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ANALYSIS OF OIL LUMPS COLLECTED AT THE T. HEYERDAHL'S RA II EXPEDITION

When Thor Heyerdahl crossed the Atlantic on his papyrus boat Ra II during the summer 1970, he observed debris and floating particles almost all the time. He took 17 samples of oil during the period May 19th through June 30th. The samples were delivered to the Norwegian Delegation of the United Nations. Through the State Department of Norway, all samples were sent to The Norwegian Institute for Water Research (NIVA) for investigation 7th August 1970. In agreement with the State Department we made up a research programme with two objectives:

1) to identify the material of the lumps
2) to trace the source of the lumps

A meeting was arranged on the 24th of August with representatives from different institutes and the oil industry who were invited to discuss an analytical programme for the samples.

The analytical work has been carried out by The Central Institute for Industrial Research (SI) as is described in the enclosed preliminary report.

A full scientific report will be published by SI later this year.

The location of the sampling spots and the dates of sampling are illustrated in fig. 1 and listed in table 1. Fig. 1 is referred to on page 1 in the SI-report.

Analytical methods

It was quickly observed that the lumps mainly consisted of oily material. The analytical programme was therefore designed to find out whether it was crude or refined oil and to estimate the origin of the oil. Analysis of vanadium, nickel, infrared spectroscopy and gas chromatography are important for this purpose.

Five of the collected samples, consisting mainly of very small lumps, have not yet been analyzed by all of the methods mentioned above. This will be done in the near future.

Results and discussions

It was assumed that some of the samples must have remained in the sea for some time. This may well have caused changes in the composition of the samples. For example, volatile compounds disappear often some time. Time of storage and changes may therefore interfere with the results and the interpretation of them.

According to the SI-report, the content of nickel and vanadium in the samples varied within a wide range.

Brunnock et. al (1) claims that the content of nickel and vanadium may indicate the origin of oil pollutants. The wide range of nickel and vanadium in the samples indicates oil pollutants of different origins.

The results of the infrared spectras clearly show that the samples consisted mainly of saturated hydrocarbons or mineral oil. Vegetable and animal oil are compunds of a different chemical nature and was apparently absent.

According to the results of the gas chromatographic analysis, the saturated hydrocarbones were normal paraffins (n-paraffins) with 14 to 40 carbon atomes in each molecule with maximum around 20 and 30 carbon atomes. Although n-paraffins are present in many types of oil, they are generally the major fractions in mineral oil from USA and North-Africa.

Oil from marine organisms is rather rich on bromine, it is therefore likely that bromine in some of the samples is of marine biological origin.

Conclusion

Without giving details about the different samples, the SI-report states that the samples are crude oil pollutants from different sources. Some samples seem to contain compounds from decomposed crude oil or heavy fuel oil.

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Literature

J.V. Brunnock, D.F. Duckworth and G.G. Stephens: J.Inst. Petrol. 54 (1968) p. 310.

TABLE 1.

Sample No.	Date of sampling [1]				Position/Location	
					N	W
1	May	19.	1970	- [3]	20° 20'	10° 37'
2	"	20.	"	A	29° 48'	11° 01'
3	"	20.	"	-	" "	" "
4	"	21.	"	B	29° 26'	11° 40'
5	"	21.	"	C	" "	" "
6	"	22.	"	D	28° 58'	11° 30'
7	"	24.	"	-	28° 37'	11° 36'
8	"	28.	"	E	26° 19'	15° 36'
9	"	28. [2]	"	-	" "	" "
10	"	29.	"	F	25° 43'	16° 23'
11	June	8	"	G	21° 25'	25° 17'
12	"	10	"	H	20° 42'	27° 13'
13	"	16	"	I	18° 26'	34° 24'
14	"	18	"	J	17° 57'	37° 08'
15	"	21	"	K	17° 39'	39° 27'
16	"	27	"	L	16° 00'	40° 09'
17	"	30.	"	-	15° 39'	47° 29'

1) According to Mr. T. Heyerdahl's report of the 4th of Nov. 1970.

2) Picked up from deck.

3) Samples marked A - L (12 samples) have been examined. Five samples (sample No. 1, 3, 7, 9 and 17) have not been examined by all analytical methods.

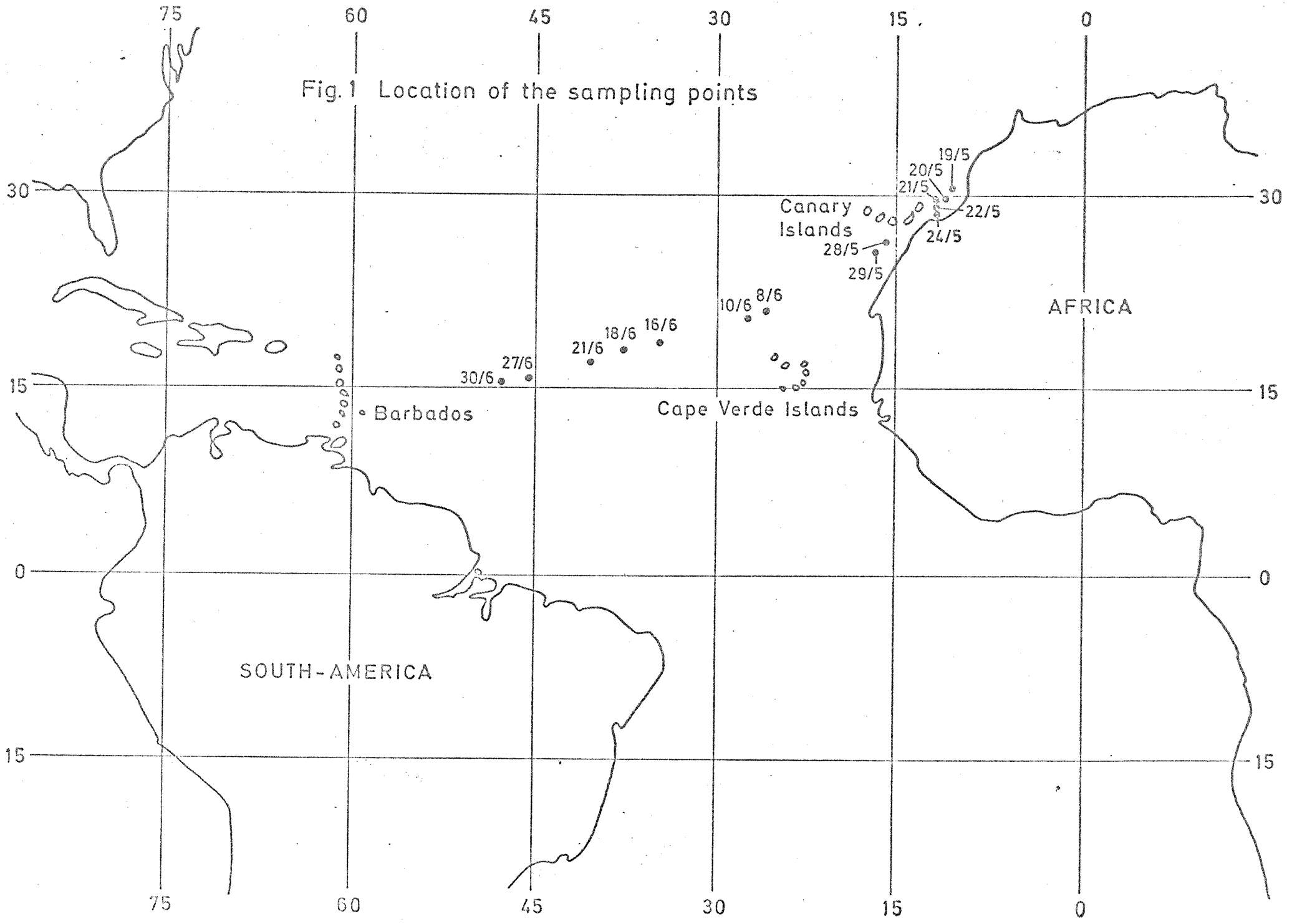

Fig. 1 Location of the sampling points

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INTRODUCTION

This is a preliminary report. Only the general trend results obtained from the analysis will be pointed out here. A more complete report, in which analytical methods and results are discussed, will be published later this year.

The samples (17) were delivered to the Central Institute for Industrial Research from the Norwegian Institute for Water Research. They were stored in flasks with screw corks and with the collecting date marked on the outside. The colour of the lumps were brown to black and they had a mousy appearance. The position of the different collections is marked on the map, fig. 1.

The purpose of the analysis was to characterise the oil lumps; in order to establish their origin i.e. mineral, marine or other. In case they were of mineral origin, it is also of interest to see if they came from different sources.

ANALYTICAL METHODS

Following analytical methods were used in this study:

1. Atomic absorption spectroscopy for analysing the nickel and vanadium content and to calculate the ratio between these two elements.

2. Infrared spectroscopy to get information about homogenity, functional groups and the nature of the hydrocarbons.

3. Gas chromatography to establish the distribution, (profile) of normal paraffins in the samples.

4. Neutron activation analysis to look for other trace elements.

Some of the collected samples consisting mainly of very small lumps, have not yet been analysed by all of the methods mentioned above. This will be done in the near future.

Especially the methods: atomic absorption and gas chromatography are widely used in this type of analytical work.

RESULTS

The content of vanadium (V) varied from < 1 ppm (µgV/g oil) to about 450 ppm and the content of nickel (Ni) from 1.5 ppm to 60 ppm. The corresponding V/Ni ratio was from < 1 to about 7.5.

The infrared spectra of the samples show that the main components present were saturated hydrocarbons.

The results of the gas chromatography analysis indicate that most of the samples contain n-paraffins from about C-14 to about C-40 and have profiles with maxima around C-20 and C-30. Such distribution of the n-paraffins is previously found for pollution samples of crude oil origin. The neutron activation show that bromine is present in some samples.

CONCLUSION

The results show that the origin of most of the samples are crude oil sludges from different localities. There is also indications that some of the samples consist of either weathered crude oil or weathered heavy fuel oil.

Blindern, March 12, 1971

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