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A BASALT FLOW IN THE FORT HAMLIN HILLS, BETTLES A-1 QUADRANGLE

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CONTENTS

FIGURES

TABLES

A BASALT FLOW IN THE FORT HAMLIN HILLS, BETTLES A-1 QUADRANGLE

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INTRODUCTION

A basalt flow is exposed in the Fort Hamlin Hills, north central Alaska along the Dalton Highway. The basalt flow was first reported by Juergen Kienle (personal commun.). The basalt flow was visited and examined on September 20, 1984 by the author assisted by T.D. Balog. The results of this brief examination including petrography, major oxide geochemistry, and geochronology are discussed in this report.

LOCATION AND DESCRIPTION

The basalt flow occurs at Mile 76 along the Dalton Highway, about 60 mi northwest of Livengood in the Bettles A-1 Quadrangle (fig. 1). Exposures of the basalt flow extend over ½ mi along the Dalton Highway. The basalt is best exposed on the eastern side of the highway; the exposure of the western side of the road is more extensive but obscured by vegetation.

The basalt is underlain by river gravels. The base of the basalt section is a massive blocky basalt approximately 12 ft thick. This massive basalt fractures to subangular blocks generally ½ ft to 4 ft thick. The relatively thin upper part of the basalt layer is vesicular with elongated vesicles up to ½ in. wide. The basalt is composed of relatively clean plagioclase laths averaging ½ mm long with augite, hypersthene, and minor olivine. Secondary calcite frequently occurs within vesicle walls. Overlying the basalt flow is a semi-consolidated conglomerate consisting of angular basalt fragments and subrounded quartz and granitic pebbles cemented in a muddy matrix. This unit varies in thickness to a maximum of 20 ft. Several feet of loess discontinuously cap the semi-consolidated conglomerate.

The vegetation cover of the area makes it difficult to determine the exact lateral extent or source of the basalt. Air photo-investigation of the area did not reveal any obvious additional outcrops of basalt flows in the region.

A basalt-andesite dike was observed about 6 mi south of the basalt flow at 68.5 Mile Dalton Highway in the Tanana A-1 Quadrangle. This dike was briefly examined for possible genetic relation to the flow. The dike is exposed along a 500 ft E-S road cut. The dike is a medium-fine grained basalt-andesite containing irregular xenoliths of shale up to ½ in. long and minor disseminated pyrite. The basalt dike is about 80 ft wide, trends roughly N. 52 W., and intrudes a friable, moderately and well-foliated, slightly crenulated, black to gray phyllite with white quartz veins parallel to foliation. The foliation is primarily N. 77 W., 35° SW.

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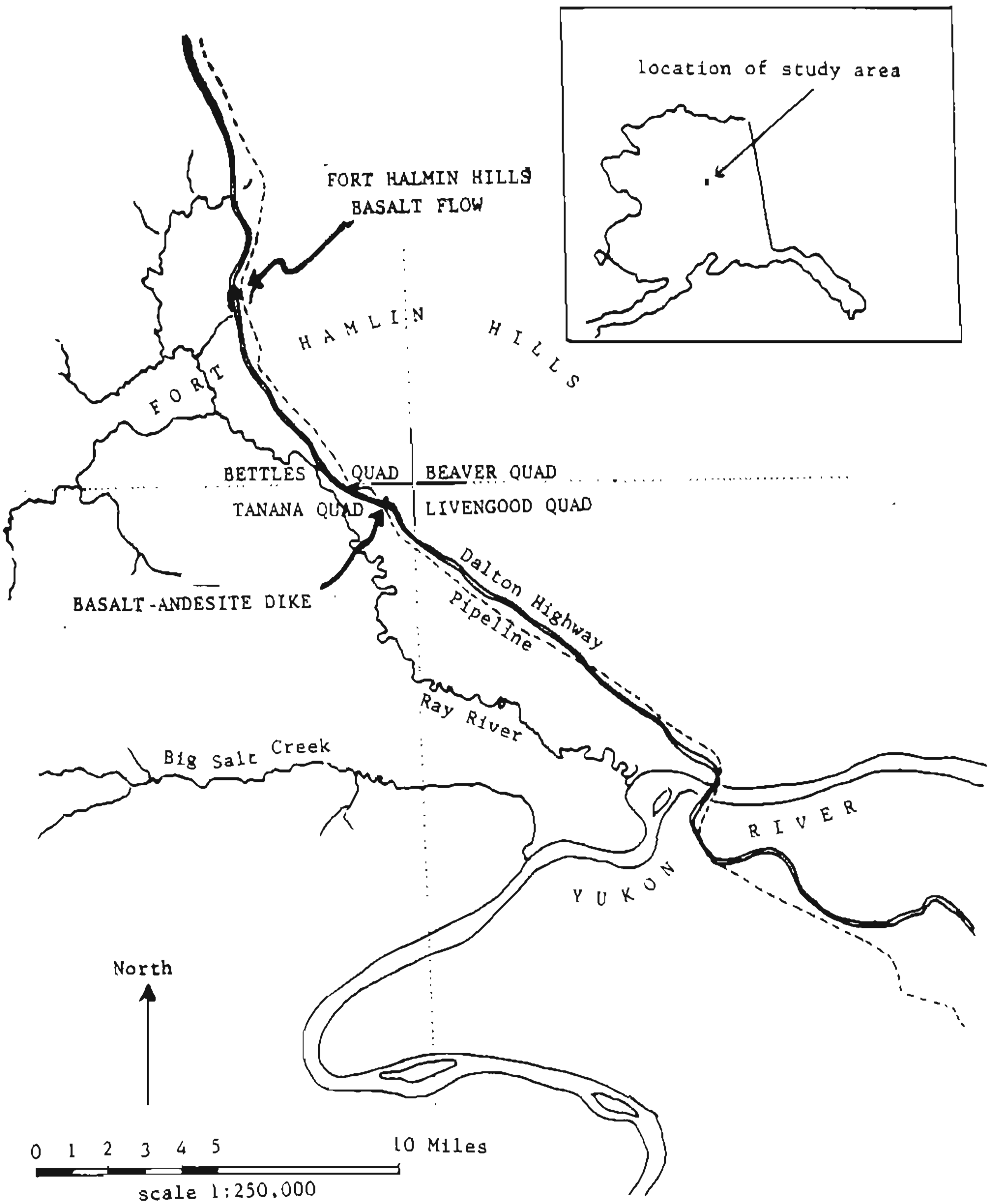

Figure 1. Location of the Fort Hamlin Hills basalt flow, north-central Alaska.

MAJOR OXIDE GEOCHEMISTRY

One sample of vesicular basalt from the basalt flow (sample 84 DHJK-1) and one sample of the basalt-andesite dike (sample 84 MA-1C) were analyzed for major oxide geochemistry for comparison. Results are listed in table 1.

The chemical affinity of these rocks is not clearly evident although they do not seem to be genetically related. The sample from the basalt flow plots within the tholeiitic field of the MacDonald and Katsura $K_2O + Na_2O$ vs. SiO_2 diagram (fig. 2) and within the calc-alkaline field of Miyashiro's FeO/MgO vs. SiO_2 diagram and Irving and Baragar's Al_2O_3 vs. normative plagioclase composition diagram (fig. 3). However, the mineralogy of the basalt flow sample, which includes two pyroxenes (a calcium-rich pyroxene and a calcium-poor pyroxene), suggests a tholeiitic or alkaline affinity which are generally the result of extensional systems.

The Fort Hamlin basalt flow is relatively undifferentiated with respect to iron enrichment (fig. 4), and when compared to other Alaskan basalts on the AFM diagram, appears only slightly more differentiated than samples of maar basalts.

The basalt-andesite dike located south of the Fort Hamlin flow plots within the alkali olivine field of MacDonald and Katsura's $K_2O + Na_2O$ vs. SiO_2 diagram (fig. 2), the tholeiitic field of Miyashiro's FeO/MgO vs. SiO_2 diagram, and the calc-alkaline field of Irving and Baragar's Al_2O_3 vs. normative plagioclase composition (fig. 3). The possibility of sample contamination (possibly by xenolith inclusions) cannot be overlooked for this analysis.

AGE OF THE BASALT FLOW

Plagioclase from a sample of the vesicular basalt from the basalt flow was analyzed for K-Ar age determination at the Geophysical Institute, University of Alaska, Fairbanks. It was initially anticipated that the basalt flow would yield a Holocene age because of its stratigraphic position above relatively recent river gravels. However, the K-Ar analysis indicated a minimum age of 30.59 m.y. ± 0.92. The K-Ar analytical data are listed in table 2. An alternative explanation for the apparently anomalously old age is that the basalt may contain a significant quantity of excess argon (D.L. Turner, personal communication, 1987).

SUMMARY

The occurrence of basalt flows in northern interior Alaska is relatively uncommon. The Fort Hamlin Hills basalt flow may be Oligocene basalt of questionable affinity and is not associated with the known basalt dike in the vicinity. The mineralogy and limited extent of the basalt suggests a local extensional tectonic setting. The apparent conflict between the Oligocene K-Ar age for the basalt flow and the much younger age inferred from field relationships is unresolved at this time.

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Table 1. Major oxide analysis and CIPW norm values for the Fort Hamlin basalt flow (sample no. 84 DHJK-1) and a basalt-andesite dike (sample no. 84 MA-1C).

	84 DHJK-1	84 MA-1C
SiO_2	51.29	52.21
Al_2O_3	16.89	17.29
Fe_2O_3 (total)	8.20	9.23
MgO	6.01	4.34
CaO	10.04	4.10
Na_2O	3.13	5.95
K_2O	0.87	0.28
TiO_2	1.75	1.01
P_2O_5	0.29	0.19
MnO	0.16	0.15
Total	99.31	99.76
Qtz	2.819	-
Or	5.239	1.672
Ab	26.987	50.880
An	30.027	19.302
di	14.906	-
hy	11.151	4.928
ol	-	17.020
mt	4.802	3.678
il	3.387	1.939
ap	0.684	0.445
cd	-	0.201
Total	100.00	100.07

Table 2. Analytical data for ^{40}K-^{40}Ar age determinations.

Field no.	Mineral	K_2O (wt %)	Sample weight (g)	$^{40}Ar_{rad}$ (mol/g) x 10E-11	$\frac{^{40}Ar_{rad}}{^{40}K}$ x 10E-3	% $^{40}Ar_{rad}$	Age ± σ (m.y.)
				*	*	*	*
84 DHJK-1	PLG	.275	1.6674	1.2226	1.7922	56.70	30.59 ± 0.92
		.278					Minimum age
		.273					
	mean =	.275					

*These values are valid to three significant figures.

Note: rad = radiogenic; σ = standard deviation.

Constants: $\lambda e + \lambda e' = 0.581 \times 10E^{-10}$/yr
$\lambda B = 4.962 \times 10E^{-10}$/yr
$^{40}K/K$ total = $1.167 \times 10E^{-4}$ mol/mol

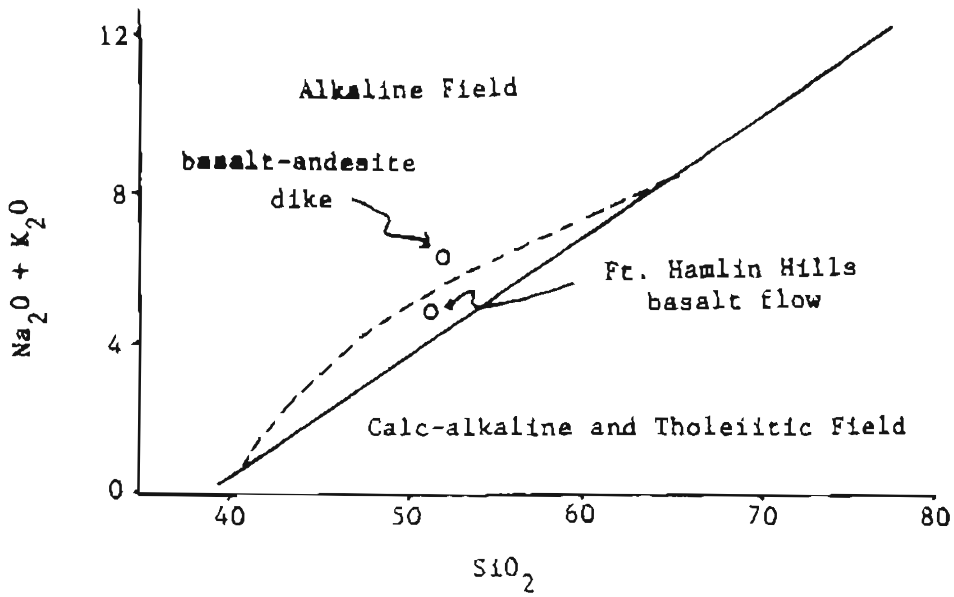

Figure 2. Alkali-silica diagram with dividing lines between the calc-alkaline and tholeiitic fields of MacDonald and Katsure (1964), solid line; and Irving and Barager (1971), dashed line.

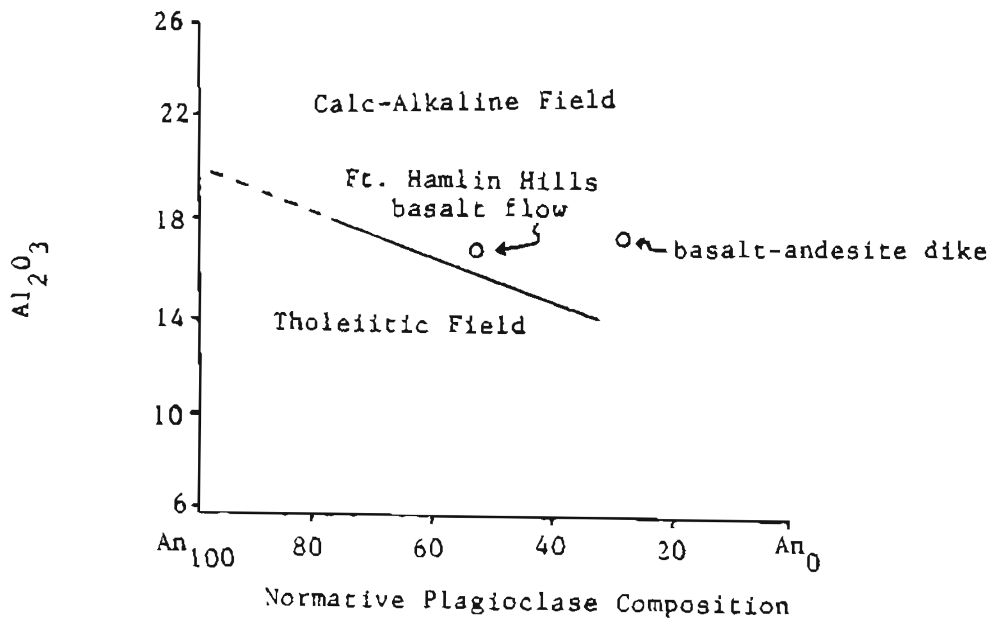

Figure 3. Normative plagioclase vs. Al_2O_3 diagram of Irving and Baragar, 1971.

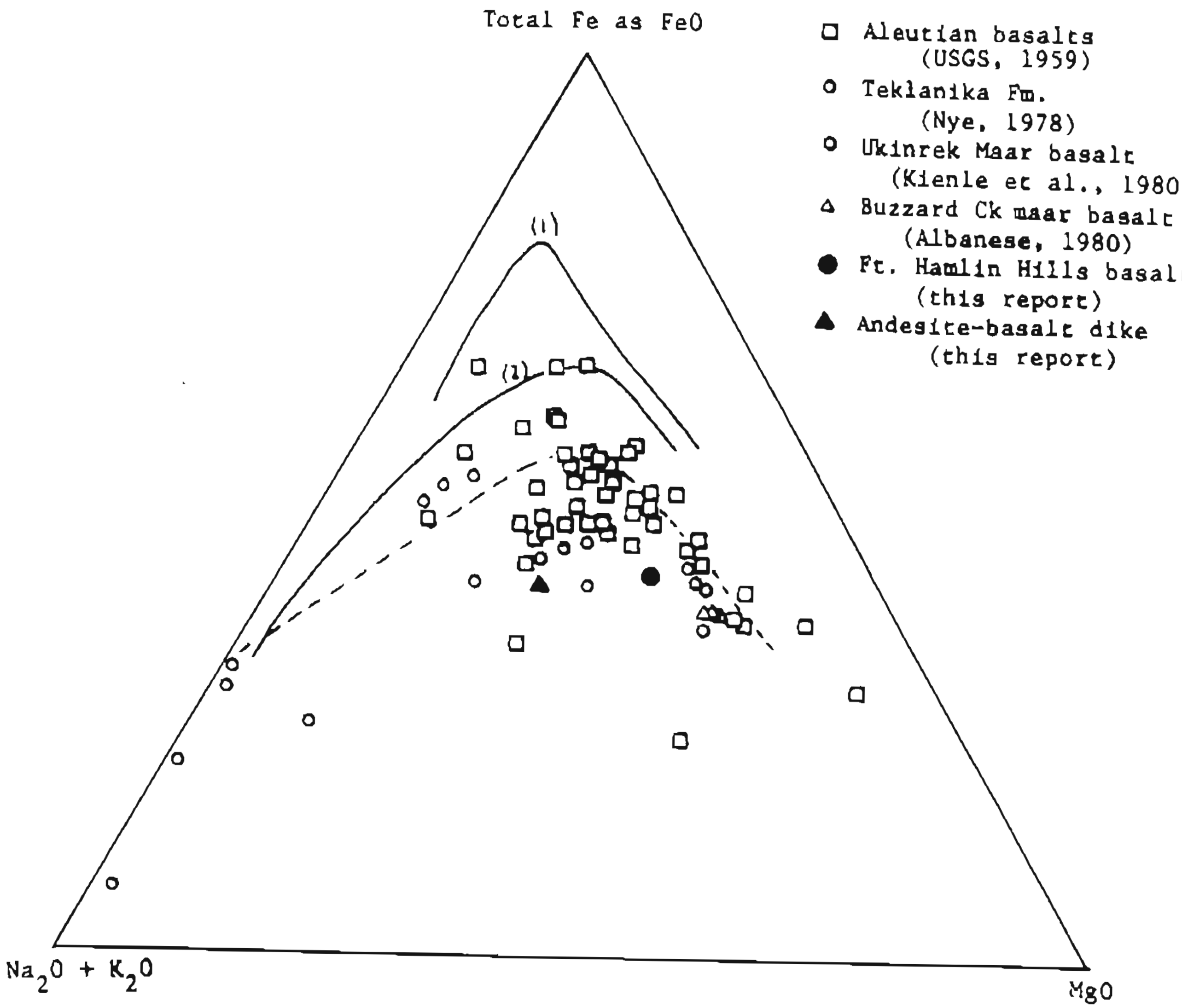

Figure 4. Alaskan basalts on the AMF diagram showing Skaergaard trend (1), Thingmuli trend (2) and tholeiite/calc-alkaline dividing line of Irving and Baragar (1971), dashed line.