

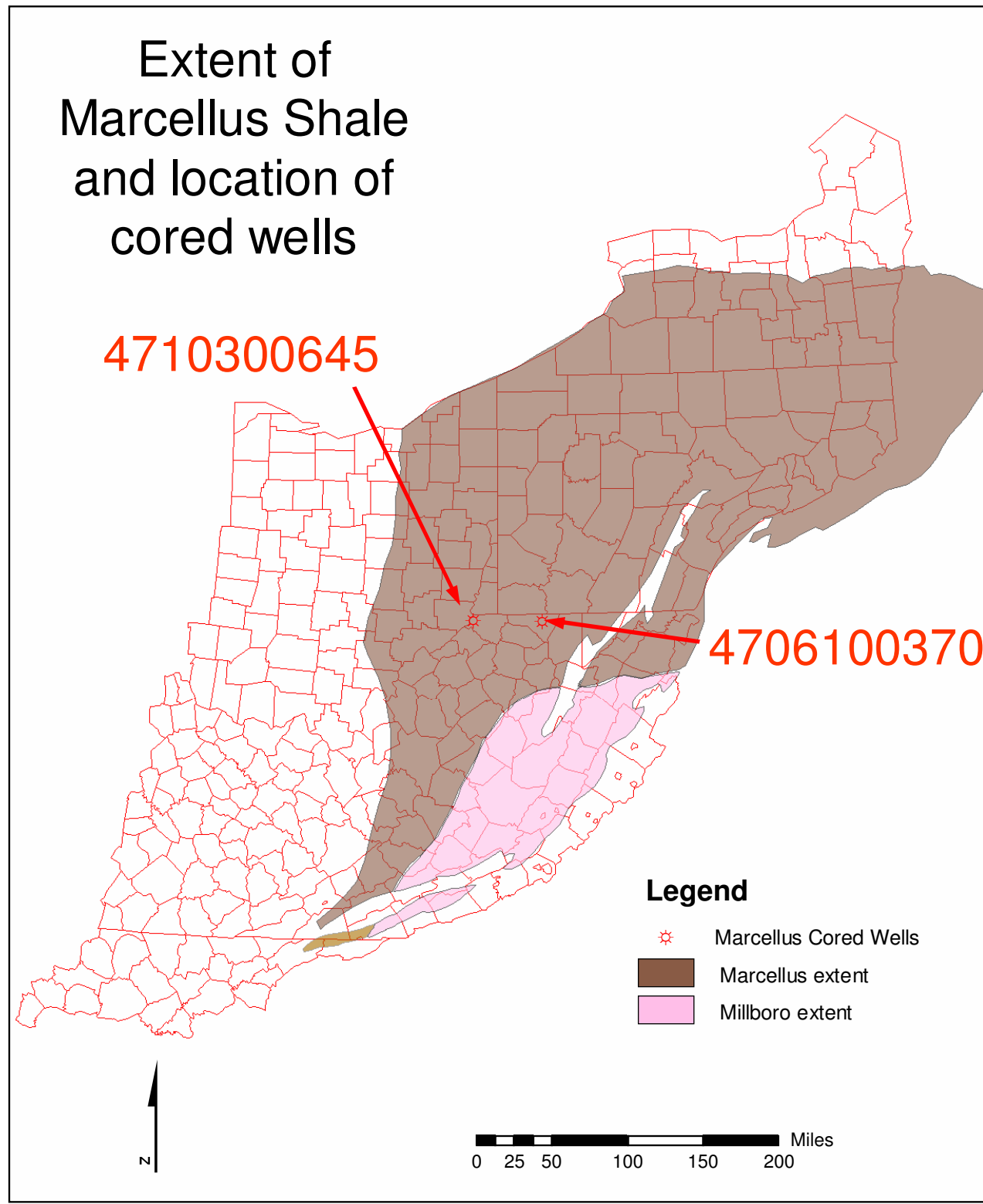
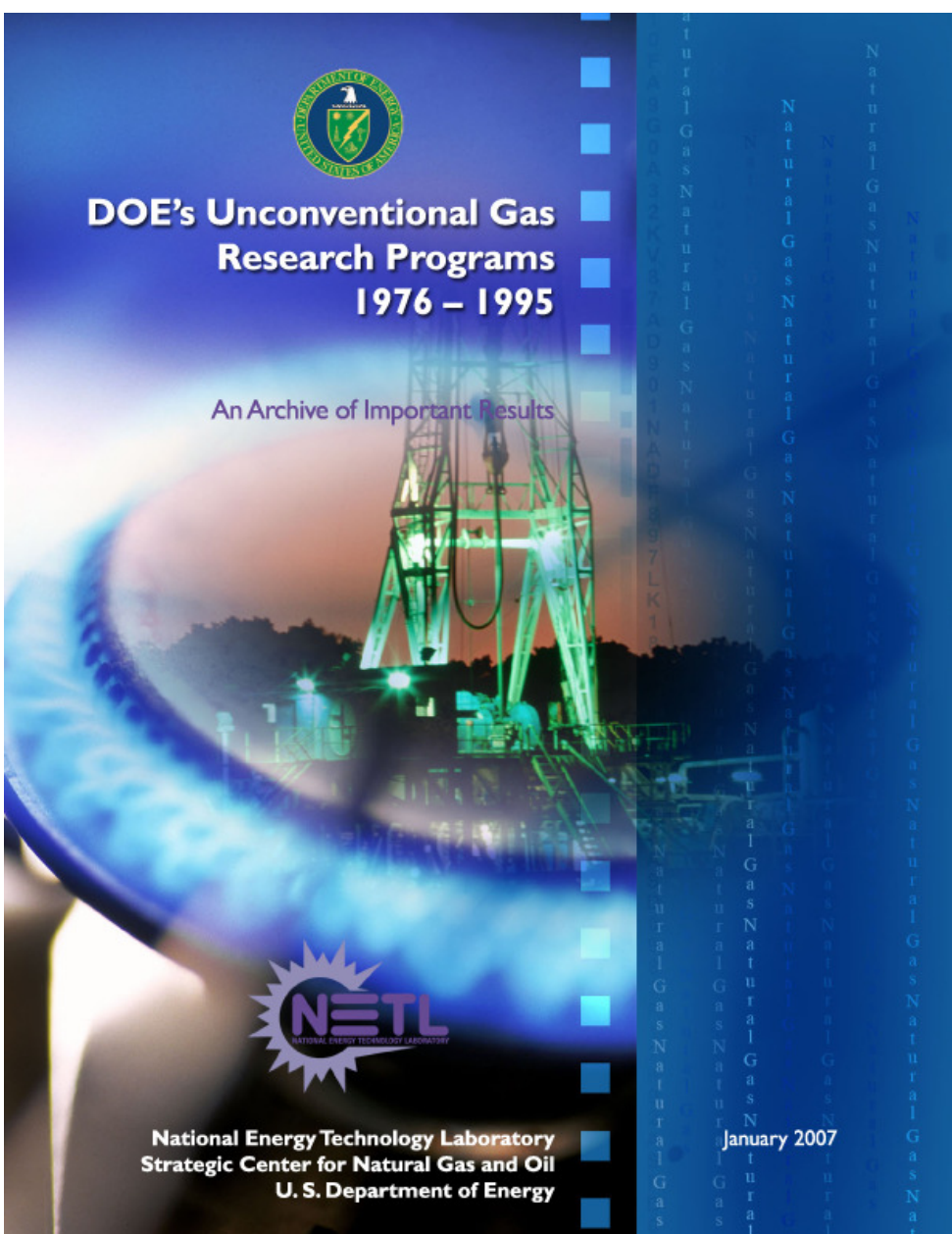
New Interest in Cores Taken Thirty Years Ago: the Devonian Marcellus Shale in northern West Virginia

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Abstract

In the late 1970's, the US Department of Energy cored a series of wells as part of its Eastern Gas Shales Program. Seven of these cored wells were located in West Virginia. The first five wells in the program targeted the Lower Huron Member of the Ohio Shale in southwestern West Virginia. This black shale has produced from thousands of wells for many decades in southwestern West Virginia and adjacent eastern Kentucky. The last two cored wells in the program focused on the older and deeper shales, the Rhinestreet Shale Member of the West Falls Formation and the Marcellus Shale of the Hamilton Group. Recent interest in the Marcellus Shale in West Virginia, Pennsylvania and New York has prompted renewed interest in these cores.

During the Eastern Gas Shales Program, a large body of data was collected for all of the cored wells. Recently, the US Department of Energy released a Natural Gas Program Archive on DVD which contains scanned versions of the documents from the Eastern Gas Shales and other unconventional gas resources programs. In an effort to make this information readily available for current evaluations, data from the two WV Marcellus cores, located in Monongalia and Wetzel counties, have been extracted from the reports and summarized. Average total organic carbon ranges from 6.19 to 6.79% while average vitrinite reflectance values range from 1.71 to 2.30 %Ro for the Marcellus in these 2 cores



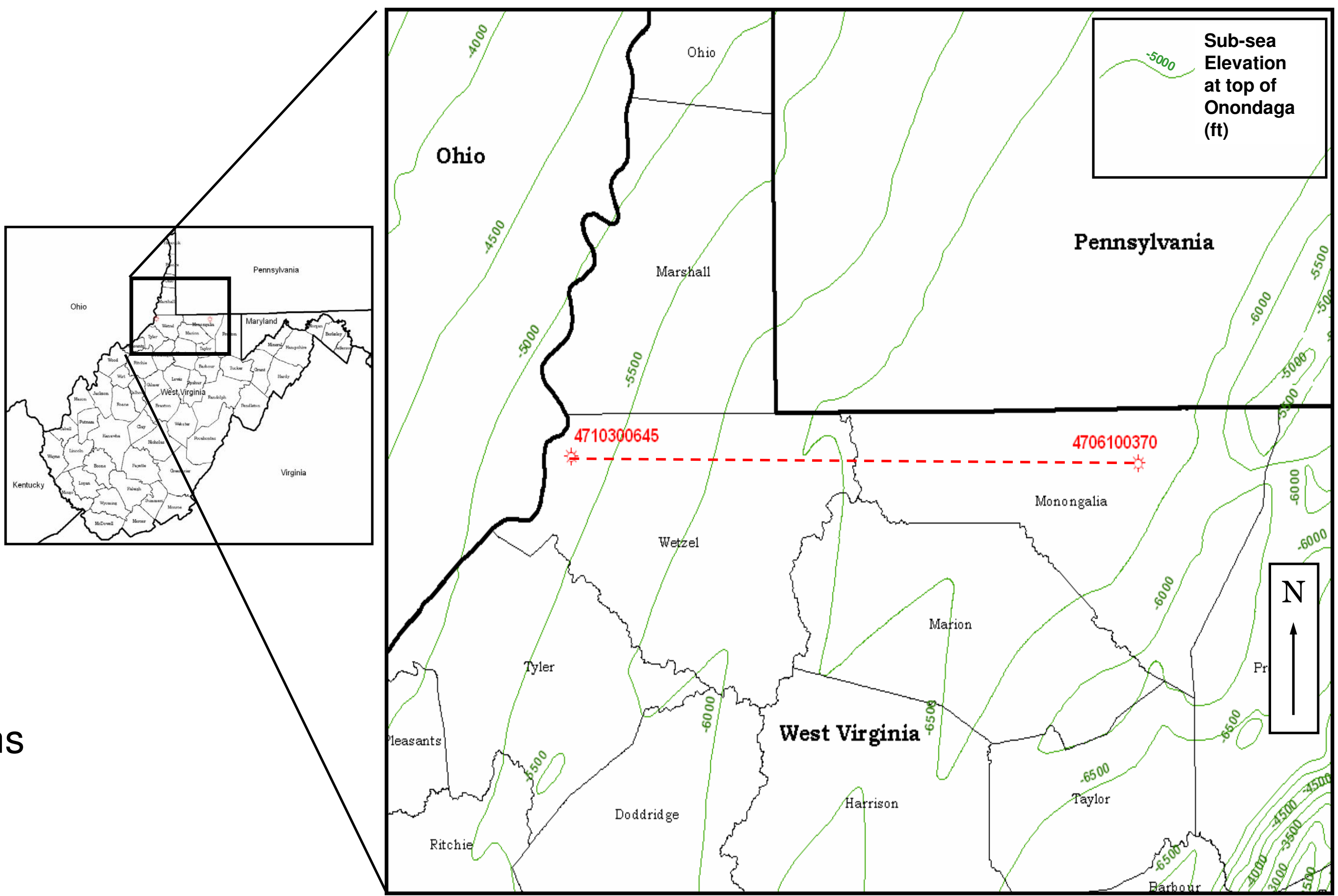
Mon 370 core showing calcareous concretion. Lens cap is 4 cm wide.



Interval	Description
7409.9'-7417.7'	Mudstone and shaly mudstone, black (N1), thinly to thickly laminated. Casts of a small, inarticulate brachiopod, <i>Orbiculoidea</i> sp. are especially common in the zone from 7,411.9' to 7,412.6'. A small, grayish black (N2) calcareous concretion occurs between 7,412.6' and 7,413.0'. The concretion shows prominent septarian cracks filled with sparry calcite and pyrite. Slickensides are present in the upper bounding surface of the concretion. Several casts of large (1 to 4 cm) articulate brachiopods occur between 7,413.0' and 7,415.8'.

From Cliffs Minerals, Inc. 1980, Phase II Report, Preliminary Laboratory Results, Eastern Gas Shales Project, West Virginia #6 well, Monongalia County, p. A-5.

Location of cored wells



Mon 370 core, showing pyrite nodules.
Lens cap is 4 cm wide.

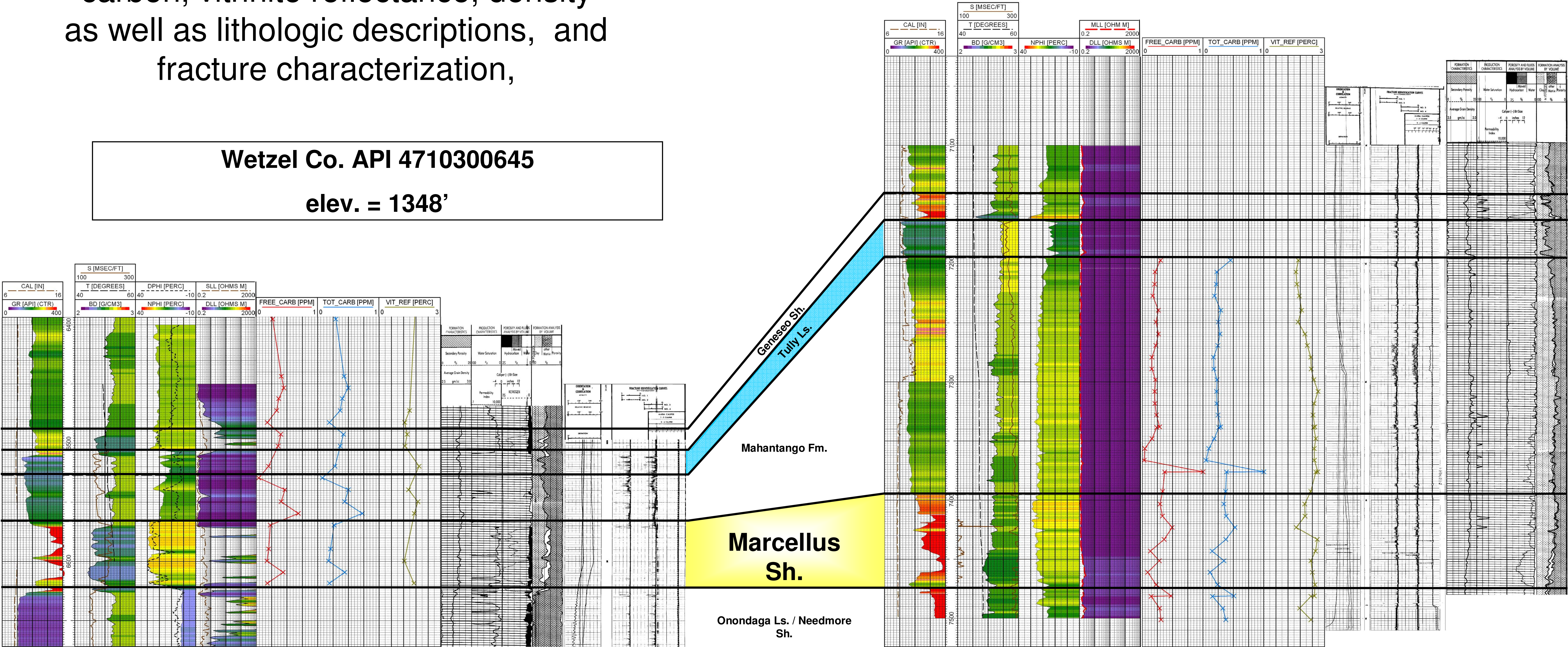
Interval	Description
7449.8'-7455.6'	Mudstone, black (N1), thinly laminated. Fossils and biogenic structures are absent from the interval. Pyrite occurs in several forms at various locations. Between 7,450.0' and 7,450.2' grains of disseminated pyrite are concentrated within a concretionary structure. Two large nodules , each about 1 cm in diameter, occur at 7,451.8'. Abundant, very small (<1 mm) nodules occur between 7,454.5' and 7,454.6'.

From Cliffs Minerals, Inc. 1980, Phase II Report, Preliminary Laboratory Results, Eastern Gas Shales Project, West Virginia #6 well, Monongalia County, p. A-6.

Data available include total organic carbon, vitrinite reflectance, density as well as lithologic descriptions, and fracture characterization,

Monongalia Co. API 4706100370
elev. = 960’

Wetzel Co. API 4710300645
elev. = 1348’



Distribution of Natural Fractures

Formation	Depth Cored, feet	Core Length, feet	Number of Fractures	Frequency per foot
West Falls Formation				
Rhinestreet Shale Member	6102-6313	211	19	0.09
Sonyea Formation				
Cashaqua Shale Member	6313-6403	90	0	0.00
Middlesex Shale Member	6403-6430	27	0	0.00
Genesee Formation				
Undifferentiated	6430-6488	58	8	0.14
Genesee Shale Member	6488-6513	25	9	0.36
Hamilton Group				
Mahantango Shale	6513-6568	55	0	0.00
Marcellus Shale	6568-6625	57	15	0.26
Onondaga Limestone	6625-6635	10	3	0.30

From: Cliffs Minerals, Inc. 1981, Phase II Report, Preliminary Laboratory Results, Eastern Gas Shales Project, West Virginia #7 well, Wetzel County, p. 20.

Marcellus Shale

The Marcellus Shale is contained between 6,568 and 6,625 feet and is composed of black (N1) shaly mudstones, with several zones of silty mudstone and calcareous mudstone present in the lower 20 feet. The black mudstones are extremely fissile, exhibiting the phenomena referred to as “poker chips”. This high degree of fissility probably contributed to the formation of numerous coring-induced torsional fractures and zones of rubble. Articulate and inarticulate brachiopods, pyrite nodules and disseminated pyrite grains are noted throughout.

Easily distinguishable on the gamma radiation and formation density logs, the Marcellus Shale is represented by a high gamma curve, varying from 230 to 320 API units, and by a low density curve, varying from 2.20 to 2.30 g/cc. In the core, the Marcellus can be distinguished from the overlying Mahantango Shale by its increased “disc” fracture frequency, darker color, and lower carbonate content. The contact between the Marcellus and the underlying Onondaga Limestone is sharp in the core, and is marked by a sudden decrease in gamma radiation and a corresponding increase in rock density.

Cliffs Minerals, Inc. 1981, Phase II Report, Preliminary Laboratory Results, Eastern Gas Shales Project, West Virginia #7 well, Wetzel County, p. 18-19.

Distribution of Natural Fractures

Formation	Depths Cored, feet	Core Length, feet	Number of Fractures	Frequency per foot
Tully Limestone	7169-7231	62	9	0.15
Mahantango Shale	7231-7396	159 (6 feet not recovered)	48	0.30
Marcellus Shale	7396-7500	104	72	0.69
Onondaga Limestone	7500-7518	18	1	0.05

From Cliffs Minerals, Inc. 1980, Phase II Report, Preliminary Laboratory Results, Eastern Gas Shales Project, West Virginia #6 well, Monongalia County, p. 17.

Marcellus Shale:

The Marcellus is composed of thinly laminated mudstone and shaly mudstone. The dominant color is black (N1). Calcareous zones, which are restricted to the lower half, increase in thickness and frequency down-core. Articulate and inarticulate brachiopods occur between 7,400 feet and 7,425 feet and below 7,460 feet. An ostracode valve is present at 7,405 feet. A single fish scale is noted at 7,445 feet. Cephalopod casts are present at 7,424 and within the lower third. Phosphatic shell fragments are noted near the base of the interval. Calcareous concretions, containing calcite-mineralized sepatrian cracks, occur between 7,410 feet and 7,470 feet. Pyrite occurs within the upper 20 feet and below 7,450 feet. Nodules are most common, but laminae, disseminated grains and coatings on shell fragments are also present.

The contact between the Marcellus Shale and the underlying Onondaga Limestone is marked by a sharp change from black mudstone to gray limestone and by a decrease in gamma radiation.

Cliffs Minerals, Inc. 1980, Phase II Report, Preliminary Laboratory Results, Eastern Gas Shales Project, West Virginia #6 well, Monongalia County, p. 15-16.

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