

Impact of Syndepositional Faulting on the Distribution of Organic-Rich Utica Shale, New York State

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The Utica Shale is a potential drilling target in eastern North America and Canada. Total thickness of the organic-rich strata ranges from zero in the west to as much as 1300 feet in the east with common TOC values of up to 3.5%. The Utica Shale was deposited during the Late Ordovician Taconic Orogeny. Thrust loading to the east led to significant syndepositional extensional faulting in the foreland basin to the west. These faults have a major control on the distribution and thickness of organic-rich mudrock in the Utica.

The Ordovician Utica Shale consists of a lower organic-rich calcareous shale overlain by an organic-rich shale with low carbonate content and gray shale. The lower calcareous shale is called the Flat Creek Formation – it overlies an unconformity and interfingers with the Trenton Limestone to the west. A major down- to the east fault system (one part of which is called the Hoffman’s fault) was actively moving during Flat Creek time. The organic-rich shale of the Flat Creek developed in relatively shallow water on the upthrown western side of the extensional fault system while organic-poor gray shales and turbidites were deposited in deeper water to the east on the downthrown side of the fault system. This fault system, which has hundreds of meters of throw, was critical to the development of the organic-rich shales as it served as a barrier to westward flow of clay, silt and sand that would otherwise have moved farther to the west, diluting the organic-rich Flat Creek significantly. This fault system likely continued to move and serve as a barrier to westward siliciclastic progradation during deposition of the overlying Dolgeville and Lower Indian Castle intervals. There may have been other more subtle extensional faults moving farther to the west that controlled thickness trends in the Flat Creek Shale.

The Flat Creek is overlain in many places by the Dolgeville Formation which consists of rhythmic cm-scale beds of organic-poor limestone and organic-rich shale. The Trenton and Dolgeville are capped by a widespread disconformity with up to 3 million years missing in the west called the Thruway Disconformity that can be traced laterally into a correlative conformity to the east. This disconformity is overlain by an organic-rich black shale that thickens into grabens that were actively forming during deposition. There is a well-described graben in the outcrop belt near Little Falls, NY that can be traced into the subsurface. Within the graben the organic-rich Lower Indian Castle Formation thickens by more than 150 meters (~500 feet). Despite the higher rate of subsidence in the graben, thickness trends suggest that the graben stayed close to full and water depths were not much deeper than they were on the surrounding highs during deposition.

The Upper Indian Castle is an organic-poor gray shale and it may have been deposited just as the extensional faulting ended. The termination of movement on the Hoffman's fault may have enabled more clay, silt and sand to migrate farther to the west.