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General Facts about the Gulf of Mexico

From: Gore, 1992; Darnell and Defenbaugh, 1990; unless otherwise noted.

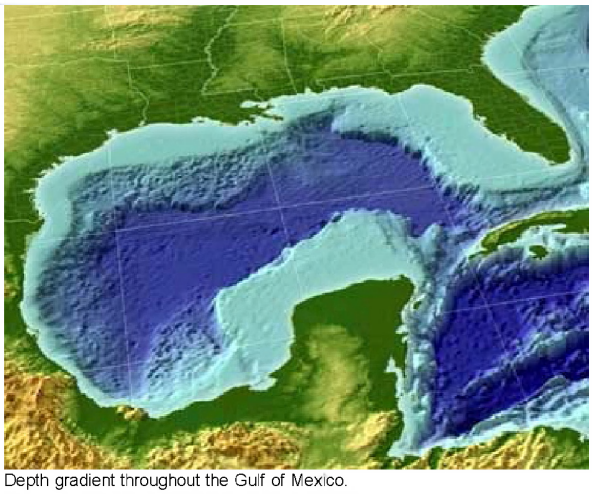
LOCATION AND SIZE

The Gulf of Mexico is a Mediterranean-type sea located at the southeastern corner of North America. The Gulf is bordered by the United States to the north (Florida, Alabama, Mississippi, Louisiana, Texas), six Mexican states to the west (Quintana Roo, Tamaulipas, Veracruz, Tabasco, Campeche, Yucatan), and the island of Cuba to the southeast.

The Gulf measures approximately 1,600 kilometers from east to west, 900 kilometers from north to south, and has a surface area of 1.5 million square kilometers. The marine shoreline from Cape Sable, Florida to the tip of the Yucatan peninsula extends ~5,700 kilometers, with another 380 kilometers of shore on the northwest tip of Cuba. If bays and other inland waters are included, the total shoreline increases to over 27,000 kilometers in the U.S. alone.

Source: http://earthobservatory.nasa.gov/

DEPTH


Depth gradient throughout the Gulf of Mexico.
Image modified from ESRI Data & Maps (2000).

The Gulf of Mexico basin resembles a large pit with a broad shallow rim. Approximately 38% of the Gulf is comprised by shallow and intertidal areas (< 20 m deep). The area of the continental shelf (< 180 m) and continental slope (180 - 3,000 m) represent 22% and 20% respectively, and abyssal areas deeper than 3,000 m comprise the final 20% (Gore, 1992). The Sigsbee Deep, located in the southwestern quadrant, is the deepest region of the Gulf of Mexico. Its exact maximum depth is controversial, and reports by different authors state maximum depths ranging from 3,750 m to 4,384 m. Mean (average) water depth of the Gulf is ~1,615 m (Turner, 1999) and the basin contains a volume of 2,434,000 cubic kilometers of water (6.43 * 10^{17} or 643 quadrillion gallons).

ORIGINS AND GEOLOGIC HISTORY

From: Gore, 1992; Donnelly, 1975; Martin, 1975; Uchupi, 1975 After Salvador, 1991

The Gulf of Mexico basin is a relatively simple, roughly circular structural basin approximately 1,500 km in diameter, filled in its deeper part with 10 to 15 km of sedimentary rocks that range in age from Late Triassic to Holocene (approximately 230 m.y. to present). Little is known about the geologic history of the Gulf of Mexico Basin before Late Triassic time. Since pre-Triassic rocks are known from only a few widely separated outcrop areas and wells, much of the geologic history of the basin during Paleozoic time needs to be inferred from the study of neighboring areas. Some authors have postulated the presence of a basin in the area during most of Paleozoic time, but most evidence seems to indicate that Paleozoic rocks do not underlie most of the Gulf of Mexico basin and that the area was, at the end of Paleozoic time, part of the large supercontinent of *Pangea*, the result of the collision of several continental plates. The present Gulf of Mexico basin, in any case, is believed to have had its origin in

Late Triassic time as the result of rifting within the North American Plate at the time it began to crack and drift away from the African and South American plates. Rifting probably continued through Early and Middle Jurassic time with the formation of "stretched" or "transitional" continental crust throughout the central part of the basin. Intermittent advance of the sea into the continental area from the west during late Middle Jurassic time resulted in the formation of the extensive salt deposits known today in the Gulf of Mexico basin. It appears that the main drifting episode, during which the Yucatan block moved southward and separated from the North American Plate and true oceanic crust formed in the central part of the basin, took place during the early Late Jurassic, after the formation of the salt deposits.

Since Late Jurassic time, the basin has been a stable geologic province characterized by the persistent subsidence of its central part, probably due at first to thermal cooling and later to sediment loading as the basin filled with thick prograding clastic wedges along its northwestern and northern margins, particularly during the Cenozoic. To the east, the stable Florida platform was not covered by the sea until the latest Jurassic or the beginning of Cretaceous time. The Yucatan platform was emergent until the mid-Cretaceous. After both platforms were submerged, the formation of carbonates and evaporites has characterized the geologic history of these two stable areas. Most of the basin was rimmed during the Early Cretaceous by carbonate platforms, and its western flank was involved during the latest Cretaceous and early Tertiary in a compressive deformation episode, the Laramide Orogeny, which created the Sierra Madre Oriental of eastern Mexico.

GEOLOGY

Today, the Gulf of Mexico is a small oceanic basin surrounded by continental land masses. Due to their physical structure, the Gulf and the Caribbean Sea are sometimes combined and referred to as the 'American Mediterranean'. Uchupi (1975) divides the Gulf into two distinct geographical provinces (Terrigenous and Carbonate) while Antoine (1972) recognizes seven. The scheme proposed by Antoine is presented here, with additional information derived from other sources.

1) Gulf of Mexico Basin
This portion of the Gulf of Mexico contains the Sigsbee Deep and can be further divided into the continental rise, the Sigsbee Abyssal Plain, and the Mississippi Cone. Located between the Sigsbee escarpment and the Sigsbee Abyssal Plain, the continental rise is composed of sediments transported to the area from the north. The Sigsbee Abyssal Plain is a deep, flat portion of the Gulf bottom located northwest of Campeche Bank. In this relatively uniform area of the Gulf bottom, the Sigsbee Knolls and other small diapiric (salt) domes represent the only major topographical features. The Mississippi Cone is composed of soft sediment and extends southeast from the Mississippi Trough, eventually merging with other sediments of the central basin. The cone is bordered by the DeSoto Canyon to the east and the Mississippi Trough to the west, and has been described in detail by Ewing et al. (1958).

2) Northeast Gulf of Mexico
Extending from just east of the Mississippi Delta near Biloxi to the eastern side of Apalachee Bay, this region of the Gulf bottom is characterized by soft sediments. To the west of the DeSoto Canyon, terrigenous (land-derived) sediments are thick and fill the remnants of the Gulf basin. In the eastern portion of the region, Mississippi-derived sediments cover the western edge of the Florida Carbonate Platform and a transition towards carbonate sediments begins. The Florida Escarpment separates the Florida Platform from the Gulf Basin and also forms the southeastern side of the DeSoto Canyon. In a region characterized by sediment deposition, the presence of the DeSoto Canyon is poorly understood. Some theories suggest that the canyon is the result of erosion caused by oceanic currents, possibly the Loop Current (Nowlin, 1971).

3) South Florida Continental Shelf and Slope
A submerged portion of the larger emergent Florida Peninsula, this region of the Gulf of Mexico extends along the coast from Apalachee Bay to the Straits of Florida and includes the Florida Keys and Dry Tortugas. A generalized progression towards carbonate sediments occurs from north to south ending in the thick carbonate sediments of the Florida Basin. Evidence suggests that this basin was at one time enclosed by a barrier reef system (Ewing et al., 1966; Sheridan et al., 1966; Oglesby et al., 1965; Antoine and Ewing, 1963). In the Straits of Florida the Jordan Knoll appears to be composed of remnants from this ancient reef system. Evidence suggests that this reef may have once extended across the straits, adjoining the Florida reefs with those of northern Cuba.

4) Campeche Bank
Campeche Bank is an extensive carbonate bank located to the north of the Yucatan Peninsula (Ordonez, 1936). The bank extends from the Yucatan Straits in the east to the Tabasco-Campeche Basin in the west and includes Arrecife Alacran. The region shows many similarities to the south Florida platform and some evidence suggests that the two ancient reef systems may have been continuous (Antoine and Ewing, 1963; Uchupi and Emery, 1968). Continental drift and erosional processes are both theorized to have played a role in the separation of the two geologically similar carbonate platforms.

5) Bay of Campeche
The Bay of Campeche is an isthmian embayment extending from the western edge of Campeche Bank to the offshore regions just east of Veracruz (~96 degrees W). The Sierra Madre Oriental forms the south-southwestern border, and the associated coastal plain is similar to the Texas-Louisiana coast in the northern Gulf. The bottom topography is characterized by long ridges parallel to the exterior of the basin. Salt domes are prevalent in the region, and the upward migration of salt is theorized to be a cause of the complex bottom profiles (Worzel et al., 1968). Similar to the northern Gulf, large quantities of oil are produced here, and thick terrigenous sediments predominate.

6) Eastern Mexico Continental Shelf and Slope
Located between Veracruz to the south and the Rio Grande to the north, this geological province spans the entire eastern shore of Mexico. The Gulf bottom of the region is characterized by sediment-covered folds that parallel the shore. Apparently created by sediment-covered evaporites, evidence suggests that the folds have impeded sediment transport from the Mexican coast to the Gulf Basin (Bryant et al., 1968). As sediment cover increases from south to north, so does the relative complexity of the bottom structure.

7) Northern Gulf of Mexico
The northern Gulf of Mexico extends from Alabama to the U.S.-Mexico border. North to south, the province extends from 200

miles inland of the present day shoreline to the Sigsbee escarpment. Sediments in the region are generally thick with the greatest sediment load provided by the Mississippi River. Widespread salt deposits are present throughout the region (Murray, 1961; Halbouty, 1967) and these structures act to create subsurface and emergent topographic features on the continental slope such as the Flower Garden Banks off the Texas/Louisiana coast, and the pinnacles region offshore of the Mississippi/Alabama coast.

CIRCULATION AND CURRENTS

Water enters the Gulf through the Yucatan Strait, circulates as the Loop Current, and exits through the Florida Strait eventually forming the Gulf Stream. Portions of the Loop Current often break away forming eddies or 'gyres' which affect regional current patterns. Smaller wind driven and tidal currents are created in nearshore environments.

Drainage into the Gulf of Mexico is extensive and includes 20 major river systems (>150 rivers) covering over 3.8 million square kilometers of the continental United States (Moody, 1967). Annual freshwater inflow to the Gulf is approximately 10.6×10^{11} m^3 per year (280 trillion gallons). 85% of this flow comes from the United States, with 64% originating from the Mississippi River alone. Additional freshwater inputs originate in Mexico, the Yucatan Peninsula, and Cuba.

RESOURCES

The Gulf of Mexico ecosystem provides a wide array of valuable resources to the nations on its shores. Brief summaries of petroleum and fisheries resources can be found below.

Physical / Mineral
It is estimated that $1.4\text{-}7.2 \times 10^8$ barrels of petroleum and $4.4\text{-}22.3 \times 10^{10}$ cubic meters of natural gas are present beneath the seafloor in the northern Gulf (Darnell and Defenbaugh, 1990). According to the Minerals Management Service, offshore operations in the Gulf produce a quarter of the U.S. domestic natural gas and one-eighth of its oil. In addition, the offshore petroleum industry employs over 55,000 U.S. workers in the Gulf (MMS, 2002). In Mexico, the Secretariat of Energy (Secretaria de Energia - SENER) estimated that the daily crude oil and natural gas production from Gulf of Mexico offshore operations in the years 2000 to 2005 ranged from 2.293 to 2.839 million barrels and 41.4 to 44.8 million cubic meters, respectively (SENER 2006).

Fisheries
Gulf fisheries are some of the most productive in the world. In 2000, the commercial fish and shellfish harvest from the five U.S. Gulf states was estimated to be 1.7 billion pounds (approximately 772 million kg), which represents almost 1/5 (19.4%) of the total domestic landings in the United States. In the same year, commercial catches in the Gulf represented approximately 25% of the total U.S. domestic commercial fishing revenue and were valued at over $900 million. The Gulf also supports a productive recreational fishery. Excluding Texas, U.S. Gulf states accounted for over 40% (>104,000 lbs or >47,000 kg) of the U.S. recreational finfish harvest in 2000 (O'Bannon, 2001).

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