Stratigraphic Nomenclature for the Upper Devonian and Lower Mississippian(?) Kanayut Conglomerate, Brooks Range, Alaska

U.S. GEOLOGICAL SURVEY BULLETIN 1529—A

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By TOR H. NILSEN *and* THOMAS E. MOORE

CONTRIBUTIONS TO STRATIGRAPHY

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A description and redefinition of the Kanayut Conglomerate in terms of three fluvial members

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CONTRIBUTIONS TO STRATIGRAPHY

STRATIGRAPHIC NOMENCLATURE FOR THE UPPER DEVONIAN AND LOWER MISSISSIPPIAN(?) KANAYUT CONGLOMERATE, BROOKS RANGE, ALASKA

By TOR H. NILSEN *and* THOMAS E. MOORE

ABSTRACT

The Kanayut Conglomerate, of Late Devonian and Early Mississippian(?) age, is one of the thickest and most laterally extensive stratigraphic units of the Brooks Range, northern Alaska. It is a coarse-grained clastic unit, as thick as 3,000 m, that extends for about 950 km along the length of the range from near the Alaska-Yukon Territory border to near the coast of the Chukchi Sea. The Kanayut forms the middle part of a large, dominantly fluvial delta that prograded southwestward over marine strata of the Noatak Sandstone and the Hunt Fork Shale, retreated, and was then overlapped by marine strata of the Kayak Shale. The Kanayut Conglomerate now crops out in a series of thrust plates that are thought to have been transported northward during a Mesozoic orogeny.

The Kanayut Conglomerate was previously divided into one formal and three informal members consisting of both marine and nonmarine deposits. We herein redefine (stratigraphically restrict) the Kanayut Conglomerate to consist of three formal members, each of which is almost wholly fluvial in origin. We consider the informal marine basal sandstone member, heretofore assigned to the Kanayut Conglomerate, to be equivalent to the marine Noatak Sandstone of the western Brooks Range, and we here apply that name to it. Thus restricted, the Kanayut Conglomerate consists, in ascending order, of: the Ear Peak Member (new name), a sequence of fining-upward fluvial cycles of conglomerate, sandstone, and shale, as thick as 1,160 m, thought to have been deposited chiefly by meandering streams; the Shainin Lake Member (new name), a sequence of fining-upward couplets of conglomerate and sandstone, as thick as 530 m, thought to have been deposited by braided streams; and the previously named—and herein redefined (stratigraphically extended)—Stuver Member, a sequence of fining-upward fluvial cycles of conglomerate, sandstone, and shale, as thick as 1,300 m, thought to have been deposited chiefly by meandering streams. These three fluvial members have been traced across most of the eastern and central Brooks Range. Where the more resistant Shainin Lake Member pinches out in the western Brooks Range, the Kanayut Conglomerate is undivided.

INTRODUCTION

The Kanayut Conglomerate is one of the major stratigraphic units of northern Alaska. The Kanayut crops out in the Brooks Range over an east-west distance of about 900 km and a north-south distance of about 65 km (fig. 1). It was originally defined by Bowsher and Dutro (1957) for exposures in the Shainin Lake area (fig. 2), where the upper part of the unit was formally designated the "Stuver Member." A variety of informal names and stratigraphic terms have been applied to the Kanayut Conglomerate since 1957, on the basis of mapping by various geologists in different areas. Our studies of the stratigraphy and sedimentology of the Kanayut Conglomerate in the Brooks Range since 1978 have been concentrated in the central and eastern areas. In this report we propose a formal stratigraphic nomenclature for the different parts of the Kanayut by defining two new members. Our nomenclatural scheme is based primarily on studies of lateral and vertical stratigraphic relations by the measurement of sections in the field.

The middle Paleozoic rocks of the Brooks Range form a thick clastic sequence that conformably overlies and is conformably overlain by platform carbonate rocks. Tailleur and others (1967) designated the lower carbonate sequence the "Baird Group," presently regarded as Silurian to Late Devonian in age, and the clastic sequence the "Endicott Group," currently regarded as Late Devonian and Early and Late Mississippian in age. Bowsher and Dutro (1957) had previously designated the upper carbonate sequence the "Lisburne Group," which is presently considered to be Mississippian and Pennsylvanian in age.

The Endicott Group, as defined by Tailleur and others (1967), consists of a succession of shale, sandstone, and conglomerate in the central Brooks Range that includes, in ascending order: the Hunt Fork Shale, the Kanayut Conglomerate, and the Kayak Shale. In the western Brooks Range, Dutro (1952, 1953a, b) recognized the Noatak Sandstone as the coarse clastic unit of the Endicott Group and correlated it with the Kanayut Conglomerate. In the northeastern Brooks Range, in the subsurface beneath the North Slope (fig. 2), and along the south margin of the Brooks Range, the Endicott Group consists of the Kekiktuk Conglomerate and the Kayak Shale (Brosgé and others, 1962) and the Itkilyariak Formation (Mull and Mangus, 1972). The Kekiktuk Conglomerate and the Kayak Shale along the south edge of the Brooks Range are in part metasedimentary (Mayfield and Tailleur, 1978; Nelson and Grybeck, 1980). In the southeastern Brooks Range, Dutro and others (1979) mapped and described the Upper Devonian (Frasnian) marine Beaucoup Formation, a mixed clastic and carbonate unit that they concluded conformably underlies the Hunt Fork Shale and disconformably overlies

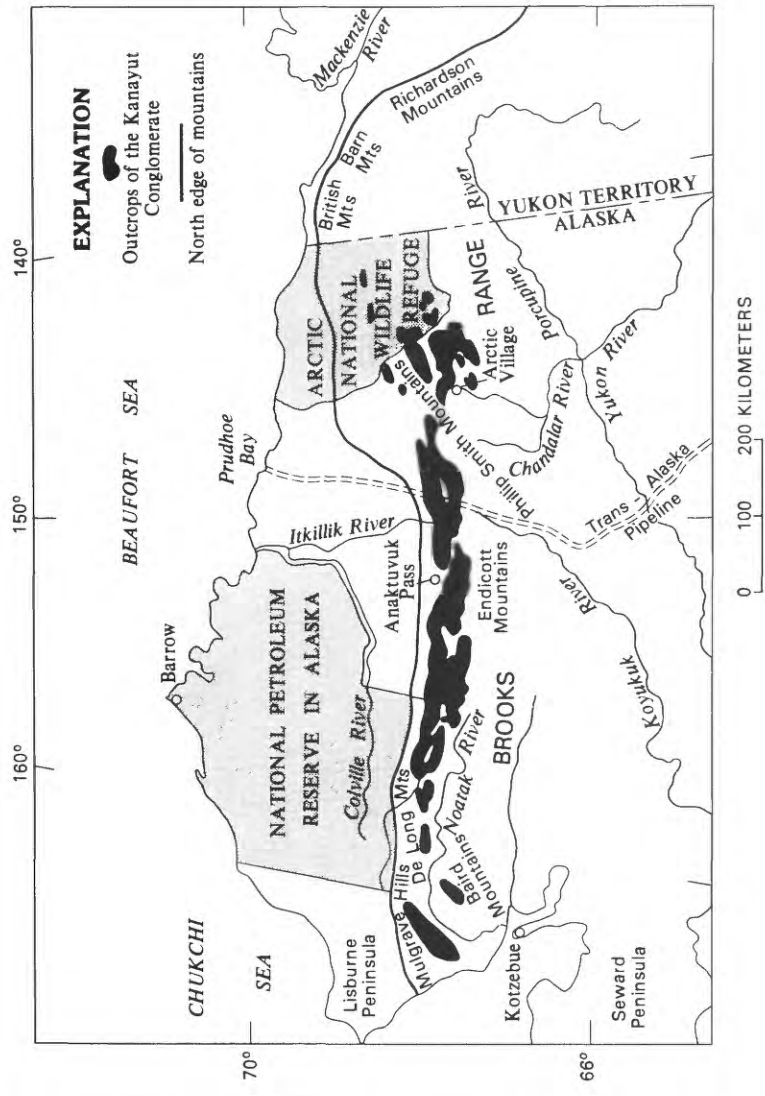

FIGURE 1.—Northern Alaska, showing outcrops of the Kanayut Conglomerate and major geographic features.

platform carbonate rocks of the Baird Group. The Beaucoup Formation, however, is not included in the Endicott Group.

The clastic units of the Endicott Group form two distinct sequences whose original spatial juxtaposition is uncertain (Tailleur and others, 1967, p. 1359; Mull and Tailleur, 1977; Nilsen, 1981). The first sequence is wholly allochthonous and consists of a conformable sequence of the Hunt Fork Shale, the Kanayut Conglomerate, and the Kayak Shale (fig. 3). The second sequence is autochthonous or parautochthonous and consists of the Kekiktuk Conglomerate, the

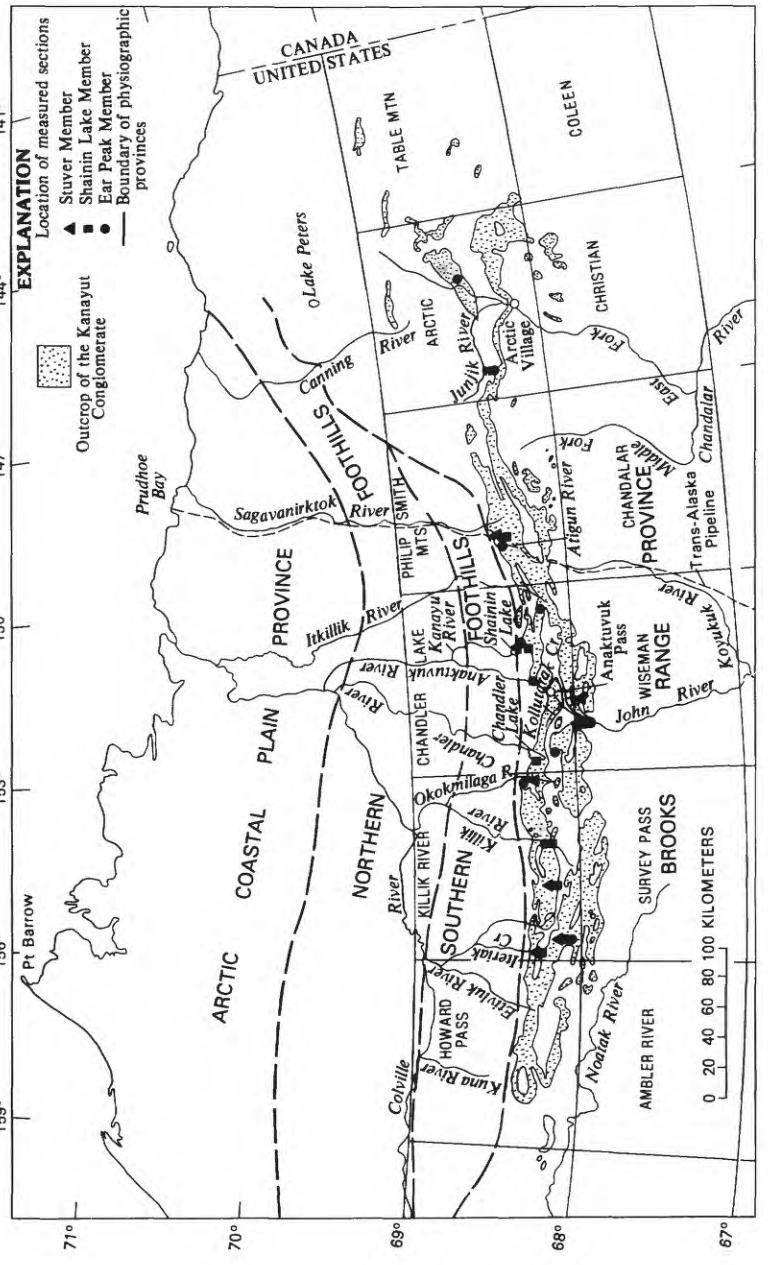

FIGURE 2.—Index map of central and eastern Brooks Range, showing locations of outcrops of the Kanayut Conglomerate.

Kayak Shale, and, locally, the Itkilyariak Formation (fig. 3). The autochthonous sequence rests unconformably on deformed pre-Late Devonian metasedimentary and metavolcanic rocks and Ordovician and

Middle Devonian granitic intrusive rocks. This report addresses the stratigraphic subdivision of the allochthonous Kanayut Conglomerate and is not concerned with the stratigraphic nomenclature of the autochthonous sequence.

The Kanayut Conglomerate has been considered Late Devonian by most earlier workers (fig. 4). The unit contains abundant plant fossils, chiefly in its lower and upper parts, that are Late Devonian (Bowsher and Dutro, 1957; Porter, 1966). At one locality in the Wiseman quadrangle, the Kanayut contains Late Devonian brachiopods in a marine tongue near its top (J. T. Dutro, Jr., oral commun., 1981). At some localities, however, the Stuver Member of the Kanayut also contains some plant fossils of probable Early Mississippian age (S. H. Mamay, written commun., 1980). We therefore consider the Stuver, as well as

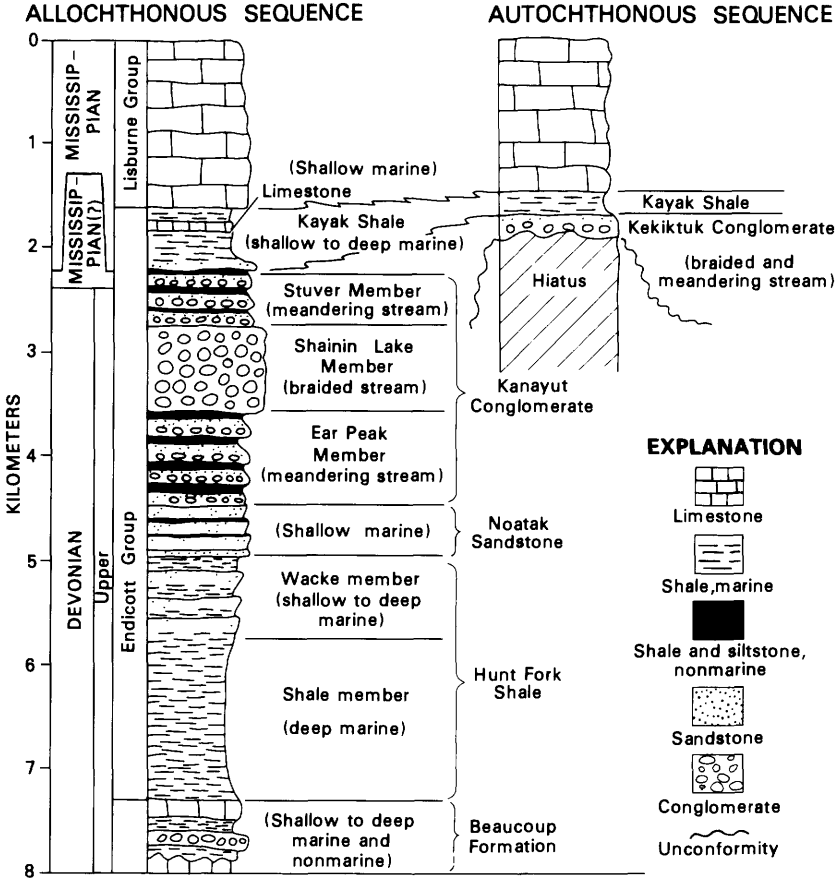

FIGURE 3.—Simplified columnar sections showing stratigraphic nomenclature of allochthonous and autochthonous sequences of the Endicott Group.

the Kanayut, to be Late Devonian and Early Mississippian(?) in age. The oldest marine fossils from the overlying Kayak Shale are Kinderhookian but not earliest Kinderhookian, an age permitting the uppermost part of the Kanayut to be Early Mississippian. The uppermost part of the Kanayut Conglomerate in the western Brooks Range is

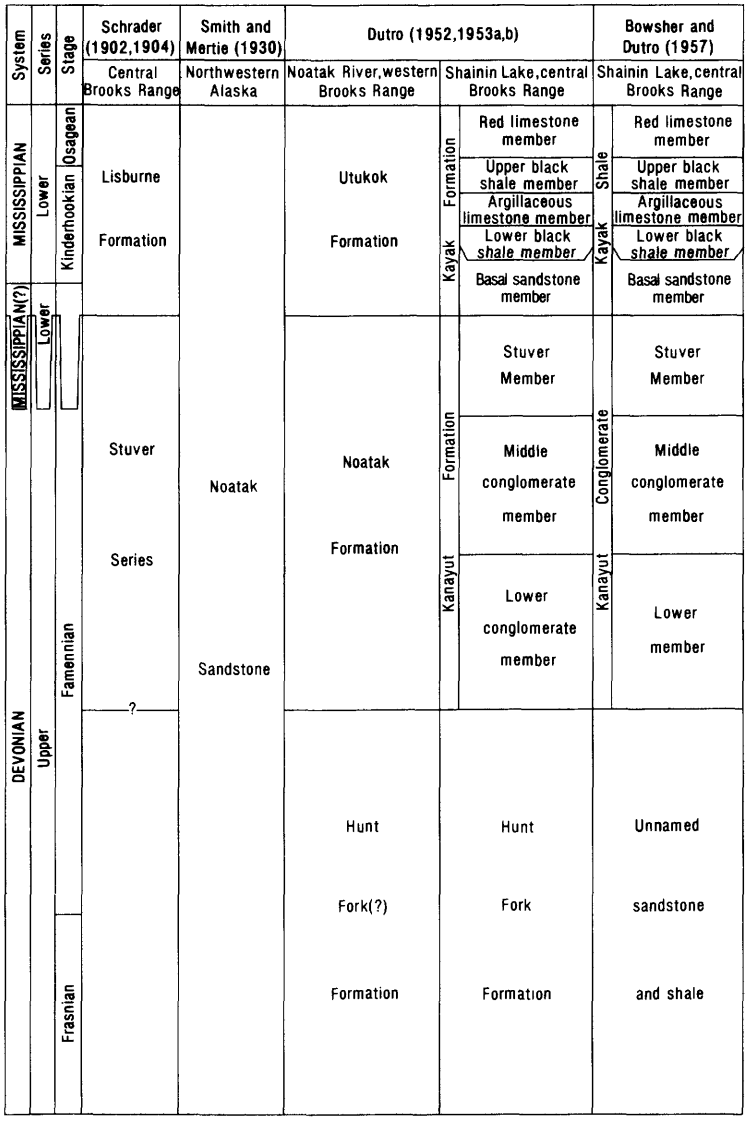

FIGURE 4.—Historical development of stratigraphy and age assignments of the Kanayut Conglomerate and associated units of allochthonous sequence of the Endicott Group.

thought to be Early Mississippian in age (I. L. Tailleur, written commun., 1982). Marine megafossils from the underlying Hunt Fork Shale and Noatak Sandstone are Frasnian (early Late Devonian) and Famennian (late Late Devonian). These ages restrict the nonmarine part of the Kanayut to the late Famennian and early Kinderhookian(?).

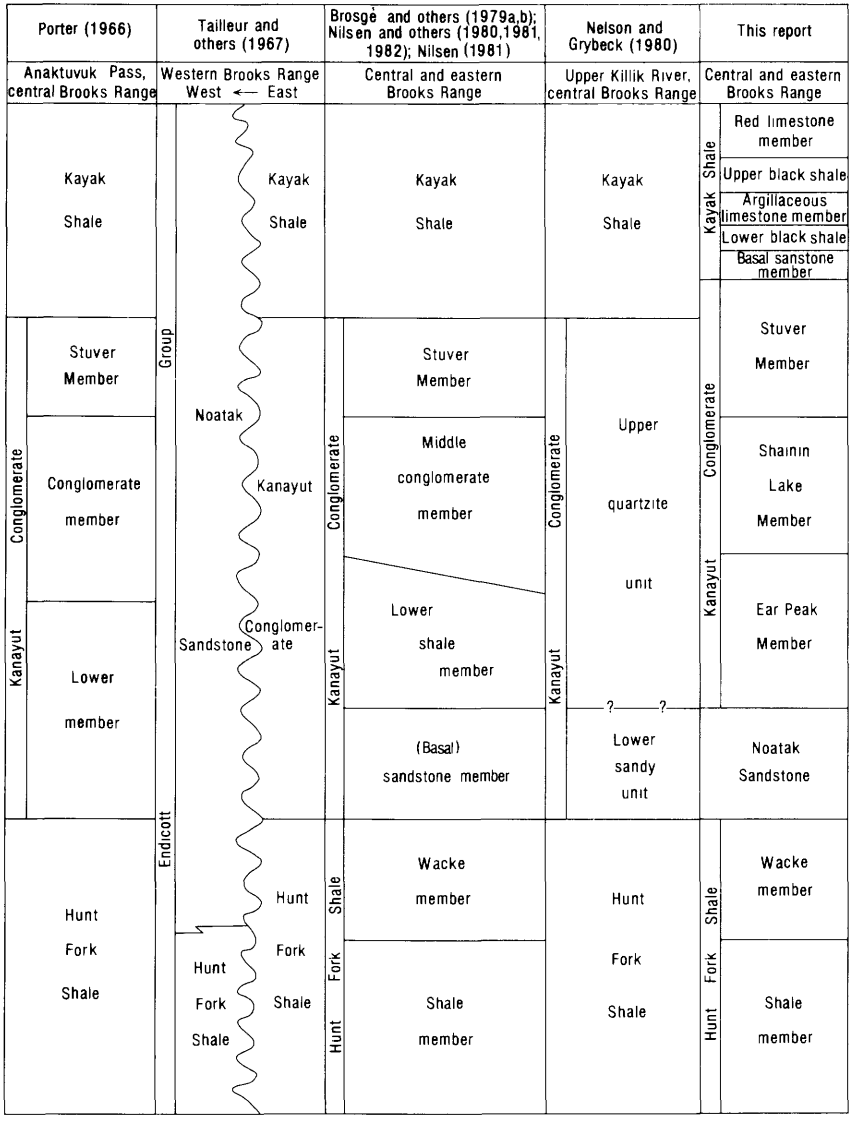

FIGURE 4.—Continued

PREVIOUS WORK

Strata of the "Stuver series," later incorporated within the Kanayut Conglomerate, were first described by Schrader (1902, p. 240; 1904, p. 60-62). He noted chiefly a very hard silica-cemented conglomerate that contained interbeds of quartzite and included some shale at the top. The conglomerate clasts, as large as small boulders, were described as consisting chiefly of chert and white quartz. Schrader (1904, p. 62) reported an exposed thickness of at least 600 m.

Smith and Mertie (1930, p. 155) included these strata within the Noatak Sandstone. Dutro (1952, 1953a, b) separated his Kanayut "formation" from the Noatak Sandstone as a mappable unit, although he recognized that his redefined Noatak Sandstone in the western Brooks Range was correlative with the redefined Kanayut "formation" in the central Brooks Range. J. T. Dutro, Jr., and A. L. Bowsher (in Dutro, 1952, app. G) measured a section of the Kanayut that was 1,150 m thick in the Kanayut Lake (later renamed "Shainin Lake") area, and Patton and others (1951, p. 5) measured a second section 1,450 m thick along the Okokmilaga River.

Dutro (1952), on the basis of fieldwork by A. L. Bowsher and himself, described three members of the Kanayut "formation" in the Shainin Lake area: (1) the lower conglomerate member, chiefly conglomerate containing thin beds of sandstone, about 485 m thick; (2) the middle conglomerate member, almost all conglomerate, about 310 m thick; and (3) the Stuver Member, consisting of interbedded quartzite, conglomerate, and shale, as thick as 310 m. The Stuver Member corresponded to the "Stuver series" as described by Schrader (1902, 1904).

Bowsher and Dutro (1957) defined three nonmarine members of the Kanayut Conglomerate in the Shainin Lake area, in ascending order: the lower member, the middle conglomerate member, and the Stuver Member. The lower member was measured, but not described, in a section north of Ear Peak. A type section for the informally named middle conglomerate member was measured along the east side of Alapah Creek, about 12 km southeast of Shainin Lake. The type locality for the Stuver Member was designated, and a section measured, along a ridgecrest southeast of Shainin Lake.

Porter (1966), working in the Anaktuvuk Pass area, recognized a fourth and lowest member of chiefly marine sandstone that is absent in the Shainin Lake area. Porter (1966) tentatively correlated this unit with the lower member of Bowsher and Dutro (1957). In preliminary regional maps of the Philip Smith Mountains area (Brosgé and others, 1979a) and the area between the Killik River and the Trans-Alaska Pipeline (Brosgé and others, 1979b), the Kanayut Conglomerate was

divided into these four previously described members. Porter's (1966) lowest, partly marine unit was informally designated the "basal sandstone member," and the three nonmarine units were designated the "lower shale member," the "middle conglomerate member," and the "Stuver Member."

Stratigraphic and sedimentologic studies of the Kanayut Conglomerate and related stratigraphic units of the Endicott Group in the central and eastern Brooks Range from 1978 to 1980 were summarized by Nilsen and others (1980, 1981) in a series of reports covering the results from each field season. These reports include numerous measured sections of the various units of the Kanayut Conglomerate in the eastern and central Brooks Range. The Kanayut in these reports is divided into the four members of Brosgé and others (1979a).

Nelson and Grybeck (1980), mapping in the upper Killik River area (Survey Pass quadrangle), divided the Kanayut Conglomerate into a lower or undifferentiated sandy unit and an upper or quartzitic unit. We infer, on the basis of our stratigraphic work, that the lower, sandy unit is equivalent to Porter's (1966) lowest member of the Kanayut (basal marine sandstone member of Brosgé and others, 1979a) and that the upper, quartzitic unit represents the undivided upper three nonmarine members.

W. P. Brosgé and others (unpub. data, 1982) have mapped at a scale of 1:500,000 the distribution of various mappable units of the Kanayut Conglomerate across the central and eastern Brooks Range. They have restricted the Kanayut Conglomerate to the upper three nonmarine units and have designated the marine basal sandstone member the "Noatak Sandstone," with which it is correlative and into which it can be traced westward.

In the western Brooks Range, Mayfield and Tailleur (1978) and Mayfield and others (1978) mapped the Kanayut Conglomerate as part of the Endicott Group. Our preliminary (1981) work in the DeLong Mountains, western Brooks Range, indicates the presence of the Kanayut Conglomerate as far west as the Mulgrave Hills, adjacent to the coast of the Chukchi Sea, where it conformably overlies the Noatak Sandstone and is conformably overlain by the Kayak Shale (Nilsen and Moore, 1982). In this area, however, the members of the Kanayut are not readily distinguishable.

In this report, we adopt the stratigraphic restriction of the Kanayut Conglomerate to its three nonmarine members; additionally, we formally propose names and type sections for the heretofore informal, lower two members. The lower shale member (lower member of Bowsher and Dutro, 1957) is here formally named the "Ear Peak Member," and the middle conglomerate member the "Shainin Lake Member." Together with the previously designated Stuver Member, the

type sections of all three members are near Shainin Lake in the north-central Brooks Range (fig. 5). The Kanayut River, for which the Kanayut Conglomerate was named, flows northward from Shainin Lake, which forms its source. The previous lowermost member of the Kanayut, heretofore referred to as the (basal marine) "sandstone member" by Brosgé and others (1979a, b), Nilsen and others (1980, 1981), and Nilsen (1981), is here reassigned to the Noatak Sandstone.

NOATAK SANDSTONE

The type area of the Noatak Sandstone is in the south-central De-Long Mountains of the western Brooks Range, along the Nimiuktuk River, north of its confluence with the Noatak River (Dutro, 1952, 1953a, b). The Noatak "formation" was first described by Smith (1913, p. 70) for exposures of mainly sandstone along the Noatak River. Smith and Mertie (1930, p. 165) expanded this definition to include all the middle Paleozoic clastic rocks above the Skajit Limestone and below the Lisburne Group in northwestern Alaska.

The Noatak Sandstone, as defined by Dutro (1952, 1953a, b), is 215 to 305 m thick in the type area, although a thickness of as much as 1,000 m was reported in other parts of the western Brooks Range (Tailleur and others, 1967, p. 1355). In its type area, the Noatak consists chiefly of sandstone, and minor amounts of shale and conglomerate. Dutro (1952, p. 7) reported that the rock has mainly a siliceous cement except at the top of the unit, where it is partly calcareous. On weathered surfaces, alteration of iron minerals to limonite results in a typical reddish-brown color. Large- and small-scale cross-strata are common in the sandstone. Dutro (1952) reported a conglomerate-clast composition of approximately 75 percent vein quartz, 15 percent medium- to dark-gray chert, and 10 percent slate and phyllite.

In its type area, the Noatak Sandstone rests conformably on shale and fine-grained sandstone of the Hunt Fork Shale and is overlain conformably by the Utukok Formation. Marine fossils from the underlying Hunt Fork Shale and the overlying Utukok Formation, as well as from the Noatak itself, suggest a Late Devonian and Early Mississippian age for the Noatak Sandstone. Dutro (1952, 1953b) correlated the Noatak Sandstone with the Kanayut Conglomerate to the east. More recent mapping by the U.S. Geological Survey in the type area of the Noatak Sandstone indicates the presence of a stratigraphic sequence that consists of the Hunt Fork Shale, the undivided Noatak Sandstone and Kanayut Conglomerate, the Kayak Shale, and the Utukok Forma-

tion (C. F. Mayfield, oral commun., 1982). The Utukok Formation, about 215 m thick, consists mainly of sandstone and limestone, with some gray to black shale near its base (Dutro, 1952, 1953b). The Utukok crops out in the western Brooks Range and is a part of the Lisburne Group (Tailleur and others, 1967). Dutro (1952, fig. 1) considered the Utukok Formation to be correlative with the Kayak Shale of the central and eastern Brooks Range.

The Noatak Sandstone of the central and eastern Brooks Range, previously referred to as the basal sandstone member of the Kanayut Conglomerate, is a laterally discontinuous unit that gradationally overlies the Hunt Fork Shale and is gradationally overlain by and laterally interfingers with the Ear Peak Member of the Kanayut Conglomerate. Where present, the Noatak varies in thickness from 90 to 560 m (Nilsen and others, 1980). It locally contains middle Famennian (late Late Devonian) shallow-marine megafossils in this area (Nilsen and others, 1980). These megafossils, which include brachiopods, gastropods, pelecypods, and echinoderm debris, indicate deposition in shelf, intertidal, lagoonal, and marginal-marine settings. Various types of marine trace fossils are locally present, including *Skolithos*.

In the central and eastern Brooks Range, the Noatak Sandstone consists chiefly of medium-bedded cross-stratified fine- to medium-grained quartzose sandstone that is locally conglomeratic, containing pebbles as long as several centimeters. The rock typically has a calcareous cement and weathers light gray to light brown. It characteristically forms bundles or packages of sandstone as thick as 15 m that are intercalated within red, brownish-gray, and black shale. These sandstone bundles most typically thicken and coarsen upward; we interpret them to represent various types of shelf and shoreline accumulations of sand, probably related to shoreline progradation, although we have not studied them in detail. Varying paleocurrent orientations indicate the divergence of shelf and shoreline current patterns.

We have not measured any complete sections of the Noatak Sandstone in the central and eastern Brooks Range—only the upper part of it adjacent to its contact with the Ear Peak Member of the Kanayut Conglomerate (Nilsen and others, 1980, 1981, 1982). In the westernmost Brooks Range, in the Mulgrave Hills and the western De-Long Mountains, it interfingers with and is overlain gradationally by the lower part of the Kanayut Conglomerate (Nilsen and Moore, 1982). In the type section of the Noatak Sandstone along the Nimiuktuk River, I. L. Tailleur (written commun., 1982) concludes that the Kanayut Conglomerate pinches out and is both underlain and overlain by the Noatak Sandstone. However, we have not seen the type section of the Noatak and thus cannot verify this suggested relation.

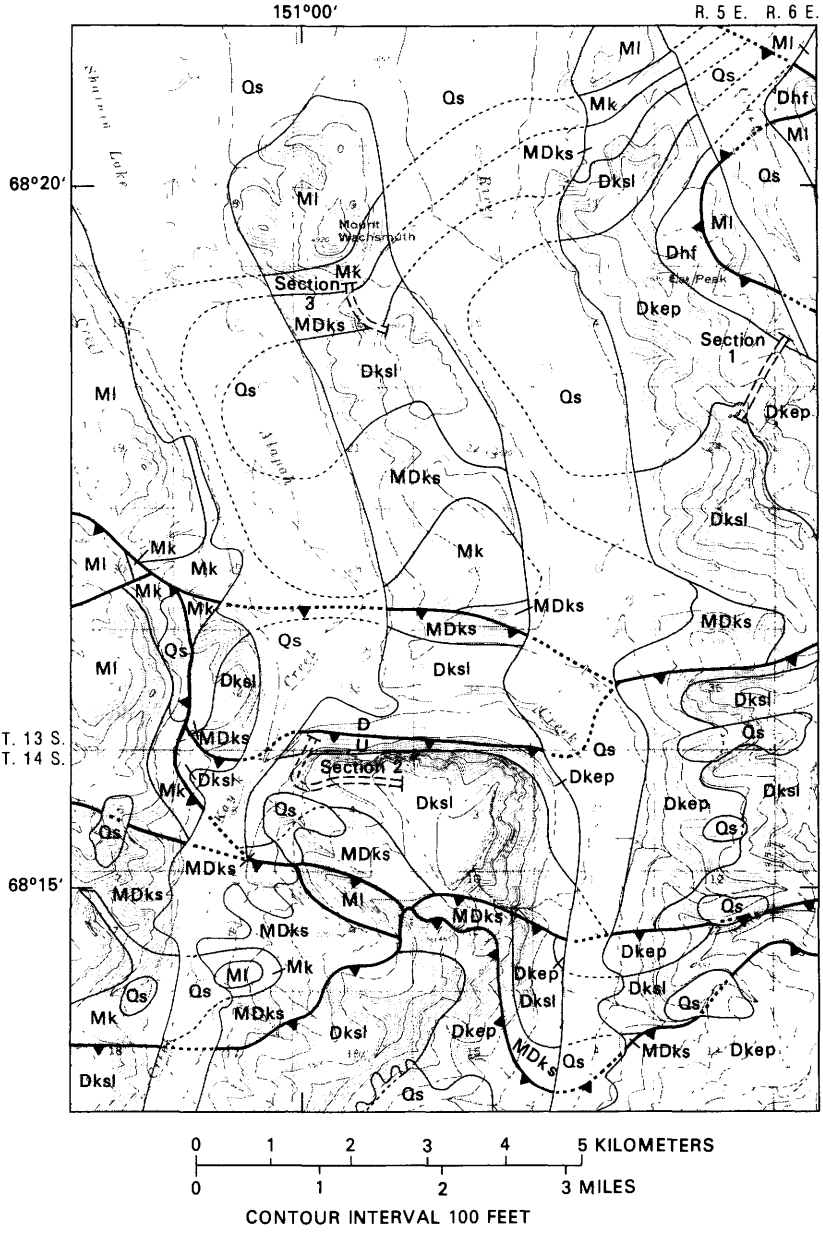

FIGURE 5.—Simplified geologic map showing locations of measured type sections of members of the Kanayut Conglomerate. Section 1 is type section of the Ear Peak Member, section 2 of the Shainin Lake Member, and section 3 of the Stuver Member. Geology modified from Bowsher and Dutro (1957), W. P. Brosge (unpub. data, 1976-80), and Hamilton (1979). Base from 1:63,360-scale Chandler Lake A-2 and B-2 quadrangle maps.

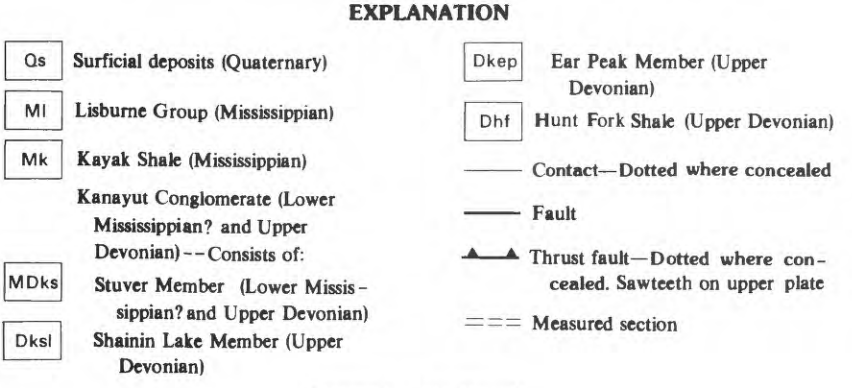

FIGURE 5.—Continued

KANAYUT CONGLOMERATE

REGIONAL FRAMEWORK

Outcrops of the Kanayut Conglomerate generally form ridges that are marked by prominent ribs or resistant ledges of conglomerate and sandstone, separated by less resistant covered recesses underlain by siltstone and shale (fig. 6). These ledges are thought to record individual fining-upward depositional cycles within the Kanayut, in which the coarser grained lower strata represent channel fills and the finer grained upper strata represent flood plains. In several localities, thick sections of the Kanayut that contain all three members form extensive upland ridges marked by alternating resistant and less resistant bands (fig. 7).

The lithology of the Kanayut Conglomerate changes markedly from east to west and from north to south in the Brooks Range. The most conspicuous changes toward the south and west are gradual thinning of the entire unit and each of its members, gradual fining of the conglomerate-clast sizes in the entire unit and each of its members, increasing number and thickness of beds of intercalated marine strata, and pinchout of the Shainin Lake Member as a recognizable, mappable stratigraphic unit (fig. 8).

In the central and eastern Brooks Range, the three members of the Kanayut Conglomerate can generally be readily distinguished and mapped (Brosgé and others, 1979a, b; W. P. Brosgé and others, unpub. data, 1982). Because the Shainin Lake Member pinches out southward, however, the three members cannot everywhere be distinguished in the southernmost outcrops of the unit in the central and eastern

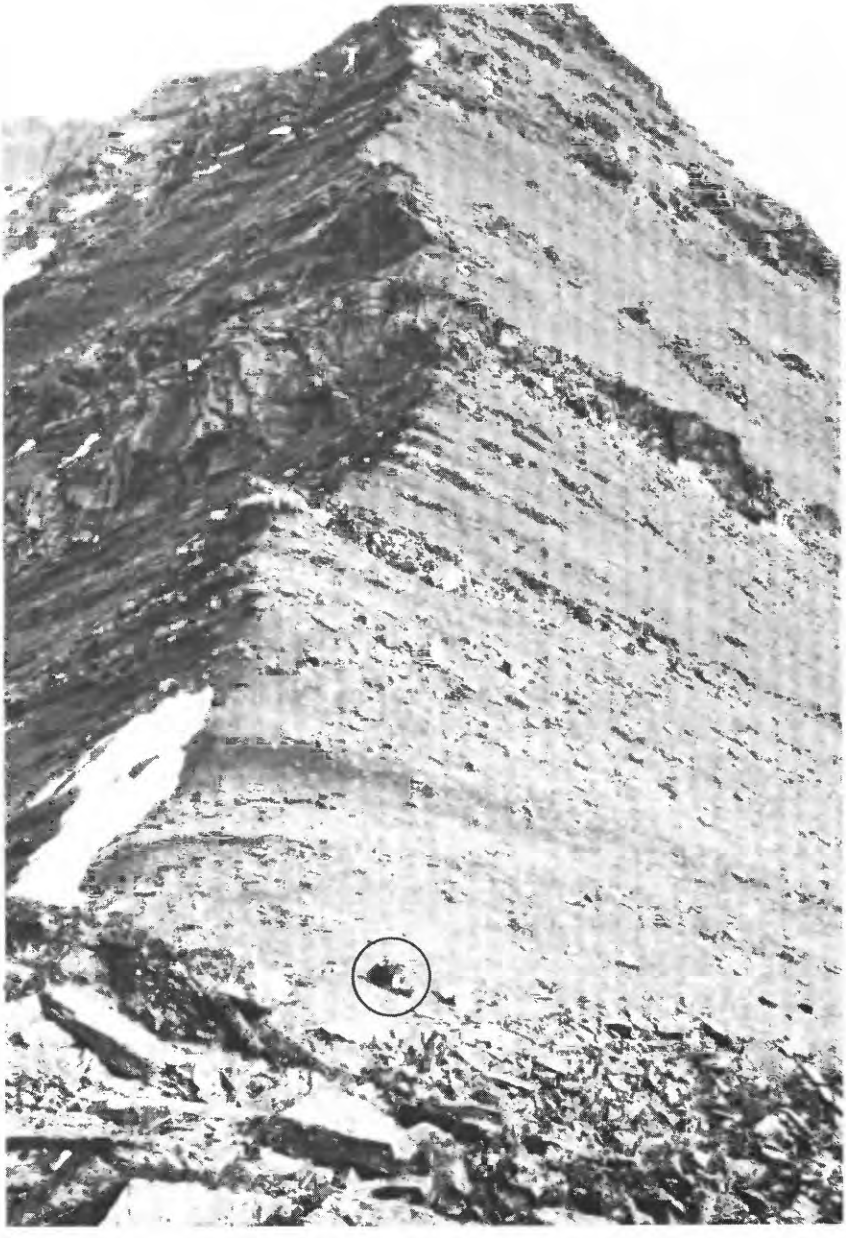

FIGURE 6.—Typical outcrops of the Stuver Member of the Kanayut Conglomerate, showing alternating resistant coarse-grained fluvial-channel deposits and less resistant fine-grained flood-plain deposits east of the Atigun River, central Brooks Range. Backpack (circled) at lower center provides scale.

Brooks Range, which form the structurally highest thrust slices. In the western Brooks Range, west of the Survey Pass quadrangle, the Shainin Lake Member pinches out and is generally not definable as a distinct member. Thus, the three members of the Kanayut cannot be distinguished and have not been mapped west and south of the pinchout of the Shainin Lake Member (fig. 8).

Because of its allochthonous nature, the original lateral contacts and facies boundaries of the Kanayut Conglomerate around the margins of its basin remain uncertain. To the north and east, the Kanayut probably passed gradually into coarser fluvial deposits and eventually thinned and lapped onto the basement that formed its provenance before thrusting; to the west and south, it probably passed laterally into shallow-marine and possibly deep marine deposits.

Our stratigraphic contacts for the members of the Kanayut Conglomerate, as discussed in this report, are based on detailed measured sections. These boundaries do not necessarily match the contacts used for regional 1:250,000-scale mapping in the central and eastern Brooks Range by Brosgé and others (1979a, b), who mapped the lower shale member (Ear Peak Member) and the Stuver Member as units composed of more than 50 percent nonresistant beds, and the middle conglomerate member (Shainin Lake Member) as a unit composed of more than 50 percent resistant beds (W. P. Brosgé, written commun., 1981). Although our boundaries and those of Brosgé and others (1979a, b) are generally similar, their middle conglomerate member is thicker than

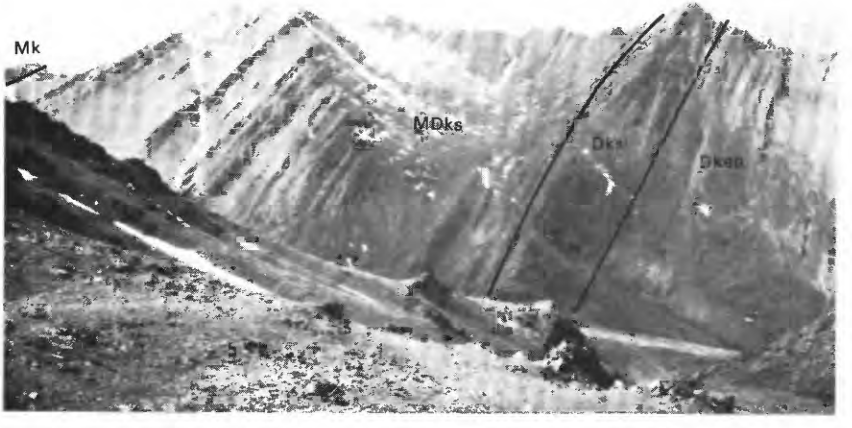

FIGURE 7.—Ridgecrest exposures of the Kanayut Conglomerate near the Atigun River. Dkep, Ear Peak Member; Dksl, Shainin Lake Member; MDks, Stuver Member; Mk, Kayak Shale. View westward.

ours and encompasses strata from the upper part of the Ear Peak Member and the lower part of the Stuver Member as (re)defined by us. In the Philip Smith Mountains quadrangle, they mapped a "massive marker bed," about 200 m thick, within their middle conglomerate member; this unit is essentially equivalent to our Shainin Lake Member (fig. 9). West of the Philip Smith Mountains quadrangle, they did not map this massive marker bed within the middle conglomerate member but mapped the middle conglomerate member as a unit that is thicker than our Shainin Lake Member.

EAR PEAK MEMBER

DEFINITION

The new name "Ear Peak Member" is here applied to the previous informal lower shale member or lower member of the Kanayut Con-

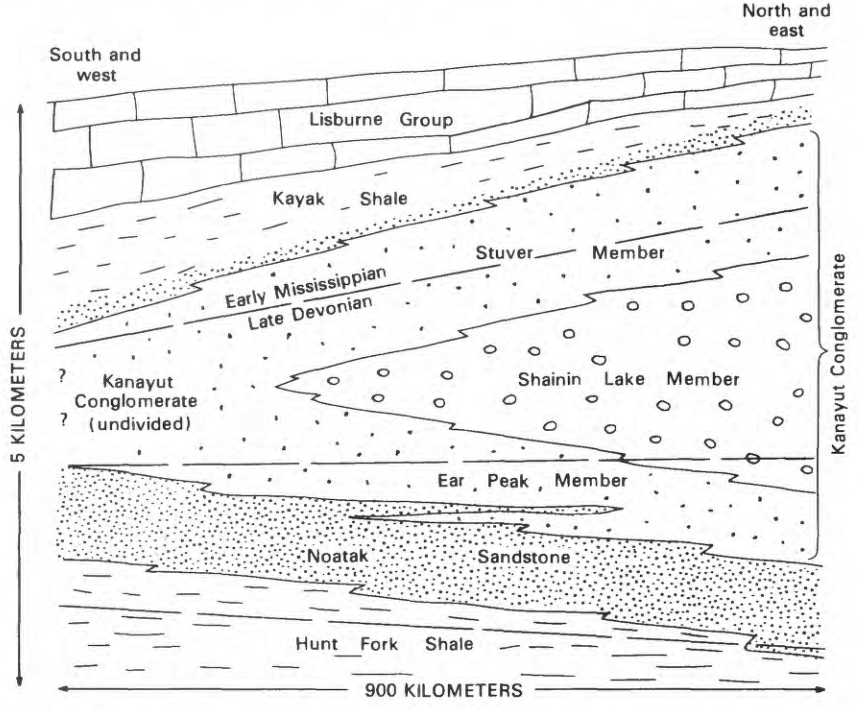

FIGURE 8.—Schematic cross section of the Endicott Group, showing pinchout to south and west of the Shainin Lake Member of the Kanayut Conglomerate. Dashed lines represent timelines that indicate southwestward thinning of fluvial deposits of the Kanayut. Possible pinchout farther south and west of the Kanayut Conglomerate into marine strata is queried.

glomerate; it also includes the lower part of the middle conglomerate member as used by Brosgé and others (1979a, b). The member is named for exposures near Ear Peak, several kilometers east of Shainin Lake. The type section was measured about 1.8 km southeast of Ear Peak (fig. 5). "Ear Peak" is a descriptive name given by U.S. Geological Survey geologists for the peak at an elevation of 5620 ft during Naval Petroleum Reserve exploration in 1944; Ear Peak is situated 44 km northeast of Anaktuvuk Pass.

The Ear Peak Member is the lowest member of the Kanayut Conglomerate, according to the new stratigraphic terminology proposed in this report. The Ear Peak rests gradationally on the Noatak Sandstone or, where the Noatak is missing (as at the type section near Ear Peak), directly on the Hunt Fork Shale; it is overlain conformably either by the Shainin Lake Member or, where absent, by the Stuver Member of the Kanayut Conglomerate.

The lower boundary is defined, in order of importance: by the lowest conglomerate in the Upper Devonian sequence; by the lowest conspicuous fining- and thinning-upward cycle; by the lowest black, brown, or red shale containing abundant plant fossils; or by the upward disappearance of marine megafossils or trace fossils. In most of the

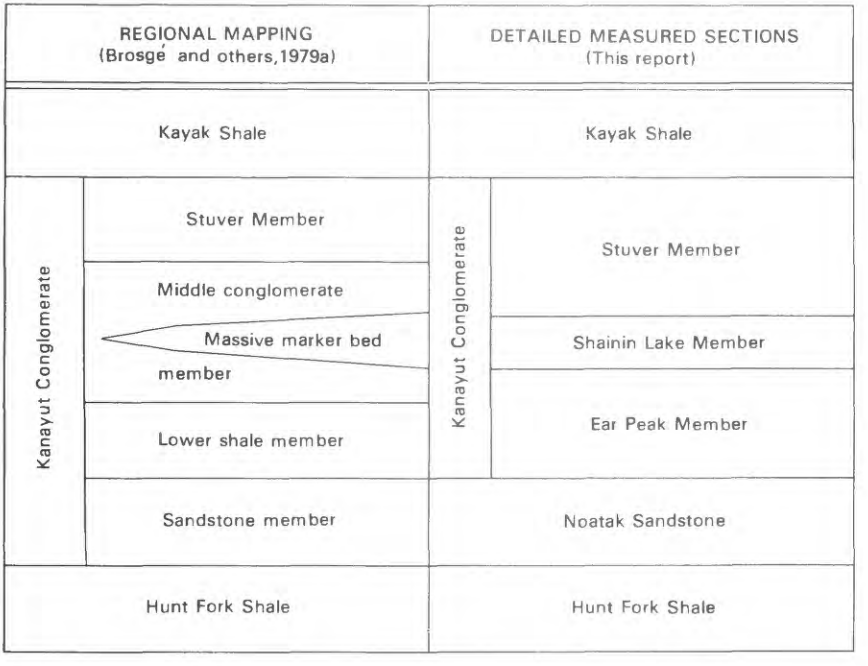

FIGURE 9.—Differences in stratigraphic subdivision of the Kanayut Conglomerate in central Brooks Range, based on regional mapping and detailed measured sections.

central and eastern Brooks Range, the lowest appearance of conglomerate that forms the channelized base of a sequence of thinning- and fining-upward cycles, averaging 5 to 15 m in thickness, can be used to define the base of the Ear Peak Member.

In the western and southern Brooks Range, where the Kanayut Conglomerate may not contain any conglomerate or where the Shainin Lake Member is not distinguishable, the appearance of thinning- and fining-upward cycles that contain sandstone in the lowest beds may be used to define the base of the Ear Peak Member. In other parts of the western and southern Brooks Range, where such cycles are not readily observable, it may be necessary to use the first appearance of plant-bearing shale or the disappearance of marine megafossils or trace fossils to mark the approximate basal contact. In areas where the different units and this contact are both very poorly exposed, the boundary may have to be determined on the basis of other criteria such as lateral continuity from adjacent places where the basal contact is known, topographic expression (because of its coarseness, resistance to erosion, and internal cycles, the Ear Peak Member typically forms steplike ridges and ridge flanks), or color (the Ear Peak Member typically weathers red brown, visible especially at low sun angle, in comparison with the green, gray, black, or white of the underlying units).

The upper contact of the Ear Peak Member in its type section and throughout most of the central and eastern Brooks Range is placed at the top of the shale bed in the uppermost fining- and thinning-upward cycle below a thick sequence of more nearly massive conglomerate and sandstone that defines the base of the Shainin Lake Member. The Ear Peak Member contains abundant shale, which typically forms the upper parts of the cycles, whereas the Shainin Lake Member typically contains little or no shale. Shale intervals within the Shainin Lake Member are very thin and laterally discontinuous in comparison with those in the Ear Peak Member. The contact typically is reflected in the topography as a change from steplike ridge flanks to very steep, massive, nonsteplike ridgecrests (fig. 7).

AREAL EXTENT

The Ear Peak Member, which extends across almost all the eastern and central Brooks Range, forms the lowest nonmarine unit of the Kanayut Conglomerate (W. P. Brosgé and others, unpub. data, 1982). We have measured sections of it as far east as the East Fork of the Chandalar River (sec. 10, loc. 79B-206 of Nilsen and others, 1981), where a thickness of 340 m for an incomplete section with neither top nor bottom was obtained, and along the Junjik River (sec. 11, loc. 79B-136 of Nilsen and others, 1981), where a thickness of 290 m for an in-

complete section without a well-defined base was obtained below the Shainin Lake Member. To the west, we have measured a section at Iteriak Creek (sec. 12, loc. 79-B70 of Nilsen and others, 1981), where at least 60 m but probably much more of the Ear Peak Member underlies the Shainin Lake Member. To the west and south of Iteriak Creek, the Ear Peak Member is difficult to distinguish because of pinchout of the Shainin Lake Member.

TYPE SECTION

The type section of the Ear Peak Member of the Kanayut Conglomerate (figs. 10 and 11) was measured along the southernmost spur of an east-facing ridge southeast of Ear Peak, east-southeast of Shainin Lake (secs. 13, 24, T. 13 S., R. 5 E., and sec. 18, T. 13 S., R. 6 E., Chandler Lake quad.). Of the approximately 510 m of section measured, about 20 percent is covered. The section consists of 35 major fining-upward cycles that average 15 m in thickness. The entire sequence generally coarsens upward toward the base of the Shainin Lake Member. Cycles typically begin with 1- to 5-m-thick beds of conglomerate or conglomeratic sandstone, overlain by trough-cross-stratified or flat-stratified sandstone that is capped in many cycles by ripple-marked siltstone and red shale. The base of individual cycles may be marked by erosional scour into the underlying unit. The amount of shale, siltstone, and fine-grained sandstone decreases upsection as the amount of coarse-grained sandstone and conglomerate increases. Plant fossils and rare burrows are present within beds of shale and fine siltstone in the lower half of the section. Marine burrows are present as high as 125 m above the base of the section within a thick cycle that may correlate with the massive marker bed of Brosgé and others (1979b) in the Okokmilaga River area.

	Thickness (m)
Kanayut Conglomerate	
Shainin Lake Member (lower part)	
Conglomerate, massive; maximum clast size, 5 cm	0.65
Conformable contact	
Ear Peak Member	
Covered interval (rubble of conglomerate)	9.30
Covered interval (rubble of shale, red)	9.00
Conglomerate, parallel-stratified; maximum clast size, 6 cm; erosive base	1.60
Covered interval	9.00
Sandstone, paleosol	1.50
Sandstone, medium-grained, tabular-cross-stratified	.20
Conglomerate, massive; maximum clast size, 4 cm; erosive base	1.20
Sandstone, very fine grained to fine-grained, paleosol at top	1.10
Shale, red, paleosol	1.00

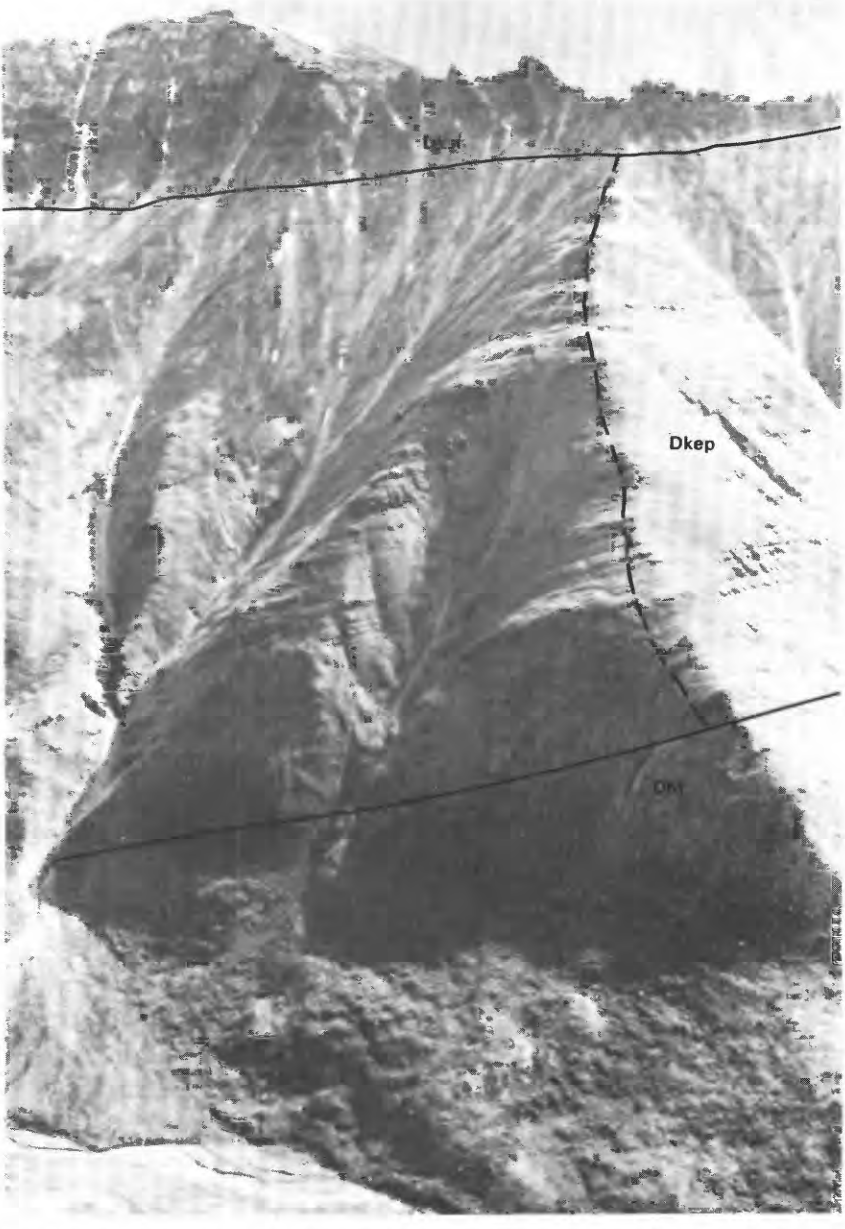

FIGURE 10.—Measured type section of the Ear Peak Member of the Kanayut Conglomerate at Ear Peak. Dashed line denotes location of measured section. Dhf, Hunt Fork Shale; Dkep, Ear Peak Member; Dksl, Shainin Lake Member. View westward.

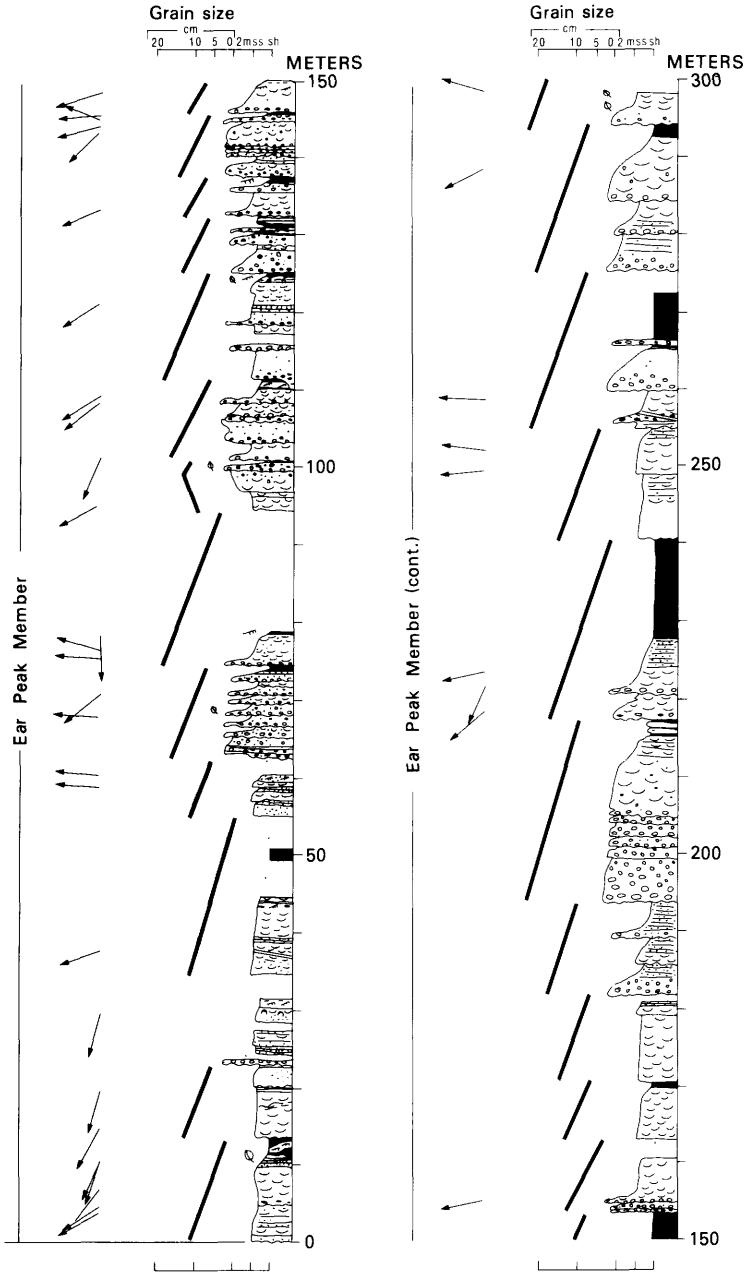

FIGURE 11.—Type section of the Ear Peak Member of the Kanayut Conglomerate.

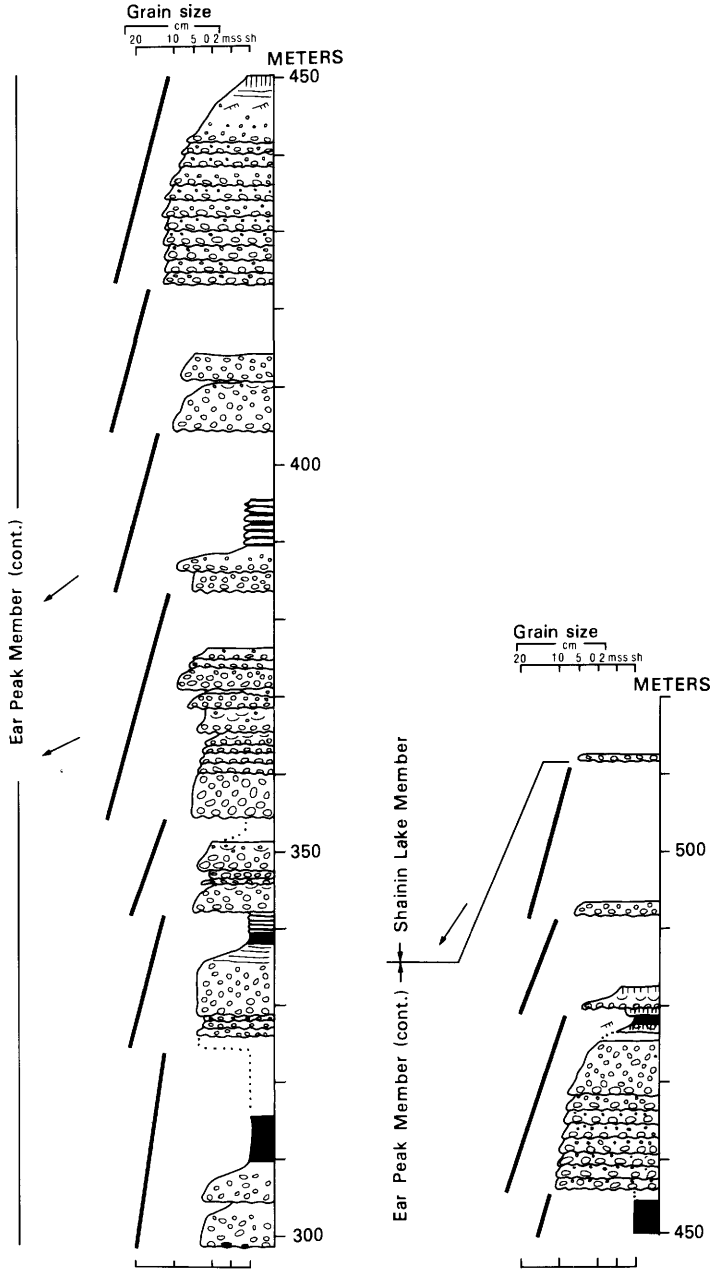

FIGURE 11.—Continued

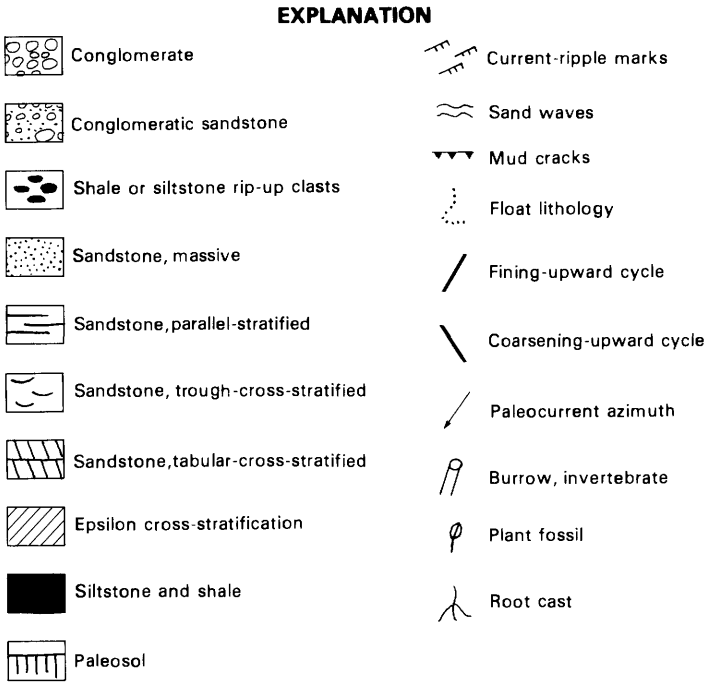

FIGURE 11.—Continued

Kanayut Conglomerate—Continued	Thickness (m)
Ear Peak Member—Continued	
Sandstone, fine- to medium-grained, trough-cross-stratified, current-ripple-laminated at top; paleosol at top	1.20
Covered interval (probably pebbly sandstone)	1.10
Conglomerate, parallel-stratified; maximum clast size, 7 cm	6.70
Conglomerate, parallel-stratified, with alternating finer and coarser grained layers; maximum clast size, 11 cm; erosive base	12.60
Covered interval (probably shale)	1.30
Shale and siltstone, red	4.70
Sandstone, fine- to coarse-grained, current-ripple-laminated, with scattered pebbles; maximum clast size, 2 cm; paleosol at top	7.20
Conglomerate, parallel-stratified; maximum clast size, 6 cm	1.30
Interbedded conglomerate and pebbly sandstone, parallel-stratified; maximum clast size, 13 cm; erosive base	18.60
Covered interval	9.00
Conglomerate, massive; maximum clast size, 8 cm; erosive base	3.40
Shale, red	.25
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.30
Conglomerate, massive; maximum clast size, 10 cm; erosive base	6.00
Covered interval (rubble of shale and siltstone, red)	8.60
Interbedded sandstone, fine- to medium-grained, and shale, red	7.10

Kanayut Conglomerate—Continued Ear Peak Member—Continued	Thickness (m)
Pebbly sandstone, coarse-grained to very coarse grained, massive; maximum clast size, 2 cm	1.20
Conglomerate, massive; maximum clast size, 9 cm	1.10
Conglomerate, massive; maximum clast size, 5 cm; erosive base	2.30
Covered interval	7.50
Sandstone, fine- to medium-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 1 cm	1.10
Interbedded conglomerate and pebbly sandstone, massive to crudely parallel stratified, maximum clast size, 6 cm	2.00
Conglomerate, massive; maximum clast size, 9 cm; erosive base	2.30
Pebbly sandstone, massive; maximum clast size, 1.5 cm	.20
Conglomerate, massive; maximum clast size, 4 cm; erosive base	2.30
Pebbly sandstone, trough-cross-stratified; maximum clast size, 2 cm	2.30
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.85
Sandstone, medium- to coarse-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 2 cm	1.20
Interbedded conglomerate and pebbly sandstone, crudely parallel stratified to massive; maximum clast size, 3 cm	3.85
Conglomerate, massive; maximum clast size, 5 cm; erosive base	5.90
Covered interval (probably sandstone and shale)	3.00
Pebbly sandstone, medium- to coarse-grained, massive; maximum clast size, 1 cm	1.70
Conglomerate, massive; maximum clast size, 1 cm; erosive base	2.20
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm; erosive base	.70
Conglomerate, massive; maximum clast size, 1 cm; erosive base	.15
Sandstone, medium-grained to very coarse grained, trough-cross-stratified	.20
Conglomerate, massive; maximum clast size, 3 cm; erosive base	.50
Sandstone, medium- to coarse-grained, trough-cross-stratified	.25
Conglomerate, massive; maximum clast size, 5 cm; erosive base	3.60
Interbedded sandstone, very fine grained, and shale	2.40
Covered interval (probably shale)	2.50
Sandstone, fine- to coarse-grained, parallel-stratified	1.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	1.50
Conglomerate, massive; maximum clast size, 4 cm; erosive base	5.40
Pebbly sandstone, tabular-cross-stratified; maximum clast size, 1.5 cm	.20
Conglomerate, massive; maximum clast size, 2.5 cm	.05
Pebbly sandstone, medium- to coarse-grained, trough-cross-stratified; maximum clast size, 1.5 cm	.20
Conglomerate, massive; maximum clast size, size 2 cm	.15
Pebbly sandstone, massive; maximum clast size, 2 cm	.40
Conglomerate, massive; maximum clast size, 3 cm	.20
Pebbly sandstone, coarse-grained to very coarse grained, trough-cross-stratified; maximum clast size, 3 cm	.15
Conglomerate, massive; maximum clast size, 2 cm; erosive base	.05
Pebbly sandstone, medium- to coarse-grained, trough-cross-stratified; maximum clast size, 2.5 cm	.08
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.08

Kanayut Conglomerate—Continued Stuver Member—Continued	Thickness (m)
Pebbly sandstone, coarse-grained to very coarse grained, trough-cross-stratified; maximum clast size, 3 cm	.40
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.70
Covered interval (probably shale)	10.50
Shale, red	6.60
Covered interval (probably sandstone)	1.50
Covered interval (rubble of conglomerate; maximum clast size, 3 cm)	2.80
Covered interval (rubble of sandstone, fine- to medium-grained)	1.30
Pebbly sandstone, massive, containing shale rip-up clasts; maximum clast size, 3 cm; erosive base	4.50
Sandstone, medium-grained, trough-cross-stratified, with scattered plant fragments	1.30
Sandstone, medium-grained, trough-cross-stratified, containing large plant fragments at base	1.55
Sandstone, medium-grained, parallel-stratified to massive, with scattered pebbles; maximum clast size, 1 cm; erosive base	1.95
Shale and siltstone, red	1.35
Sandstone, very fine grained to fine-grained, parallel-stratified to trough-cross-stratified	2.00
Sandstone, fine- to coarse-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 1.5 cm	5.50
Pebbly sandstone, massive; maximum clast size, 2 cm; erosive base	.95
Sandstone, fine- to medium-grained, trough-cross-stratified	2.10
Pebbly sandstone, massive, at base to sandstone, medium-grained, parallel-stratified, at top; maximum clast size, 1 cm; erosive base	2.80
Pebbly sandstone, massive, at base to sandstone, medium-grained, parallel-stratified, at top; maximum clast size, 2 cm	4.30
Covered interval	3.00
Shale and siltstone, red	6.00
Sandstone, medium- to coarse-grained, massive, with scattered pebbles; maximum clast size, 1 cm; sharp base and top	.45
Interbedded sandstone, very fine grained, current-ripple-laminated, and shale	.85
Sandstone, fine- to medium-grained, parallel-stratified to trough-cross-stratified	2.75
Pebbly sandstone, massive; maximum clast size, 2 cm; erosive base	2.35
Sandstone, fine- to medium-grained, parallel-stratified to massive	1.20
Sandstone, medium, trough-cross-stratified to massive	1.90
Sandstone, medium-grained, containing epsilon cross-strata, scattered pebbles, and shale rip-up clasts at base; maximum clast size, 1 cm	.95
Sandstone, fine- to medium-grained, parallel-stratified to massive; erosive base	.95
Covered interval (probably sandstone, very fine grained, parallel-stratified, and shale)	.85
Sandstone, medium-grained at base to fine-grained at top, trough-cross-stratified	5.00
Sandstone, fine- to medium-grained, trough-cross-stratified to parallel-stratified	.65

	Thickness (m)
Kanayut Conglomerate—Continued	
Ear Peak Member—Continued	
Sandstone, fine-grained, trough-cross-stratified to parallel-stratified	2.80
Covered interval (probably sandstone)	5.00
Covered interval (rubble of shale and siltstone, red)	15.00
Sandstone, very fine grained to fine-grained, parallel-stratified to trough-cross-stratified	2.50
Sandstone, medium-grained, trough-cross-stratified	1.65
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm; erosive base	.90
Sandstone, fine- to medium-grained, trough-cross-stratified	.45
Sandstone, medium-grained, trough-cross-stratified	.20
Sandstone, fine- to medium-grained, trough-cross-stratified	.40
Pebbly sandstone to sandstone, medium-grained, at top; trough-cross-stratified, containing shale rip-up clasts at bottom; maximum clast size, 1 cm; erosive base	2.20
Interbedded sandstone, very fine grained, siltstone, and shale, reddish	2.45
Sandstone, fine- to medium-grained, parallel-stratified to trough-cross-stratified	2.50
Interbedded pebbly sandstone (maximum clast size, 2 cm) and sandstone, medium-grained, trough-cross-stratified	6.75
Interbedded pebbly sandstone (maximum clast size, 2 cm) and sandstone, medium-grained, crudely parallel statified	1.70
Interbedded conglomerate and pebbly sandstone, crudely parallel stratified	4.50
Pebbly sandstone, trough-cross-stratified; maximum clast size, 1.5 cm	.50
Conglomerate, trough-cross-stratified to massive; maximum clast size, 2 cm	.95
Conglomerate, massive; maximum clast size, 3.5 cm; erosive base	4.00
Sandstone, very fine grained, and siltstone	3.00
Sandstone, very fine grained to fine-grained, parallel-stratified	.60
Sandstone, medium-grained, massive, with scattered pebbles; maximum clast size, 1.5 cm; erosive base	1.15
Sandstone, very fine grained, parallel-stratified to current-ripple-laminated, and siltstone, red	1.05
Sandstone, very fine grained to fine-grained, parallel-stratified	.70
Sandstone, medium-grained, trough-cross-stratified; erosive base	1.50
Sandstone, very fine grained to medium-grained, parallel-stratified	2.05
Pebbly sandstone, massive; maximum clast size, 2 cm	2.15
Covered interval (probably sandstone, fine-grained)	.95
Sandstone, fine-grained, parallel-stratified to trough-cross-stratified	.40
Sandstone, fine- to medium-grained, trough-cross-stratified	1.25
Sandstone, fine-grained, trough-cross-stratified	4.25
Sandstone, fine- to medium-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 1 cm; erosive base	4.50
Covered interval (rubble of sandstone, very fine grained, siltstone, and shale)	1.50
Sandstone, fine-grained, trough-cross-stratified to parallel-stratified	2.35

Kanayut Conglomerate—Continued Ear Peak Member—Continued	Thickness (m)
Sandstone, fine-grained, trough-cross-stratified	3.00
Sandstone, fine- to medium-grained, parallel-stratified to trough-cross-stratified	.60
Covered interval (probably sandstone, siltstone, and shale)	2.65
Sandstone, fine-grained, parallel-stratified to trough-cross-stratified	3.40
Sandstone, fine- to medium-grained, trough-cross-stratified	1.55
Sandstone, fine- to medium-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 0.5 cm	.35
Conglomerate, massive; maximum clast size, 2.5 cm	.25
Sandstone, medium- to coarse-grained, massive, with scattered pebbles; maximum clast size, 1 cm	.50
Conglomerate, massive; maximum clast size, 1.5 cm	.50
Pebbly sandstone, massive, maximum clast size, 1 cm	.40
Covered interval (rubble of conglomerate; maximum clast size, 2 cm)	.30
Covered interval (probably sandstone, fine-grained, siltstone, and shale)	3.25
Sandstone, fine- to medium-grained, trough-cross-stratified to current ripple-laminated at top, with scattered pebbles; maximum clast size, 0.5 cm	1.20
Sandstone, medium-grained to very coarse grained, massive, with scattered pebbles; maximum clast size, 1 cm at base; erosive base	2.65
Covered interval (rubble of shale, red)	.25
Sandstone, fine-grained, trough-cross-stratified to parallel-stratified	.30
Pebbly sandstone, medium- to coarse-grained, massive; maximum clast size, 2.5 cm; tabular-cross-stratified at base	.50
Sandstone, fine- to medium-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 1 cm	.40
Pebbly sandstone, medium-grained, trough-cross-stratified; maximum clast size, 1 cm	.20
Sandstone, medium-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 2 cm	2.60
Sandstone, medium- to coarse-grained, trough-cross-stratified to massive	.15
Conglomerate, massive; maximum clast size, 2 cm; erosive base	.25
Sandstone, medium- to coarse-grained, trough-cross-stratified to massive	.10
Conglomerate, massive; maximum clast size, 1 cm; erosive base	.05
Sandstone, medium- to coarse-grained, parallel stratified to massive	.08
Conglomerate, massive; maximum clast size, 1 cm; erosive base	.10
Sandstone, medium- to coarse-grained, massive	.25
Conglomerate, massive; maximum clast size, 2 cm; erosive base	.10
Sandstone, medium- to coarse-grained, massive	.25
Conglomerate, massive; maximum clast size, 1.5 cm; erosive base	.15
Sandstone, medium- to coarse-grained, massive; erosive base	.40
Sandstone, fine- to medium-grained, parallel-stratified, micaceous, with scattered pebbles; maximum clast size, 0.5 cm	.25

Kanayut Conglomerate—Continued Ear Peak Member—Continued	Thickness (m)
Pebbly sandstone, medium- to coarse-grained, trough-cross-stratified; maximum clast size, 2 cm	1.45
Conglomerate, massive; maximum clast size, 2 cm	.05
Sandstone, medium- to coarse-grained, massive, with scattered pebbles; maximum clast size, 1.5 cm; erosive base	.55
Sandstone, very fine grained, current-ripple-laminated, micaceous; siltstone; and shale, red	.15
Sandstone, fine-grained, parallel-stratified to current-ripple-laminated, micaceous	.30
Pebbly sandstone, medium-grained, trough-cross-stratified; maximum clast size, 1.5 cm	1.40
Sandstone, medium-grained, trough-cross-stratified, with scattered pebbles	2.10
Pebbly sandstone at base to sandstone, coarse-grained, massive; maximum clast size, 2 cm; erosive base	1.00
Covered interval	.50
Sandstone, fine-grained, parallel-stratified, micaceous, red	.75
Covered interval (probably shale)	.35
Siltstone and shale, red; paleosol at top	.15
Pebbly sandstone, parallel-stratified to massive; maximum clast size, 0.5 cm; erosive base	.30
Sandstone, fine-grained, parallel-stratified	.25
Pebbly sandstone, massive; maximum clast size, 1 cm; erosive base	1.35
Sandstone, fine-grained, parallel-stratified to trough-cross-stratified	.85
Pebbly sandstone, massive, containing shale rip-up clasts; maximum clast size, 0.5 cm; erosive base	3.05
Covered interval (rubble of siltstone, current-ripple-laminated, micaceous, and shale, red)	.50
Sandstone, very fine grained, current-ripple-laminated, micaceous, containing mud cracks, burrows, and plant fragments	.50
Sandstone, fine-grained, parallel-stratified to trough-cross-stratified	.25
Sandstone, medium-grained, trough-cross-stratified	1.15
Sandstone, fine- to medium-grained, trough-cross-stratified	1.50
Sandstone, medium-grained, parallel-stratified	1.15
Sandstone, medium-grained, massive	1.05
Conglomerate, massive; maximum clast size, 2 cm; erosive base	.40
Sandstone, fine- to medium-grained, trough-cross-stratified	1.30
Covered interval	1.30
Sandstone, medium-grained, massive	.45
Conglomerate, massive; maximum clast size, 1 cm; erosive base	.30
Sandstone, medium-grained at base, fine-grained at top, massive	3.00
Sandstone, medium-grained, massive, containing abundant shale rip-up clasts; erosive base	.75
Sandstone, very fine grained, and siltstone, current-ripple-laminated, micaceous	1.30
Sandstone, fine-grained, trough-cross-stratified	.40
Covered interval (probably sandstone)	.80
Sandstone, fine- to medium-grained, trough-cross-stratified	.30
Conglomerate, massive; maximum clast size, 3.5 cm; erosive base	.18

Kanayut Conglomerate—Continued	Thickness (m)
Ear Peak Member—Continued	
Pebbly sandstone, medium-grained, trough-cross-stratified; maximum clast size, 2 cm	1.90
Conglomerate, massive; maximum clast size, 1.5 cm; erosive base	.05
Pebbly sandstone, medium- to coarse-grained, massive; maximum clast size, 1 cm	.20
Pebbly sandstone, coarse-grained to very coarse grained, massive; maximum clast size, 2 cm; erosive base	.12
Pebbly sandstone, crudely parallel stratified; maximum clast size, 3 cm	1.10
Pebbly sandstone, medium- to coarse-grained, massive; maximum clast size, 2 cm	1.65
Conglomerate, massive; maximum clast size, 2 cm	.40
Sandstone, medium- to coarse-grained, trough-cross-stratified, coarse-enning upward	.75
Sandstone, medium-grained, trough-cross-stratified to massive	1.35
Sandstone, fine- to medium-grained, trough-cross-stratified, with scattered pebbles; maximum clast size, 1 cm; erosive base	.12
Interbedded sandstone, very fine grained; siltstone; and shale, red, current-ripple-laminated, containing mud cracks and burrows	.25
Pebbly sandstone at base to sandstone, medium-grained at top, massive, containing shale rip-up clasts and plant fragments; erosive base	.60
Sandstone, coarse-grained to very coarse grained, massive, containing plant fragments	.10
Conglomerate, massive, containing shale rip-up clasts; maximum clast size, 1.5 cm; erosive base	.10
Sandstone, coarse-grained to very coarse grained, massive, with scattered pebbles	.10
Conglomerate, massive, containing plant fragments; maximum clast size, 2 cm; erosive base	.08
Pebbly sandstone, trough-cross-stratified at base to massive at top; maximum clast size,1 cm, coarsening upward	2.60
Sandstone, medium-grained, trough-cross-stratified to parallel-stratified	2.30
Covered interval (rubble of siltstone and shale, red)	15.65
Sandstone, very fine grained, current-ripple-laminated; siltstone; and shale	.40
Sandstone, very fine grained, trough-cross-stratified	.85
Sandstone, fine-grained, massive	1.00
Sandstone, fine- to medium-grained, trough-cross-stratified	.70
Sandstone, medium-grained, trough-cross-stratified	.80
Pebbly sandstone, medium- to coarse-grained, crudely parallel stratified to massive; maximum clast size, 2 cm; erosive base	.75
Sandstone, very fine grained, current-ripple-laminated; siltstone, micaceous; and shale, red	.45
Sandstone, very fine grained, parallel-stratified	.20
Pebbly sandstone at base to sandstone, medium, at top, massive; maximum clast size, 1 cm; erosive base	1.35
Sandstone, fine-grained, trough-cross-stratified; erosive base	.50

	Thickness (m)
Kanayut Conglomerate—Continued	
Ear Peak Member—Continued	
Conglomerate at base to sandstone, fine-grained, at top, massive; maximum clast size, 1 cm; erosive base	1.35
Sandstone, very fine grained to fine-grained, trough-cross-stratified	.75
Sandstone, fine- to medium-grained, massive	.20
Conglomerate, massive; maximum clast size, 1 cm; erosive base	.05
Sandstone, medium-grained, massive, containing scattered pebbles and plant fragments; maximum clast size, 1 cm	1.20
Conglomerate, massive; maximum clast size, 2 cm; erosive base	.30
Sandstone, medium-grained, massive at base to parallel-stratified at top, with scattered pebbles; maximum clast size, 1 cm	1.25
Conglomerate, massive; maximum clast size, 2 cm; erosive base	.15
Sandstone, fine-grained, trough-cross-stratified	1.00
Pebbly sandstone at base to sandstone, fine- to medium-grained, at top, crudely parallel stratified; maximum clast size, 2 cm; erosive base	.45
Sandstone, medium-grained, massive, with scattered pebbles; maximum clast size, 1 cm	1.15
Pebbly sandstone, coarse-grained, parallel-stratified, containing shale rip-up clasts; maximum clast size, 2 cm	1.00
Sandstone, medium-grained, parallel stratified to massive, containing abundant rip-up clasts of red shale	.45
Covered interval (rubble of shale, red, and siltstone)	2.45
Sandstone, very fine grained, parallel-stratified to current-ripple-laminated	.75
Sandstone, fine- to medium-grained, trough-cross-stratified	.65
Sandstone, very fine grained, parallel-stratified	.20
Sandstone, very fine grained, parallel-stratified	.40
Sandstone, medium-grained, trough-cross-stratified	1.10
Sandstone, very fine grained to fine-grained, parallel-stratified, ferruginous	.30
Sandstone, fine- to medium-grained, massive	1.70
Covered interval	4.10
Shale and siltstone, red	1.70
Covered interval (rubble of sandstone, very fine grained, current-ripple-laminated, and shale)	4.50
Sandstone, very fine grained to fine-grained, parallel-stratified to trough-cross-stratified	.90
Sandstone, fine-grained, massive	.50
Sandstone, fine-grained, current-ripple-laminated, containing shale rip-up clasts	.15
Sandstone, very fine grained, trough-cross-stratified	3.95
Sandstone, fine- to medium-grained, trough-cross-stratified to parallel-stratified, ferruginous	.40
Sandstone, fine- to medium-grained, trough-cross-stratified	1.20
Sandstone, fine- to medium-grained, trough-cross-stratified, containing epsilon cross-stratification	.85
Sandstone, fine- to medium-grained, massive	.95
Sandstone, fine- to medium-grained, trough-cross-stratified	.25
Sandstone, medium-grained, parallel-stratified to massive, trough-cross-stratified in upper 30 cm	.90
Covered interval	3.00

	Thickness (m)
Kanayut Conglomerate—Continued	
Ear Peak Member—Continued	
Sandstone, very fine grained to fine-grained, parallel-stratified at base, trough-cross-stratified in middle, and current-ripple-laminated at top	1.45
Sandstone, very fine grained to fine-grained, trough-cross-stratified to current-ripple-laminated, *Skolithos* burrows	.80
Sandstone, fine-grained, massive	.95
Covered interval (rubble of sandstone, fine-grained, parallel-stratified)	1.10
Sandstone, fine- to medium-grained, parallel-stratified and trough-cross-stratified to massive	1.20
Sandstone, fine- to medium-grained, massive	.95
Covered interval (probably sandstone, fine-grained)	.15
Sandstone, fine-grained, parallel-stratified	.60
Covered interval (probably sandstone, coarse-grained)	.80
Pebbly sandstone, very coarse grained, massive, red, calcareous; erosive base	.65
Covered interval (rubble of sandstone, very fine grained, and shale, red)	.25
Sandstone, very fine grained, parallel-stratified	.15
Sandstone, fine-grained, parallel-stratified to massive, trough-cross-stratified at top	1.70
Sandstone, fine- to medium-grained, massive; erosive base	.90
Sandstone, fine-grained, parallel-stratified to trough-cross-stratified	.40
Sandstone, fine-grained, trough-cross-stratified	5.60
Sandstone, fine-grained, massive; erosive base	.50
Covered interval (rubble of shale and siltstone, current-ripple-laminated, micaceous, brown, containing mud cracks and burrows)	2.60
Sandstone, very fine grained, parallel-stratified, micaceous, containing shale partings and plant fragments	.20
Covered interval (rubble of sandstone, very fine grained to fine-grained, parallel-stratified)	.55
Sandstone, fine-grained, parallel-stratified	.10
Sandstone, fine-grained, parallel-stratified, containing tabular cross-strata near top	.40
Sandstone, fine-grained, trough-cross-stratified	1.95
Sandstone, fine- to medium-grained, trough-cross-stratified	.42
Sandstone, fine-grained, trough-cross-stratified, containing shale rip-up clasts in basal 3 cm; erosive base	2.70
Sandstone, fine-grained, trough-cross-stratified	1.45
Covered interval (probably sandstone)	.30
Sandstone, fine- to medium-grained, parallel-stratified	.25
Covered interval (probably sandstone)	.35
Sandstone, medium-grained, parallel-stratified to trough-cross-stratified	2.25
Total thickness (m)	512.41

Conformable contact

Hunt Fork Shale (upper part)

Sandstone, very fine grained to fine-grained, with interbedded shale and siltstone; sandstone is parallel-stratified to trough cross-stratified; shale is brown to red, containing local calcareous and ferruginous layers and abundant broken megafossil debris.

The contact between the Ear Peak Member and the underlying Hunt Fork Shale is transitional and marked by the upward disappearance of marine megafossil debris and the initiation of distinct fining-upward cycles. The base of the first distinct fining-upward cycle (at an elevation of 4820 ft) forms the contact between these two units. We interpret this contact to mark the change upward from dominantly marine to dominantly fluvial deposition. The distinct fining-upward cycles result from lateral and vertical accretion of meandering-stream-channel and point-bar deposits. Epsilon crossbeds, which form inclined surfaces transecting the vertical sequences, probably represent the actual inclined surfaces of point bars within the system. The upper-point-bar and flood-plain deposits consist of shale and ripple-marked siltstone, with thin interbeds of fine-grained sandstone possibly representing crevasse-splay deposition.

The clast composition approximately 320 m above the base of the type section is 87 percent white, gray, and black chert, 11 percent white quartz, and 2 percent quartzite. The clast composition 50 m below the base of the Shainin Lake Member consists of 82 percent white, gray, and black chert, 13 percent white quartz, 4 percent quartzite, and 1 percent argillite. The maximum clast size ranges from less than 1 cm near the base of the Ear Peak Member to a maximum of 13 cm just below the base of the Shainin Lake Member.

A total of 44 paleocurrent measurements from the type section of the Ear Peak Member have an azimuthal-vector mean and standard deviation of $243° \pm 29°$. These measurements include 19 sets of trough cross-strata, 17 bedding surfaces with primary current lineations, two flute marks, two sets of tabular cross-strata, two sites of clast-long-axis orientation, and one oscillation ripple mark. Because the unidirectional indicators show southwestward sediment transport, the bidirectional indicators have been preferentially assigned a similar transport direction.

STRATIGRAPHIC RELATIONS

Both the lower and upper contacts of the Ear Peak Member are gradational and characterized regionally by interfingering with adjacent units. The basal contact with the Hunt Fork Shale or the intervening Noatak Sandstone is particularly gradational and commonly contains a sequence, as thick as 50 m, of conglomeratic fining-upward fluvial cycles alternating with more irregular cycles, locally coarsening upward, of marine sandstone and shale. In these transitional and clearly interfingering intervals, the basal contact of the Ear Peak Member may be difficult to pinpoint. Southward and westward, the Ear Peak Member essentially progrades over the underlying units and becomes thinner and finer grained.

A conspicuous partly marine tongue of sandstone is present in the Ear Peak Member between the Killik River and Trans-Alaska Pipeline about a third of the way up its total thickness. This tongue forms a thick and complex cycle within a sequence of thinner, relatively simple fining-upward cycles characteristic of the Ear Peak Member. Although marine megafossils have not been found in the tongue, the presence of marine trace fossils of the *Skolithos* type, bidirectional planar cross-strata, and oscillation-ripple marks, as well as the apparent wide lateral extent of the tongue and the unusual thickness and complexity of the cycle, suggest an origin at least partly marine. A similar conspicuous tongue that is thick and well developed is present between the Killik and Okokmilaga Rivers in the west-central Brooks Range. Brosgé and others (1979b) mapped this tongue as the massive marker bed of the lower shale member. We have measured one section in it, near the Okokmilaga River, where it is about 35 m thick (Nilsen and others, 1982, fig. 13, sec. 11). These partly marine tongues may be correlative and may also be present in several other measured sections, including the type section at Ear Peak as presented herein (110-125 m above base of section) and a thick section adjacent to the Atigun River (405-420 m above base of section; Nilsen and others, 1982, fig. 4). Thus, the sandstone tongue may extend laterally for an overall east-west distance of as much as 200 km. This tongue evidently represents a major eastward incursion of the marine sea over the fluvial sequence during the Late Devonian.

The upper contact of the Ear Peak Member with the Shainin Lake Member, though typically sharp in most sections, is clearly gradational in others and, over a broader area, probably is interfingering. Because the Shainin Lake Member prograded southward and westward over the Ear Peak Member, tongues of the Shainin Lake Member probably extend southwesterly into and pinch out within the Ear Peak Member (fig. 8). To the west and south the Ear Peak Member is generally thinner and finer grained, whereas to the north and east it is thicker and coarser grained.

THICKNESS

The Ear Peak Member varies considerably in thickness from east to west and also from thrust plate to thrust plate. It generally appears to thin to the east, west, and south of the Atigun River area, where a thickness of 1,150 m was measured. In the eastern Brooks Range, partial thicknesses of 340 m along the East Fork of the Chandalar River (Nilsen and others, 1981, figs. 5*A*, 5*B*, sec. 10, loc. 79B-106) and of 290 m near the Junjik River (Nilsen and others, 1981, figs. 6*A* and 6*B*, sec. II, loc. 79B-136) have been measured. In the central Brooks Range,

the Ear Peak Member is 510 m thick at the type section at Ear Peak, about 38 km west of the Atigun River. Other thicknesses measured for the Ear Peak Member in the central Brooks Range include: at least 40 m in an incomplete section near Kollutarak Creek, about 12 km west of the village of Anaktuvuk Pass (Nilsen and others, 1980, fig. 5, sec. 5, loc. 78B-111); 120 m near the John River; 260 m near Mount MacVicar (southeast of Chandler Lake); and 240 m near the Killik River. In the west-central Brooks Range, the only measured section of the Ear Peak Member is along Iteriak Creek, where a partial section 60 m thick was measured (Nilsen and others, 1981, fig. 7, sec. 12, loc. 79B-70).

DEPOSITIONAL ENVIRONMENT

The Ear Peak Member was deposited almost completely in a fluvial environment, primarily by southwest-flowing meandering streams. The member consists of fining-upward stream-channel cycles consisting of conglomerate, sandstone, and siltstone, alternating with flood-plain deposits of shale and siltstone. Paleosols and oxidized intervals are common at the tops of the channel cycles and within the flood-plain deposits.

At its base, where it interfingers with underlying marine strata of the Noatak Sandstone or the Hunt Fork Shale, the Ear Peak Member may include some shallow-marine strata, as evident in the type section, where marine burrows are present at the tops of some fining-upward cycles in the lower 50 m of the section. However, the member contains a conspicuous tongue of partly marine sandstone and conglomerate about 200 m above its base, probably deposited during a regional transgression. At its top, where it interfingers with the Shainin Lake Member, the Ear Peak Member may include some braided-stream deposits more typical of that unit.

AGE AND CORRELATION

The age of the Ear Peak Member is known from plant fossils found within it and from marine fossils in the underlying Noatak Sandstone and Hunt Fork Shale. Plant fossils, in the form of fragments of roots, branches, and stems, are locally common in the finer grained units of the Ear Peak Member. Plant fossils collected at two localities in the eastern Brooks Range indicate a Late Devonian age (Mamay, 1962; Brosgé and Reiser, 1965; Nilsen and others, 1980). Marine megafossils from the upper part of the underlying marine units are upper Frasnian and lower Famennian. Brachiopods of Famennian age have been found in beds that are probably within the Ear Peak Member, about 150 m

above the base of the Kanayut Conglomerate along the upper Sagavanirktok River (fig. 2; Brosgé and others, 1979a).

To the south and west, the Ear Peak Member overlies, partly grades into, and appears to be partly correlative with the underlying Noatak Sandstone (fig. 8). To the south and east, across the Porcupine River, the Ear Peak Member is separated by major faults from coeval units. It is correlative with the Nation River Formation of east-central Alaska, an Upper Devonian quartz-rich deep-sea-fan deposit (Nilsen and others, 1976), and with the upper part of the Imperial Formation of the Yukon Territory and western Northwest Territories of Canada, a deep-marine turbidite sequence (Martin, 1959; Norris, 1968).

SHAININ LAKE MEMBER

DEFINITION

The new name "Shainin Lake Member" is here applied to the previously informally designated "middle conglomerate member" of the Kanayut Conglomerate. The member is named for exposures several kilometers south of Shainin Lake, the area in which the type section was measured. Shainin Lake was named by U.S. Geological Survey geologists in 1951 for Vincent E. Shainin, a U.S. Geological Survey geologist who drowned in the lake in 1950. The lake is 37 km northeast of Anaktuvuk Pass; the Eskimo name for the lake is "Kanayut Lake." The Shainin Lake Member is the middle member of the Kanayut Conglomerate under the new stratigraphic terminology adopted in this report (fig. 4). It rests gradationally on the Ear Peak Member and is overlain gradationally by the Stuver Member of the Kanayut Conglomerate.

The lower boundary in the type section is defined by the basal contact of massive beds of conglomerate and sandstone with the uppermost shale interval of the series of fining- and thinning-upward cycles that characterizes the underlying Ear Peak Member. The Shainin Lake Member typically consists almost completely of alternating thick beds of conglomerate and sandstone, and contains little or no shale or siltstone. In most places, the basal contact is well defined by a topographic change from a steplike gently to steeply sloping ridge flank to a massive steep wall of sedimentary rocks that can be easily traced across the countryside. In other areas, the basal contact may be vaguer, and interbeds of shale are commonly present in what appears to be the Shainin Lake Member; we arbitrarily place this contact in these areas at the top of the highest shale interval thicker than 5 m.

The upper boundary in the type section is defined by a similar contact of massive beds of conglomerate and sandstone of the Shainin Lake Member below a series of fining-upward cycles that includes

abundant interbedded shale. We place this upper contact at the base of the lowest recognizable fining- and thinning-upward cycle above the massive units, if well defined by a shale break, or at the base of the first shale interval thicker than 5 m.

AREAL EXTENT

The Shainin Lake Member extends across most of the eastern and central Brooks Range and eventually pinches out toward the west and south into the underlying Ear Peak and overlying Stuver Members (fig. 8). We have not distinguished it in the Mulgrave Hills, the De-Long Mountains, and adjacent areas west of Iteriak Creek (figs. 1, 2). West and south of where the Shainin Lake Member pinches out, the Kanayut Conglomerate consists of a thick sequence of fining-upward cycles that includes abundant shale; in these areas, the Ear Peak and the Stuver Member cannot be distinguished.

We have measured sections of the Shainin Lake Member as far west as Iteriak Creek (sec. 12, loc. 79B-70 of Nilsen and others, 1981), where it is about 85 m thick, and as far east as the Junjik River (sec. 10, loc. 79B-136 of Nilsen and others, 1981), where it is 255 m thick. Where present, it always occupies topographically higher and steeper areas, and can typically be easily traced on aerial photographs and by aerial reconnaissance.

TYPE SECTION

The type section of the Shainin Lake Member of the Kanayut Conglomerate was measured on the prominent cliff directly south of the confluence of Kayak and Alapah Creeks, about 8 km south-southeast of Shainin Lake, in sec. 4, T. 14 S., R. 5 E., Chandler Lake quadrangle (fig. 5). The almost completely exposed section is 526 m thick and has relatively little cover (figs. 12, 13). The section is relatively uniform and consists of thick beds of conglomerate that fine upward into conglomeratic sandstone and medium-grained to very coarse grained sandstone. Shale is generally absent except for some thin intervals between 450 and 490 m above the base of the section. The coarsest and thickest bedded conglomerate is present in the middle part of the section, from 260 to 440 m above the base. Thinner bedded and finer grained conglomerate, with more abundant interbedded sandstone, characterizes the lower and upper parts of the section and marks the transitions from the Ear Peak Member and to the Stuver Member, respectively.

Kanayut Conglomerate	Thickness (m)
Stuver Member (lower part)	
Covered interval (rubble of conglomerate, pebbly sandstone, sandstone, and shale)	15.00
Conformable contact	
Shainin Lake Member	
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	2.25
Conglomerate, massive; maximum clast size, 14 cm	1.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	1.20
Conglomerate, massive; maximum clast size, 12 cm; erosive base	3.60
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	3.00
Conglomerate, massive; maximum clast size, 7 cm; erosive base	4.50
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	1.00
Conglomerate, massive; maximum clast size, 7 cm; erosive base	6.80
Conglomerate, massive; maximum clast size, 5 cm; erosive base	3.60
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	.40
Covered interval (probably pebbly sandstone)	4.00
Conglomerate, massive; maximum clast size, 9 cm; erosive base	3.25
Pebbly sandstone, massive; maximum clast size, 3 cm	.25
Conglomerate, massive; maximum clast size, 6 cm; erosive base	6.50
Siltstone, parallel-laminated to massive	.80
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.50
Siltstone, parallel-laminated to massive	.05
Sandstone, fine-grained, massive; paleosol	.15

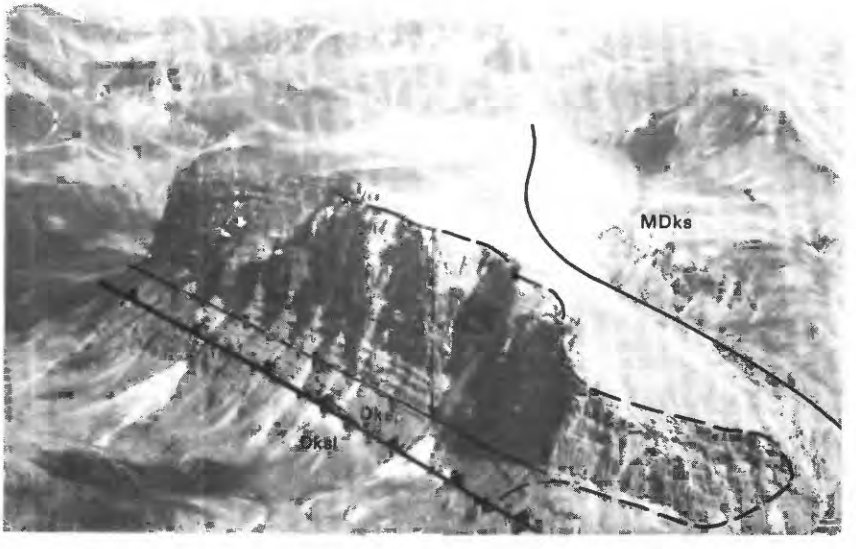

FIGURE 12.—Measured type section of the Shainin Lake Member of the Kanayut Conglomerate south of Shainin Lake. Barbed line denotes location of thrust fault; dashed line denotes location of measured section. Kanayut Conglomerate: Dkep, Ear Peak Member; Dksl, Shainin Lake Member; MDks, Stuver Member. View southeastward.

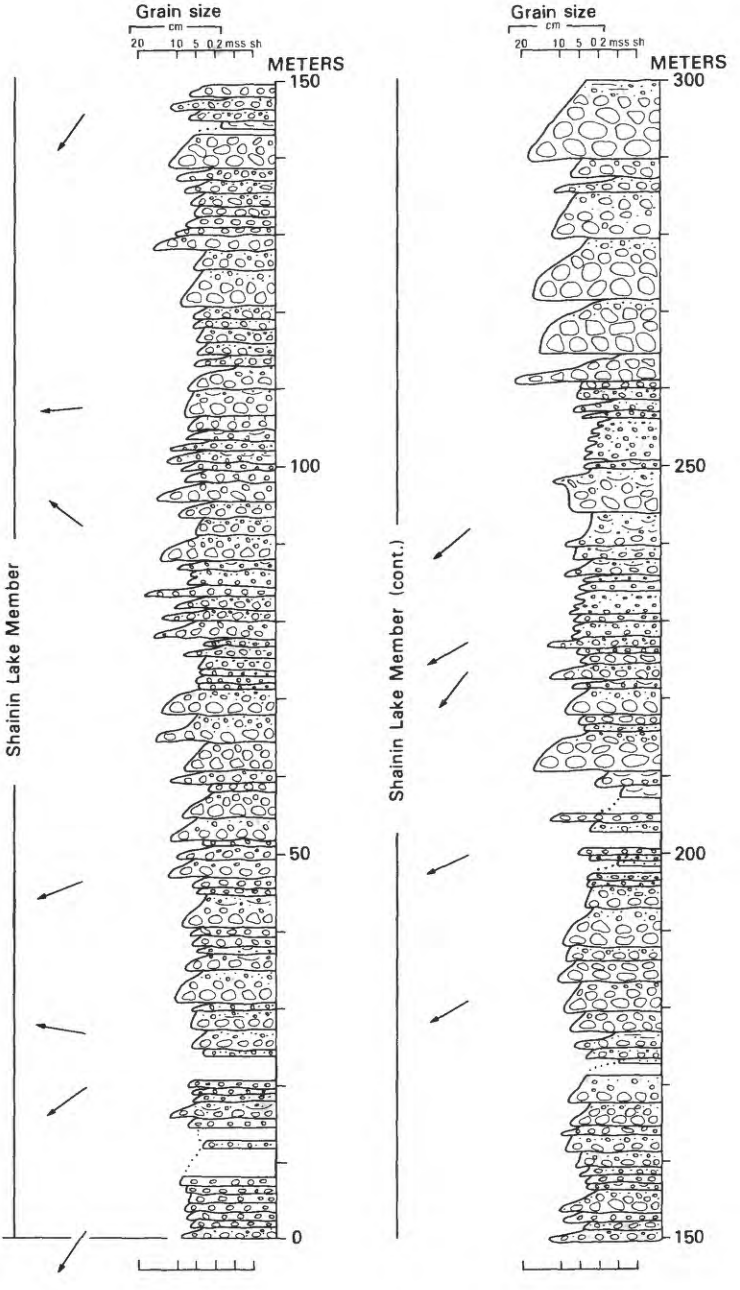

FIGURE 13.—Type section of the Shainin Lake Member of the Kanayut Conglomerate. See figure 11 for explanation of symbols.

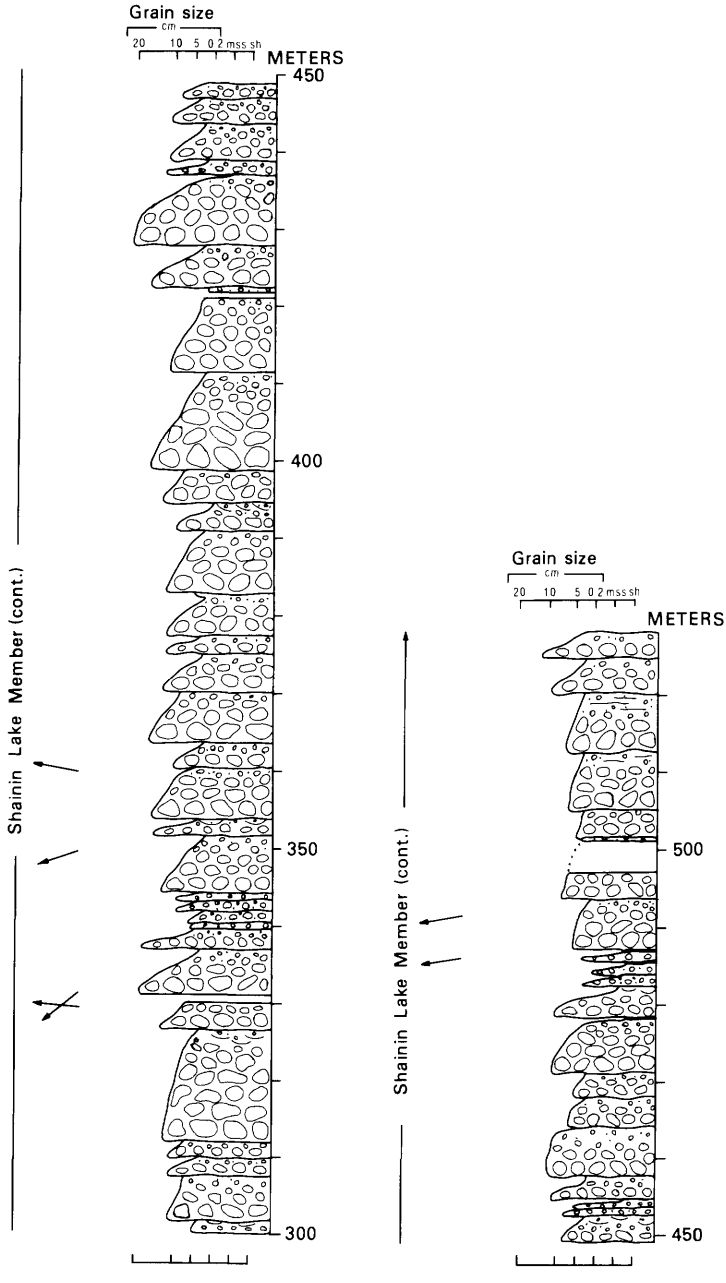

FIGURE 13.—Continued

Kanayut Conglomerate—Continued Shainin Lake Member—Continued	Thickness (m)
Sandstone, fine-grained, parallel-stratified	.20
Pebbly sandstone, trough-cross-stratified; maximum clast size, 1.5 cm	1.10
Siltstone, parallel-laminated to massive	.20
Pebbly sandstone, trough-cross-stratified; maximum clast size, 1 cm	.30
Conglomerate, massive; maximum clast size, 4 cm; erosive base	1.00
Sandstone, fine- to medium-grained, trough-cross-stratified	.35
Conglomerate, massive; maximum clast size, 11 cm; erosive base	3.80
Siltstone, laminated	.10
Conglomerate, massive; maximum clast size, 12 cm; erosive base	7.20
Pebbly sandstone, massive; maximum clast size, 2 cm	.40
Conglomerate, massive; maximum clast size, 6 cm	2.80
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.80
Conglomerate, massive; maximum clast size, 7 cm; erosive base	3.00
Pebbly sandstone, parallel-stratified; maximum clast size, 11 cm	1.20
Conglomerate, massive, mostly covered	4.50
Pebbly sandstone, massive; maximum clast size, 2 cm	.10
Conglomerate, massive; maximum clast size, 12 cm; erosive base	2.80
Siltstone, laminated	.25
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.60
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.10
Conglomerate, massive; maximum clast size, 8 cm; erosive base	.80
Pebbly sandstone, trough-cross-stratified; maximum clast size, 3 cm	1.50
Conglomerate, massive; maximum clast size, 9 cm; erosive base	2.10
Pebbly sandstone, massive; maximum clast size, 3 cm; erosive base	.25
Conglomerate, massive; maximum clast size, 9 cm; erosive base	1.65
Pebbly sandstone, parallel-stratified to massive; maximum clast size, 3 cm	.65
Conglomerate, massive; maximum clast size, 12 cm; erosive base	2.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.40
Conglomerate, massive; maximum clast size, 12 cm; erosive base	4.50
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.20
Conglomerate, massive; maximum clast size, 13 cm; erosive base	1.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.25
Conglomerate, massive; maximum clast size, 21 cm	9.00
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.75
Conglomerate, massive; maximum clast size, 16 cm	5.10
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.30
Covered interval	.80
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.50
Conglomerate, massive; maximum clast size, 11 cm; erosive base	9.20
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.25
Conglomerate, massive; maximum clast size, 16 cm; erosive base	12.50
Conglomerate, massive; maximum clast size, 13 cm; erosive base	4.00
Pebbly sandstone, tabular-cross-stratified; maximum clast size, 3 cm	1.40
Conglomerate, massive; maximum clast size, 9 cm; erosive base	2.15
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.75
Conglomerate, massive; maximum clast size, 12 cm; erosive base	7.50
Pebbly sandstone, massive; maximum clast size, 4 cm	.30
Pebbly sandstone, massive; maximum clast size, 1 cm	.70

Kanayut Conglomerate—Continued	Thickness (m)
Shainin Lake Member—Continued	
Conglomerate, massive; maximum clast size, 12 cm; erosive base	4.30
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.30
Conglomerate, massive; maximum clast size, 12 cm; erosive base	1.90
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.85
Conglomerate, massive; maximum clast size, 12 cm; erosive base	3.80
Conglomerate, massive; maximum clast size, 16 cm	6.75
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.20
Conglomerate, massive; maximum clast size, 10 cm; erosive base	2.70
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	.40
Conglomerate, massive; maximum clast size, 15 cm; erosive base	6.20
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.70
Conglomerate, massive; maximum clast size, 12 cm; erosive base	1.20
Pebbly sandstone, massive; maximum clast size, 3 cm	.25
Conglomerate, massive; maximum clast size, 13 cm; erosive base	7.70
Pebbly sandstone, massive; maximum clast size, 2 cm	.10
Conglomerate, massive; maximum clast size, 10 cm; erosive base	.75
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.15
Conglomerate, massive; maximum clast size, 9 cm; erosive base	1.15
Pebbly sandstone, parallel-stratified; maximum clast size, 1.5 cm	.10
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.25
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.15
Conglomerate, massive; maximum clast size, 5 cm	.60
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	.45
Conglomerate, massive; maximum clast size, 18 cm; erosive base	2.10
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	1.00
Conglomerate, massive; maximum clast size, 18 cm; erosive base	5.00
Pebbly sandstone, massive; maximum clast size, 4 cm	.10
Covered interval	1.00
Conglomerate, massive; maximum clast size, 13 cm; erosive base	3.50
Conglomerate at base to sandstone at top, parallel-stratified to massive; maximum clast size, 3 cm; erosive base	.45
Conglomerate at base to sandstone at top, massive; maximum clast size, 4 cm	.60
Pebbly sandstone, trough-cross-stratified to parallel-stratified; maximum clast size, 5 cm	1.75
Conglomerate, massive; maximum clast size, 12 cm; erosive base	12.00
Conglomerate, massive; maximum clast size, 11 cm; erosive base	2.10
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.05
Conglomerate, massive; maximum clast size, 11 cm; erosive base	2.25
Pebbly sandstone, parallel-stratified; maximum clast size, 7 cm	.45
Conglomerate, massive; maximum clast size, 11 cm; erosive base	5.50
Pebbly sandstone, trough-cross-stratified to parallel-stratified; maximum clast size, 3 cm	.95
Conglomerate, massive; maximum clast size, 5 cm	.60
Conglomerate, massive; maximum clast size, 3 cm	.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.55
Conglomerate, massive; maximum clast size, 18 cm; erosive base	9.00
Conglomerate, massive; maximum clast size, 8 cm; erosive base	2.20
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	.05
Conglomerate, massive; maximum clast size, 11 cm; erosive base	1.80

Kanayut Conglomerate—Continued Shainin Lake Member—Continued	Thickness (m)
Pebbly sandstone, parallel-stratified; maximum clast size, 6 cm	.90
Conglomerate containing thin lenses of pebbly sandstone; maximum clast size, 12 cm; erosive base	5.20
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.25
Conglomerate, massive; maximum clast size, 1 cm	.65
Conglomerate, massive; maximum clast size, 17 cm; erosive base	7.00
Sandstone, medium-grained to very coarse grained, parallel-stratified, lens-shaped	.20
Conglomerate, massive; maximum clast size, 15 cm; erosive base	6.50
Pebbly sandstone, trough-cross-stratified to parallel-stratified; maximum clast size, 3 cm	.25
Conglomerate, massive; maximum clast size, 22 cm; erosive base	3.40
Conglomerate, massive; maximum clast size, 5 cm; erosive base	1.05
Pebbly sandstone, massive; maximum clast size, 5 cm	.60
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.20
Sandstone, medium- to coarse-grained, parallel-stratified	.25
Conglomerate, massive; maximum clast size, 7 cm; erosive base	1.50
Sandstone, fine- to medium-grained, massive	.20
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.20
Pebbly sandstone, parallel-stratified; maximum clast size, 1 cm	.30
Conglomerate with interbedded pebbly coarse sandstone, parallel-stratified to massive; maximum clast size, 5 cm	4.60
Pebbly sandstone, medium- to coarse-grained, trough-cross-stratified; maximum clast size, 3 cm	.35
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.45
Pebbly sandstone, trough-cross-stratified; maximum clast size, 12 cm	2.00
Conglomerate, massive; maximum clast size, 8 cm; erosive base	3.80
Pebbly sandstone, trough-cross-stratified; maximum clast size, 2 cm	4.25
Conglomerate, massive; maximum clast size, 9 cm; erosive base	.25
Pebbly sandstone, trough-cross-stratified; maximum clast size, 7 cm	1.10
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.50
Pebbly sandstone, trough-cross-stratified; maximum clast size, 2 cm	1.95
Conglomerate, massive; maximum clast size, 10 cm; erosive base	.20
Sandstone, medium-grained, parallel-stratified	.15
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.25
Pebbly sandstone, trough-cross-stratified; maximum clast size, 3 cm	.55
Conglomerate interbedded with pebbly sandstone; maximum clast size, 6 cm	.55
Conglomerate interbedded with pebbly sandstone, parallel-stratified; maximum clast size, 6 cm	2.15
Conglomerate, massive; maximum clast size, 9 cm; erosive base	.75
Conglomerate at base to pebbly sandstone at top, parallel-stratified to massive; maximum clast size, 7 cm	1.15
Conglomerate interbedded with pebbly sandstone, parallel-stratified to massive; maximum clast size, 8 cm	2.20
Pebbly sandstone, trough-cross-stratified; maximum clast size, 3 cm	.75

Kanayut Conglomerate—Continued Shainin Lake Member—Continued	Thickness (m)
Conglomerate, massive; maximum clast size, 13 cm; erosive base	.65
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.65
Conglomerate at base to pebbly sandstone at top, massive; maximum clast size, 7 cm; erosive base	1.40
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	.75
Conglomerate, massive, reverse-graded; maximum clast size, 13 cm	1.60
Sandstone, medium- to coarse-grained, trough-cross-stratified	.65
Conglomerate, massive; maximum clast size, 8 cm; erosive base	.10
Pebbly sandstone, massive; maximum clast size, 3 cm	.40
Conglomerate, massive; maximum clast size, 9 cm; erosive base	3.00
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.10
Pebbly sandstone at base to coarse-grained sandstone at top; maximum clast size, 6 cm; erosive base	.35
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	.45
Conglomerate, massive; maximum clast size, 3 cm	.20
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.60
Conglomerate, massive; maximum clast size, 17 cm; erosive base	4.80
Pebbly sandstone at base to coarse-grained sandstone at top, trough-cross-stratified; maximum clast size, 2 cm	1.80
Sandstone, medium-grained, trough-cross-stratified	1.80
Covered interval (probably sandstone)	2.20
Conglomerate, massive; maximum clast size, 13 cm	1.05
Pebbly sandstone, parallel-stratified; maximum clast size, 2.5 cm	1.50
Covered interval	2.00
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.90
Pebbly sandstone at base to coarse-grained sandstone at top; maximum clast size, 3 cm; erosive base	.80
Pebbly sandstone, medium-grained, massive; maximum clast size, 1 cm	.80
Covered interval (probably pebbly sandstone)	1.00
Conglomerate at base to pebbly sandstone at top, massive; maximum clast size, 3.5 cm; erosive base	1.10
Conglomerate at base to pebbly sandstone at top, massive; maximum clast size, 3 cm; erosive base	.75
Pebbly sandstone, massive; maximum clast size, 2 cm	1.50
Conglomerate, massive; maximum clast size, 4 cm; erosive base	1.80
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.40
Conglomerate, massive; maximum clast size, 9 cm; erosive base	4.50
Pebbly sandstone, massive; maximum clast size, 8 cm	.45
Conglomerate, massive; maximum clast size, 9 cm; erosive base	1.40
Conglomerate, massive; maximum clast size, 11 cm; erosive base	2.70
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	1.10
Conglomerate, massive; maximum clast size 9 cm; erosive base	2.70
Conglomerate, massive, reverse-graded; maximum clast size, 12 cm; erosive base	2.55
Sandstone, medium- to coarse-grained, parallel-stratified	.90
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.60
Covered interval	.20

Kanayut Conglomerate—Continued	Thickness (m)
Shainin Lake Member—Continued	
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.85
Covered interval	.15
Pebbly sandstone, massive; maximum clast size, 2 cm	.20
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.55
Sandstone, medium-grained, parallel-stratified	.50
Covered interval (probably pebbly sandstone)	1.50
Pebbly sandstone, massive; maximum clast size, 4 cm	1.90
Conglomerate, massive; maximum clast size, 8 cm; erosive base	1.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.15
Conglomerate, massive; maximum clast size, 8 cm; erosive base	2.80
Conglomerate, massive; maximum clast size, 10 cm; erosive base	1.05
Pebbly sandstone, massive; maximum clast size, 7 cm	.90
Conglomerate, massive, maximum clast size, 8 cm; erosive base	1.25
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	1.10
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.95
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.10
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.55
Conglomerate, massive; maximum clast size, 4.5 cm; erosive base	.50
Pebbly sandstone, trough-cross-stratified; maximum clast size, 1 cm	.50
Conglomerate, massive; maximum clast size, 3 cm; erosive base	.35
Pebbly sandstone, massive; maximum clast size, 2 cm	.25
Conglomerate, massive; maximum clast size, 10 cm; erosive base	2.65
Conglomerate, massive; maximum clast size, 10 cm; erosive base	1.00
Pebbly sandstone, massive; maximum clast size, 2 cm	.40
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.75
Pebbly sandstone, parallel-stratified; maximum clast size, 7 cm	.60
Conglomerate, massive; maximum clast size, 14 cm; erosive base	.95
Conglomerate, massive; maximum clast size, 9 cm; erosive base	1.45
Sandstone, medium- to coarse-grained, parallel-stratified	.10
Conglomerate, massive; maximum clast size, 12 cm; erosive base	1.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.45
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.75
Pebbly sandstone, trough-cross-stratified; maximum clast size, 4 cm	1.05
Covered interval (probably conglomerate)	.75
Conglomerate, massive; maximum clast size, 12 cm; erosive base	4.20
Conglomerate, massive; maximum clast size, 1 cm	.85
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.55
Conglomerate, massive; maximum clast size, 10 cm; erosive base	.35
Pebbly sandstone, massive; maximum clast size, 2 cm	.10
Conglomerate, massive; maximum clast size, 8 cm; erosive base	1.40
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.35
Conglomerate, massive; maximum clast size, 6 cm	1.40
Conglomerate, massive; maximum clast size, 5 cm; erosive base	1.50
Pebbly sandstone, massive; maximum clast size, 3 cm	.40
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.95
Conglomerate at base to pebbly sandstone at top, parallel-stratified; maximum clast size, 7 cm; erosive base	1.00
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.10
Conglomerate, massive; maximum clast size, 10 cm; erosive base	1.00

Kanayut Conglomerate—Continued	Thickness (m)
Shainin Lake Member—Continued	
Conglomerate, massive; maximum clast size, 16 cm; erosive base	2.45
Pebbly sandstone, massive; maximum clast size, 2 cm	.40
Pebbly sandstone, massive; maximum clast size, 3 cm	.80
Conglomerate, massive; maximum clast size, 5 cm; erosive base	1.45
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.50
Conglomerate, massive; maximum clast size, 5 cm	2.50
Conglomerate, massive; maximum clast size, 8.5 cm; erosive base	1.60
Pebbly sandstone, massive; maximum clast size, 2 cm	.30
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.50
Pebbly sandstone, parallel-stratified; maximum clast size, 3.5 cm	.30
Conglomerate, parallel-stratified; maximum clast size, 6 cm; erosive base	.80
Pebbly sandstone, massive; maximum clast size, 3.5 cm	.35
Conglomerate, massive; maximum clast size, 4 cm; erosive base	1.55
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.10
Conglomerate, massive; maximum clast size, 5 cm; erosive base	1.35
Pebbly sandstone, medium- to coarse-grained, parallel-stratified; maximum clast size, 2 cm	.30
Conglomerate, massive; maximum clast size, 4 cm; erosive base	1.00
Pebbly sandstone, medium-grained, parallel-stratified; maximum clast size, 4 cm	.80
Conglomerate, massive; maximum clast size, 7 cm	2.35
Pebbly sandstone, trough-cross-stratified; maximum clast size, 5 cm	.35
Conglomerate, crudely parallel stratified to massive; maximum clast size, 8 cm; erosive base	3.20
Sandstone, medium- to coarse-grained, massive; paleosol at top	.35
Conglomerate, massive; maximum clast size, 7 cm; erosive base	1.50
Pebbly sandstone, coarse-grained, massive; maximum clast size, 1 cm	.10
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.25
Pebbly sandstone, trough-cross-stratified; maximum clast size, 1 cm	.35
Conglomerate, massive; maximum clast size, 8 cm; erosive base	.85
Conglomerate, massive, maximum clast size 2 cm	.15
Conglomerate, massive; maximum clast size, 12 cm; erosive base	1.20
Pebbly sandstone, trough-cross-stratified; maximum clast size, 2 cm	.35
Conglomerate, massive; maximum clast size, 12 cm; erosive base	.95
Conglomerate, massive; maximum clast size, 9 cm; erosive base	.95
Conglomerate, massive; maximum clast size, 8 cm; erosive base	1.50
Conglomerate, massive; maximum clast size, 3 cm	.20
Conglomerate, massive; maximum clast size, 15 cm; erosive base	2.50
Pebbly sandstone, parallel-stratified to low-angle-trough-cross-stratified; maximum clast size, 3 cm	.40
Conglomerate, crudely parallel stratified to massive; maximum clast size, 9 cm; erosive base	1.70
Pebbly sandstone, massive; maximum clast size, 2 cm	1.20
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.90
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	1.20

Kanayut Conglomerate—Continued	Thickness (m)
Shainin Lake Member—Continued	
Conglomerate, massive; maximum clast size, 14 cm; erosive base	2.60
Pebbly sandstone, trough-cross-stratified to tabular-cross-stratified; maximum clast size, 2 cm	.15
Conglomerate, massive; maximum clast size, 10 cm	1.20
Interbedded conglomerate and pebbly sandstone, parallel-stratified to massive; maximum clast size, 7 cm; lens-shaped units	2.10
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.05
Conglomerate, massive; maximum clast size, 8 cm; erosive base	.35
Pebbly sandstone, massive; maximum clast size, 3 cm	.10
Conglomerate, massive; maximum clast size, 18 cm; erosive base	1.15
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.30
Conglomerate, massive; maximum clast size, 10 cm; erosive base	1.35
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.20
Conglomerate, massive; maximum clast size, 13 cm; erosive base	.90
Interbedded conglomerate and pebbly sandstone, crudely parallel stratified to massive; maximum clast size, 12 cm	.90
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.30
Conglomerate, massive; maximum clast size, 11 cm; erosive base	.75
Conglomerate, massive; maximum clast size, 16 cm; erosive base	.35
Sandstone, coarse-grained, parallel-stratified	.55
Conglomerate, massive; maximum clast size, 3 cm; erosive base	.25
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.25
Conglomerate, massive; maximum clast size, 8 cm; erosive base	1.20
Interbedded conglomerate and pebbly sandstone, crudely parallel stratified to massive; maximum clast size, 5 cm	1.40
Pebbly sandstone, parallel-stratified; maximum clast size 2 cm	.10
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.45
Pebbly sandstone, massive; maximum clast size, 2 cm	.20
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.75
Pebbly sandstone, massive; maximum clast size, 2 cm	.25
Conglomerate, massive; maximum clast size, 3 cm; erosive base	.30
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.55
Conglomerate, massive; maximum clast size, 13 cm; erosive base	2.95
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	1.80
Conglomerate, massive; maximum clast size, 15 cm; erosive base	1.70
Conglomerate, massive; maximum clast size, 8 cm; erosive base	3.70
Pebbly sandstone, massive; maximum clast size, 2 cm	.10
Conglomerate, massive; maximum clast size, 12 cm; erosive base	1.50
Conglomerate, massive; maximum clast size, 1 cm; erosive base	1.10
Conglomerate, massive; maximum clast size, 8 cm; erosive base	3.40
Pebbly sandstone, parallel-stratified to low-angle-trough-cross-stratified; maximum clast size, 5 cm	.25
Conglomerate, massive; maximum clast size, 12 cm; erosive base	2.60
Conglomerate, massive; maximum clast size, 3 cm; erosive base	.65
Conglomerate, massive; maximum clast size, 10 cm; erosive base	1.80
Conglomerate, massive; maximum clast size, 12 cm; erosive base	2.20
Pebbly sandstone, massive; maximum clast size, 2 cm	.10
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.50
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.50

Kanayut Conglomerate—Continued Shainin Lake Member—Continued	Thickness (m)
Pebbly sandstone, trough-cross-stratified; maximum clast size, 3 cm; lens-shaped	2.10
Conglomerate, massive; maximum clast size, 9 cm; erosive base	2.00
Conglomerate, massive; maximum clast size, 7 cm; erosive base	1.45
Conglomerate, massive; maximum clast size, 7 cm; erosive base	1.20
Pebbly sandstone, trough-cross-stratified; maximum clast size, 2 cm; lens-shaped	.15
Conglomerate, massive; maximum clast size, 5 cm; erosive base	.55
Pebbly sandstone, trough-cross-stratified; maximum clast size, 3 cm; lens-shaped	.60
Conglomerate, massive; maximum clast size, 8 cm; erosive base	1.60
Pebbly sandstone, parallel-stratified; maximum clast size, 3.5 cm	.90
Conglomerate, massive; maximum clast size, 10 cm; erosive base	3.30
Sandstone, medium-grained to very coarse grained, parallel-stratified, lens-shaped	.10
Pebbly sandstone, parallel-stratified; maximum clast size, 3 cm	.45
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.30
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	1.80
Conglomerate, massive; maximum clast size, 6 cm	.80
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	1.15
Conglomerate, massive; maximum clast size, 6 cm; erosive base	1.40
Pebbly sandstone, parallel-stratified; maximum clast size, 2 cm	.30
Conglomerate, massive; maximum clast size, 3 cm	.40
Covered interval	3.10
Conglomerate, massive; maximum clast size, 7 cm; erosive base	.95
Pebbly sandstone, parallel-stratified to massive; maximum clast size, 1.5 cm	.35
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.45
Pebbly sandstone, massive; maximum clast size, 5 cm	.50
Conglomerate, massive; maximum clast size, 6 cm; erosive base	.45
Pebbly sandstone, parallel-stratified; maximum clast size, 4.5 cm	.45
Pebbly sandstone, parallel-stratified to low-angle-trough-cross-stratified; maximum clast size, 5 cm	1.25
Conglomerate, massive; maximum clast size, 11.5 cm; erosive base	.60
Pebbly sandstone, parallel-stratified; maximum clast size, 5 cm	.25
Conglomerate, massive; maximum clast size, 7 cm	.70
Covered interval	.75
Conglomerate, massive; maximum clast size, 4 cm	.35
Covered interval	.70
Pebbly sandstone, massive; maximum clast size, 3 cm	.75
Covered interval (probably conglomerate)	4.00
Conglomerate, massive; maximum clast size, 9 cm; erosive base	1.20
Conglomerate, massive; maximum clast size, 8 cm; erosive base	.80
Conglomerate, massive; maximum clast size, 7 cm; erosive base	1.15
Conglomerate, massive; maximum clast size, 8 cm; erosive base	1.10
Conglomerate at base to pebbly sandstone at top, massive; maximum clast size, 8 cm; erosive base	.40
Conglomerate at base to pebbly sandstone at top, crudely parallel-stratified to massive; maximum clast size, 7 cm; erosive base	.90
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	.12

Kanayut Conglomerate—Continued	Thickness (m)
Shainin Lake Member—Continued	
Conglomerate, crudely parallel stratified; maximum clast size, 7 cm erosive base	.70
Pebbly sandstone, very coarse grained, tabular-cross-stratified; maximum clast size, 3 cm	.65
Conglomerate, massive; maximum clast size, 9 cm; erosive base	.60
Pebbly sandstone, parallel-stratified; maximum clast size, 4 cm	.25
Total thickness (m)	523.27
Conformable contact	
Ear Peak Member (upper part)	
Covered interval (rubble of conglomerate, pebbly sandstone, sandstone, and shale)	10.00

The conglomerate beds typically have erosional bases, characterized by coarse conglomerate resting on finer conglomerate, conglomeratic sandstone, sandstone, or shale. The conglomerate beds most commonly are massive and characterized by normal size grading of conglomerate clasts, well-developed imbrication, and uniform clast long-axis orientation. The matrix consists of finer conglomerate and sandstone. Clast-supported conglomerate is most typical, although in the finer grained conglomerate and conglomeratic sandstone, matrix-supported conglomerate also is common; nowhere, however, is the matrix mud rich. There is no indication of sediment transport and deposition by debris flows or related processes; all the coarse-grained deposits appear to have resulted from streamflow.

The finer conglomerate typically has parallel stratification that commonly is crudely developed and marked by interlayering of coarser and finer conglomerate. Medium- and large-scale trough cross-strata and planar cross-strata are present in the upper parts of some conglomerate beds but are most characteristic of the conglomeratic sandstone and sandstone units that rest without erosional scour on the beds of massive conglomerate.

The fining-upward sequences of conglomerate to sandstone or shale average about 2 to 3 m in thickness in the lower 260 m of the section, about 7 m in the middle 180 m, and about 4 m in the upper 90 m. These sequences record stream deposition, most likely on a broad braid plain, in which braided streams transporting very coarse debris spread out over a broad aggrading depositional surface. There is no evidence for deposition by meandering streams, and no indication for the development of fining-upward point-bar cycles. The absence of significant thicknesses of shale indicates that extensive fine-grained flood-plain deposits were not formed. The massive and parallel-stratified beds of conglomerate probably represent longitudinal gravelbars formed on the braid plain. The trough- and planar-cross-stratified beds probably represent transverse bars and dunes as well as deposits laid down on

the downstream flanks of longitudinal bars. The thin shale intervals in the upper part of the section probably represent drapes of mud deposited over bars during postflooding lowering of stream levels. In most of the sections, these mud drapes, if deposited, were probably eroded away before or during deposition of the overlying bed of conglomerate.

A total of 18 paleocurrent measurements from the type section of the Shainin Lake Member have an azimuthal-vector mean and standard deviation of $249° \pm 25°$. These measurements include 15 sites of clast long-axis orientation and imbrication, two sets of tabular cross-strata, and one set of trough cross-strata. Because the unidirectional indicators show southwestward sediment transport, the bidirectional indicators have been preferentially assigned a similar transport direction.

STRATIGRAPHIC RELATIONS

The basal and upper contacts of the Shainin Lake Member most commonly are sharply defined but locally are gradational, indicating interfingering of the massive conglomerate and sandstone with shale-rich fining-upward cycles of the Ear Peak and Stuver Members. The basal contact represents southwestward progradation of the Shainin Lake Member over the Ear Peak Member, and the upper contact northeastward retrogradation or retreat of the Shainin Lake Member (fig. 8).

THICKNESS

The Shainin Lake Member appears to be thickest at its type section near Shainin Lake in the central Brooks Range, where a thickness of 526 m was measured (fig. 13); it appears to thin eastward, westward, and southward from there. The westernmost measured section, at Iteriak Creek, is 85 m thick (Nilsen and others, 1981, fig. 7, sec. 12), and the easternmost measured section, at the Junjik River, is 255 m thick (Nilsen and others, 1981, figs. 6*B*, 6*C*, sec. 11, loc. 79B-136). Other thicknesses measured in the central Brooks Range include 155 m near the Atigun River and 400 m along the west side of the John River. Incomplete measured sections of the Shainin Lake Member yield minimum thicknesses of 70 m near Kollutarak Creek (Nilsen and others, 1980, fig. 5, sec. 5, loc. 78B-111), 305 m near Chandler Lake (Nilsen and others, 1980, fig. 7, sec. 7, loc. CHA), 165 m near the Anaktuvuk River, and 530 m near the Killik River.

DEPOSITIONAL ENVIRONMENT

The Shainin Lake Member was deposited in a fluvial environment, primarily by southwest-flowing braided streams. The member consists

chiefly of fining-upward couplets of conglomerate and sandstone that are discontinuous laterally and characterized by abundant small channels. Shale is present in minimal amounts or absent. Paleosols or oxidized zones are present locally but are not well developed. The Shainin Lake Member appears to form a broad wedge- to lens-shaped body that is thickest in its central area and wedges out completely into meandering-stream deposits of the Ear Peak and Stuver Members to the southwest. We interpret the Shainin Lake Member to have been deposited on a broad braid plain during deposition of the middle part of the the Kanayut Conglomerate.

AGE AND CORRELATION

No age-diagnostic fossils have been recovered from the Shainin Lake Member. Plant fragments that are typically large single pieces of stems or roots are locally present. On the basis of its stratigraphic position, however, we believe that the member is Late Devonian, equivalent to part of the marine Famennian Stage.

The Shainin Lake Member may be correlative with and form part of the Noatak Sandstone of the western Brooks Range (fig. 8). It also correlates with, but is separated by major faults from, the Nation River Formation of east-central Alaska and the upper part of the Imperial Formation of the Yukon Territory and Northwest Territories of Canada.

STUVER MEMBER

DEFINITION

The Stuver Member of the Kanayut Conglomerate was previously named by Bowsher and Dutro (1957) for the uppermost part of the Kanayut Conglomerate. They described it, designated and measured a type section for it on a ridgecrest southeast of Shainin Lake, and provided some data on its areal extent, age, and correlation. The name "Stuver" is taken from nearby Mount Stuver, which has an elevation of 6220 ft and is 19 km northeast of Anaktuvuk Pass. Mount Stuver was named by F. G. Schrader or W. J. Peters of the U.S. Geological Survey in 1901 for Charles H. Stuver, a member of their field party. On the basis of more extensive mapping, remeasurement of the type section, and measurement of numerous additional sections, we herein redefine and redescribe the Stuver Member. Although we retain most aspects of the original definition of the Stuver Member by Bowsher and Dutro (1957), we define (stratigraphically extend) the basal part of the

member to include part of the former middle conglomerate member of the Kanayut Conglomerate (see fig. 9).

The Stuver Member is the uppermost member of the Kanayut Conglomerate. It rests gradationally on the Shainin Lake or Ear Peak Member and is overlain, in most places abruptly but conformably, by the marine Kayak Shale. The redefined lower boundary of the Stuver Member in the central and eastern Brooks Range, where the unit rests on the Shainin Lake Member, is placed at the base of the lowest conspicuous fining- and thinning-upward cycle, if well defined by a shale break, or at the base of the lowest shale interval thicker than 5 m. The basal contact essentially represents a change upward from deposition of massive interbeds of conglomerate and sandstone of the Shainin Lake Member to deposition of fining-upward cycles consisting, in ascending order, of conglomerate, sandstone, siltstone, and shale or mudstone. The lower boundary in the western and southern Brooks Range, where the Shainin Lake Member is missing, is generally not recognizable, and the Ear Peak and Stuver Members cannot be differentiated.

The upper boundary of the Stuver Member is generally abrupt and is defined by the lowest occurrence of fine-grained quartzose sandstone containing marine trace fossils or megafossils, extensive small-scale oscillation-ripple markings, and flaser bedding above the uppermost fining- upward cycle of the nonmarine Stuver Member. The Stuver Member typically contains conglomerate or medium-grained to very coarse grained sandstone in the basal parts of its repetitive fining-upward cycles, whereas the basal sandstone member of the Kayak Shale is a fine-grained quartzose sandstone overlain by black marine shale containing a characteristic marine megafossil assemblage. In the Atigun River area and several other places, the contact is gradational rather than abrupt and is contained within an interval of interbedded conglomerate and very fine grained sandstone with wave ripples. This interbedded interval forms a thick cycle at the top of the Stuver Member that has nonmarine plant-bearing shale below and marine megafossil-bearing shale above (Nilsen and others, 1982). Where the contact is clearly gradational and interfingering, we arbitrarily place it at the top of the uppermost conglomerate interval.

AREAL EXTENT

The Stuver Member extends across almost all the eastern and central Brooks Range in which the Kanayut Conglomerate has been mapped, where it forms the uppermost nonmarine deposits. We have measured sections of it as far east as the Junjik River, where a partial section 185 m thick was measured (loc. 79B-136 of Nilsen and others,

1981), and as far west as Iteriak Creek, where a partial section about 45 m thick was measured (Nilsen and others, 1981, figs. 6*C*, 7, loc. 79B-70). West and south of Iteriak Creek, where the underlying Shainin Lake Member pinches out, neither we (Nilsen and others, 1982) nor Nelson and Grybeck (1980) have distinguished the Stuver Member from the rest of the Kanayut Conglomerate.

TYPE SECTION

The type section for the Stuver Member was designated and measured by Bowsher and Dutro (1957); it is about 1 km south-southeast of Mount Wachsmuth in sec. 16, T. 13 S., R. 5 E., Chandler Lake quadrangle (figs. 5, 14). We remeasured this type section during the 1978 field season (Nilsen and others, 1980, fig. 6, sec. 6, loc. STU) and present it herein in graphic form, similar to the type sections of the Ear Peak and Shainin Lake Members (fig. 15).

	Thickness (m)
Kayak Shale (lower part)	
Basal sandstone member	
Sandstone, very fine grained to fine-grained, with interbedded shale and siltstone; sandstone contains current ripple marks, interference ripple marks, linguoid ripple marks, wavy laminations, small-scale herringbone cross-strata, shale rip-up clasts, flaser bedding, and forms beds that are 1 to 5 cm thick; shale and siltstone form thin drapes over ripple-marked and wavy-laminated sandstone beds that are 0.1 to 2.0 cm thick; bioturbation common, particularly by *Skolithos*	13.40
Conformable contact	
Kanayut Conglomerate	
Stuver Member	
Siltstone and shale, laminated to massive, reddish-black, poorly exposed	6.65
Sandstone, very fine grained to fine-grained, parallel-stratified and current-ripple-laminated, carbonaceous, with scattered plant-fossil fragments	2.25
Shale, black, laminated to massive, carbonaceous, containing scattered plant-fossil fragments and some plant roots in growth position	2.20
Sandstone, fine- to medium-grained at base and very fine grained to fine-grained at top, cross-stratified and current-ripple-laminated, containing abundant plant roots in growth position and scattered plant fragments	8.60
Covered interval (probably shale)	5.50
Pebbly sandstone, medium- to coarse-grained, massive; maximum clast size, 5 cm	5.00
Conglomerate, massive; maximum clast size, 13 cm	1.20
Shale and some silty very fine grained sandstone, massive, mottled, containing paleosols, red	1.35
Pebbly sandstone, coarse-grained, trough-cross-stratified to massive; maximum clast size, 1 cm	.95
Conglomerate, massive; maximum clast size, 3 cm; lens-shaped	.15

Kanayut Conglomerate—Continued	Thickness (m)
Stuver Member—Continued	
Pebbly sandstone, coarse-grained, trough-cross-stratified to massive; maximum clast size, 1 cm	1.05
Pebbly sandstone at base to sandstone, coarse-grained, and granule conglomerate at top, trough-cross-stratified; maximum clast size, 2 cm; erosive base	.60
Sandstone, fine- to medium-grained, massive	.45
Sandstone, fine- to medium-grained, massive, containing scattered lenses of pebble conglomerate in lower part; maximum clast size, 1 cm; paleosol at top	.60
Sandstone, very fine grained, massive, mottled, pyritic; paleosol in part	.12
Sandstone, medium-grained to very coarse grained, with scattered pebbles in lower part, pyritic; maximum clast size, 2 cm; paleosol at top	.88
Conglomerate, massive; maximum clast size, 4 cm; erosive base	.30
Conglomerate at base to sandstone, fine-grained, at top; maximum clast size, 3 cm; paleosol at top; erosive base	1.12
Shale and siltstone, massive, with scattered plant-fossil fragments, containing paleosols throughout, red, brown, and orange	7.80
Shale, laminated to massive, containing some paleosols and abundant plant-fossil fragments, black	.85
Sandstone, fine-grained, laminated and current-ripple-marked; paleosol at top	.60

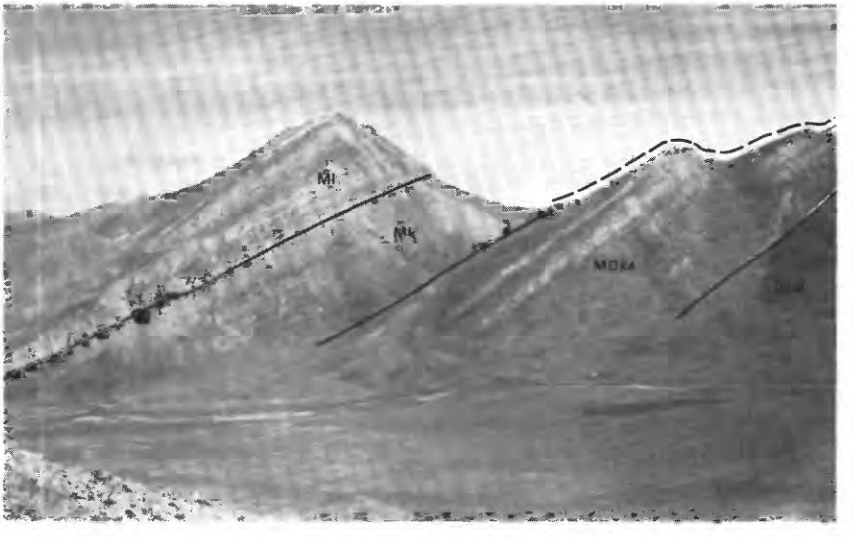

FIGURE 14.—Measured type section of the Stuver Member of the Kanayut Conglomerate southeast of Shainin Lake. Heavy dashed line denotes location of measured section. Kanayut Conglomerate: Dksl, Shainin Lake Member; MDks, Stuver Member; Mk, Kayak Shale; Ml, Lisburne Group. View westward. Photograph by J. T. Dutro, Jr.

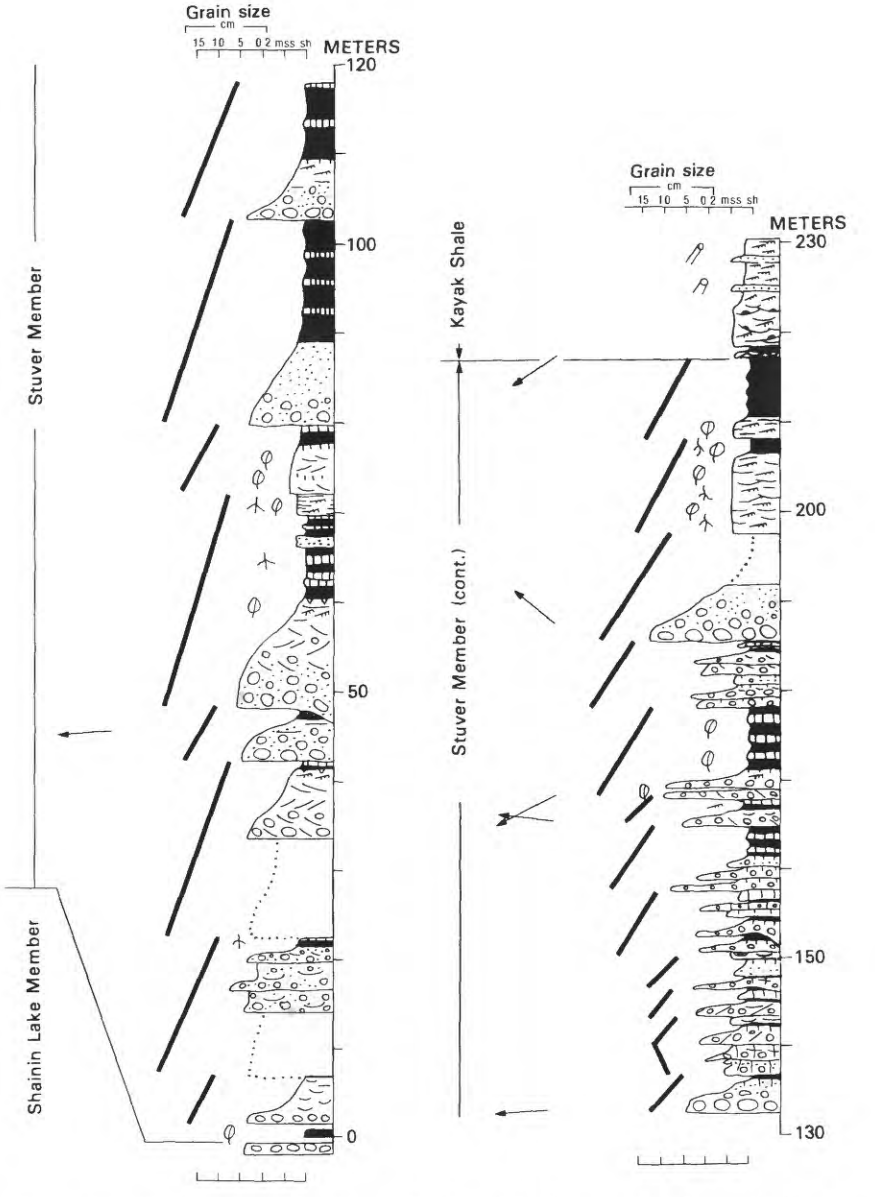

FIGURE 15.—Type section of the Stuver Member of the Kanayut Conglomerate. See figure 11 for explanation of symbols.

Kanayut Conglomerate—Continued Stuver Member—Continued	Thickness (m)
Conglomerate, massive; maximum clast size, 9 cm; slightly erosive base	.35
Siltstone and sandstone, very fine grained, laminated to massive; containing scattered plant-fossil fragments	.10
Conglomerate, cross-stratified; maximum clast size, 10 cm; erosive base	1.45
Pebbly sandstone, coarse-grained, massive; maximum clast size, 4 cm; slightly erosive base	.15
Sandstone, very fine grained, silty, laminated and locally current-ripple laminated to massive; containing some paleosols	1.30
Pebbly sandstone, trough-cross-stratified; maximum clast size, 2 cm	.75
Conglomerate, cross-stratified; maximum clast size, 6 cm; erosive base	.86
Shale, silty, massive, mottled; containing paleosols throughout, red to brown	3.45
Sandstone, medium-grained, massive, pyritic, with scattered pebbles; maximum clast size, 1 cm; paleosol at top	1.40
Sandstone, very fine grained, laminated; containing paleosols throughout, brown	.30
Sandstone, fine- to medium-grained, massive, pyritic; containing paleosols throughout	.25
Conglomerate, massive; maximum clast size, 3 cm; erosive base	.08
Conglomerate at base to pebbly sandstone, coarse-grained, at top, parallel-stratified to massive; maximum clast size, 3 cm; erosive base	.73
Sandstone, fine- to medium-grained, massive, pyritic; containing some paleosols	.52
Conglomerate, massive; maximum clast size, 8 cm; erosive base	.75
Sandstone, very fine grained to fine-grained, massive, mottled; containing some paleosols	1.05
Sandstone, fine-grained, massive; slightly erosive base	.10
Shale and siltstone, laminated to massive; containing mud cracks and paleosols	.22
Sandstone, fine-grained, massive; paleosol at top	.42
Conglomerate, massive; maximum clast size, 2 cm; slightly erosive base	.10
Sandstone, medium-grained, massive; containing some paleosols	.92
Shale and siltstone, massive to laminated; containing some thin laminae of sandstone, very fine grained, and some paleosols	.68
Sandstone, fine- to medium-grained, massive; some paleosols in upper part	.80
Conglomerate, massive; maximum clast size, 3 cm; strongly erosive base	.35
Shale, silty, fissile; containing minor paleosols, gray to red	.98
Conglomerate at base to pebbly sandstone, fine grained, massive; maximum clast size, 2 cm; erosive base	.85
Sandstone, fine-grained, at base to siltstone at top, massive; containing some paleosols	.82
Shale, massive, red	.05

Kanayut Conglomerate—Continued Stuver Member—Continued	*Thickness (m)*
Sandstone, very fine grained to fine-grained, laminated to massive; containing some paleosols	1.15
Sandstone, medium-grained, massive; erosive base	.55
Sandstone, very fine grained, silty, massive; containing some paleosols	.08
Sandstone, medium-grained to very coarse grained, trough-cross-stratified; erosive base	.32
Sandstone, medium-grained to very coarse grained, massive, mottled, pyritic; containing some paleosols	.15
Conglomerate, cross-stratified to massive; maximum clast size, 4 cm; strongly erosive base	.44
Sandstone, fine-grained, at base to siltstone at top, massive; containing some paleosols	.10
Sandstone, medium-grained to very coarse grained, massive; containing paleosols at top; slightly erosive base	.10
Sandstone, silty to fine-grained, mottled; containing paleosols	.10
Sandstone, fine- to medium-grained, trough-cross-stratified	.88
Shale and siltstone, massive to laminated, locally mottled; containing some laminae of sandstone, very fine grained, and some paleosols	.10
Pebbly sandstone, coarse-grained, trough-cross-stratified, pyritic; containing some paleosols; maximum clast size, 2 cm	.30
Conglomerate at base to sandstone, medium-grained, at top, trough-cross-stratified; maximum clast size, 3 cm; erosive base	1.45
Siltstone, massive	.05
Sandstone, medium-grained, trough-cross-stratified, pyritic, with scattered pebbles; maximum clast size, 1 cm; local paleosols	.65
Sandstone, very fine grained, silty, massive, mottled; containing paleosols	.48
Conglomerate at base to pebbly sandstone, coarse-grained, at top, trough-cross-stratified; maximum clast size, 2 cm; slightly erosive base	1.95
Sandstone, fine- to medium-grained, mottled, pyritic; containing some trough cross-strata and paleosols	.50
Sandstone, medium-grained, trough-cross-stratified, pyritic, with scattered pebbles; maximum clast size 2 cm; some paleosols	.80
Sandstone, medium- to coarse-grained, massive, mottled, pyritic; containing some paleosols	.08
Conglomerate, massive; maximum clast size, 1 cm; lens-shaped	.07
Sandstone, medium-grained, massive, pyritic; containing paleosol	.05
Sandstone, fine- to coarse-grained, massive to laminated, pyritic; containing some laminae of sandstone, very coarse grained, and some paleosols	.25
Sandstone, medium- to coarse-grained, massive, mottled, pyritic, with scattered pebbles; maximum clast size, 1 cm; some paleosols	1.35
Sandstone, medium- to coarse-grained, massive, mottled, pyritic, with scattered pebbles; maximum clast size, 1 cm; some paleosols	.70

Kanayut Conglomerate—Continued Stuver Member—Continued	Thickness (m)
Shale, massive, mottled, gray	.20
Sandstone, medium-grained, parallel-stratified to massive, locally mottled, pyritic; containing some paleosols	.98
Conglomerate, massive; maximum clast size, 5 cm; erosive base	2.40
Covered interval	14.10
Shale and siltstone, massive; containing some paleosols, red to buff; poorly exposed	9.10
Conglomerate at base grading upward to sandstone, fine-grained; maximum clast size, 3 cm; massive at base to laminated and current-ripple-marked at top; paleosol at top	6.60
Shale and siltstone, massive; containing paleosols; poorly exposed	13.50
Conglomerate at base grading upward to sandstone, very fine grained, at top; maximum clast size, 2 cm; parallel-stratified to massive, poorly exposed	9.60
Siltstone and shale, massive, mottled; containing paleosols, red and brown; poorly exposed	1.95
Sandstone, fine-grained; containing some trough cross-strata; poorly exposed	5.60
Sandstone, very fine grained, silty, thinly stratified to laminated, current ripple-marked, micaceous; with plant roots in place	2.05
Shale and siltstone, massive, mottled; containing paleosol, red	1.00
Siltstone and sandstone, very fine grained, massive, brown; containing paleosol	.28
Shale and siltstone, massive, mottled; with plant roots in place; containing paleosol, red	.63
Siltstone and sandstone, very fine grained, massive; poorly exposed	1.35
Shale and siltstone, massive, mottled; with plant roots in place; containing paleosol, red	3.35
Siltstone, massive, mottled; containing paleosol, red, brown, and orange	1.98
Interbedded very fine sandstone and siltstone, laminated, current-ripple-marked, carbonaceous; containing mud cracks and abundant fossil-plant fragments	2.45
Pebbly sandstone, trough-cross-stratified to massive; maximum clast size, 5 cm; strongly erosive base; poorly exposed	10.00
Siltstone and sandstone, very fine grained, laminated; containing mud cracks, micaceous, brown	.85
Conglomerate and sandstone, very coarse grained, parallel-stratified to massive; maximum clast size, 4 cm; erosive base	4.50
Siltstone and shale, massive, brown	.42
Sandstone, very fine grained to fine-grained, laminated and current-ripple-marked; containing mud cracks, micaceous	.53
Sandstone, medium-grained to very coarse grained, trough-cross-stratified; with scattered pebbles; maximum clast size, 1.5 cm	3.80
Pebbly sandstone, coarse-grained to very coarse grained, trough-cross-stratified; maximum clast size, 3 cm	3.65
Covered interval (scattered fragments of conglomerate and sandstone, medium- to coarse-grained)	10.90

Kanayut Conglomerate—Continued	Thickness (m)
Stuver Member—Continued	
Interbedded sandstone, very fine grained to fine-grained, siltstone, and shale, laminated to massive; containing paleosols; with plant roots in place, micaceous; containing pyrite nodules, red	2.05
Pebbly sandstone, medium- to coarse-grained, trough-cross-stratified; maximum clast size, 3 cm	.78
Conglomerate, massive; maximum clast size, 3 cm; lens-shaped	.10
Pebbly sandstone, medium-grained to very coarse grained, trough-cross-stratified; maximum clast size, 2 cm	2.50
Pebbly sandstone, medium-grained, trough-cross-stratified; maximum clast size, 3 cm	1.50
Conglomerate, massive; maximum clast size, 7 cm; lens-shaped	.20
Pebbly sandstone, medium- to coarse-grained, trough-cross-stratified; maximum clast size, 4 cm	2.50
Covered interval (probably conglomerate)	7.10
Shale, massive, red, mostly covered	.30
Pebbly sandstone, coarse-grained, at base to sandstone, fine-grained, at top, trough-cross-stratified to massive; maximum clast size, 3 cm; poorly exposed	5.45
Covered interval	.90
Shale, locally silty, massive, carbonaceous; containing fossil-plant fragments, black	.83
Covered interval	.75
Total thickness (m)	217.38
Conformable contact	
Shainin Lake Member	
Conglomerate, massive	

The type section as measured by us is 217 m thick, in comparison with the thickness of 287 m measured by Bowsher and Dutro (1957). The section of Bowsher and Dutro (1957, p. 11-13, pl. 3) includes a covered interval at its base of 43 m, whereas our section begins at the first conspicuous exposed interval of shale. Measurement of much of the section down steeply dipping slopes probably also contributed to the differences in thickness. The Stuver Member consists of 14 fining- and thinning-upward cycles that average about 16 m in thickness. Shale, including most covered intervals, composes about 95 m of the section, or 40 percent of the thickness of the Stuver Member. Almost all these cycles begin with conglomerate that has an erosional basal contact with shale. The conglomerate grades upward through cross-stratified sandstone into current-ripple-marked fine-grained sandstone and siltstone and, at the top, shale containing locally abundant paleosols. The shale is most typically black and contains abundant plant fossils but also includes shale with red, orange, yellow, and maroon colors, probably developed under varying conditions of oxidation.

The fining-upward cycles are thicker and better defined in the lower part of the Stuver Member, which contains sequences of shale as thick as 20 m or more. In the interval from 130 to 170 m, these cycles are poorly defined, and the Stuver Member consists of repetitively interbedded conglomerate and sandstone similar in appearance to the Shainin Lake Member; deposition by braided streams may have become dominant again within this interval. The uppermost 50 m of the Stuver Member is relatively fine grained and consists mostly of sandstone and shale. This uppermost interval, however, contains the coarsest clasts in the Stuver, as large as 13 cm, at the base of a fining-upward cycle about 200 m above the base of the Stuver Member.

Five paleocurrent measurements from the type section of the Stuver Member have an azimuthal vector mean and standard deviation of $249° \pm 25°$. These measurements were taken primarily from sites of clast long-axis orientation and imbrication in coarse-grained conglomeratic and cross-stratified sandstone units. Because regional unidirectional indicators in the Stuver Member show southwestward sediment transport, the bidirectional indicators have been preferentially assigned a similar transport direction.

The upper contact of the Stuver Member with the basal sandstone member of the Kayak Shale is well defined. Marine trace fossils, herringbone cross-strata, reactivation surfaces, oscillation ripple marks, flaser bedding, absence of plant fossils, conglomerate, or paleosols, and the presence of very fine grained, well-sorted quartzose sandstone suggest marine deposition, probably under tidal conditions, for the basal part of the Kayak.

STRATIGRAPHIC RELATIONS

The lower boundary of the Stuver Member is marked by an upward change from outcrops of massive beds of conglomerate, sandstone, and little or no shale of the Shainin Lake Member to fining- and thinning-upward cycles of conglomerate, sandstone, siltstone, and shale that characterize the Stuver Member. The basal contact may be either sharp or gradational. We place this contact at the base of the first well-defined fining-upward cycle that contains appreciable shale or at the base of the first shale interval thicker than 5 m.

The upper contact marks the onset of marine transgression over the fluvial deposits of the Kanayut Conglomerate. Although westward-thinning tongues of conglomerate may mark this transition locally (fig. 8), it is generally marked by an abrupt change in grain size from conglomerate-bearing fining-upward cycles to very fine-grained ripple-marked sandstone of the basal sandstone member of the Kayak Shale.

THICKNESS

The Stuver Member varies considerably in thickness from east to west and from thrust plate to thrust plate. In general, it is thin along the north margin of the Brooks Range, from west of the Itkillik River to west of the Killik River. This area includes the type section of Bowsher and Dutro (1957) in the Shainin Lake area, where the Stuver Member is about 217 m thick. East of the Itkillik River, the Stuver Member thickens greatly and reaches a maximum measured thickness of 1,310 m along the Atigun River (Nilsen and others, 1982, fig. 6, sec. 3). East of the Atigun River, we measured a partial thickness of about 185 m along the Junjik River (Nilsen and others, 1981, fig. 6*C*, sec. 11, loc. 79B-136). In the central Brooks Range, we measured thicknesses of 250 m at Chandler Lake (Nilsen and others, 1981, fig. 7, sec. 7, loc. CHA), of 165 m west of the John River, and of 160 m near the Okokmilaga River. In the west-central Brooks Range, we measured only an incomplete thickness of about 45 m of the Stuver Member along Iteriak Creek (Nilsen and others, 1981, fig.7, sec. 12, loc. 79B-70).

DEPOSITIONAL ENVIRONMENT

The Stuver Member was deposited in a fluvial environment, primarily by southwest-flowing meandering streams. The member consists of fining-upward stream-channel cycles of conglomerate, sandstone, and siltstone, alternating with floodplain deposits of siltstone and shale. Paleosols and oxidized intervals are present at the tops of the channel cycles, within the flood-plain sequences, and, locally, within channel fills. Plant fossils are common and are most abundant and well preserved in floodplain shale of the upper part of the Stuver Member.

The Stuver Member locally contains some coarse-grained deposits that appear to be more characteristic of braided-stream deposits. These units are most common in the lower part of the Stuver Member but may also be present in other intervals, as in the type section. The upper contact with the Kayak Shale, as in the section near the Atigun River, may locally consist of interbedded marine and nonmarine deposits that represent interfingering of these two depositional environments.

AGE AND CORRELATION

The age of the Stuver Member can be determined on the basis of its plant fossils and on its stratigraphic relations with overlying and underlying fossiliferous marine strata. Plant fossils from most of the Stuver Member indicate a Late Devonian age (Bowsher and Dutro,

1957; Porter, 1966). However, at a few localities between Shainin Lake and Iteriak Creek, as well as at some localities in the western Brooks Range (I. L. Tailleur, written commun., 1982), species indicative of an Early Mississippian age have been identified (S. H. Mamay, written communs., 1976, 1979). At most of these localities, the plant fossils are in beds at the top of the Stuver Member, but at one locality between Shainin Lake and Anaktuvuk Pass, species indicative of a possible Early Mississippian age have been identified from beds in the lower part of the Stuver (S. H. Mamay, written communs., 1979, 1980; Nilsen and others, 1980).

Marine megafossils from the lower part of the overlying Kayak Shale indicate an Early Mississippian age for that unit (J. T. Dutro, Jr., written communs., 1980, 1981; Nilsen and others, 1980). However, the oldest stage represented by the Kayak is late Kinderhookian, an age permitting the youngest part of the Stuver Member to be early Kinderhookian. Until more convincing paleontologic information is presented, we prefer to consider the Stuver Member as Late Devonian (late Famennian) and Early Mississippian(?) in age.

The Stuver Member is probably correlative with, but separated by major faults from, the Nation River Formation of east-central Alaska and the upper part of the Imperial Formation of the Yukon Territory and Northwest Territories of Canada.

KAYAK SHALE

The marine Kayak Shale stratigraphically overlies the Stuver Member of the Kanayut Conglomerate in the central and eastern Brooks Range. In the western Brooks Range, in the Mulgrave Hills area, Nilsen and Moore (1982) recognized the Kayak Shale resting on the Kanayut Conglomerate. The Kayak there forms a sequence of marine strata that onlaps the Stuver Member as a result of a northward and eastward marine transgression during the Early Mississippian that followed southwestward progradation of the fluvial Kanayut Conglomerate. The type locality of the Kayak Shale is on Mount Wachsmuth, about 2 km east of Shainin Lake (fig. 5), where the unit is about 320 m thick.

At the type locality the Kayak was informally divided into five members, in ascending order: (1) A basal sandstone member, 44 m thick; (2) a lower black shale member, 198 m thick; (3) an argillaceous limestone member, 27 m thick, (4) an upper black shale member, 47 m thick; and (5) a red limestone member, 4 m thick (Bowsher and Dutro, 1957). The three lower members can be traced across most of the north-central Brooks Range, where they are of approximately the

same thickness (Nilsen and others, 1980). Extensive tectonic transport through and over the Kayak Shale, however, has locally affected the thicknesses of some of these members, particularly the lower black shale member. The argillaceous limestone member contains a varied assemblage of brachiopods, bryozoans, echinoderms, mollusks, and ostracodes of Early Mississippian (late Kinderhookian) age. The Kayak Shale grades upward into massive platform limestone of the Lisburne Group.

SUMMARY AND CONCLUSIONS

In this report, we redefine (stratigraphically restrict) the Kanayut Conglomerate, redefine (stratigraphically extend) its Stuver Member, formally name its lower and middle members, and describe the areal extent, thickness, stratigraphic relations, type sections, depositional environments, age, and correlation of these three members with units that are geographically close. The former, informally designated (basal marine) sandstone member is here reassigned to the Noatak Sandstone. The former, informally designated lower shale and middle conglomerate members of the Kanayut are here formally named the Ear Peak Member and the Shainin Lake Member, respectively; and the redefined Stuver Member remains the uppermost member of the Kanayut Conglomerate. As thus redefined, the Kanayut Conglomerate is almost wholly nonmarine and consists of three members deposited mainly by fluvial processes.

The three type sections for the respective members of the Kanayut Conglomerate are in the Shainin Lake area of the central Brooks Range, as is that of the overlying Kayak Shale. The type section of the Noatak Sandstone is in the western Brooks Range, as defined by Dutro (1952, 1953a, b).

The three members of the Kanayut Conglomerate can be mapped and traced across most of the central and eastern Brooks Range in the many thrust plates that constitute its outcrop extent (W. P. Brosgé and others, unpub. data, 1982). In the western Brooks Range the Shainin Lake Member, the coarsest grained unit of the Kanayut Conglomerate, pinches out toward the west and south into a continuous sequence of finer grained fluvial deposits in which the Ear Peak and Shainin Lake Members cannot be distinguished.

The Kanayut Conglomerate was deposited as the result of a major progradation of coarse-grained fluvial deposits to the southwest over finer grained marine deposits. The Shainin Lake Member represents the coarsest outbuilding of this prograding system. This member was deposited on a braid plain of great lateral extent. After the maximum pulse of progradation, the fluvial wedge of sediment retreated and was

eventually overlapped by a transgressing sea in which finer grained marine sediment and, eventually, platform carbonate sediment was deposited. Thus, the Kanayut Conglomerate represents the outbuilding of a very large and coarse-grained dominantly fluvial delta. Its original position before thrusting, and its source area, remain speculative because of problems related to palinspastic reconstructions of the depositional system (Nilsen, 1981).

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