INFLUENCE OF BASIN DYNAMICS ON UPPER DEVONIAN BLACK SHALE DEPOSITION, WESTERN NEW YORK STATE AND NORTHWEST PENNSYLVANIA

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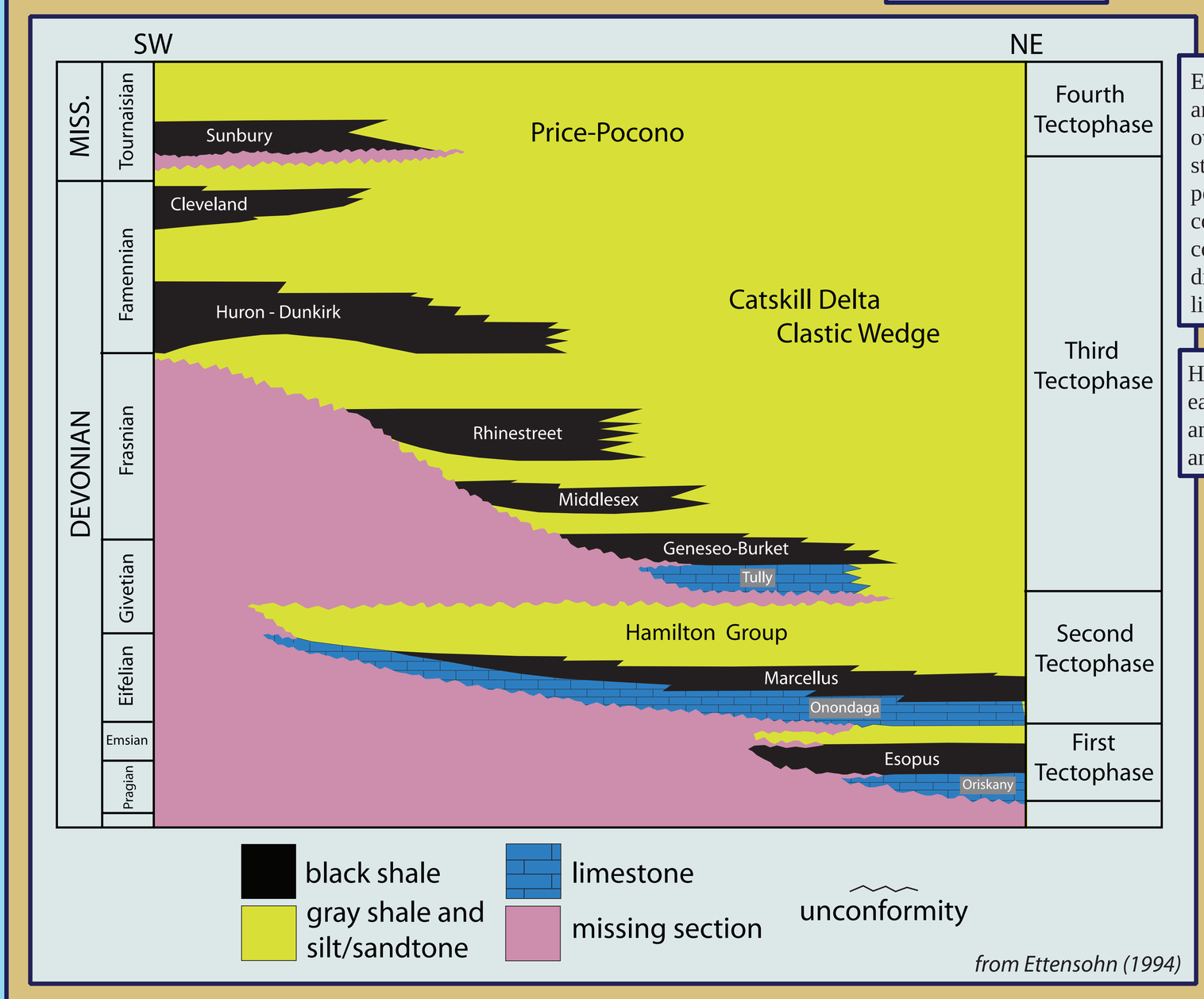
ABSTRACT

Black shale is ubiquitous to the Upper Devonian succession of the Appalachian Basin of western New York and northwest Pennsylvania. The spatial distribution of the organic-rich deposits appears to have been partly controlled by Acadian basin dynamics. Middle Devonian tectonic quiescence reflected by the Tully limestone was terminated by development of an Acadian forebulge. The resulting Taghanic unconformity achieved its maximum hiatal extent in Chautauqua and Cattaraugus counties, New York, extending south into Pennsylvania. Uplift may have been controlled by basin structures, including the Clarendon-Linden Fault (CLF), which lies close to the eastern zero-thickness line of the Tully limestone. Subsidence of the forebulge is marked by onlap of the Upper Devonian Geneseo black shale onto the eroded Tully limestone and underlying Middle Devonian shale. However, the fact that the Geneseo is not present in extreme western New York and northwest Pennsylvania suggests that the forebulge had migrated to the west. The forebulge was no longer a positive area in New York when the uniformly south- and west-thinning Middlesex black shale accumulated. However, the CLF appears to have accommodated down - to - east offset during deposition of the Rhinestreet black shale resulting in abrupt eastward thinning of the radioactive facies proximal to the CLF. Subsidence to the east of the CLF, perhaps a consequence of further migration of the Acadian thrust complex, ponded the more clastic facies of the Rhinestreet in this area of the basin; the organic-rich deposits accumulated in the more elevated region west of the fault. The Upper Devonian Dunkirk black shale attains a maximum thickness in northwest Pennsylvania reflecting subsidence of the forebulge perhaps induced by advance of the Acadian thrust terrane.

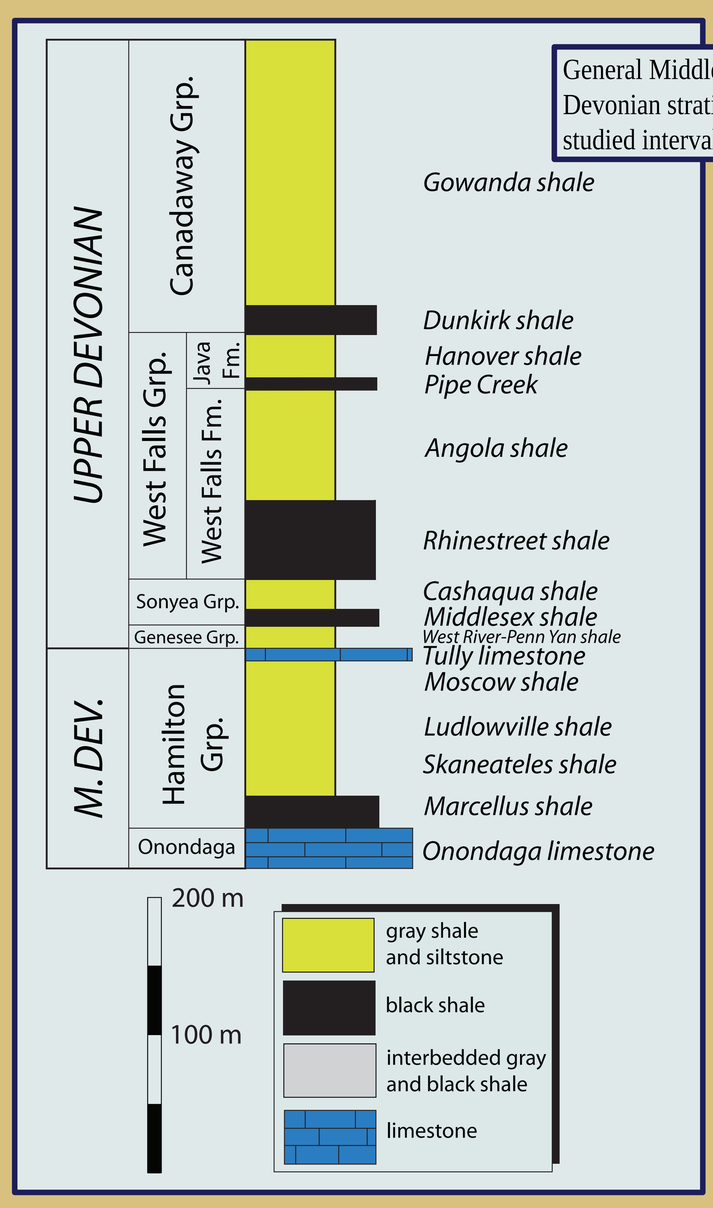
INTRODUCTION



from Ettensohn (1994)

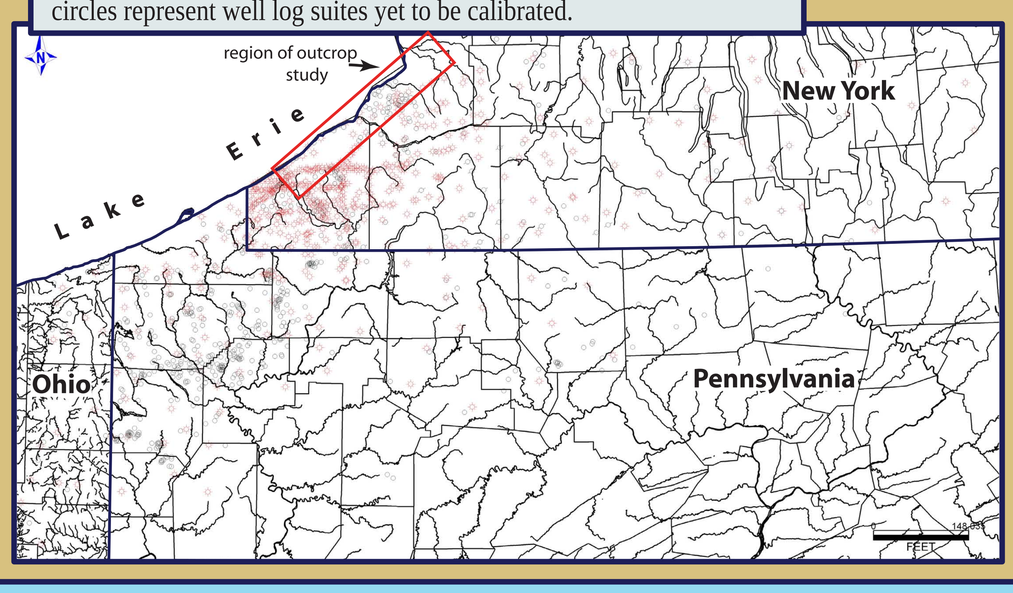
Ettensohn (1985, 1994) has demonstrated that major stratigraphic patterns of Middle and Upper Devonian black shale units, specifically their westward transgression over time, can be described in terms of four tectophases, each one defined by four stages, including (1) the inception of tectonism and consequent rapid subsidence of a peripheral basin and consequent accumulation of black shale; (2) impending collision and associated regression and accumulation of gray shale and siltstone; (3) collision accompanied by widespread uplift and development of regional disconformities; and (4) tectonic quiescence and widespread accumulation of limestone in slowly transgressing seas.

However, local basin dynamics (i.e., development of forebulges inheretid from earlier events) appear to have played an important role in the accumulation of Middle and Upper Devonian black shale in the western New York, northwest Pennsylvania, and eastern Ohio region of the Appalachian Basin.

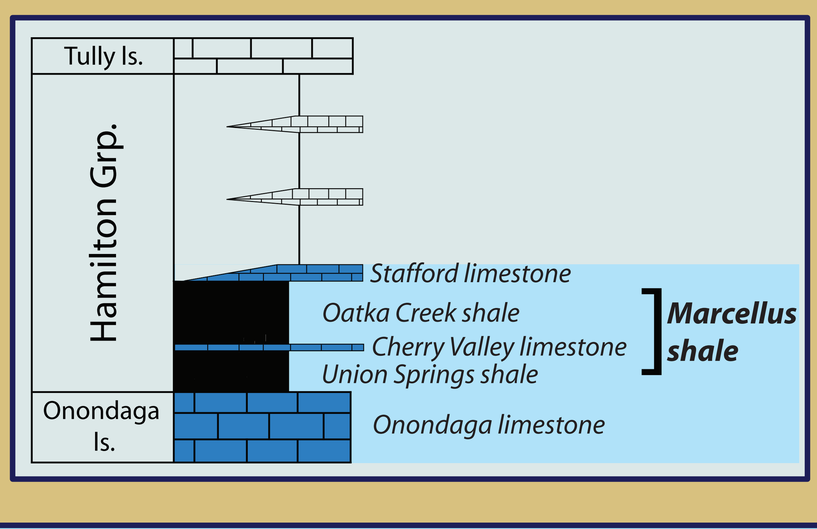


General Middle and Upper Devonian stratigraphy of the studied interval.

Study area showing location of outcrops; red symbols represent locations of geophysical well log suites used in this study to the present time; black circles represent well log suites yet to be calibrated.



MARCELLUS SHALE - STAFFORD LIMESTONE INTERVAL



The transition from the **Onondaga limestone** to the **Union Springs shale** marks the start of Ettensohn's (1985) second tectophase as the stable platform started to subside as a consequence of thrust loading in the hinterland. The local disappearance of units of the Onondaga limestone suggests that the contact is erosional (e.g., Rickard, 1984). The Union Springs black shale onlaps the eroded surface to the WNW. However, appears to have further eroded the Onondaga to the west. A brief period of stabilization, perhaps partly as a consequence of a eustatic rise in sea level, is marked by accumulation of the **Cherry Valley limestone**, which overlies the Onondaga limestone in the absence of the Union Springs shale.