Maverick basin of the Rio Grande embayment is a series of overlapping sand bars striking northeast-southwest. Grain-size plots and core descriptions indicate that these bars developed in a shallow-marine shelf environment. There are as many as five cycles of sand sedimentation, all but one having established production. These sandstones have a cumulative production of over 50,000 bbl of oil since 1948. Over 30,000,000 bbl of oil has been produced from stratigraphic-type fields discovered since 1970. Stratigraphic-type fields have produced over 90% of the total production. Structural traps, caused by differential compaction over volcanic necks, account for the remainder. Torch field, associated with a volcanic neck in Zavala County, and Sacatosa field, a stratigraphic trap in Maverick County, are typical. The depth and density of control, as well as the subtle expression of the traps, leave many prospective areas.

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Independent Geologists—Endangered Species

During the last 5 years, while constantly complaining about a supposed lack of competition in the extractive industries, the U.S. Congress and administrative regulatory agencies have focused their power to make this “lack of competition” real. Current examples are: (1) in the SEC, the constant effort to broaden the definition of a security and bring the attendant registration and disclosure requirements to bear on the most mundane joint venture; (2) in the Congress and the SEC, the pressure to bring about accounting changes limiting independents’ access to equity markets and encouraging sellouts and mergers; (3) in the IRS, grotesque definitions of joint ventures as partnerships, partnerships as corporations, and farms as income; (4) in the FERC, strained interpretations of gas contracts as “convenants running with the land” in order to introduce the principle of administrative confiscation of mineral rights without due process. The ponderous weight of the regulatory hand weighs most heavily on the independent geologist who has no legal or accounting staff.

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Stratigraphy and Exploration Geology of Marble Falls Group, Llano Uplift to Southern Part of Fort Worth Basin

The Marble Falls Group is a Lower Pennsylvanian carbonate complex that crops out in a discontinuous arcuate belt rimming the east, north, and west sides of the Llano uplift. The carbonate beds accumulated on the eastern part of the Texas craton, which sloped toward the adjacent Fort Worth basin. Three units within the Marble Falls Group have been mapped in the outcrop area. They are informally referred to as the “lower limestone,” “middle shale,” and “upper limestone.” The same tripartite subdivision is evident in the subsurface north of the Llano uplift in Lampasas, Mills, Hamilton, Comanche, and Brown Counties.

Marble Falls gas production in the southern part of the Fort Worth basin is almost exclusively from the upper limestone. The upper Marble Falls forms several northeast to southwest-trending carbonate-bank complexes. The bank complexes terminate abruptly and pass laterally into shale and dark spiculitic limestone. Both structural and stratigraphic traps are evident within the bank complexes. Potts ville field in Hamilton County is a deep-sided structural trap from which 10 wells have produced approximately 33 Bcf of gas at depths of 2,600 to 2,900 ft (792 to 884 m). Santa Anna field in Coleman and Brown Counties is a large stratigraphic trap discovered in 1928. More than 100 gas wells have been completed in Santa Anna field. Early production records are not available. However, the incomplete data that are published substantiate the fact that Santa Anna is a large, economically attractive field, in which many wells have produced at least 1 to 2 Bcf of gas at depths of 2,300 to 2,400 ft (700 to 732 m).

Porosity tends to develop within three facies of the upper Marble Falls limestone: phylloid algal limestone, stromatoporoid limestone, and oolitic caracrenite. At the outcrop, the algal, stromatoporoid, and oolitic facies are most prevalent near the edge of basin complexes. However, they are by no means restricted to the outer part of the banks. Fractures related to a system of mostly down-to-basin normal faults enhance permeability in many places.

Structure is complicated and difficult to perceive without seismic data. Even where seismic data are available, standard isopach mapping techniques cannot be employed because there are no continuous shallow seismic reflectors. Moreover, topographic highs capped by Edwards Limestone outcrops tend to yield poor-quality records.

In spite of the problems inherent in exploring a structurally and stratigraphically complex area, there are undoubtedly undiscovered, commercially attractive gas fields in the southern part of the Fort Worth basin. The high exploration risk is to some extent offset by shallow depth, low acreage costs, and the attractive nature of potential targets.

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San Andres Facies Patterns, Palo Duro and Dalhart Basins, Texas

Regional facies analysis of San Andres/Blaine (Guadalupian, Permian) strata of the Palo Duro and Dalhart basins by use of cores, cuttings, and well logs is of interest for hydrocarbon exploration. San Andres rocks are composed of dolomite, anhydrite, and salt and exhibit basinward (southerly) facies changes from supratidal to subtidal. Supratidal facies reflect many features of modern, low-relief coastal sabkhas.

Lower San Andres strata include five mappable cyclical units; each cycle is comprised of (1) subtidal to intertidal shelf carbonates (basal transgressive facies), (2) lower sabkha, nodular and bedded anhydrite, and (3) upper sabkha salt formed in brine ponds and evaporating pans. Cycles represent repetitive progradation of facies to the south through time. Salt beds pinch out in the central and southern parts of the Palo Duro basin and mark the basinward limit of the upper sabkha evaporating terrane. Upper San Andres intertonguing anhydrite
beds and salt, representing lower to upper sabkha pro-
gradational couplets, reflect dominance of sabkha sedi-
mentation during upper San Andres deposition. The
overall genetic aspect of the stratigraphy is a general
southerly facies shift through time.

Porosity is best developed in subtidal dolomite facies.
Facies mapping delineates areas of potential porosity
preservation and is important to explorationists predict-
ing updip San Andres porosity trends and pinch-
outs.

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opment Co., Houston, Tex.

Design and Function of Oil and Gas Traps

Oil and gas are found in traps. If we can understand
what is going on in traps, we should be able to look
back along the migration trail with special insight as to
what has happened. That insight could even extend all
the way back to the “source.”

Traps are the most logical places for hydrocarbon
mixtures to be put together as distinct oil and gas fluids.
It follows that traps are not just passive receivers or
containers of hydrocarbon mixtures put together else-
where. Effective oil and gas traps of different well-
known styles have a very important feature in common:
structurally and stratigraphically, they are designed to
discharge waters from depth. Thus they function as ac-
tive focal mechanisms to gather and process feedstock
waters carrying hydrocarbons and other organic mate-
rals. It is a forced-draft system. The concept adds an
exciting new dimension to the anticlinal theory. It
honors all factual observations around oil and gas de-
posits.

Very simply, the most important function of a trap is
to leak water while retaining hydrocarbons. The water
can leak because the enclosing membranes and cover
are water-soaked, like a wick. The hydrocarbons and
other organic materials are separated from the waters as
they pass through the trap. The separation is caused by
abrupt changes in pressure, temperature, and possibly
salinity—those changes being related to the basic
change in direction of feedstock (water) movement
from lateral to upward. Coalescence of hydrocarbons
makes bubbles or globules which cannot move so easily
as water. The ultimate composition of a trapped hydro-
carbon mixture depends on the respective residence
times of the various components of that mixture which
in turn depend on (1) what the water carries to the trap,
(2) what the trap retains, and (3) the pore-volume ex-
change rate.

SANNES, TORSTEIN, Saga Petroleum U.S., Inc.,
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Waveland Field, Unique Structural and Stratigraphic
Trap

Waveland field, located in Hancock County, Missis-
sippi, and currently being developed, was discovered in
1965 by Humble Oil and Refining Co. Gas Unit I, Sec.
22, T8S, R15W. One additional field well was drilled, a
northwest diagonal in Sec. 16, T8S, R15W. After these
two field wells were completed and put on production,
there was no additional development until 1975, when
lease blocks were assembled by Phillips Petroleum Co.,
Saga Petroleum, Marshall R. Young Oil Co., and others.

There is no massive deposition of Ferry Lake Anhy-
drite in the area. Because of the lack of massive anhy-
drite, actual definition of the formations of the Trinity
Group (Lower Cretaceous) is difficult to impossible.
However, it is interpreted that the primary reservoir of
Waveland, a porous limestone, is the Moorsport For-
mation.

The depositional environment of the Moorsport
limestone reservoir is extremely complex because of the
influence of the large regional carbonate banks on the
south. For convenience, the Moorsport porosity
zones are lettered A through G. To date, the A and B
zones are the primary contributors to production. The B
zone may be subdivided within the field proper.

The reservoir rock is best described as a two-porosity
system—matrix porosity (range 6 to 12%) and vugular
porosity (range 7 to 16%) directly related to the mineral-
ogy, lithology, and diagenetic history. Matrix perme-
ability is generally low, not exceeding 2 md and usually
less than 1 md. Fractures are essential for good produc-
tivity and intense fracturing is present in all the higher
crestal positions.

The Waveland field comprises the crestal 19,000 pro-
ductive acres (7,600 ha.) of a north-to-south-elongated
nose having no apparent structural closure, fault closu-
re, or north dip at the Moorsport limestone level.
Structural elevation at the Moorsport level is a major
factor in determining hydrocarbon saturation, but no
direct relation has been found among pore-throat size,
rock type, porosity, structural elevation, and hydrocar-
bon saturation. The Waveland field is a complex com-
bined structural and stratigraphic trap.

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las, Tex.

Evidence for Wrench Faulting, Southern Val Verde Ba-
sin, Southwest Texas

A structural analysis in the southwest Edwards Pla-
ateau area included four 15-minute quadrangles in Ed-
wars, Kinney, and Val Verde Counties, Texas. Seven
rock units of the Cretaceous Comanche Series and two
units of the Cretaceous Gulf Series crop out. Subsurface
Paleozoic foreland facies rocks of the southern Val
Verde basin are present in the northern study area; the
Devils River uplift, partly blanketed by allochthonous
upper Paleozoic metamorphic rocks, underlies the
southern part. A pronounced east-west-trending fault
zone which cuts through the center of the study area is
at least 55 mi (88 km) long and 1 to 2 mi (1.6 to 3.2 km)
wide. This trend, named the Carta Valley fault zone, is
characterized by a complex series of en echelon, north-
east-oriented faults which are cross-cut by a lesser num-
er of northwest-trending faults. These faults bound a
series of grabens, downthrown by 200 to 300 ft (60 to 91
m), which are as large as 3 sq mi (7.7 sq km). Nine
gently dipping, northwest-plunging, en echelon anti-
clines parallel the south side of the fault zone. The con-