MARATHON THRUST BELT PROVINCE (046)

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INTRODUCTION

This province comprises parts of four counties in southwestern Texas and covers an area of about 9,400 sq mi. It has been the site of large-scale subsidence, thick sedimentary accumulations, and intense folding associated with thrust faulting. Much of what is known about the geology is interpreted from outcropping rocks present in the Marathon Basin, a topographic basin located on the Marathon uplift. Portions of four major thrust sheets are exposed in the province.

Sedimentary rocks of the overthrust sequence range in age from Upper Cambrian through Pennsylvanian and attain thicknesses of greater than 16,000 ft. Only the northern part of the province has been rather well explored for oil and gas. The structural complexity of the Marathon fold-and-thrust belt has made oil and gas exploration difficult. Oil and gas fields discovered to date occur in imbricate thrust culminations near the front of the fold and thrust belt. Overlap relations at the northern edge of the province show that the last phase of thrusting occurred in Early Permian time.

South of the Marathon Basin, in the Big Bend area of the province, there is a northward-thinning sequence of Cretaceous rocks that have not been subjected to contractional deformation. Cretaceous and younger rocks are as much as 4,000 ft thick near the southern edge of the province, where they unconformably overlie metamorphosed Paleozoic rocks of the overthrust sequence (Muehlberger and others, 1984). The younger rocks do not appear to be prospective because they do not contain known source beds and have never been buried deeply enough for hydrocarbon generation. One play was individually assessed in the province, the Frontal Zone Oil and Gas Play (4601).

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CONVENTIONAL PLAY

4601. FRONTAL ZONE OIL AND GAS PLAY

This confirmed conventional play is defined by oil and gas accumulations in open folds, large anticlinal masses of thrust imbricates, or other thrust-fault related traps in mainly clastic, carbonate, and chert reservoirs of Devonian to Pennsylvanian age. The play is a northwardly facing, planoconvex, lens-shaped 3,000 sq mi area that forms a broad, elongated band extending for about 150 mi east-west and from 12 mi wide in the eastern part to more than 25 mi wide in the western part. The northern play boundary is coincident with the province boundary. The southern boundary of the play is the approximate northern edge of the internal zone in which rocks have been subjected to greater burial, and display greater thermal alteration than rocks within the play. The western boundary extends slightly outside (west) of the province boundary, and the eastern limit is formed by the Devil's River Uplift to the east. Maximum sedimentary thickness of the overthrust sequence is about 16,900 ft, and rocks of the thrust belt range in age from Cambrian to Lower Permian with a very thin cover of Cretaceous to Holocene unconsolidated sediments.

Reservoirs: Known reservoir rocks include the Silurian(?), Devonian, and Mississippian Caballos Novaculite, the Pennsylvanian Tesnus Formation, and the Pennsylvanian Dimple Limestone. Reservoirs in the Caballos are 80-200 ft thick; porosity ranges from 5-15 percent and is fracture enhanced. Reservoirs in the Dimple are typically 100 ft in pay thickness, and porosities range from 8-12 percent. The Tesnus is a friable, fine to coarse-grained sandstone or arkose, and the Dimple locally contains layers of coarse-grained fossil debris. The Caballos Novaculite ranges from 200 to 600 ft thick; the Tesnus exceeds 6,500 ft in thickness; and the Dimple reaches a maximum thickness of 1,000 ft. Undiscovered natural gas accumulations may range in depth from 3,500 to 18,000 ft, and oil accumulations may range in depth from 2,000 to 12,000 ft, based on cross sections by Reed and Strickler (1990).

Source rocks: Source rocks are probably black shale, bituminous limestone and black chert of the Caballos Novaculite and underlying Ordovician Maravillas Chert. Assuming an average geothermal gradient of 1.60 per 100 ft and present burial depths (as deep as 9,700 ft), Devonian rocks could have experienced a thermal history sufficient to have generated hydrocarbons as early as Late Pennsylvanian time. Numerous faults present in the play could have provided avenues of migration for hydrocarbons. However, if hydrocarbons were generated during the Late Paleozoic, subsequent faulting may have destroyed hydrocarbon-filled traps.

Traps: Anticipated traps are highly fractured and folded imbricate thrust slices of Caballos Novaculite and Dimple Limestone, open folds involving the Tesnus Formation, and fault blocks that place reservoir beds adjacent to seals. Adequate seals are present in the thick shales of the Tesnus Formation and in relatively impermeable carbonate rocks of the Dimple Limestone.

Exploration status: Approximately 100 wildcat wells have been drilled in the play since 1919, resulting in two oil and gas fields, McKay Creek and Thistle, discovered respectively in 1979 and 1984, and one producing gas field, Pi–on, discovered in 1982. All are near the northern margin of the play (Reed and Strickler, 1990; Wilde, 1990). There are 10 producing wells in the McKay Creek field, with cumulative production of 6.1 BCFG and 1,037 MBO oil, all from Caballos Novaculite; 14 producing wells in the Thistle field, with cumulative production of 3.19 BCFG and 3,529 MBO oil; and 4 producing wells in the Pi–on field, with cumulative production of 1.55 BCFG from three Dimple completions and 13.6 BCFG from the one Caballos completion through August, 1993. The gas/oil ratio is reported as 3,279 CF/BBL at McKay Creek and 4,400 CF/BBL at Thistle (field average). Estimated grown ultimate reserves for Pi–on field are 56 BCFG and for Thistle field are 11 MMBO and 11 BCFG.

Resource potential: The future oil and gas potential of the play is estimated to be fair to good. Estimated median size of undiscovered oil and gas accumulations is inferred to be 2.5 MMBO and 20 BCFG. At least two oil and gas and at most eight oil and five gas accumulations remain to be discovered.

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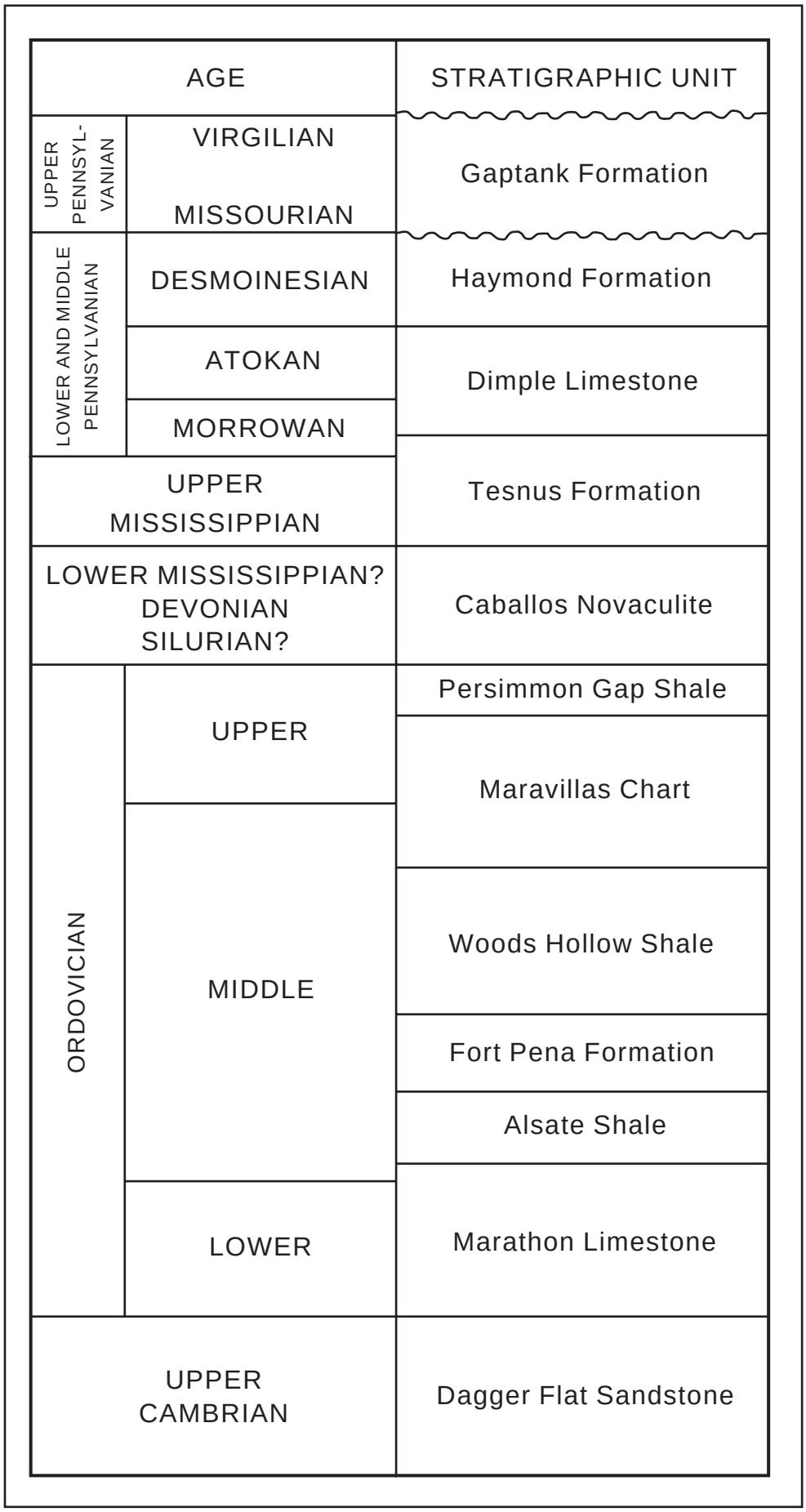
AGE
STRATIGRAPHIC UNIT
UPPER PENNSYL-VANIAN
VIRGILIAN
MISSOURIAN
Gaptank Formation
LOWER AND MIDDLE PENNSYLVANIAN
DESMOINESIAN
Haymond Formation
ATOKAN
Dimple Limestone
MORROWAN
UPPER MISSISSIPPIAN
Tesnus Formation
LOWER MISSISSIPPIAN?
DEVONIAN
SILURIAN?
Caballos Novaculite
ORDOVICIAN
UPPER
Persimmon Gap Shale
Maravillas Chart
MIDDLE
Woods Hollow Shale
Fort Pena Formation
Alsate Shale
LOWER
Marathon Limestone
UPPER CAMBRIAN
Dagger Flat Sandstone