gaps in the existing aeromagnetic coverage will be closed and more detailed information will be obtained from areas of proven interest. The attempt will be to cover in sufficient detail as large a part of the shelf as is economically and logistically possible.

During the *fourth* phase, starting at the end of the airborne operations in 1979, a final interpretation of the old and new data will be performed. The major results probably will be presented as magnetic contour maps and interpretational maps but as yet the scale and exact coverage of these maps is not decided. Intermediate results during the project will be reported to Danish authorities in a number of scientific and technical reports, and to the scientific community in the usual manner through scientific journals and at meetings. All results will be gathered in a major publication to be expected by the end of the project.

Discussion

It is important to note that the completion of this project in 1980 does in no way signal the opening of general exploration for oil and gas on the eastern Greenland continental shelf. Decisions on such matters remain to be taken by the relevant authorities. GGU intends to continue working in the region using other methods, e.g. marine seismic surveys and 1980 is thought to be a suitable time for the start of such activity. With the increased knowledge of the shelf gained through project EASTMAR the critical targets for future marine surveys can be carefully pin-pointed.

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Rb/Sr age of the Kap Washington Group, Peary Land, North Greenland, and its geotectonic implication

Ole Larsen, Peter R. Dawes and Norman J. Soper

The Kap Washington Group is a bedded suite of rhyolitic lavas and tuffs that forms the northernmost rock province of Greenland (Dawes & Soper, 1973). The volcanic group borders on the north the Palaeozoic North Greenland fold belt from which it is separated by the southerly-dipping Kap Cannon thrust (fig. 38). K/Ar whole-rock age determinations of 34.9±5.3 m.y. and 32.3±3.2. m.y. on somewhat mylonitised lava samples were earlier regarded as giving an approximate minimum age of volcanic consolidation and a maximum age of the Kap Cannon thrusting (Dawes & Soper, 1971).

This note reports on Rb/Sr isotopic work that dates the Kap Washington Group, the five

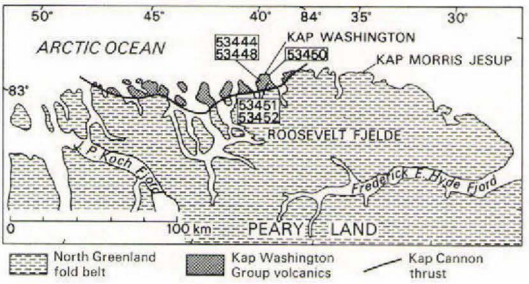

Fig. 38. Sketch map of northernmost Peary Land, North Greenland, showing outcrop of Kap Washington Group and the locations of the samples used in the Rb/Sr isotopic work.

samples processed suggesting an age of about 63 m.y. Thus the general age of extrusion and consolidation of the volcanic pile is considered to be earliest Tertiary.

Field work and sampling

The samples used in this study were collected in 1969 during a sea ice sledge traverse around the northern peninsula of Peary Land. No systematic mapping and collecting of the volcanic province could be attempted at that time and consequently only a limited number of samples were collected. From this material only a handful of rocks were considered at all suitable for Rb/Sr analysis and subsequently five of the least altered lavas were selected for the present work.

The Kap Washington Group has been investigated only in the outer coastal area of the eastern part of the province between Kap Cannon and Lockwood Ø. The western part of the group is unknown and while the age presented here is regarded as a reliable age of consolidation for the extrusive rocks studied, further isotopic work on the intrusives which are believed to be present and on rocks from the western part of the province is essential to determine the age range of the volcanic activity.

Experimental procedure and results

The Rb/Sr ratios were determined by isotope dilution using calibrated ^{87}Rb and ^{84}Sr spikes. The isotopic ratios of the samples were measured on a Varian MAT TH-5 solid source mass spectrometer and $^{87}Sr/^{86}Sr$ ratios were calculated from spiked Sr samples.

The position of the regression line was determined using the method of McIntyre *et al.* (1966). An MSWD value of 12.6 indicates a spread of the data points beyond the limits of experimental error, so the regression according to the McIntyre *et al.* model 4 was preferred. Using the 1.42×10^{-11} value for the Rb decay constant an age of 63 ± 2 m.y. was obtained (fig. 39). The corresponding initial isotopic ratio is 0.708 ± 0.001. If our estimates of experimental error are correct the regression line cannot be considered a true isochron and the error limits given above (1 sigma) may be used only as rough estimates of the quality of the calculated values of age and initial ratio.

Chemical composition and other analytical data are given in Table 8.

Discussion

The Kap Washington Group occupies a position on the edge of the Greenland landmass, bordering the Eurasian part of the Arctic Ocean. The Eurasian basin is the site of active

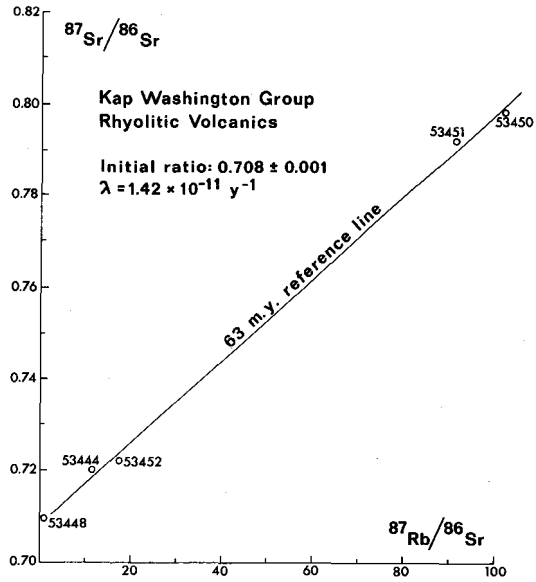

Fig. 39. Whole-rock Rb/Sr plot of analytical data for Kap Washington Group volcanics, Peary Land.

oceanic expansion, and thus the age of the Kap Washington volcanicity is significant in the tracing of the geotectonic history of the Arctic Ocean.

The earliest recognisable magnetic pattern flanking the Nansen Cordillera is anomaly 24 (Feden *et al.*, 1974; Phillips *et al.*, 1976) corresponding to an age of 56 m.y. (LaBreque *et al.*, 1977). It is generally assumed that the opening of the Eurasian Basin began at, or immediately pre-dated, this, say at anomaly 25 time (Pitman & Talwani, 1972). The Kap Washington rhyolitic volcanics were erupted during a period of crustal instability that pre-dates the generation of basalt beneath the Barents Shelf and the initiation of sea-floor spreading on the Nansen axis. Whatever the fundamental causes of this crustal instability and fracturing (and its relationship to the eventual independent movement of Greenland as a rigid block), the lavas reflect the presence of a region of abnormally hot mantle on the northern Greenland continental margin at about the Cretaceous–Tertiary boundary. There is good evidence to suggest the persistence of this hot spot in the region for millions of years.

A distinct positive magnetic anomaly over the Kap Morris Jesup Rise encroaches on land in northern Peary Land suggesting correlation with the Kap Washington Group and a possible offshore extension of the volcanic province (Dawes, 1973). However, more recent aeromagnetic data show the eastern part of this anomaly to be matched by a twin, high amplitude, long-wave length anomaly over the Yermak Plateau off northern Svalbard (Feden *et al.*, 1974). Available evidence strongly suggests that these anomalies represent extensive areas of oceanic basalt that have been separated by spreading on the Nansen axis. The expression of these twin anomalies as protuberances across at least the outer linear magnetic anomalies suggests basic magma generation from the hot spot until at least early Oligocene times.

The detailed implications of this interpretation seen in relation to the geotectonic evolution of the Greenland block within the Arctic–North Atlantic Ocean system will be presented elsewhere.

Table 8. Analytical data from Kap Washington Group volcanics, northern Peary Land

CGU Sample no.	53448	53444	53452	53451	53450
SiO_2	77.04	73.60	73.72	74.84	74.30
TiO_2	0.59	0.19	0.37	0.31	0.27
Al_2O_3	13.70	14.37	10.61	11.77	10.05
Fe_2O_3	0.36	1.52	4.57	3.09	6.27
FeO	0.60	1.50	1.50	1.30	0.40
MnO	0.01	0.05	0.16	0.06	0.13
MgO	0.08	0.19	0.11	0.06	0.07
CaO	0.02	0.02	0.42	0.02	0.03
Na_2O	7.21	5.27	3.72	4.05	3.52
K_2O	0.36	3.27	4.79	4.48	4.92
P_2O_5	0.03	0.02	0.03	0.02	0.03
Rb (ppm)	19.8	111	117	151	203
Sr (ppm)	53.1	28.3	19.1	4.8	5.8
$^{87}Rb/^{86}Sr$	1.08	11.43	17.75	91.1	102.2
$^{87}Sr/^{86}Sr$	0.7096	0.7199	0.7219	0.7922	0.7982

Major elements determined by XRF (J.G.Holland, Univ. Durham, U.K.)
Trace elements determined by isotope dilution (O.Larsen)

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C^{14} dating of Survey material carried out in 1977

General compilation by **Anker Weidick**

Fourty-two radiocarbon age determinations of shell samples (27), wood (2) and gyttja (13) from North-West, North, East, and South Greenland are summarised below. All the material was collected during GGU field work in recent years.

The samples have been dated by the Geological Survey of Canada, Ottawa (marked GSC), Isotopes Inc., Westwood, New Jersey, USA (marked I) and the Carbon-14 Dating Laboratory of the Geological Survey of Denmark and the National Museum, Copenhagen (marked K).

The samples in North-West, South and East Greenland are located by the coordinates from the Danish Geodetic Institute maps; in North Greenland coordinates are from the U.S.A.F. World Aeronautical Chart 1:1000 000, 5th edition.

Samples collected in North-West Greenland by Peter R. Dawes

GGU 212655: I-9802. Morris Jesup Gletscher **650±80 B.P.**

Shells of *Hiatella arctica* in moraine in front of Morris Jesup Gletscher, 3–3.5 m above sea level. South coast of Neqe Fjord, Thule district, 77°52'N, 71°10'W.

GGU 166678: I-9801. Chamberlin Gletscher **280±80 B.P.**

Shells of *Hiatella arctica* and a few fragments of *Mya truncata.* From moraine spit 14 m above sea level on eastern side of Chamberlin Gletscher. Wolstenholme Fjord, Thule district, 76°41.3'N, 68°16'W.

GGU 166679: I-9800. Chamberlin Gletscher **2650±105 B.P.**

Shells of *Mya truncata* and *Hiatella arctica.* From moraine spit 28 m above sea level at east side of Chamberlin Gletscher. Wolstenholme Fjord, Thule district, 76°41.3'N, 68°16'W.