ent formations. Most of the rules listed below are empirical, and causative factors are still poorly understood. The list is also not complete.

1. The detrital mineral composition of a sand predetermines 50-80% of its diagenetic history.
2. Porosity lost by compaction cannot be regenerated during subsequent diagenetic events. Sands with abundant ductile grains (clay clasts, fecal pellets, shale clasts, micaceous rock fragments) can lose much primary porosity from the mashing of these grains during compaction.
3. The loss of primary porosity through compactional deformation of clays and ductile grains takes place during burial of 8,000-10,000 ft (2,450-3,050 m); loss of porosity by compaction at greater depths is by pressure solution of detrital grains.
4. Pressure solution of quartz grains is enhanced by the presence of grain coatings of illite and to a lesser degree by chlorite.
5. Quartz cement has an affinity for the coarser, more permeable sands in a formation. However, it rarely fills all pores in a sandstone except in some coarser grained laminae or in quartzarenites.
6. Carbonate cement may have a patchy distribution in a bed, but it fills all pores to produce a nonporous rock where it is present.
7. Carbonate cement is the dominant or only cement in sands with abundant carbonate fossil fragments or carbonate rock fragments; the carbonate cement is derived from the sand.
8. Poikilotopic calcite cement is the result of cementation that progressed from widely spaced nucleation sites.
9. Kaolinite forms by the replacement of feldspar and to a lesser degree of muscovite and also by free-standing growth in both primary and secondary pores.
10. Kaolinite should be expected as a diagenetic mineral in feldspar-rich sands (arkose and subarkose) that are poor in volcanic rock fragments.
11. Chlorite and/or mixed-layer clay should be expected as a diagenetic mineral in sandstone with more than 10% volcanic rock fragments.
12. Chlorite and mixed-layer clay, because of their tendency to bridge pores and produce baffles in pores, can seriously reduce permeability.
13. Early formed illite, typically present as grain coatings, does not seriously reduce permeability; late-formed illite tends to bridge pores and produce baffles and seriously reduce permeability.
14. Micrite cement is formed in continental sands above the water table.
15. Opal cement is formed in continental sands above the water table in stratigraphic sections where volcanic ash beds are intercalated with sands.
16. Some degree of secondary porosity is to be expected in a sandstone. However, there are few clues at present to predict the degree of secondary porosity or the cleanliness of secondary pores produced. Many secondary pores are micropores within incompletely dissolved feldspar or rock fragments. The best secondary pores are produced by dissolution of carbonate cement and evaporite cement.
17. Secondary porosity develops chiefly at depths greater than 6,000 ft (1,830 m) in the Gulf Coast, but can persist to depths of 20,000 ft (6,100 m). After their generation, secondary pores undergo some destruction during subsequent deeper burial by infilling with late-diagenetic ferroan carbonate and/or kaolinite.
18. Sands that had the greatest permeability at the time of deposition will develop the best secondary porosity. The best permeability will be in the coarsest, well-sorted sandstones (except in quartzarenites, where the coarsest beds selectively may undergo complete cementation by quartz).

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Southwestward Extension of Vicksburg-Jackson Shale Ridge, Refugio and Aransas Counties, Texas

Exploratory drilling in Refugio and Aransas Counties, Texas, has demonstrated that the major structural axis of the Vicksburg-Jackson shale ridge, which was first identified in north-central Calhoun County, Texas, plunges southwestward in the subsurface across northeastern Refugio County into northern Aransas County. The length of the shale ridge is approximately 52 mi (84 km), extending southwestward from Lavaca Bay in Calhoun County to Copano Bay in Aransas County, Texas.

The southwestern limb of this regional structure is not as strongly uplifted in the subsurface of Refugio and Aransas Counties as it is in north-central Calhoun County. The structural characteristics of the ridge are steep dip to the southeast in the upper Frio, lower Frio unconformities associated with dip reversal to the north-northwest in the lower Frio section, and up-to-the-coast faulting.

Oil and gas discoveries in recent years along the southwestern extension of the shale ridge have been from structures similar to those found along the shale ridge in north-central Calhoun County. Two of the discoveries have been significant; additional exploration along the shale ridge should identify other drillable anomalies.

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Recent Foraminifera of St. Andrew Bay, Florida

Foraminiferal analysis was conducted on 403 bottom samples from St. Andrew Bay, a polyhaline to ultrahaline estuary on the northwest coast of Florida. Intertidal samples (140) and subtidal samples (263) were collected by the National Marine Fisheries Service during November 1974 and April 1975. Water properties samples were collected also at 69 of the subtidal stations. Foraminiferal concentrates were obtained by carbon tetrachloride float from an undisturbed, upper 1 cm (0.4 in.) of tube (intertidal) and grab (subtidal) samples. A census of populations was taken by random, 300-specimen counts. Subspecies were recognized but none are new. Biofacies were based on percentages of populations and geographic patterns of distribution.

The genus *Ammonia* dominates foraminiferal populations at 75% of the statistically valid stations (stations with 300 or more foraminifera) and forms the only major biofacies of the bay. *Ammonia parkinsoniana tepida* and *typica* are the dominant *Ammonia*. The smaller and more fragile *A. parkinsoniana tepida* is dominant in the central, deeper parts of the St. Andrew Bay, where salinity and temperature are higher; whereas *A. parkinsoniana typica* is dominant in intertidal areas, where salinity and temperature are lower. The salinity and temperature relationships of the ecophenotypes are the same as reported for San Antonio Bay, Texas, but the bathymetric relationships are reversed. The ecophenotypes define secondary biofacies within the major one.

Several species characteristic of the continental shelf occur in widely varying percentages, but with a definite geographic pattern, along the deepest and most central parts of the bay. It is suggested that this secondary biofacies reflects the effect of flood tidal action on meroplanktonic larval stages of the species.

The remaining 25% of the stations are dominated by *Elphidium*, miliolids, *Ammobaculites, Nonionella, Miliammina, Rosalina,* and *Trochammina,* which occur erratically in abundance and distribution. *Elphidium* shows the greatest adaptability to pollution. No biologic relationship is apparent between bottom sediment and foraminifers.

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Detrital Composition of Pliocene-Pleistocene Sands, Offshore Louisiana

Pliocene and Pleistocene sands that underlie the Louisiana shelf are lithic arkoses and feldspathic litharenites. The composition of this detrital material is similar to that of Eocene and Oligocene sandstones of the Texas Gulf Coast. Among rock fragments, grains of volcanic and low-rank metamorphic origins dominate. Untwinned plagioclase is the dominant feldspar. Calcium content of plagioclase in unalbitized sands is as great or greater than that observed in unalbitized sandstone samples from the Eocene and Oligocene of Texas.

Despite a primary detrital composition that is potentially as reactive as detrital assemblages in the older units, Pliocene-Pleistocene sands have comparatively lesser amounts of cementation and grain alteration. An interesting reflection of the lesser degree of grain alteration is the relatively more unstable and complex assemblage of heavy minerals present in the younger sands.

In addition to detrital composition, the depositional setting of the Pliocene-Pleistocene clastics was also broadly similar to that of other major wedges of Tertiary sediment in the Gulf Coast basin. Thus, differences in stages of diagenesis are believed to be the result of different physical and/or chemical environments present during burial.