Table 1.--Outline of geologic history of the Monument Valley area, Arizona.

System	Group	Formation	Member	Event
				Post-Morrison interval
				As deposits of Eocene age are extensively exposed elsewhere on the Colorado Plateau, sedimentary deposition probably continued at least until the close of the Eocene. South of the Monument Valley area the Cretaceous rocks forming Black Mesa (fig. 1) have been folded. Evidence for the late Cretaceous-early Tertiary age of this folding is the presence of undeformed Eocene strata which lie across eroded older folded rocks. Exposures of this nature are near Escalante, Utah (Gregory and Moore, 1931, p. 117-124), and at the north end of the Waterpocket fold (Dutton, 1880, p. 286-295). Hunt (1953, p. 209) suggests that the Monument upwarp was also formed at this time. The laccolithic mountains in Utah and Arizona were probably intruded in mid-Tertiary time before great progress had been made in the dissection of their cover (Hunt, 1953, p. 212). Active dissection probably began at the close of the Eocene as a result of epeirogenic uplift and has continued uninterrupted to this day. All perennial streams of the region have been superimposed upon older strata. On the basis of included xenoliths, the igneous rocks exposed in the Monument Valley area were intruded at least after the Mancos shale of late Cretaceous age was deposited. Intrusive relations elsewhere, however, have convinced Williams (1936, p. 148) that the age of these intrusives is Pliocene.
				UNCONFORMITY
Jurassic	San Rafael group	Morrison formation	Salt Wash sandstone	The major source area that produced most of the sediments forming the Salt Wash member of the Morrison formation lay west of the Monument Valley area in west-central Arizona (Craig and others, 1955). Streams flowed northward and eastward from this source area and deposited clastic sediments in the shape of a broad thin alluvial fan. The Monument Valley area was covered by these sediments. As these streams lost velocity a period of deposition by relatively quiet waters began and siltstones and claystones were deposited to form the Brushy Basin member of the Morrison formation.
			Brushy Basin shale	
		Bluff sandstone		On the final northward withdrawal of the Carmel sea, eolian sands and silt derived principally from a local source mingled with the uppermost red sediments of the Summerville. Gradually wind-worked sands prevailed and a large wedge-shaped mass of sandstone was deposited with its thickest part near Bluff, Utah, and its southern edge in the Monument Valley area, Arizona.
		Summerville formation		The second advance of the Carmel sea from the north into the Monument Valley area buried and truncated the eolian crossbedded sandstones of the Entrada (Baker, Dane, and Reeside, 1936, p. 54). Sediments deposited by these marine waters consist of orangish- to reddish-brown thin-bedded sandstones with some intercalated siltstone lenses that together form the Summerville formation. The Monument Valley area once again was at or near the southern margin of this sea. Probably the Summerville was deposited under shallow quiet waters and near an oscillating shoreline that locally withdrew and exposed small areas to subaerial deposition and erosion.
		Entrada sandstone		With the temporary withdrawal of this marine sea to the north, a surface of low relief was exposed upon which the basal sandstones of the Entrada were deposited. The sediments of the Entrada seem to have been deposited under arid climatic conditions in part by eolian and in part by subaqueous action. The dominant source area of the material was to the northwest (Baker, Dane, and Reeside, 1936, p. 46) although the Navajo highland may have supplied some sediments from the south (Smith, C. T., 1951, p. 100).
		Carmel formation		The eolian deposition characteristic of the Navajo was ended by an extensive marine sea (i.e., the Carmel sea) which invaded the Monument Valley area from the northwest and deposited the red siltstones and fine-grained sandstones of the Carmel (Baker, Dane, and Reeside, 1936, p. 54). The Monument Valley area was probably at or near the very southernmost extent of this sea. This is indicated by the alternating beds of sandstone and siltstone, the sand-filled mud cracks, and the current-type ripple marks, all of which suggest deposition in marginal marine waters that were locally exposed to subaerial erosion.
				UNCONFORMITY
Jurassic and Jurassic (?)		Navajo sandstone		As the streams that deposited the Kayenta waned, eolian conditions prevailed and the tangentially crossbedded sandstones of the Navajo were deposited. The sediments seem to come from the northwest (Stewart and others, in preparation)_/, although Baker, Dane, and Reeside (1936, p. 53) suggest that the source of the Navajo was from the southwest. Near the end of this episode of eolian deposition, local lacustrine conditions prevailed and dense unfossiliferous gray limestone lenses in uppermost Navajo strata indicate the presence of ephemal fresh water playa lakes.
Jurassic (?)	Glen Canyon group	Kayenta formation		The eolian sandstones of the Wingate grade into the fluviatile deposits of the Kayenta. The Kayenta consists predominantly of conglomerates, coarse crossbedded conglomeratic sandstones, and lenses of mud-pebble conglomerate, all indicative of deposition by turbulent streams. Intercalated shale lenses suggest periods of relatively quiet deposition. The material was derived predominantly from the north and northeast (Stewart and others, in preparation)_/ although local variations in the direction of crossbedding in the sedimentary units suggest that stream directions were not constant.
		Wingate sandstone		The Wingate is an eolian deposit near the center of its basin of deposition; near its margins, however, Baker, Dane, and Reeside, (1936, p. 53) consider the deposits of the Wingate to represent the commingling of water-worked and wind-worked material. Near the close of Chinle time a new positive element, known as the Navajo highland, began to rise in central Arizona south of the Monument Valley area. This highland may have furnished some of the sediments for the Church Rock member of the Chinle but apparently did not furnish any for the Glen Canyon group (Smith, C. T., 1951, p. 91). The highland served principally to confine deposition to the north. Continental conditions prevailed during formation of the Glen Canyon group and most of the sediments were derived from the northwest and probably from the same source area (Stewart and others, in preparation)_/. The Monument Valley area is at about the center of the basin in which Glen Canyon group sediments were deposited.
Triassic		Chinle formation	Church Rock member	As the northward-flowing streams lost velocity, the depositional environment changed to one marked by nearly continuous quiet water sedimentation. The conglomerates and crossbedded sandstones of the Monitor Butte member represent the final stages of this episode of turbulent fluviatile deposition. The siltstones and claystones of the Petrified Forest member denote a long period of continuous deposition by quiet waters. Near the close of this episode of quiet fluviatile deposition, lacustrine conditions set in and local fresh water playa lakes were formed. Their sites are now marked by the limestones characteristic of the Owl Rock member. Arid conditions were dominant at the close of Chinle time and the red fluvially deposited siltstones of the Church Rock member were locally reworked by winds. Northward-flowing streams heading in this newly uplifted highland began to deposit coarse clastics over most of northeastern Arizona and southeastern Utah in the form of a broad thin sheet of gravel. This extensive gravel deposit is the Shinarump member of the Chinle formation. The amount of time represented by the unconformity between the Moenkopi-Shinarump is difficult to determine. McKee (1951a, p. 88) suggests that the time involved was considerable. In the Monument Valley area, it would seem that the period was of relatively short duration, and that the streams flowed across a Moenkopi surface that was only partly indurated.
			Owl Rock member	
			Petrified Forest member	
			Monitor Butte member	
			Shinarump member	
				UNCONFORMITY
		Moenkopi formation		The shoreline of this western sea changed continuously, locally inundating and then exposing certain areas (McKee, 1954, p. 78). Most of the sediments that form the Moenkopi were deposited under these shallow water conditions. In places lagoons and playa lakes were formed (McKee, 1954, p. 79). Deltalike deposits were built on this sloping plain by westward-flowing rivers and in time these were buried by a renewed advance of the sea. With the complete westward withdrawal of the sea a period of subaerial erosion began. The surface of the Moenkopi was dissected into a series of broad shallow elongate swales and ridges. During this time, extensive uplift began in central and southern Arizona and probably continued throughout late Triassic (McKee, 1951b, p. 493).
Permian		Cutler formation	Hoskinnini tongue	According to Baker and Reeside (1929, p. 1446) the first red beds of the Cutler formation, represented by the Halgaito, were deposited by westward-flowing streams which headed in a highland mass in western Colorado. These sediments, deposited under arid climatic conditions, are coarse near their source and finer grained to the west. These red beds were displaced by the light orange-colored Cedar Mesa sediments which were probably brought in from the northwest by streams and then modified by eolian action. As the westward-flowing streams regained the initiative, a second period of red bed deposition began, represented by the Organ Rock. These rapidly buried the Cedar Mesa sediments. This second sequence of red beds was interrupted by the sands that form the DeChelly sandstone. Probably these were also derived from the
			DeChelly sandstone member	
			Organ Rock tongue	
			Cedar Mesa sandstone member	