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THE GEOLOGICAL DISTRIBUTION OF CHERT IN THE BROOKS RANGE

by

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THE GEOLOGICAL DISTRIBUTION OF CHERT IN THE BROOKS RANGE

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By C G Mull

ABSTRACT

Geological mapping in the Brooks Range shows that high quality chert for tool making is abundant in sedimentary rocks in a number of areas along the northern flank and particularly in the foothills of the central and western Brooks Range. These cherts are dominantly black, light to dark gray, greenish gray, banded gray to black, or tan. Some distinctive chert colors can be correlated with specific rock units and the geographic distribution of these formations has been mapped; this may help narrow the search for sources of specific lithic types. Minor gray, brown to reddish brown, or bright turquoise blue-green chert is associated with basalt in a few areas on the north side of the range. On the south side of the mountains, minor gray to black chert pebbles in conglomerate are probably derived from a linear belt of basalt. Except in a few isolated localities, chert is not present in the main part of the range itself.

ORIGIN OF CHERT IN THE BROOKS RANGE

To the geologist, chert is considered to be a hard, dense rock composed of microcrystalline or cryptocrystalline silica—SiO2—or silicon dioxide—that breaks with a conchoidal fracture and has a vitreous or glassy luster. This material, when not highly fractured, may yield good raw material for tool making. The term "chert" is also sometimes broadly and loosely used by geologists to describe other dense siliceous rocks that fracture with a dull and somewhat granular appearance, but these rocks are more properly considered silicified mudstone or limestone and do not yield as high a quality of material for tool making. Chert is found dominantly associated and interbedded with fine grained sedimentary rocks that were deposited slowly on the ocean floor, and occasionally is found interbedded with fine grained igneous rock such as basalt that was extruded in the ocean. Chert is not normally found interbedded with coarse grained sediments such as sandstone or conglomerate, nor is it associated with igneous rocks such as granite, or with metamorphic rocks that have been intensely deformed by heat and pressure. Although extrusive basalt with some associated chert is present in the Brooks Range foothills, obsidian, which is an extrusive igneous rock deposited on land, is not known in the Brooks Range.

The original source of the silica in chert is generally thought to be from siliceous sediment derived from micro-organisms such as radiolaria and some varieties of sponges that use silica as skeletal material. Other cherts appear to have formed by replacement of fine-grained limestone or mudstone by silica that migrated through the sediment as it was being compacted and lithified through geological time. Chert is not present in sandstone or conglomerate, except sometimes as pebbles or cobbles recycled from older rocks, because sandstone and conglomerate are deposited rapidly in settings in which the slow rain of silica-bearing organisms is diluted by the abundance of coarse detritus.

The chert in the Brooks Range is commonly found as scattered nodules or elongate lenses in limestone, or as evenly thin bedded and occasionally nodular units interbedded with less silicified thin shale, mudstone, or limestone. The limestone with nodular and lenticular chert is found along the northern flank of the British, Romanzof, Philip Smith, and eastern Endicott Mountains of the eastern and east-central Brooks Range. The thin-bedded cherts and interbedded silicified units are widespread in the foothills along the north side of the Endicott and DeLong Mountains of the central and western Brooks Range. All of these are areas in which the streams flow northward to the Beaufort or Chukchi Sea and may contain chert pebbles and cobbles in the alluvium.

Most of the southern Brooks Range is composed of coarse clastic rocks, metamorphic rocks, and igneous rocks such as granite. None of these rocks contain chert, and the sedimentary rocks in the basins on the south side of the range were derived largely from these non-cherty rocks. However, limestone with chert nodules is present in some of the headwaters of the south-flowing Junjik, East Fork Chandalar, Sheenjek, and Coleen Rivers in the southeastern Brooks Range. Chert-bearing limestone is also present in the headwaters of some of the south-flowing streams that are tributaries of the Noatak River and the Wulik River in the western DeLong Mountains of the western Brooks Range. The alluvium in these drainages may contain chert pebbles and cobbles that could be a source of lithic material. And finally, limestone with chert nodules that could be a source of tool making material is widespread in the Lisburne Hills between Cape Thompson and Cape Lisburne at the extreme western end of the Brooks Range. In addition, a linear belt composed dominantly of basalt that forms the southern flank.of the range may contain minor amounts of gray or black chert.

The drainages that flow through the areas of chert-bearing sediments have been emphasized, because although chert outcrops are abundant in some areas, it seems reasonable that the most likely source of most of the tool-making material for the prehistoric inhabitants of

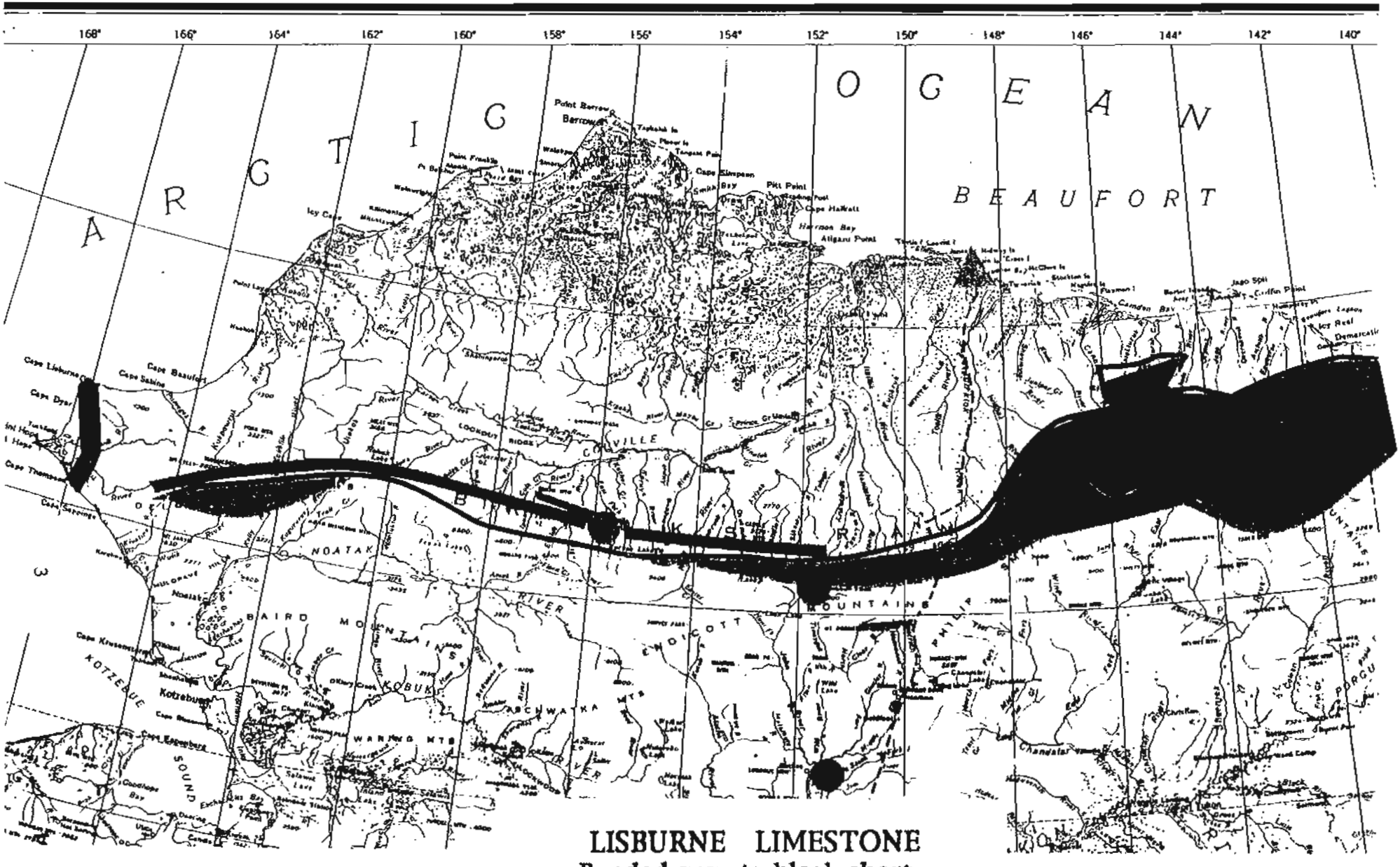

Fig. 1. Distribution of Lisburne Group limestone

northern Alaska was probably from the streams that cut through the outcrops. There, the action of abrasion in the streams tends to concentrate the more resistant materials and make the good material in the river cobbles more obvious to the eye. Nevertheless, I know of one locality in the DeLong Mountains that was obviously a site in which abundant large solid chert nodules were quarried by the prehistoric inhabitants. Ed Hall and I reported on this locality some years ago in the Anthropological Papers of the University of Alaska.

The dominant cherts found in the outcrop in the Brooks Range and its foothills are black, dark gray, light to medium gray, greenish gray, or bluish gray. Light to dark gray to black banded chert is common in some areas; a distinctive dark gray to black chert with a dull tan-colored outer rind is common in other areas. Maroon, red, and bright turquoise blue cherts are found occasionally in outcrop, but are uncommon. These various colors of chert are probably the result of minor impurities that were deposited with the rain of siliceous sediment on the ocean floor or were present when migrating silica moved into and replaced other marine muds. Our work in the Alaska Geological Survey has dealt only with the map distribution of the various rock units in the Brooks Range, and we have not studied chert geochemistry, which shows some distinctive characteristics that probably vary from area to area depending upon the original environment of deposition and the type and concentration of impurities. Chert geochemistry is being studied by Sue Karl of the U.S. Geological Survey in Anchorage and Natasha Selivanova from Rutgers University.

DISTRIBUTION OF CHERT IN THE BROOKS RANGE

Regional mapping throughout the Brooks Range shows that many of the various varieties and colors of chert, some of which are relatively distinctive, are confined to specific formations for which the geographic distribution is fairly well known. Thus, although some of these formations have a fairly wide geographic distribution, in some cases of distinctive chert, it may be possible to point to general regions that could have been the source of the raw lithic materials used by the the prehistoric inhabitants.

Banded light to dark gray and black chert (Lisburne Group)

Gray to black banded chert is probably largely from scattered nodules and lenses in the massive light-gray cliff forming Lisburne limestone, which is the most widespread of the chert-bearing units in the Brooks Range (fig 1).. The Lisburne limestone, of Mississippian and early Pennsylvanian age (about 313 to 350 million years old) is up to 2500 feet thick in some areas. It extends as a nearly unbroken outcrop belt along the northern mountain front westward

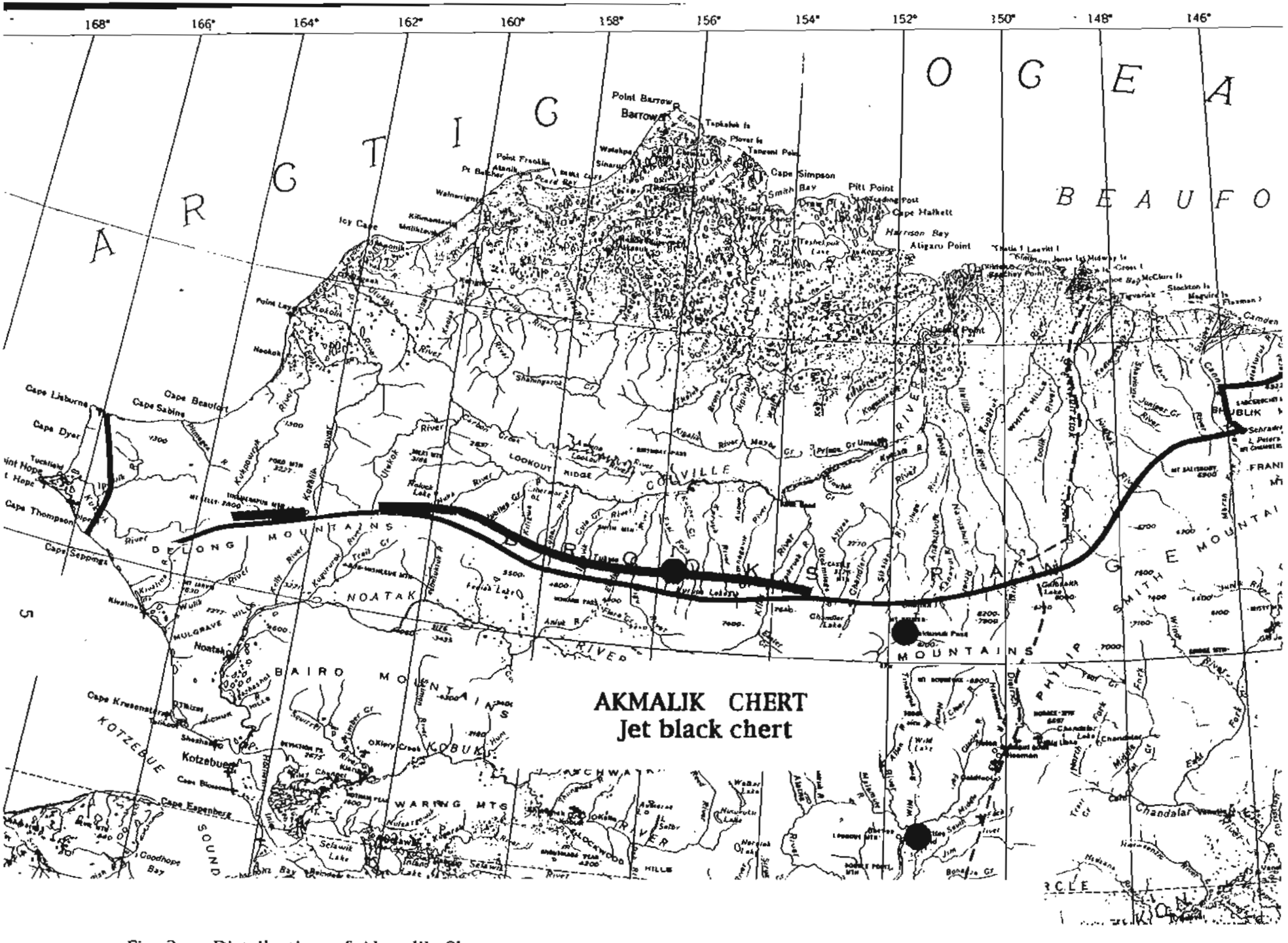

Fig. 2. Distribution of Akmalik Chert.

from the Barn Mountains in the northern Yukon Territory to west of Kurupa Lake in the central Endicott Mountains, near the Mesa Site in the western Killik River quadrangle. It is also present in the south-flowing Kugururok, Kelly, and Wulik Rivers areas in the western DeLong Mountains, in the Lisburne Hills near Pount Hope, and in the upper Junjik, East Fork Chandalar, and Sheenjek River areas in the southeastern Brooks Range.

A word of caution: Large areas in parts of the southern Brooks Range contain conspicuous cliff forming limestone of the Skajit Limestone and the Baird Group. These rocks are particularly prominent between the Dietrich River and East Fork of the Chandalar east of the Dalton Highway, between the John River and the Ambler River and at the head of the Noatak River in the Schwatka Mountains, and in the Igichuk Hills north of Kotzebue. Although these limestones superficially resemble the Lisburne, they are much older and one of their characteristics is the absence of chert. Lithic material found in these areas is almost certainly imported.

Jet black chert (Akmalik Chert)

Deep black chert with no mottling or banding in common along the central Brooks Range mountain front. When examined with a hand lens, it often can be seen to contain scattered finely disseminated spots of pyrite. This distinctive high quality chert is derived from the Akmalik Chert, also of Mississippian age (in this case, about 340-355 million years old). This distinctive formation is relatively thin--less than 250 feet thick--but is composed entirely of thin bedded chert. It is found discontinuously in a relatively narrow band in the foothills from the Okpikruak River at the central Endicott Mountains front (eastern Killik River quadrangle) westward to the Kukpowruk River in the western DeLong Mountains (fig. 2). It is particularly abundant west of the Killik River in the Imnaitchiak Creek and Kurupa Hills areas in thecentral Brooks Range foothills, and also in the DeLong Mountains foothills from NoLuck Lake and the Nuka River area to the upper Utukok River. It is also present in one isolated local area near Porcupine Lake near the head of the Marsh Fork of the Canning River in the eastern Philip Smith Mountains.

Gray and maroon to green chert (Siksikpuk Formation)

Light to dark gray, greenish gray, steel gray, and mottled maroon to pale green cherts of seem to be confined mostly to the Siksikpuk Formation of Permian age (270-300 million years) and Imnaitchiak Chert of Triassic to mid-Pennsylvanian age (about 220-320 million years). Both of these formations are relatively thin (less than 300 feet thick) and contain relatively few solid chert beds but occasional zones with large solid nodules. Discontinuous exposures of

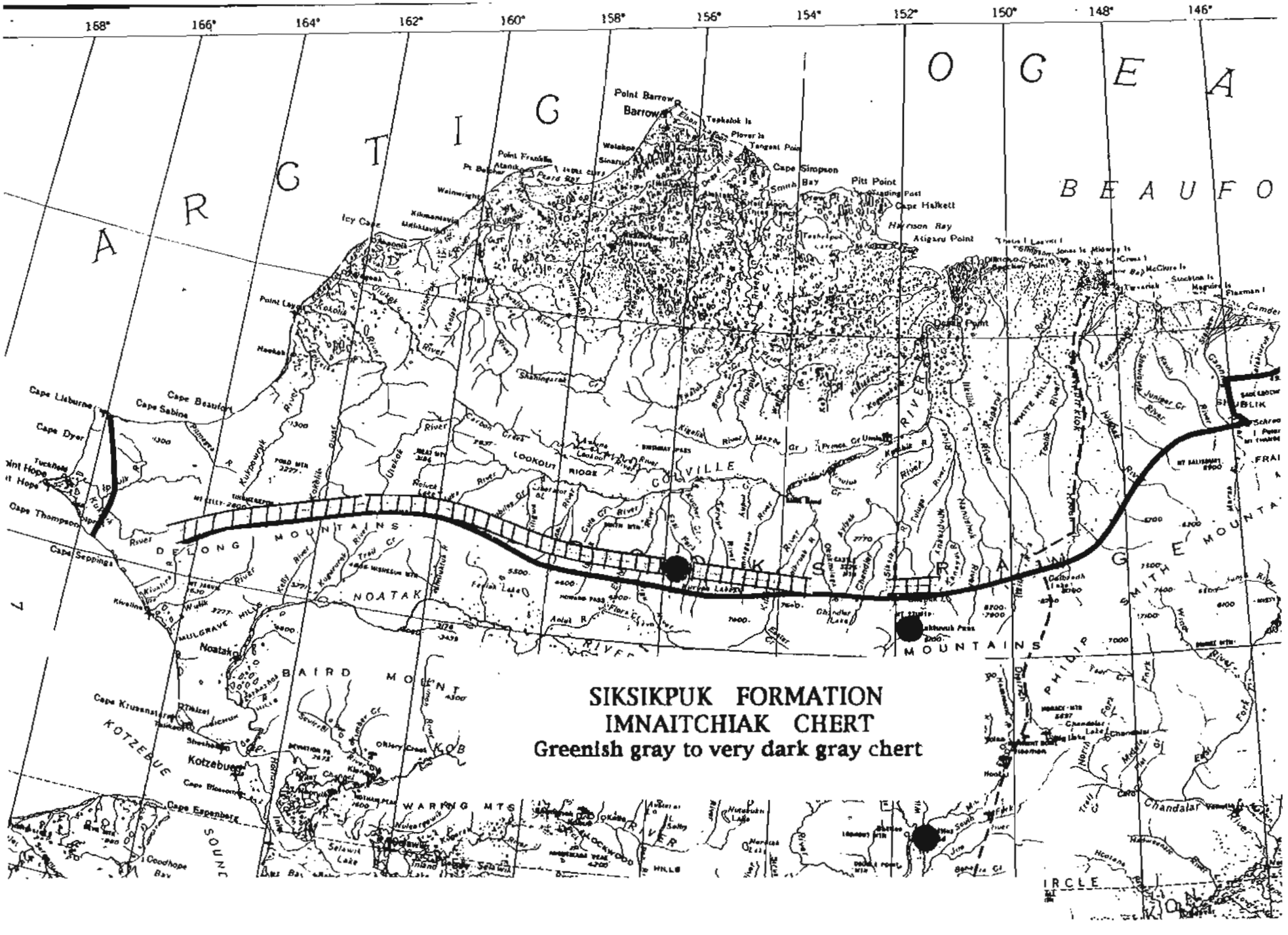

Fig. 3. Distribution of Siksikpuk Formation and Imnaitchiak Chert

cherty beds in these formations are present at the mountain front and in the foothills from just west of the Anaktuvuk River in the central Endicott Mountains west to the Wulik Peaks in the western DeLong Mountains (fig.3). Imnaitchiak Chert is particularly abundant in the foothills west of the Killik River, in the Imnaitchiak Creek and Kurupa Lake area of the central Brooks Range. The quarry site in the DeLong Mountains mentioned previously is in these rocks near the head of the Kelly River and contains a distinctive high quality gray chert with a very uniform color and texture.

Cherts of this age of a quality for tool making are not known in the eastern Brooks Range foothills or mountain front east of the Anaktuvuk River. Siliceous rocks of this age are present on the southern side of the eastern Brooks Range in the Christian River area southeast of Arctic Village, but I do not know if high quality chert is present in these rocks.

Tan to gray to black banded chert (Otuk Formation)

Thin bedded, banded tan to black chert with wispy mottling is widespread in the central Brooks Range foothills. It commonly has distinctive light gray to tan or cream-colored upper and lower bedding surfaces that grade to black in the bed centers. When examined closely with a hand lens, the tan to gray upper and lower bands can commonly be seen to contain tiny translucent light gray spherules about the size of a small pin head. These small spherules are recrystalized radiolaria; although radiolaria are present in other cherts in northern Alaska, they are most visible in the Otuk Formation This distinctive chert is confined to the limestone member of the Otuk Formation of middle and late Triassic age (215-240 million years). This unit is usually less than 50 feet thick but contains a number of 2" to 6" thick beds of the banded chert and limestone; it is relatively resistant and forms conspicuous tan-weathering slopes and hillsides covered with chert rubble. Fossil pelecypod shell fragments are common on some bedding surfaces but are not common in the better quality chert. A lower chert member of the Otuk Formation consists of thin bedded black chert and silicified limestone, but appears to be too intensely fractured to yield good tool making material.

The cherty beds in the Otuk Formation are present discontinuously in many areas along the mountain front and foothills of the Endicott Mountains from the Anaktuvuk River west to the Kuna River area in the western Howard Pass quadrangle (fig. 4).. The Otuk Formation is also present in the DeLong Mountains foothills, but I have not observed high quality chert in the formation in this area. Triassic cherts of a quality adequate for tool making do not appear to be present in the eastern Brooks Range or foothills east of the Anaktuvuk River.

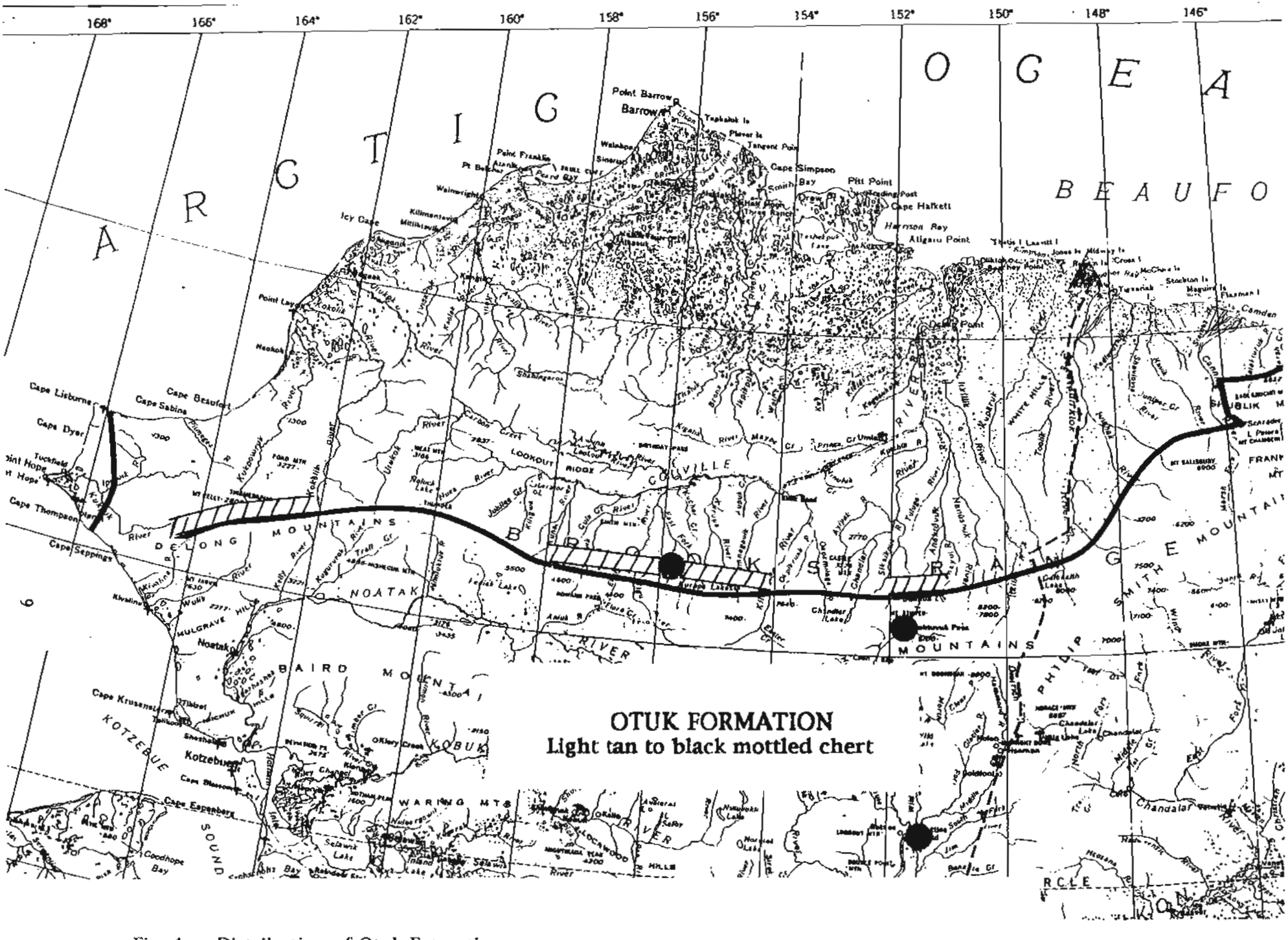

Fig. 4. Distribution of Otuk Formation.

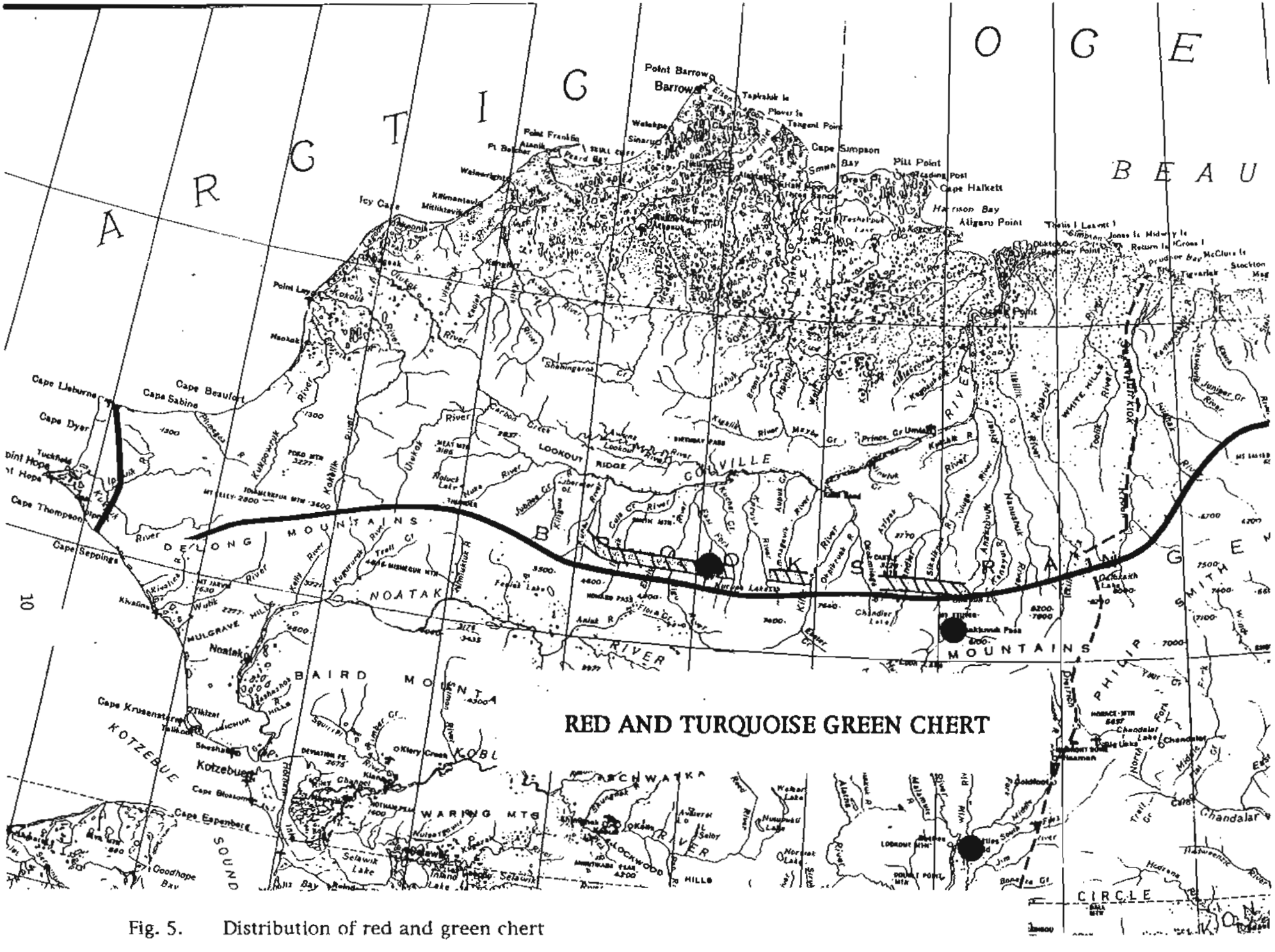

Fig. 5. Distribution of red and green chert

Black chert in the Otuk Formation closely resembles the black chert from the Mississippian Akmalik Formation. In absence of the wispy mottling or black and tan banding that is characteristic of the Otuk cherts, or absence of fine pyrite flecks that are characteristic of the Akmalik chert, the origin of small black tools and flakes may be difficult to determine.

Bright red, maroon, and turquoise green chert:

Distinctive brighly colored red, maroon, and turquoise green chert is uncommon in the Brooks Range foothills, but is conspicuous where present. This chert seems to be closely associated with basalt that is locally present in scattered small isolated exposures in the Endicott Mountains foothills from the Anaktuvuk River west to the Kuna River (fig. 5).

SUMMARY

Chert of a variety of distinctive color and textures is widespread in the northern Brooks Range and foothills, and some distinctive characteristics can be identified with specific formations for which the general distribution is fairly well known. Some of these formations are widely distributed in the Brooks Range and foothills, and identification of the source of much of the chert can probably be narrowed down only to general areas. In addition, there is overlap in the color and textural ranges in some of the cherts, and identification of the source formations of these lithic materials can be given only as a best guess. Nevertheless, in specific cases, our knowledge of the distribution of the siliceous rocks in the Brooks Range may allow closer identification of some of the lithic sources and prehistoric trade routes in northern Alaska.