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James G. Clough, Rocky R. Reifenstuhl, C. Gil Mull, DeAnne S. Pinney, Gregory M. Laird, and Shirley A. Liss

INTRODUCTION

Geologic mapping of the Charley River D-1, C-1 and the northwest corner of the B-1 Quadrangles at 1:63,360 scale (sheets 1, 2 and 3) took place June 13 to June 28, 1995. The study area adjoins 34 miles of the Yukon Territory, Canada border beginning approximately 50 miles north of the Yukon River between latitude ~65°30'N to latitude 66° N (fig. 1). The geology of the Step Mountain area, northwest corner of the Charley River B-1 Quadrangle was included in this study because of its well exposed stratigraphic sections. Geologic mapping was supplemented by interpretation of 1:63,360-scale false-color aerial photographs taken in 1982 and 1986 and 1:45,000-scale black and white aerial photographs taken in 1955.

Additional 1:63,360 scale geologic maps produced as part of this study include: (1) interpretive bedrock geologic maps (Clough and others, 1995); (2) surficial geologic maps (Pinney and others, 1995a); (3) derivative geologic-materials maps (Pinney and others, 1995b); and (4) geologic hazards maps (Pinney and others, 1995c).

The study area is unpopulated and roadless with access primarily by helicopter. Topography ranges from 1,000 ft above sea level in river and stream valleys to 3,500 ft elevations on mountain tops. Ridges below 2,200- to 3,000-ft elevations are heavily wooded with boreal forests dominated by black spruce. Outcrops are generally restricted to ridges and stream and river cuts. A traverse by boat down the Kandik River through the map area made accessed excellent river exposures.

GEOLOGICAL SUMMARY

The project area has 13 bedrock map units and 12 unconsolidated map units which range in age from lower(?) Paleozoic to Holocene. Complete map unit descriptions are provided on sheets 1 and 2 and are summarized below. Field station locations and traverses are shown on sheet 3. The quadrangles studied are situated at the northern edge of the Kandik Basin / Charley River fold-and-thrust belt to the south (Brabb and Churkin, 1969; Dover and Miyaoka, 1988; Dover, 1992), and south of the Black River Quadrangle (1:63,360-scale map by Brabb, 1970), and the relatively less well known Porcupine platform (1:63,360-scale geologic map by Brosgé and others, 1966).

Previous Investigations

The first geologic investigation in the region was in the Yukon-Alaska International boundary area between the Porcupine and Yukon Rivers (Maddren, 1912; Cairnes, 1914). Later geologic studies in the region (Mertie,1930; 1933) established regional stratigraphic framework and structural elements. More recent stratigraphic studies were conducted by Churkin and Brabb (1965, 1967), Laudon and others (1966), Brabb (1969), and Lane and Ormiston (1976). Stratigraphic and structural studies in the adjacent Ogilvie River and Porcupine River quadrangles in the Yukon Territory include Norris (1972, 1976, 1981, 1982). Previous regional-scale bedrock geologic mapping includes 1:250,000-scale geologic maps by Brabb and Churkin (1969) and Dover and Miyaoka (1988) and a 1:100,000-scale geologic map by Dover (1992).

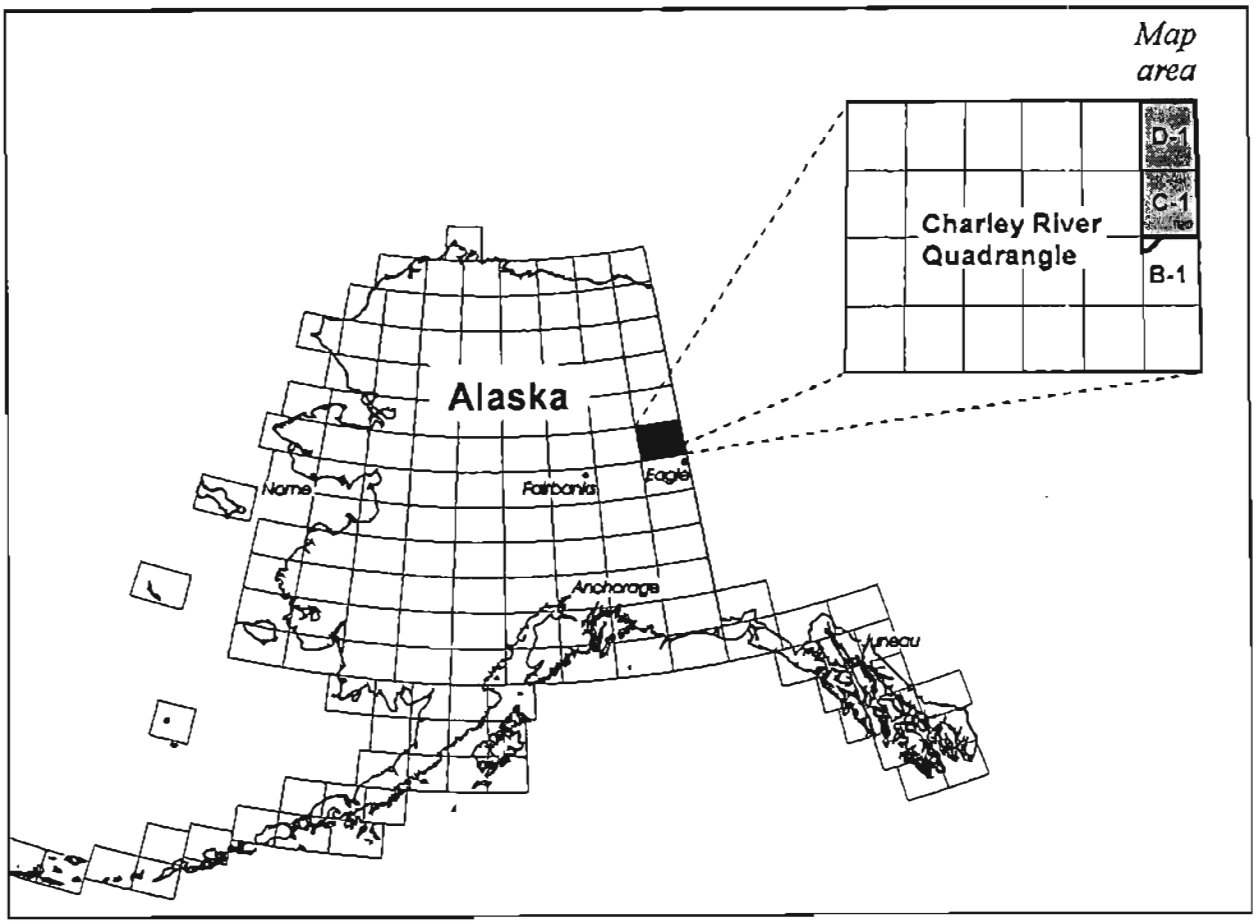

Figure 1. Location of map area in Charley River D-1, C-1 and B-1 Quadrangles.

Bedrock Geology

Our bedrock micropaleontological age determinations were inconclusive and our map units are correlated with rocks exposed elsewhere in the Charley River Quadrangle and described in Brabb (1969), Brabb and Churkin (1969), Dover and Miyaoka (1988) and Dover (1992). Lower Cretaceous clastic rocks include the Kandik Group (Brabb and Churkin, 1969) comprised of (youngest to oldest): the Kathul Graywacke, Biederman Argillite, Indian Grave shale (informal name herein), and Keenan Quartzite (table 1). The Lower Cretaceous-age Kathul Graywacke has been subdivided herein into lower and upper informal 'units'. Our upper part of the Kathul Graywacke is mapped based on the amount of volcanic lithic content relative to the lower part. The upper Kathul Graywacke contains far less volcanic component (pyroxene, hornblende, plagioclase, and volcanic lithics) than the lower Kathul Graywacke. In the Charley River C-1 Quadrangle the informal name 'Indian Grave shale' has been assigned to a black- to light-gray-weathering shale and phyllitic shale with pervasive cleavage which forms rubble on dip slopes two km northwest of Indian Grave Mountain. The close association of this unit with the underlying Keenan Quartzite is similar to the stratigraphic position of the Hauterivian to Barremian age 'pebble shale' unit above the Kemik Sandstone on Alaska's North Slope. The Glenn Shale (table 1) exposed in the southern part of the map

Table 1. Bedrock map units

MAP UNIT	NAME or FORMATION	REFERENCES	AGE
TKs	*poorly consolidated* sandstone, mudstone and conglomerate/ unnamed	Brabb and Churkin (1969)	Cretaceous and Tertiary
Kkau	Kathul Graywacke-upper part	Brabb (1969); subdivision into *lower* and *upper*, this paper	Lower Cretaceous (Albian?)
Kkal	Kathul Graywacke-lower part	Brabb (1969); subdivision into *lower* and *upper*, this paper	Lower Cretaceous (Albian?)
Kb	Biederman Argillite	Brabb (1969)	Lower Cretaceous
Ks	Indian Grave shale (informal)	this paper	Lower Cretaceous
Kke	Keenan Quartzite	Brabb (1969)	Lower Cretaceous (Valanginian?)
KJg	Glenn Shale	Brabb (1969)	Jurassic(?) to Lower Cretaceous
Pt	Tahkandit Limestone	Brabb and Churkin (1969)	Permian (Guadalupian?)
Ps	Step Conglomerate	Brabb (1969)	Permian (Guadalupian?)
Dnr	Nation River Formation	Brabb and Churkin (1967)	Upper Devonian
Dwv	Woodchopper(?) Volvanics	Brabb and Churkin (1969)	Lower Devonian
Pza	phyllitic argillite	Brabb and Churkin (1969)	Paleozoic(?)
Pzl	limestone and dolomite	Brabb and Churkin (1969); this paper	Paleozoic(?)

area (Charley River B-1 and C-1 Quadrangles) is Late Jurassic to Early Cretaceous in age (Dover and Miyaoka, 1988). These rocks were deposited in the northeastern edge of the Kandik Basin above the Permian-age Step Conglomerate, Tahkandit Limestone and the Upper Devonian-age Nation River Formation (table 1).

Porphyritic mafic volcanic rocks in the northwestern corner of the Charley River D-1 Quadrangle (sheet 1) are correlated with the Woodchopper Volcanics (Brabb and Churkin, 1969; Dover and Miyaoka, 1988) which are exposed on the Yukon River near the mouth of Woodchopper Creek, Charley River B-5 Quadrangle. Here, the rocks are interbedded with Lower Devonian limestone (Lane and Ormiston, 1976). Pending geochronological analysis we tentatively assign the Charley River D-1 volcanic rocks to the Woodchopper(?) Volcanics (table 1). Exposures of undifferentiated Paleozoic carbonate and argillite (table 1) are associated with the Woodchopper(?) Volcanics in the northern Charley River D-1 Quadrangle.

Surficial Geology

The region was not glaciated during Pleistocene time (Coulter and others, 1965) but was subjected to intense periglacial weathering when glaciers existed in nearby mountains and isolated uplands in eastern Beringia (Hopkins, 1967; Hopkins and others, 1982). Crests of bedrock ridges were stepped by cryoplanation processes during intense periglaciation, and ridge surfaces are littered with frost-shattered bedrock rubble and coarse, angular colluvium. Loess transported by winds blowing across nearby braided proglacial streams blankets most of the topography. This silt blanket has been locally eroded by fluvial processes and redeposited as thick organic-rich fills in valley bottoms (Péwé, 1975a,b). The region is underlain by discontinuous permafrost (Ferrians, 1965). Fine-grained valley fills are ice rich as indicated by the widespread distribution of open-

Table 2. Surficial map units

MAP UNIT	NAME	AGE
Qal	Alluvium	Holocene
Qfp	Floodplain Alluvium	Holocene
Qb	Point Bar Alluvium	Holocene
Qat	Terrace Alluvium	Holocene
Qaf	Alluvial Fan Deposits	Holocene
Qc	Undifferentiated Colluvium	Holocene
Qac	Undifferentiated Colluvium and Alluvium	Holocene
Qct	Talus Deposits	Holocene
Qca	Colluvial Apron Deposits	Holocene
Qs	Undifferentiated Swamp Deposits	Holocene
Ql	Undifferentiated Lacustrine Deposits	Holocene
Qel	Eolian Loess	Late Pleistocene to Holocene

system pingos and thaw lakes in these deposits. Pingos commonly form in low lying exposures of heavily fractured bedrock, notably the Biederman Argillite which is dominated by pencil cleavage.

Two tephras(?) were identified in loess deposits. The age of one is unknown, but its shallow depth suggests it may be the Holcene White River Ash. The second tephra is older than 38,770 +5,540/-3,250 yr. B.P. (C-14 age date) and possibly correlative with the Old Crow Tephra (older than 70,000 yr. B.P.).

Regional Structure

The Charley River D-1, C-1 and B-1 Quadrangles are within the Charley River fold-and-thrust belt (Dover, 1992). Geologic mapping indicates that folding and thrusting is the dominant structural style in all pre-Tertiary stratigraphy. All rock units are cut by high angle faults. Thrusting may be related to the fold-and-thrust belt of the northern Cordilleran in adjacent Yukon Territory. Many of the mapped faults are older-on-younger thrusts where stratigraphic control is known. Elsewhere the distribution of stratigraphic units and facies relationships requires thrust fault juxtaposition. Thrusting direction, on the basis of map patterns, regional dips, and folds, is most commonly from northwest to southeast or from west to east. Tectonic transport is on the order of tens of kilometers, at a minimum. Age of thrusting is post-Albian age Kathul Graywacke deposition, and pre-Maestrichtian to Paleocene-age sedimentary rock unit deposition.

High angle faults also juxtapose rock units, are typically post thrusting, and trending northeasterly to northwesterly. The Tintina fault zone lies 50 km southwest of the map area. This major right-lateral system has produced over 450 km of pre-Late Cretaceous offset in Canada, and up to 50 km of post-Eocene offset. High angle faulting in the Charley River area may be, in part, splays related to Tintina fault movement.

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