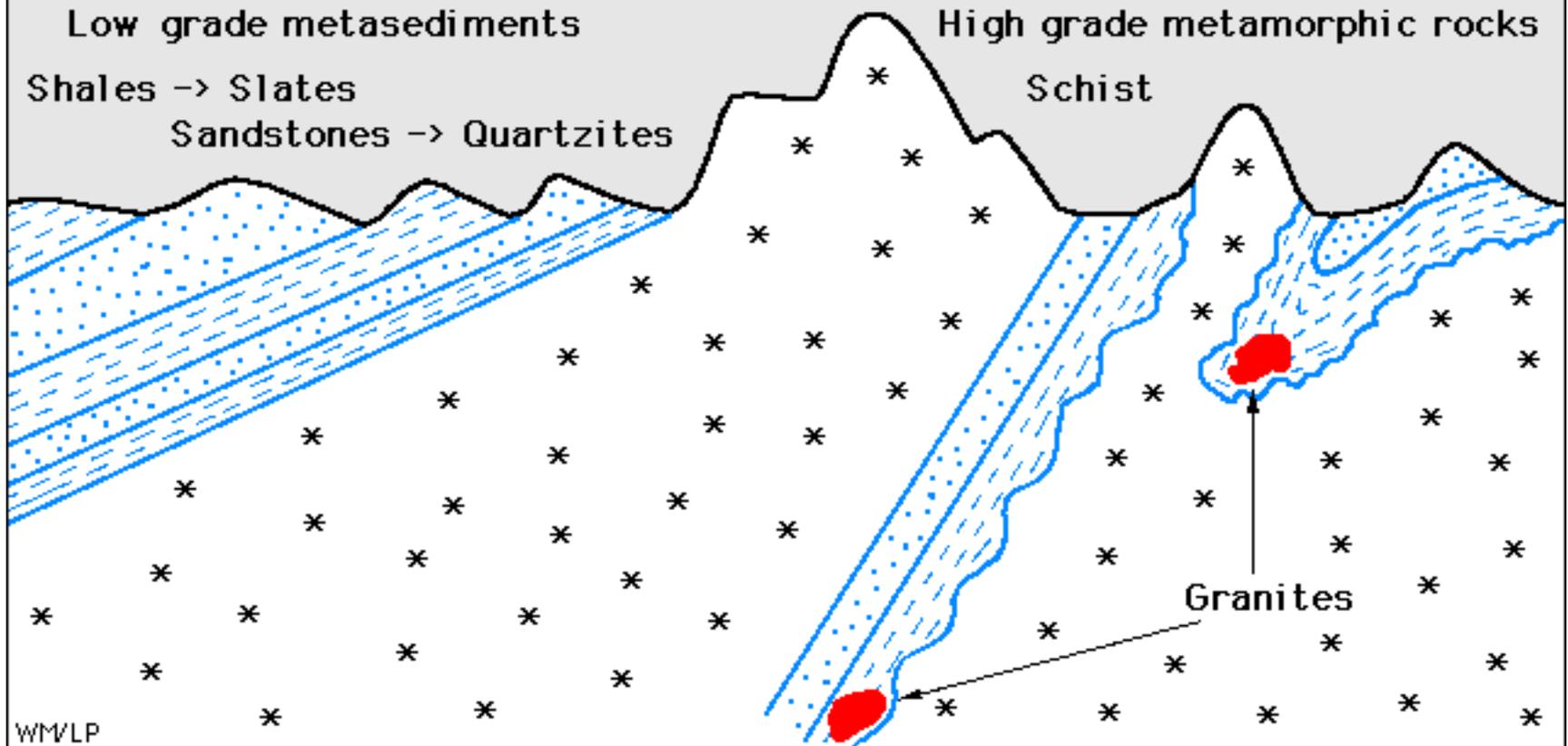


450 Million Years Ago: Little is known about the oldest, Precambrian (1000 my) rocks in the greater New York metropolitan region. They have been extensively metamorphosed during a continental collision during the late Precambrian (the so-called Grenville Orogeny), and recrystallized into very high-grade gneisses. But by the early Phanerozoic, they formed the 'basement' rocks of a continental margin. Sedimentary rocks, including sandstones, shales and limestones were deposited on top of these rocks during the Cambrian-Silurian periods. The ocean was not the Atlantic, but rather a now-defunct body of water sometimes called the Iapetus.



400 Million Years Ago: Subduction zones developed along the Iapetus margin, and the ocean closed up. The continent to the east collided with North America, forming the Pangea supercontinent. The intense compressional forces caused extensive thrust faulting. Some of the sediments were deeply buried and metamorphosed by the high temperatures below ground. Some areas were buried deeply: shales were recrystallized to schists, and limestones to marbles. Others were less deeply buried, resulting in less metamorphism (slates to slates, sandstones to quartzites). The continental collision produced uplift, forming the Appalachian mountain range.

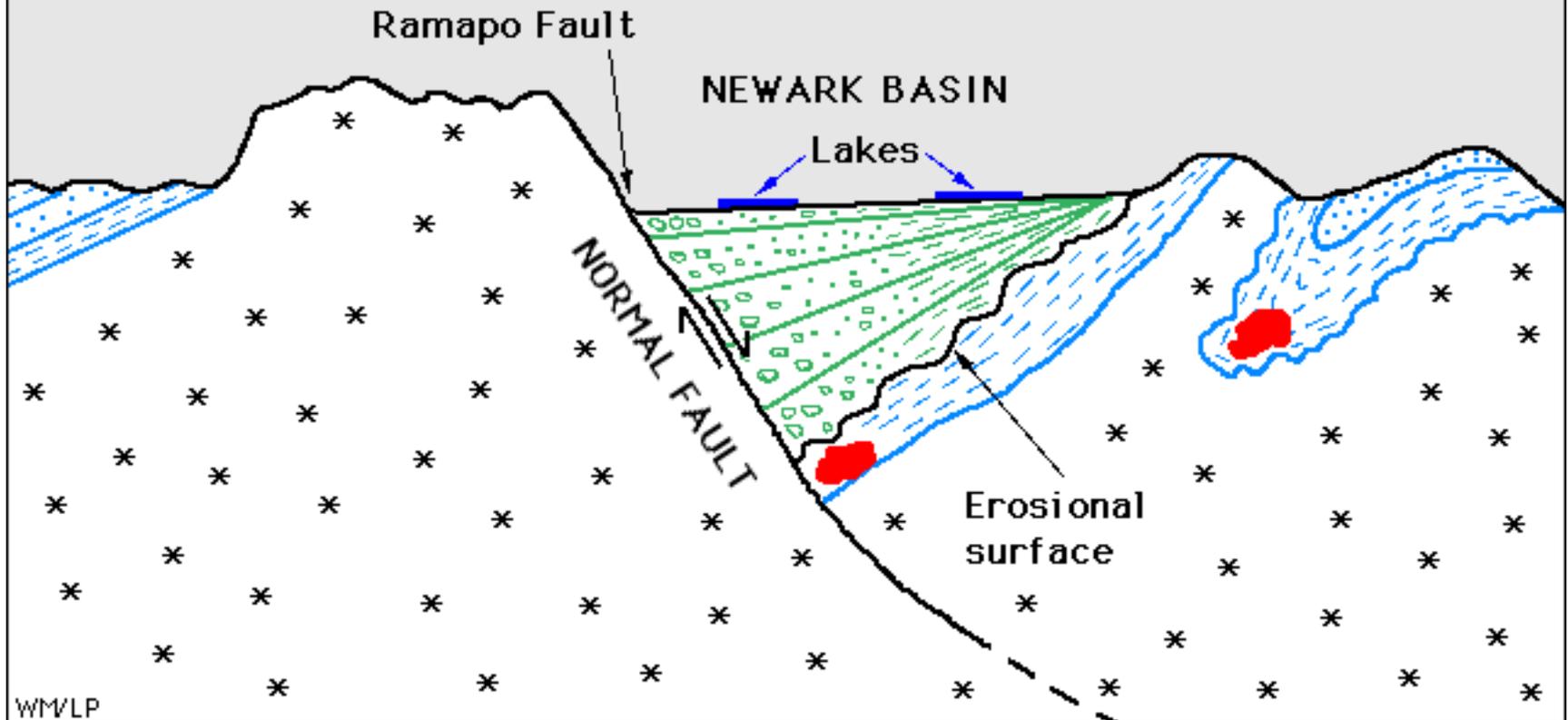
300 my Erosion



300 Million Years Ago: The Appalachian mountains, now in the central part of the Pangea supercontinent, slowly weathered. The deeply buried metamorphic rocks were slowly brought to the surface.

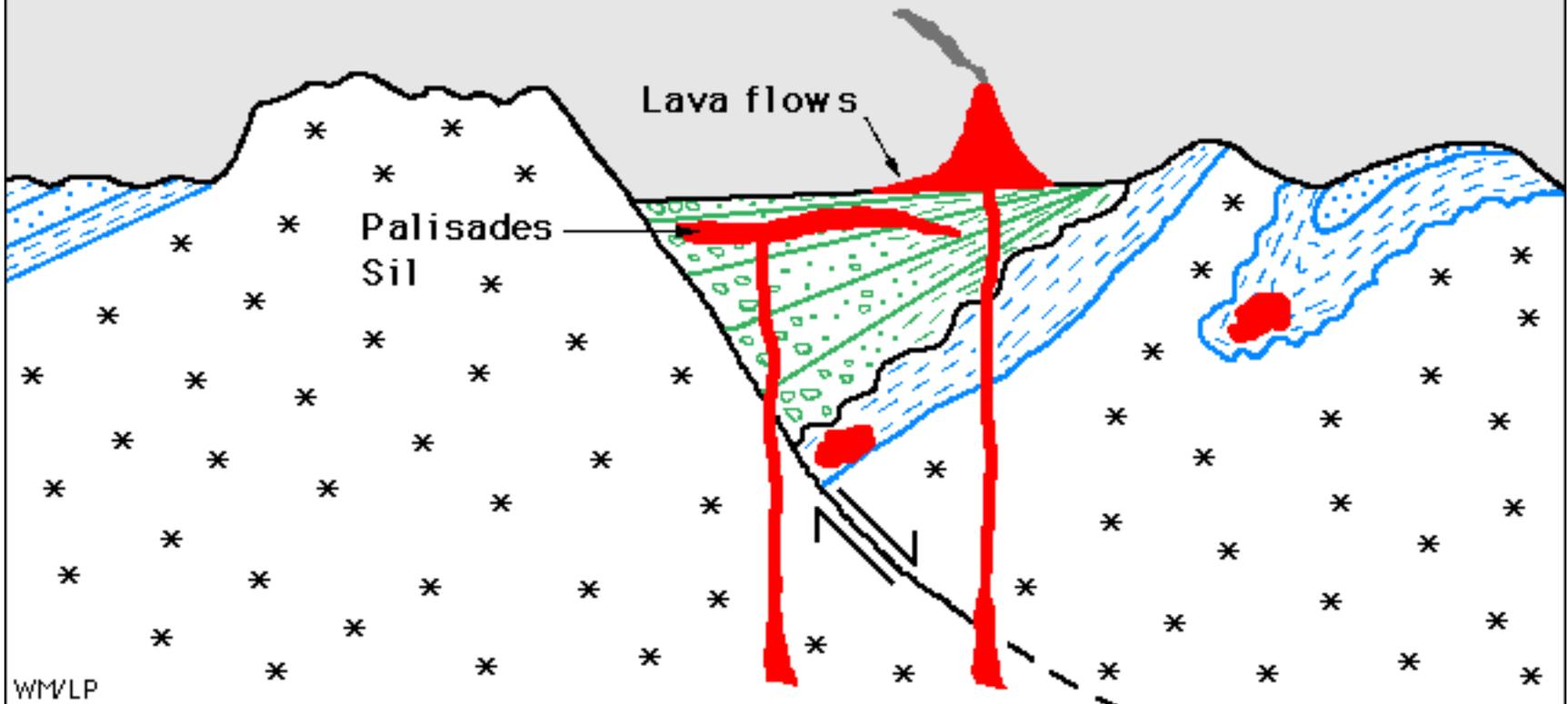
250 my

Extension and Sedimentation

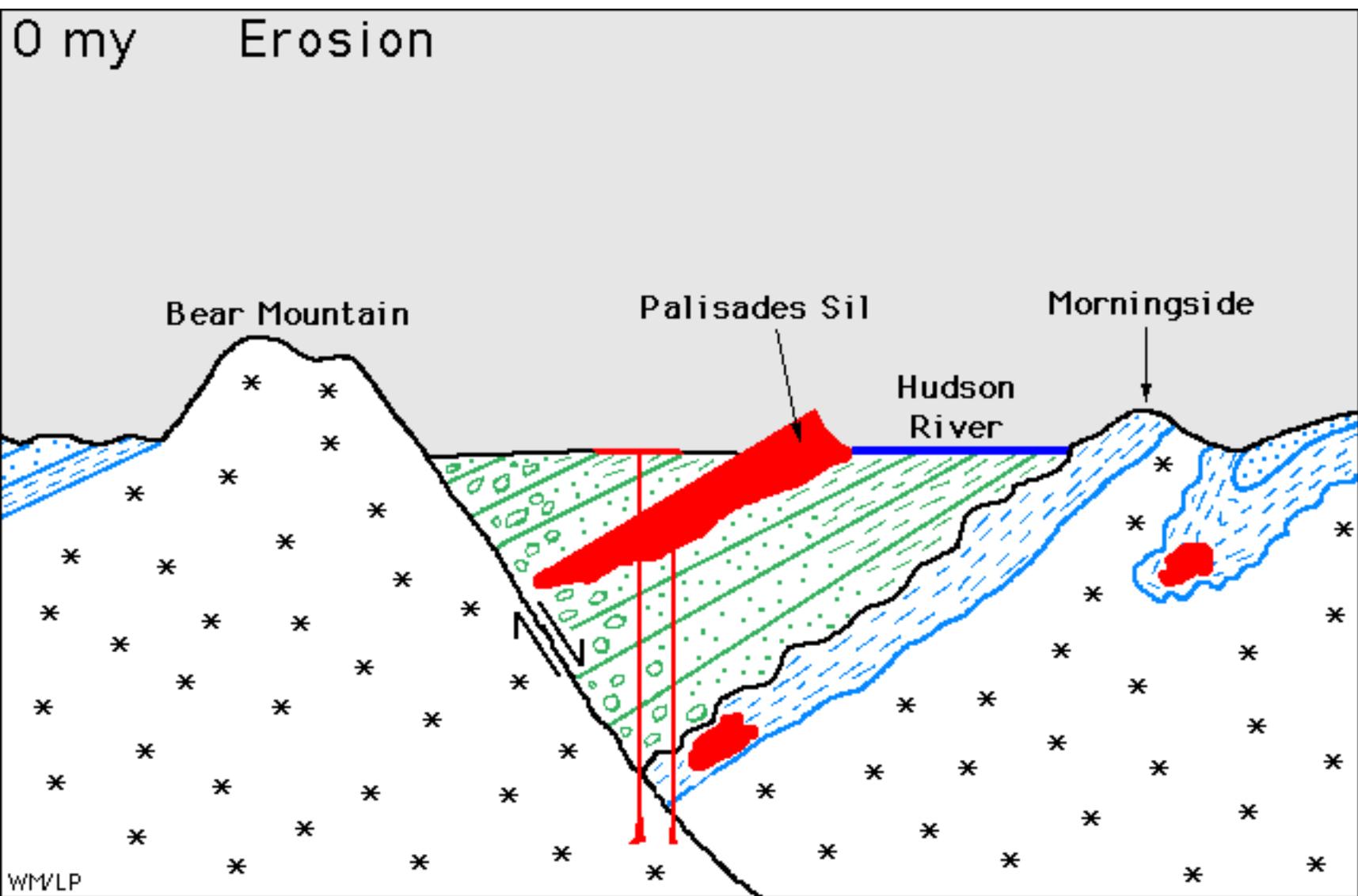


250 Million Years Ago: The Pangea supercontinent broke up, starting with the formation of a series of rift basins along what is now the Atlantic margin. The Newark basin, just west of Manhattan, is one of these. Its northern boundary is a normal fault (the Ramapo fault) that has experienced several kilometers of displacement. As the rift deepened, it was filled with clastic sediments being eroded from the highlands to the north. Conglomerates are found nearest the fault, and shales the furthest away. Fresh water fish fossils and dinosaur footprints are found in the shales, indicating that the region was above sea level.

200 my Volcanism



200 Million Years Ago: The rifting continued, along with massive basaltic volcanism that formed such features as the Palisades sill (a layer of basalt intruded between layers of sediments) and the Wachung Mountains (a lava flow). The young Atlantic ocean began to widen.



0 Million Years Ago: The center of volcanism is now the mid-Atlantic ridge, in the central Atlantic ocean. Fluvial (river-borne) erosional processes have slowly nibbled away at the rock. During the Pliestocene, the great Ice Age continental ice sheets pushed down from Canada, scouring the land further. They left numerous scratches on surficial rocks, and dumped many boulders (erratics, transported from the north) in the NYC region. They also deepened the Hudson valley, which was a 200 meter deep fjord 20000 years ago. With the exception of Long Island, which is a ridge of gravel (moraine) dumped by the glaciers, all of the topography of the greater metropolitan region is caused by differential erosion. Mountains are high because they are relatively resistant to erosion. Valleys are low because they are relatively prone to erosion.