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THE DOONERAK FENSTER
CENTRAL BROOKS RANGE, ALASKA

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April 1986

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SUBMITTED FOR DNAG CENTENNIAL FIELD GUIDE TO CLASSIC
FIELD LOCALITIES IN THE CORDILLERAN SECTION OF GSA
MASON L. HILL, COORDINATOR

THE DOONERAK FENSTER, CENTRAL BROOKS RANGE, ALASKA

C.G. Mull[1], J.T. Dillon[1], and Karen E. Adams[2]

LOCATION AND ACCESSIBILITY

The Doonerak fenster is located in the central Brooks Range about 55 km (35 mi) south of the Endicott Mountains front. It can be traced for at least 110 km (70 mi) southwest from the Dalton Highway (the Trans-Alaska Pipeline haul road) about 80 km (50 mi) north of the village of Coldfoot. The area is located on the Wiseman and Chandalar 1:250,000 quadrangle maps and the Wiseman D1 and D2 and Chandalar D6 1:63,360 quadrangle maps.

The most significant stratigraphic and structural relationships in the fenster and at the base of the allochthon are best exposed near Mount Doonerak and in the canyon of Amawk Creek 24 to 35 km (15 to 22 mi) west of the Dalton Highway. These areas are most easily reached by helicopter, or by bush planes which can be landed on a gravel bar near the junction of Bombardment Creek and the North Fork of the Koyukuk River. The area is within the Gates of the Arctic National Park, and permission for helicopter access must be obtained in advance from the Superintendent, Gates of the Arctic National Park, P.O. Box 74680, Fairbanks, Alaska 99707.

The easternmost end of the fenster is accessible by foot from the Dalton Highway from between Miles 225 and 226. By wading the Dietrich River, an 8 km (5 mi) hike up Kuyuktuvuk

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Creek or Trembley Creek and a 2000 to 3000 ft. elevation gain gives access to some of the major stratigraphic units exposed in the fenster and at the base of the allochthon. However, in this area, exposures are not as good, and the structure is much more complicated than in the area of Mount Doonerak and Amawk Creek to the west.

Only the base of the Endicott Mountains allochthon is present in the area of the Doonerak fenster. The upper part of the Upper Devonian clastic sequence and the Mississippian to Triassic rocks on the allochthon are best exposed from the Brooks Range crest at Atigun Pass north to the mountain front, and are most easily reached from the Dalton Highway in the northern Endicott Mountains.

SIGNIFICANCE OF LOCALITY

The Doonerak fenster is the most significant locality for understanding the regional structural style and tectonic history of the central Brooks Range. The fenster is a major northeast-southwest trending antiform bounded by the Endicott Mountains allochthon, which to the north forms the northern Endicott Mountains of the central Brooks Range (Fig.1). The core of the fenster contains a distinctive Lower Mississippian to Upper Triassic section that unconformably overlies lower Paleozoic volcanic and metamorphic rocks (Fig. 2). A similar, coeval stratigraphic sequence is found 240 km (150 mi) to the north and northeast in the Arctic Slope subsurface and in outcrop in the northeastern Brooks Range. Rocks in the fenster are overlain by the Amawk thrust, the sole fault of the Endicott Mountains allochthon (Fig.3).

Distinctive features that distinguish the stratigraphic

sequence on the allochthon from the sequence in the fenster include the following: 1) a thick sequence of Upper Devonian deltaic deposits on the allochthon that conformably underlie Mississippian to Jurassic sediments, in contrast to lower Paleozoic argillite and metavolcanic rocks in the fenster that unconformably underlie Mississippian to Triassic sediments.; 2) the presence of siliceous Permian and Triassic strata on the allochthon in contrast to non-siliceous coeval strata in the fenster; and 3) the presence of maroon and green shale with associated siderite and barite nodules in the Permian section on the allochthon, in contrast to correlative dark-gray to black shale in the fenster.

Restoration of the Endicott Mountains allochthon to south of the Doonerak fenster results in a logical reconstruction of the Mississippian therough Triassic depositional basin. A minimum of 88 km (55 mi) of tectonic overlap of the allochthon over the Doonerak fenster is indicated by regional relationships; the actual shortening is at least an order of magnitude greater. Thrust emplacement of the allochthon probably occurred during the Early Cretaceous part of the Brooklan orogeny and was followed by Late Cretaceous folding, which formed the Doonerak antiform.

GENERAL STRATIGRAPHY

Two major depositional sequences are present in the Doonerak fenster. The Lower Paleozoic Franklinian sequence consists of low-rank metasedimentary and metavolcanic rocks, overlain by the Ellesmerian sequence of Mississippian to Triassic age shelf-carbonate and shallow-marine clastic rocks. A regional unconformity at the base of the Mississippian separates the Ellesmerian sequence from the Franklinian

sequence. Details of the stratigraphy in the fenster are given by Dutro and others (1976) and by Mull and others (in press).

In contrast to the rocks of the fenster, the Endicott Mountains allochthon consists of a thick Upper Devonian deltaic sequence conformably overlain by Mississippian to Jurassic shelf carbonate and clastic rocks.

STRUCTURE

The generalized structural relationship between the Doonerak fenster and the Endicott Mountains allochthon is illustrated in Figure 3. The Doonerak fenster is defined by major thrust faults that dip away from the axis of the antiform. The Amawk thrust (Fig. 4), which forms the base of the Endicott Mountains allochthon, can be readily traced from the north flank of the eastern Doonerak fenster around the eastern plunge to the south flank of the antiform. On the north flank, northwest of Mount Doonerak, the Ellesmerian stratigraphic sequence is a complete section with relatively uniform regional north dip broken only by minor faulting. However, to the east, deformation within the Ellesmerian rocks becomes progressively more complex, and is characterized by thrust imbrication and isoclinal folding. Thrust faults have also been identified in the Franklinian sequence; however, these faults may have been pre-Mississippian faults reactivated during the Cretaceous orogeny. In addition, a series of east-west-trending high angle faults cut the Franklinian and Ellesmerian sequences; some of these faults also cut the overlying Amawk thrust and the lower beds of the Endicott Mountains allochthon.

SIGNIFICANT GEOLOGIC LOCALITIES

The locations of some of the most significant structural and stratigraphic features in the Doonerak fenster are plotted on fig 1. and are discussed below.

Franklinian sequence--Pre-Mississippian argillite and Cambrian- Ordovician metavolcanic rocks form the main mass of Mount Doonerak (locality 1) (Fig. 5), and are also well exposed in the canyon of Bombardment Creek (locality 2) and near the head of an unnamed canyon between Mount Doonerak and Wien Mountain (locality 3).

Kekiktuk Conglomerate and Kayak Shale--Kekiktuk Conglomerate and Kayak Shale are generally buried beneath limestone talus from the overlying Lisburne. However, Kekiktuk unconformably overlying the Franklinian sequence is present in several localities near the head of the unnamed canyon between Mount Doonerak and Wien Mountain. (locality 3). Kayak Shale and Kekiktuk Conglomerate are both well exposed on large north-dipping flatirons on the north flank of Amawk Mountain near the head of Amawk Creek (locality 4).

Lisburne Group--Complete sections of the limestone of the Lisburne Group are present in cliff exposures in Bombardment Creek canyon and in the two canyons to the east north of Mount Doonerak (localities 2, 5, and 6) (Fig. 5). The Lisburne is also well exposed on the north side of Amawk Creek canyon (locality 7, Fig. 6).

Sadlerochit Group--Fine-grained calcareous sandstone of the Echooka Formation of the Sadlerochit Group is present on a number of north-dipping flatirons north of Mount Doonerak. One of the best exposures of the Echooka and an overlying black phyllitic shale interval is on the north side of Amawk Creek

canyon (locality 7)(Fig. 6). The trace fossil Zoophycos, which is characteristic of the Echooka in northern Alaska, and scattered brachiopods are present at this locality. The Sadlerochit is also well exposed in a narrow gorge near the mouth of Bombardment Creek (locality 8). The upper part of the section, and the contact with the overlying Shublik Formation is readily accessible in the canyon; however, the lower part of the section is difficult to reach in the very narrow upper part of the gorge. The depositional contact of the Echooka with the underlying Lisburne Group carbonates can be examined just above a waterfall at the head of the gorge. This locality may be reached by climbing above the west side of the gorge.

Shublik Formation and Karen Creek Sandstone--The youngest strata in the Ellesmerian sequence in the Doonerak fenster consist of the Shublik Formation and the Karen Creek Sandstone. These units are exposed at only one locality - near the mouth of the canyon of Bombardment Creek (locality 8). Thin-bedded black earthy limestone and shale of the Shublik is exposed on both sides of the canyon, but the Karen Creek, 2 m thick, is exposed only on the east side of the downstream end of the canyon. Phosphatic nodules and the flat pelecypods Halobia sp. and Monotis sp. are common in the limestone beds of the Shublik.

Amawk thrust--The Amawk thrust is generally not exposed. On the north wall of the Amawk Creek canyon (locality 7)(Fig. 6) it is in a covered interval between the gray limestone cliffs of an imbricate thrust sheet of Lisburne and the overlying argillite of the Beaucoup and Hunt Fork Formations near the base of the Endicott Mountains allochthon. On a low flatiron just west of the mouth of the Amawk Creek canyon (locality 9), the Amawk thrust is in a narrow covered interval between the Lisburne

Group limestone and a schistose quartzite which forms the base of the allochthon. The thrust is also present in some places in the valley of Trembley Creek near the east end of the fenster.

High-angle faults--A high -angle fault that cuts the Franklinian sequence and the Lisburne Group is well exposed in the canyons north of Mount Doonerak (localities 3 and 5) (Fig. 5). North of Falsoola Mountain, high-angle faults also cut the Amawk thrust (locality 10).

Basal beds on the Endicott Mountains allochthon--Intensely deformed phyllite and schist with abundant quartz veining is present in several river bluff exposures along the North Fork of the Koyukuk River both upstream and downstream from the mouth of Bombardment Creek (locality 8). Thick purple and green argillite of the Beaucoup Formation and dark-gray phyllitic shale of the basal Hunt Fork are exposed on the mountain slopes north of the Amawk Creek canyon. (locality 11). (Fig. 6). Isolated blocks of intensely fractured and quartz-veined schistose quartzite and conglomerate are also present in the lower parts of these slopes. The quartzite and conglomerate may be part of the Beaucoup Formation or may be tectonic blocks derived from an unknown source.

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Figure Captions

Figure 1..--Index map of eastern end of Doonerak fenster showing location of major geographic features and significant geologic localities.

Figure 2.--Generalized stratigraphy of Doonerak fenster and Endicott Mountains allochthon.

Figure 3-- Diagrammatic cross section of Brooks Range and Arctic Slope showing generalized relationship of Doonerak fenster and Endicott Mountains allochthon. T--Tertiary; Ku--Upper Cretaceous; Kl--Lower Cretaceous; J--Jurassic; TRM--Mississippian to Triassic; TRD--Devonian to Triassic on Endicott Mountains allochthon; D--Middle and lower Upper Devonian on Endicott Mountains allochthon; Pzl--lower Paleozoic; D€--Devonian to Cambrian; sch--schist; m-um--mafic-ultramafic rocks.

Figure 4--View to the west from Falsoola Mountain along north flank of Doonerak fenster toward Mount Doonerak (center skyline). North-dipping Lisburne Group limestone (PMl) and Kayak Shale and Kekiktuk Conglomerate (Mk) are overlain by the Amawk thrust, the sole fault of the Endicott Mountains allochthon. Base of allochthon consists of Beaucoup Formation and Hunt Fork Shale undifferentiated (Ds), and possible Kanayut Conglomerate (MDk?).

Figure 5--View to southwest, of Mount Doonerak, showing high-angle fault separating lower Paleozoic metavolcanic rocks and argillite (Pzl) from Lisburne Group limestone (PMl) Throw is more than 300 m (1000ft).

Figure 6--View to the east up Amawk Creek canyon showing good exposure of Sadlerochit Group (Ps) beneath imbricate thrust slice of Lisburne Group limestone (PMl). Devonian Hunt Fork Shale (Dhf) and Beaucoup Formation (Db) on lower part of Endicott Mountains allochthon are separated from the Lisburne Group by the Amawk thrust. North-dipping flatirons of Lisburne, Kayak Shale and Kekiktuk Conglomerate depositionally overlie lower Paleozoic rocks (Pzl) on Amawk Mountain (right center skyline).

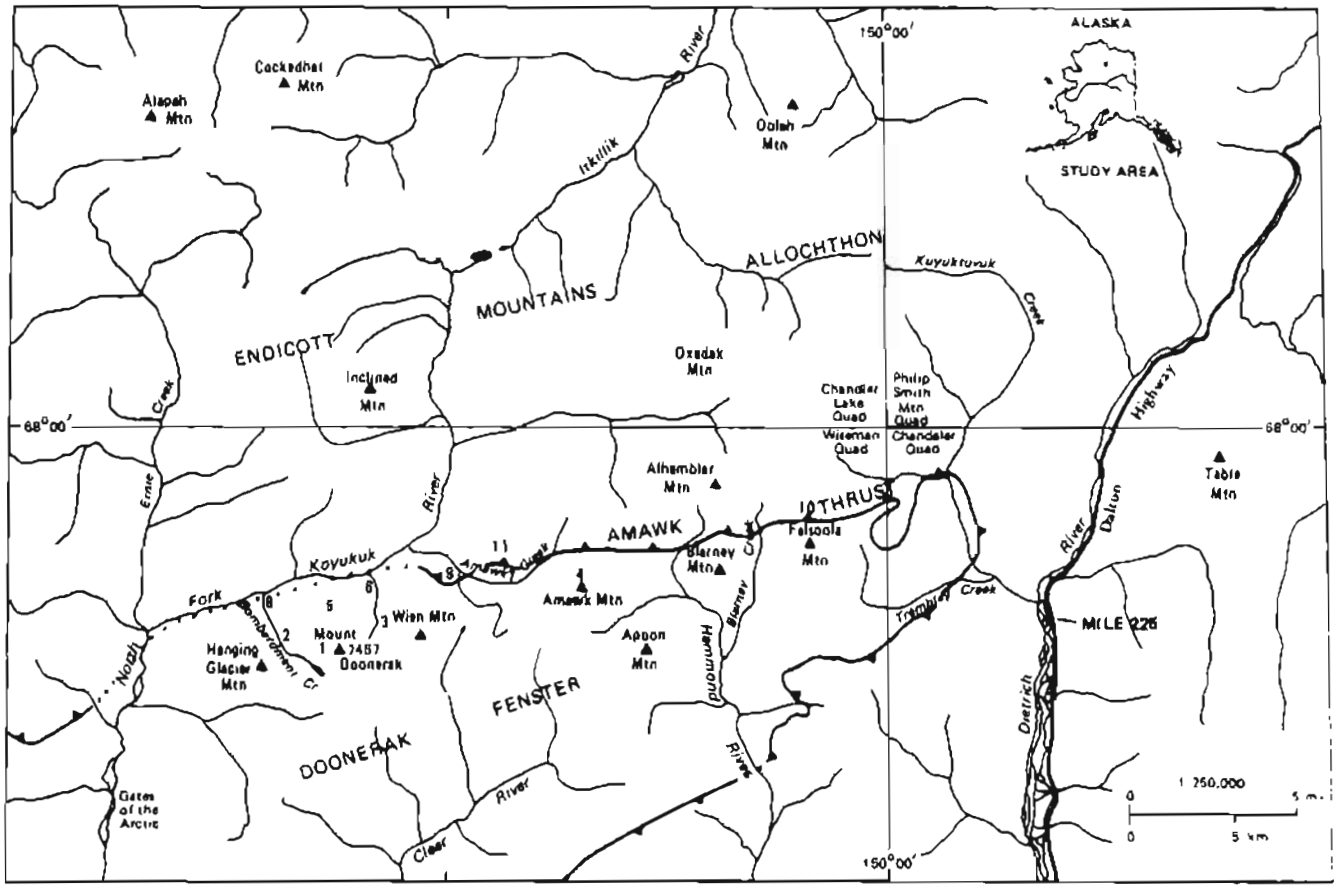

ALASKA
STUDY AREA
150°00'
68°00'
Cockedhat Mtn
Alapah Mtn
Ootah Mtn
Itkillik River
MOUNTAINS
ENDICOTT
ALLOCHTHON
Kuyuktuvuk Creek
Inclined Mtn
Oxdak Mtn
Chandler Lake Quad
Philip Smith Mtn Quad
Wiseman Quad
Chandalar Quad
Ernie Creek
Alhambler Mtn
Koyukuk River
AMAWK
10THRUST
Falsoola Mtn
Blarney Mtn
Blarney Creek
Amawk Mtn
Wien Mtn
Mount Doonerak
Hanging Glacier Mtn
Bonanza Creek
Nolan Creek
Apoon Mtn
Hammond River
FENSTER
DOONERAK
Gates of the Arctic
Clear River
Trimble Creek
MILE 226
Dietrich River
Dalton Highway
Table Mtn
1:250,000
0
5 km

Fig. 1

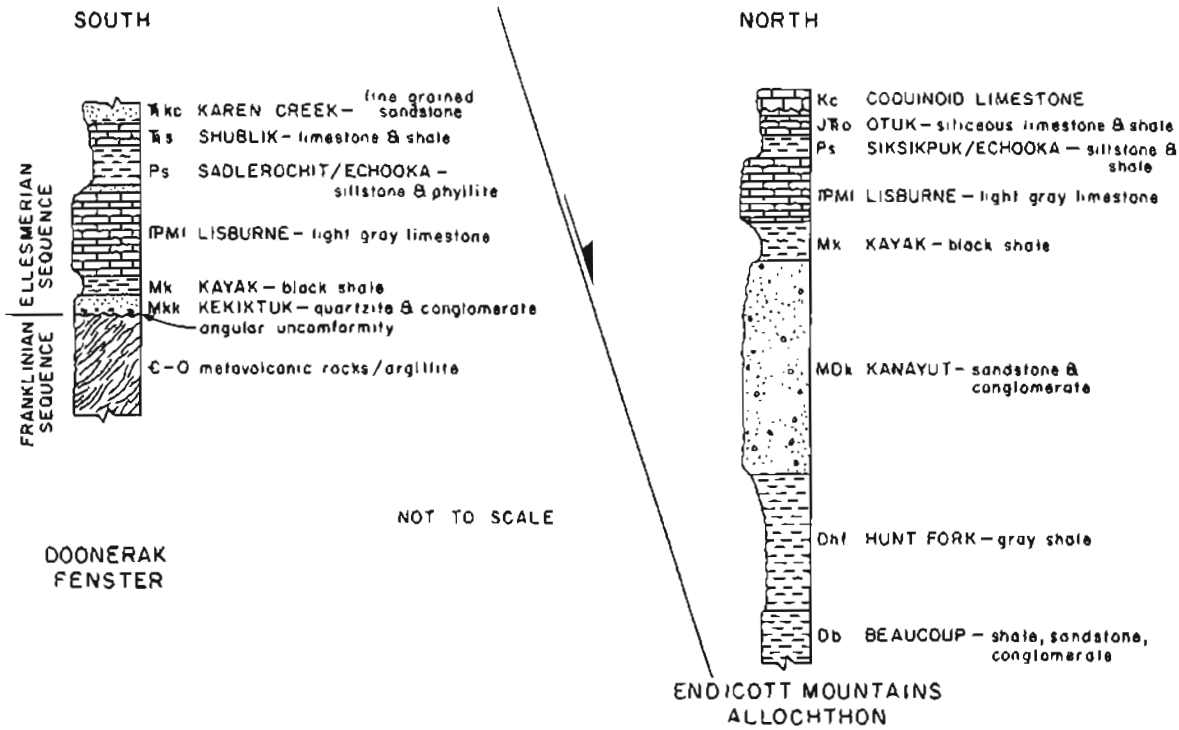
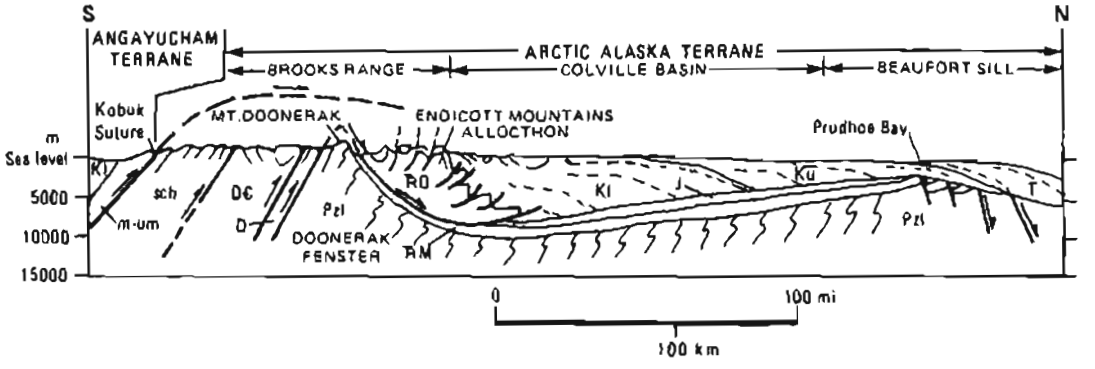

SOUTH
NORTH
ELLESMERIAN SEQUENCE
FRANKLINIAN SEQUENCE
Tkc KAREN CREEK – fine grained sandstone
Ts SHUBLIK – limestone & shale
Ps SADLEROCHIT/ECHOOKA – siltstone & phyllite
PMl LISBURNE – light gray limestone
Mk KAYAK – black shale
Mkk KEKIKTUK – quartzite & conglomerate
angular unconformity
€–O metavolcanic rocks/argillite
NOT TO SCALE
DOONERAK FENSTER
Kc COQUINOID LIMESTONE
JTo OTUK – siliceous limestone & shale
Ps SIKSIKPUK/ECHOOKA – siltstone & shale
PMl LISBURNE – light gray limestone
Mk KAYAK – black shale
MDk KANAYUT – sandstone & conglomerate
Dhf HUNT FORK – gray shale
Db BEAUCOUP – shale, sandstone, conglomerate
ENDICOTT MOUNTAINS ALLOCHTHON

Fig. 2


S
N
ANGAYUCHAM TERRANE
ARCTIC ALASKA TERRANE
BROOKS RANGE
COLVILLE BASIN
BEAUFORT SILL
Kobuk Suture
MT. DOONERAK
ENDICOTT MOUNTAINS ALLOCTHON
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DOONERAK FENSTER
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0
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Fig 3

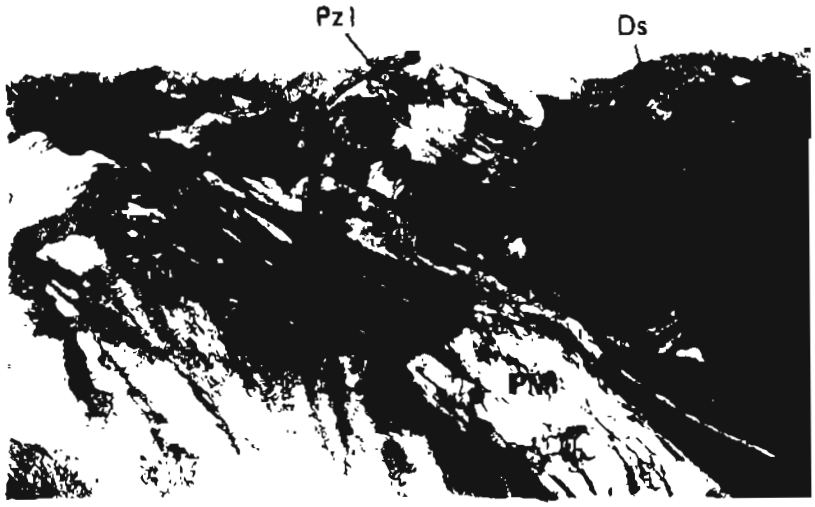
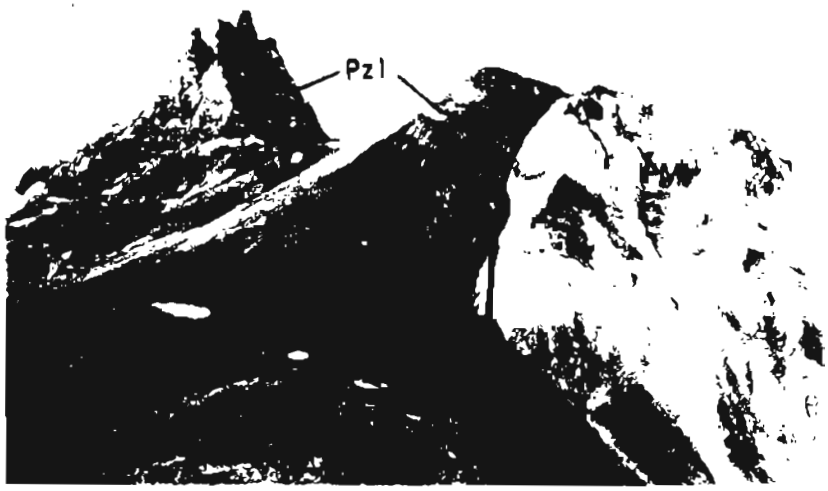


Fig. 7



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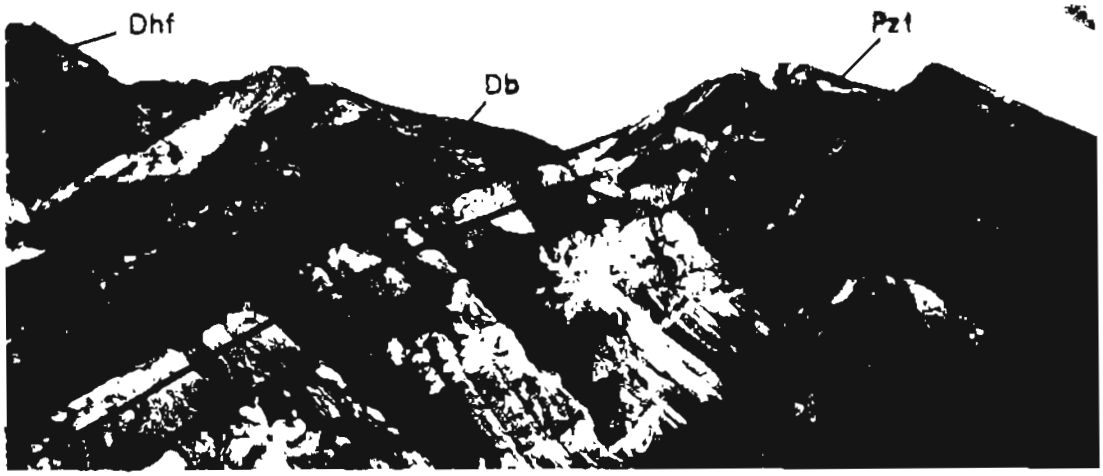
Dhf
Db
Pz1