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Physical Geography and Climate: Overview

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SEE ALSO

Family and Household

Geography and Climate

In response to a request to sketch the complex physical patterns of Middle America, Cortés abandoned pen and ink altogether, crumpled up a sheet of paper, and laid it on the table. Pithy and evocative, this anecdote emphasizes the dramatic elevational differences that characterize the region's physical geography and underpin an unmatched environmental diversity. Squeezed among the margins of six lithospheric plates, the ancient rocks have folded and faulted into a rugged topography, while volcanism has mantled the surface with younger rocks and built the highest peaks—with Volcán Pico de Orizaba's glacial cap gleaming within sight of the Gulf Coast's man-

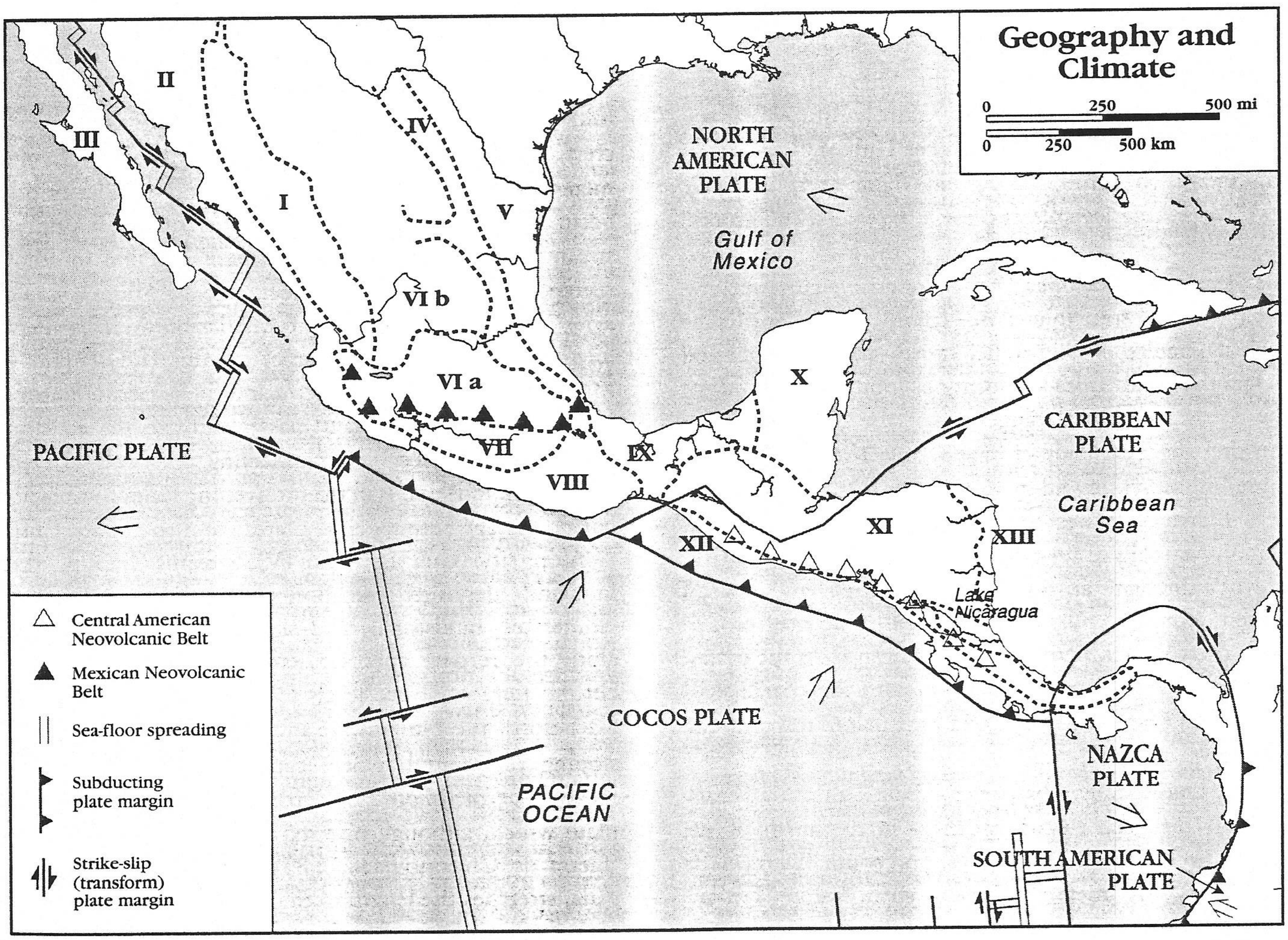
Table 1.

Physiographic Regions	*Significant Mineral Resources*
I. Sierra Madre Occidental	basalt, copper, gold, silver
II. Mexican Pacific Lowland	basalt, copper, gold, salt, shell, silver
III. Baja California Peninsula	asphalt, copper, gold, pearls, salt, shell, silver
IV. Sierra Madre Oriental	basalt, limestone
V. Gulf Lowland	asphalt, basalt, gold, salt, shell
VI. Mexican Plateau	
VIa. Mesa Central	basalt, cinnabar, copper, gold, hot springs, ice, obsidian, salt, silver, turquoise
VIb. Mesa del Norte	basalt, cinnabar, copper, flint, gold, hematite, jadeite, salt, silver, turquoise
VII. Balsas Depression	basalt, copper, gold, jade, jadeite, limestone, serpentine, silver, turquoise
VIII. Mexican Southern Highland	basalt, gold, limestone, salt, shell, silver, turquoise
IX. Isthmus of Tehuantepec	gold, limestone, salt, shell
X. Yucatan Peninsula	chert, flint, limestone, salt, shell
XI. Central American Highland	basalt, gold, hot springs, jade, jadeite, limestone, obsidian, serpentine, silver
XII. Central American Pacific Lowland	salt, shell
XIII. Central American Caribbean Lowland	salt, shell

grove swamps. While the eruptions and earthquakes associated with such energetic tectonism produce relatively brief and localized catastrophes, the more enduring lithological and structural patterns have endowed some general order on the landscape.

Thirteen physiographic regions (see map) thus define the environments of ancient Middle American cultures—a suite of landforms, drainage patterns, soils, mineral resources (see Table 1), and climates characterizing each region. As a preliminary overview, three extensive highlands dominate Middle America. In the north, the Sierra Madre Occidental (Region I) and Sierra Madre Oriental (Region IV) flank the Mexican Plateau (Region VI). The Mexican Southern Highland (Region VIII) occupies the center. The Central American Highland (Region XI) extends from southern Mexico to the Isthmus of Panama. Lowlands bound and divide those highlands. The Mexican Pacific Lowland (Region II) abuts the Sierra Madre Occidental, separated from the Baja California Peninsula (Region III) by the Gulf of California. The Gulf Lowland (Region V) separates all three highlands from the Gulf of Mexico, grading into the Yucatan Peninsula (X) at the foot of the Central American Highland, itself fringed by narrower, discontinuous lowlands: the Central American Pacific Lowland (XII) and the Central American Caribbean Lowland (XIII). The Balsas Depression (Region VII) and Isthmus of Tehuantepec (Region IX) flank the Mexican Southern Highland.

The Sierra Madre Occidental (I) rose during Tertiary time, 65 million–2 million years ago (mya); the Farallon



The physiographic regions of Mexico. Map design by Mapping Specialists Limited, Madison, Wisconsin, after original provided by Andrew Sluyter.

Plate, an extinct sector of the Cocos Plate, subducted beneath the North American Plate, melting and welling upward into a western backbone of volcanic peaks built of rhyolite and andesite. Continued tectonism during the Pleistocene (2–0.01 mya) further uplifted the range and faulted its eastern versant (slope) into parallel (northwest–southeast) ridges and valleys, where streams carved out a labyrinth of lava-capped mesas that grade into those of the Mesa del Norte. In contrast, the streams plummeting down the western escarpment to the Pacific Lowland have cut deep canyons (e.g., Barranca del Cobre). From a relatively modest northern terminus, the range gains elevation toward the south (e.g., Cerro de la Mohinora, 3,250 meters)—in total, a massive barrier with daunting heights, a few slightly less daunting passes cut headward by the major streams (Río Yaqui, Río Fuerte) of the Pacific drainage, and isolated pockets of valley bottom scattered along the eastern fringe and the drainage axes.

The Mexican Pacific Lowland (II) consists of ranges of granite that predate the Tertiary, eroded nearly to sea level, the nubs largely buried beneath sediments deposited by streams descending from the Sierra. It tenuously perches on the edge of the San Andreas Rift, which was inundated during the Tertiary by the Gulf of California as subduction consumed the Farallon Plate and the Pacific and North American plates came into contact and ground past each other. To the south, where the lowland clings to the Sierra along the open Pacific, longshore currents have extended sand spits to enclose lagoons. To the north, the rock has faulted into parallel (north–south) basins and ranges that grade from a continuous foothill margin along the Sierra to isolated ranges along the coast, in places forming the headlands of bays (Bahía Kino) but largely buried by alluvium and by dune fields (Desierto Altar) of sand blown southwest from the Colorado River Delta. The alluvial soils of the floodplains and coastal deltas (Río Mayo) punctuate an otherwise forbidding landscape of ancient, rounded hills smothered under detritus eroded from the younger Sierra. The north even lacks the deltas; its streams (Río Sonora) disappear into the coarse sediments and evaporate in the arid heat before reaching the coast.

Two granite ranges bracket the Baja California Peninsula (III) between elevational highs in the north (Sierra San Pedro Mártir, 3,100 meters) and south (Sierra de la Victoria, 2,100 meters). Erosion since before Tertiary times has rounded the summits and carved broad headwater basins with deep soils. As the San Andreas Rift opened, the block comprising the peninsula uplifted and tilted westward, and the sedimentary rocks lying between the two ranges presented a jagged fault scarp (Sierra de la Giganta, 1,500 meters) to the east. Subsequent volcanism mantled the sedimentary rocks, and the intermittent streams draining westward have carved narrow valleys between mesas capped with lava and tuff, with springs bubbling from the volcanic rocks. Continued uplift has restricted lowland to isolated pockets along the west coast, where the sand dunes of small deserts (Desierto Vizcaíno) merge into the barrier islands and spits that enclose bays (Bahía Magdalena).

The Sierra Madre Oriental (IV) counterpoises the western orogenic belt with an eastern backbone of marine limestones and shales deposited during Jurassic and Cretaceous times (213–65 mya). During the latest Cretaceous and early Tertiary, as the Farallon and North American plates pressed together, the sedimentary rocks compressed and folded into a series of parallel valleys and ridges: some stretch for hundreds of kilometers, and all increase in elevation westward to a crest at 2,000–3,000 meters. Faulting and limited volcanism complicates the folded structure and occasionally interrupts the regular crest with higher peaks (Cerro Peña Nevada, 3,540 meters). Karst features, the result of limestone solution, occur throughout the Sierra and flanking foothills: streams plunge into sinkholes *(resumideros),* flow for kilometers through caverns, and reemerge as springs *(ojos de agua);* sinkholes coalesce to form flat-bottomed valleys filled with alluvium. The larger streams (Río Pánuco–Moctezuma) draining the Sierra and the Mexican Plateau have cut deep canyons and passes through the echelon of ridges, in places interconnecting the well-watered stretches of fertile soils in the intervening valleys and facilitating passage between high plateau and coastal lowland.

Along the Gulf Lowland (V), streams draining the highlands deposited piedmonts of detritus—now conglomerates, sandstones, and shales—in fans and deltas along the Tertiary coastline, entrenching meanders and cutting terraces as sea levels fell during the Pleistocene glaciations; the canyons are thus separated by eastward-sloping plains and, where capped with volcanics, by mesas. The piedmont's hilly fringe grades into a coastal plain which, although bisected by the Neovolcanic Belt (Sierra de Chiconquiaco, 2,850 meters) at Punta Delgada, stretches the length of the Gulf of Mexico. Streams with drainage basins dominated by the limestone of the Sierra Madre Oriental did not deposit major fans of detritus, and so there is a more abrupt transition from folded foothills to coastal plain. Low ranges divide the lowland into a series of broad basins filled with fertile alluvium by the large, perennial streams (Río Pánuco, Río Papaloapan, Río Grijalva). While some of the low ranges represent the dissected sandstones and shales of the Tertiary deltas, others formed as isolated volcanism uplifted and faulted the thick marine rocks (Sierra de Tamaulipas, 1,250 meters). In the north, volcanic necks (Bernal de Horcasitas, 1,100 meters) thrust up isolated needles of basalt to signal extinct and highly eroded volcanoes. In the south, the Sierra de los Tuxtlas (1,700 meters) harbors small lakes (Lake Catemaco, 340 meters) and valleys of well-watered and fertile basaltic soils. Except at the Mexican Neovolcanic Belt, where the Gulf nearly laps the foothills, the streams meander across a broad coastal plain and are flanked by cordons of levees, backswamps, abandoned channels, oxbow lakes, and salt-intruded uplands that stand above the copious annual floods. Along the littoral, mangroves root in the muds of extensive delta-estuary systems and fringe lagoons protected by reefs, barrier islands, spits, and dune fields—some of them active and low, and some dating to Pleistocene times and having crest elevations over 100 meters.

The Mexican Plateau (VI)—a crustal block of Cretaceous and older marine sedimentary rocks, uplifted during the Tertiary formation of the paired Sierra Madres—crouches atop those two mountainous backbones; the Mesa Central (VIa) in the south grades into the Mesa del Norte (VIb). The Tertiary volcanics of the western range and the Cretaceous, folded sedimentary rocks of the eastern range converge on the Mesa Central. This is a landscape born of the volcanism which, as the Cocos Plate subducted beneath the North American Plate, began to intrude and cloak the plateau's older limestones and shales in late Tertiary times, a process that has continued to the present; it is manifest in high andesite peaks (La Malinche, 4,461 meters), swarms of low cinder cones (Paricutín, 2,500 meters), and flows of basalt, welded ash, and mud-rafted boulders. This Mexican Neovolcanic Belt—anchored by Volcán de Colima (4,240 meters) in the west and Pico de Orizaba (5,610 meters) in the east, where volcanics almost completely bury the folded marine sedimentary rocks of the southern Sierra Madre Oriental—cuts across the breadth of the continent, uplifting the Mesa Central to over 2,000 meters, bounding its verge with a dramatic suite of peaks, and bridging the southern termini of the two Sierra Madres. Those peaks, the highest scarred with cirques and draped with moraines dating to Pleistocene glaciations, enclose a series of basins (Toluca, 2,600 meters; Puebla, 2,100 meters). Most of them were periodically closed by lava flows during the Pleistocene, inhibiting exterior drainage and forming large, shallow lakes rich in aquatic resources and fringed by plains of fertile alluvium. The lakes left flat basin floors after eventual drainage, infilling, or desiccation. Four streams drain the Mesa Central: the Balsas and Santiago-Lerma Rivers to the Pacific, and the Papaloapan and Pánuco-Moctezuma Rivers to the Gulf.

The Basin of Mexico remained closed until it was drained in the Colonial period through a tunnel to the Pánuco-Moctezuma system. Its floor is underlain by hundreds of meters of sediment and covered by a series of shallow, interconnected lakes (Lake Texcoco, 2,250 meter). Deposits dating to the terminal Pleistocene and early Holocene (Upper Becerra Formation) contain remains of Paleoindians (e.g., the Tepexpan Woman) and extinct mammals such as mammoths. Between the fertile soils of the lacustrine plain—derived from erosion of basalt and andesite—and the enclosing peaks (Iztaccíhuatl, 5,300 meters; Popocatépetl, 5,465 meters), alluvial fans of volcanic detritus dating to the Pleistocene form a piedmont apron. Topsoil erosion in some piedmont sectors has exposed the underlying duricrusts *(tepetate),* indurated but friable soils cemented by chemical precipitation. More recent basalt flows cover other piedmont sectors, such as the Pedregal de San Angel that flowed from Volcán Xitle.

As the Mexican Plateau gradually drops in elevation northward from the Mexican Neovolcanic Belt, ultimately to less than 1,000 meters, a series of lower basins (El Bajío, 1,800 meters)—occupied by lakes (Lake Chapala, 1,500 meters) and drained by the Santiago-Lerma River—marks the transition to the Mesa del Norte. Squeezed between the Sierra Madres, with marine rocks predominating to the east and volcanics to the west, fault blocks form a series of parallel (north–south to northwest–southeast) ridges and valleys *(bolsones),* flanked by fans and aprons of coarse sediments *(bajadas)* and floored by expanses *(playas)* of fine sediments *(barriales)* ephemerally occupied by shallow lakes that precipitate salts on evaporation (Bolson de Mapimí, 1,100 meters). Except for the Conchos River draining northward into the Rio Grande (Río Bravo del Norte), drainage is interior and intermittent, and ultimately evaporates from the *playa* lakes. Elevations increase from east to west; the western ranges comprise the foothills of the Sierra Madre Occidental, a labyrinth of sediment-filled basins walled by lava-capped mesas.

Draining the peaks and basins of the Mexican Neovolcanic Belt, streams (Río Atoyac, Río Cutzamala) plunge into the Balsas Depression (VII), fragmenting the southern escarpment of the Mexican Plateau. The highly dissected terrain in the western ranges (Sierra de Mil Cumbres) gives way to a series of broad, gently sloping valleys (Atlixco) in the east, which are filled with more recent volcanic ash, mudflow, and alluvial deposits—highly fertile soils. The valleys are well watered and facilitate passage to the south. Outcrops of Cretaceous limestones introduce karst features such as caverns, sinkholes, and springs. The depths of the depression—floored with Cretaceous granite, limestone, and even older metamorphosed rocks that dropped in relation to the uplift of the Mexican Plateau—comprise a crazy-quilt of low hills and tiny swatches of alluvium, only a few of any appreciable size (Ciudad Altamirano, 300 meters).

To the south of the Balsas Depression rises the Mexican Southern Highland (VIII). On the west, the ranges of the Sierra Madre del Sur plunge into the Pacific and have a lithology similar to the Balsas Depression, in places mantled by Tertiary lavas. Only a few pockets of coastal plain front the Pacific, formed by the deltas of major streams (Río Balsas) and including lagoons guarded by barrier islands. In the interior, similar rocks comprise the Mesa del Sur, a dissected plateau of knife-edged ridges and steep, narrow valleys, carved into a labyrinth by the headwaters of the Balsas drainage. Only a few remnants of the ancient plateau surface and a few fault-block valleys relieve the sea of ridges with extensive flats; the Valley of Oaxaca (1,600 meters), watered by the headwaters of the Río Atoyac, comprises the largest expanse of alluvium. The Sierra Madre de Oaxaca—parallel (northwest–southeast) folds of marine sedimentary rocks, similar to the Sierra Madre Oriental—bounds the eastern flank of the Mesa del Sur. Volcanic peaks (Cerro Zempoaltepec, 3,390 meters) provide the highest elevations.

The Isthmus of Tehuantepec (IX), associated with the strike-slip fault where the Cocos and North American plates have ground past each other, provides a lowland pass between the Gulf Coast Lowland and the Pacific littoral, separating the similar lithologies of the Mexican Southern Highland and the Central American Highland. Meandering streams descend toward the coasts from a divide in the Sierra Atravesada (Cordón la Cordillera, 750 meters), crossing alluvial plains sprinkled with low hills that grade into the lagoons and barrier islands of the Pacific littoral and Gulf Lowland. Tertiary and Pleistocene tectonism raised the carbonate rocks of the Yucatán Peninsula (X) above sea level, with a gentle tilt toward the northwest, thus forming the only extensive lowland in Middle America. The northern and western coasts have gradually resubmerged with Holocene (0.01–0 mya) sea-level rise, merging into the shoals and reefs of the Campeche Banks. Lagoons and mangrove swamps fringe the shorelines, with numerous saltpans (Celustún) along the low-lying northern and western coasts, and with cliffs (Tulum) fronting reef-enclosed lagoons along the higher eastern coast. The pitted plain of limestone, marl, and gypsum in the north is unrelieved by surface drainage; the soils are thin and stony, with settlements clustering around the numerous cenotes (sinkholes accessing underground streams) and aguadas (clay-lined, shallow sinks collecting runoff). The plain abuts a scarp (northwest–southeast) that formed as the northern sector dropped relative to uplift. The Puuc Hills (350 meters) anchor the western terminus of the scarp, with elevations decreasing toward the southeast. South of the scarp, the higher, and thus longer exposed, limestones form a rolling surface (100–300 meters) underneath the expanse of the Petén forest. High precipitation leaches the already nutrient-poor soils, and the water table lies farther below the surface than north of the scarp. Nonetheless, the soils are older, deeper, and more fertile; the karst topography is more mature, cloaked by soil, and subdued; and surface streams augment subterranean channels and caverns. In the southwest, the karst grades into the alluvial plain of the Gulf Lowland. To the east, faulted valleys and low ridges parallel the coast, controlling the drainage pattern of the moderately sized surface streams (Río Hondo, New River) and forming bays (Bahía de Chetumal) and islands (Cozumel) upon reaching sea level. Stretches of alluvium, swampy *bajos* (clay-bottomed, coalesced sinkholes), and lakes (Lake Sacnab, 200 meters) occupy the fault valleys. The Maya Mountains (Victoria Peak, 1,122 meters)—a highly dissected block of granite and metamorphosed sedimentary rocks—comprise the only extensive highland, isolated from the Central American Highland to the south.

The Central American Highland (XI) rises from the Yucatán Peninsula and the Isthmus of Tehuantepec, continuing largely uninterrupted southeastward to the Isthmus of Panama. To generalize an immensely complex and still poorly understood region, the deep Montagua Valley forms the suture between the North American and

Caribbean plates, marking an impact that formed a cordon of folded ranges during latest Cretaceous times and bounded the Yucatán Peninsula on the south. Along the Pacific, the Central American Neovolcanic Belt became active during Tertiary times, as the Cocos Plate subducted beneath the Caribbean Plate; volcanism, continuing to the present, has capped a jumble of older granites, volcanics, and sedimentary rocks, building a chain of high peaks (Tajamulco, 4,210 meters). Basins (Quetzaltenango-Totonicpan, 2,400 meters) enclosed by those peaks harbor lakes (Atitlan, 1,560 meters; Ilopango, 450 meters) surrounded by fertile soils developed on ash, similar to the landforms of the Mexican Neovolcanic Belt. The Pacific versant slopes precipitously toward the coastal plain, frayed by deep canyons. In the north, the eastern drainage descends more gradually, with streams (Río Grijalva–Grande de Chiapas) flanked by broad terraces and intervening fault-block mountains capped by karsted limestone, with fertile soils on substrates of alluvium and on volcanic ash blown from the south. Southeastward, limestones become less frequent, but the general pattern continues of high volcanoes along the Pacific and lower, faulted ranges and basins toward the Caribbean. Elevations generally decrease from highs in Guatemala to a low at the Isthmus of Panama. One fault-block depression, occupied by large lakes (Lake Nicaragua, 35 meters), interrupts the highland: the Nicaraguan Graben. Where the Central American Highland peters out at the Isthmus of Panama, spurs of sedimentary and volcanic rocks rise to form the northern terminus of the Andes.

From the Isthmus of Tehuantepec, the Central American Pacific Lowland (XII) widens (the Soconusco) before pinching out on meeting the Nicaraguan Graben at the Gulf of Fonseca. Detritus from the neovolcanic chain forms an apron of gently sloping alluvial fans (Boca Costa) grading into a coastal plain; fertile soils form on substrates of weathered ash and detritus eroded from the volcanic slopes. Sand spits and barrier islands enclose lagoons. Southeastward from the Gulf of Fonseca, mountains front the Pacific more closely except where fault blocks form lowland peninsulas.

The Miskito Coast comprises the only extensive Central American Caribbean Lowland (XIII). Tertiary marine sediments extend a sloping plain between highland and coast, with streams cutting shallow valleys separated by laterite-capped mesas. Large deltas extend into shallow lagoons enclosed by reefs, atolls, and barrier islands. From Mosquitia eastward to the Maya Mountains, only small deltas intervene between mountain spurs that abut the sea. Southward, the large delta of the San Juan River, draining the Nicaraguan Graben, presses out into the sea, rife with estuaries, lagoons, and swamps; longshore currents carry its sediments to build a coastal plain to the southeast. Eastward, the reefs continue, but only small deltas punctuate the mountainous shore.

Climate

Extending from 8° to 33° north latitude, Central America and Mexico bridge the transition from tropical to temperate climates. This, together with climate change over the course of the Quaternary (2–0 mya), further increased the diversity of the environments of ancient Middle American cultures. Central America and southern Mexico enjoy a tropical climate (more than 1,600 mm precipitation per annum) all year round, while central and northern Mexico are under the influence of subtropical climates (250–1,000 mm precipitation per annum). Mid-latitude weather systems prevail in the north of Mexico, but in winter they may also penetrate deep into the tropics. Altitude conspicuously affects the temperature distribution from hot lands at sea level to cold lands upward of 3,000 meters. The local diversity of climates is further controlled by the mountain ranges, which help to accentuate land-sea breezes along the coastlines and to produce rain shadow effects on the leeward side of the mountains and over the Mexican Plateau (250–500 mm precipitation per annum). During the winter dry season, the subtropical westerly jet dominates the upper tropospheric circulation, and the North Pacific and North Atlantic anticyclones, which are closest to the equator in this season, influence the surface circulation. The trade winds affect only Central America and southeastern Mexico, while the mid-latitude westerlies influence mainly northern and central Mexico, meaning that less precipitation falls in the latter two regions. The occurrence of a cold cyclonic vortex over northwestern Mexico (the Sonora Track) may account for most of the rain in this area and for the occasional snowfall on the Sierra Madre Occidental.

During strong meridional flow conditions over northwestern Canada, cold air masses may enter the Mexican Plateau, the Gulf of Mexico, and even as far south as Central America. These cold surges, or *nortes,* are associated with light rains, low temperatures, and frosts. The El Niño/Southern Oscillation (ENSO) warm events (cold ENSO events are known as La Niña) also have an impact on the winter circulation by enhancing strong meridional flow over northwestern Canada and a strong subtropical westerly jet that extends across Mexico and the Gulf of Mexico. Consequently, El Niño (warm ENSO) events have been documented as producing colder, wetter weather over northeastern Mexico during winter, with La Niña (cold ENSO) events having the opposite effect. El Niño events also seem to be associated with dry conditions in some parts of Central America.

During summer, the subtropical westerly jet disappears and the North Atlantic and North Pacific highs and the equatorial trough of low pressure shift northward. Easterly flow aloft along the Bermuda-Azores anticyclone brings moist air over Mexico and Central America and the main rainy season develops. Convective clouds, orographic lifting, and abundant rains are produced over the windward slopes of the mountain ranges. In general, the rainy season lasts from May through November, with a maximum in July on the Mexican Plateau, in July and August in northwestern Mexico (when the Mexican monsoon occurs), and in September in coastal regions. The exceptions include the northwestern part of the Baja California Peninsula, which experiences winter rains (Mediterranean climate); the coastal plains of the southern Gulf of Mexico (tropical wet-dry, with 1,500–2,000 mm precipitation per annum); and Central America, which has rainfall throughout the year. The northeasterly trades, tropical storms, and hurricanes account for the September rainfall maximum in Central Mexico as well as the coastal regions of the Gulf of Mexico and the Caribbean. The northeastern coasts of Central America, which face the Caribbean Sea, are usually wetter (tropical rainy, more than 2,000 mm per annum) than the southward ones, which are on Pacific Ocean, leeward side of the mountains (tropical wet-dry, 800–1600 mm per annum). The equatorial southwesterlies, associated with the northward location of the Intertropical Convergence Zone (ITCZ), account for the September-October precipitation on the Pacific coast of Central America, while tropical storms and cyclones are responsible for the maximum on the Pacific coast of Mexico. However, between June and September there is a relatively dry period, called Canícula in Mexico and Veranillo in Central America. Drought conditions along the Gulf of Mexico and the Caribbean coasts are established during summer when the upper tropospheric circulation is dominated by a trough (cyclonic flow) over the Caribbean and a ridge over the Mexican Plateau. Therefore, large-scale ascending motion over the sea decreases or changes to subsidence, dampening precipitation processes. Recent studies also indicate that reduced seasonal upper tropospheric anticyclonic flow over the western Atlantic should be associated with weak hurricane activity. Moreover, low hurricane activity in the Atlantic basin seems to be associated with the occurrence of a moderate to strong El Niño event. Accordingly, several studies document that during ENSO warm events summer rainfall decreases in some regions of Mexico and Central America.

Several studies based on pollen and lake-level records show that climates in Mexico and Central America have changed over the past 20,000 years. Despite much uncertainty, the most consistent inferences indicate that before 14,000 years ago, climates in general were colder and drier than present. Subsequently, wetter periods (but still colder than present) seem to correspond with glacial advances and changes in the position of the polar front. Several studies generally agree that in relative terms, the Formative period was humid, the Classic dry, and the Postclassic humid.

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SEE ALSO

Fauna; Flora; Hydrology; Minerals, Ores, and Mining

Gheo-Shih (Oaxaca, Mexico)

Gheo-Shih (Zapotec, "River of the Gourd Trees") is a 1.5-hectare open-air site of the hunting, gathering, and incipient cultivation era in highland Mexico. It lies along the right bank of the Río Mitla in the eastern Valley of Oaxaca and was excavated by Frank Hole as part of a University of Michigan expedition. The most interesting feature of Gheo-Shih is a cleared area 20 meters long and 7 meters wide, swept clean of artifacts and lined with boulders. It resembles a dance ground or ritual area like those used by the Indians of the Great Basin of the western United States. There were also oval concentrations of stone tools and fire-cracked rocks, which may indicate ephemeral shelters or huts of some kind. Scattered among them were areas for tool manufacturing, including some where flat river pebbles had been drilled as pendants. Gheo-Shih, which probably dates somewhere in the period 5000–3000 B.C., provides a glimpse of the kind of open-air encampment that could be the ancestor of the earliest Mesoamerican villages.

FURTHER READINGS

Flannery K. V., and J. Marcus. 1983. *The Cloud People.* New York: Academic Press.

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SEE ALSO

Oaxaca and Tehuantepec Region

Gibson, Charles (1920–1985)

Perspectives, methods, and scholarly standards of the American ethnohistorian Charles Gibson shaped subsequent research on Indian and colonial societies of Latin America. Gibson (Ph.D., History, Yale University, 1950) welded primary documents from Mexican and Spanish archives into his monumental book, *The Aztecs Under Spanish Rule,* an account of the Valley of Mexico's indigenous peoples in the Colonial period. Its topics include society; town political organization, taxation, and finances; Spanish colonial *encomiendas;* religious institutions; labor; land and agriculture; production and exchange; and the city of Mexico during the years 1519–1810. One of Gibson's major contributions to community studies is *Tlaxcala in the Sixteenth Century.* His investigations of colonial institutions provided new insights into pre-Columbian practices; these studies include "Llamamiento General, Repartamiento, and the Empire of Acolhuacan" and "The Structure of the Aztec Empire." Gibson's "Survey of Prose Manuscripts in the Native Historical Tradition" and, with John Glass, "Census of Middle American Prose Manuscripts in the Native Historical Tradition" are important bibliographic tools for students and scholars of all levels of expertise.

FURTHER READINGS

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SEE ALSO

Ethnohistorical Sources and Methods

Grillo, El (Jalisco, Mexico)

Situated in the Atemajac Valley on the northern outskirts of Guadalajara, this site's surface remains and salvage