50 YEARS OF RESEARCH

Institutt for energiteknikk
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DATAREPORT ON STABLE ISOTOPES, GAS SAMPLE FROM WELL 6706/11-1
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Summary

One gas sample from well 6706/11-1, 3740m, is analysed for gas and isotopic composition.

The work is done in accordance with «The Norwegian Industry Guide to Organic Geochemical Analyses», third edition 1993.

Distribution

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1 Introduction

One gas sample from well 6706/11-1, bottle no 606, 3740m is analysed for gas and isotopic composition.

On the sample C_1 - C_5 and CO_2 are quantified. The $\delta^{13}C$ value is measured on methane, ethane, propane, the butanes and CO_2. In addition the δD value is measured on methane.

2 Analytical procedures

Aliquots of 0.5 ml are sampled with a syringe for analysis on a Poraplot Q column connected with flame ionisation (FID) and thermal conductivity (TCD) detectors. The detection limit for the hydrocarbon gas components is 0.01 µl/ml, for CO_2 0.2 µl/ml.

For the isotope analysis 5-10 ml of the gas is sampled with a syringe and then separated into the different gas components by a Carlo Erba 4200 gas chromatograph. The hydrocarbon gas components are oxidised in separate CuO-ovens in order to prevent cross contamination. The combustion products CO_2 and H_2O are frozen into collection vessels and separated.

The combustion water is reduced with zinc metal in a sealed quarts tubes to prepare hydrogen for isotopic analysis. The isotopic measurements are performed on a Finnigan MAT 251 and a Finnigan Delta mass spectrometer.

IFEs value on NBS 22 is -29.77 ± .06‰ PDB.

The uncertainty in the $\delta\ ^{13}C$ value is estimated to be ± 0.3‰ PDB and includes all the different analytical steps. The estimate is based on repeated analysis of a laboratory standard gas mixture. The uncertainty in the δD value is likewise estimated to be ± 10‰.

3 Results

The normalised volume composition of the gas sample is shown in Table 1. The stable isotope composition is shown in Table 2. Due to an analytical problem the uncertainty in the reported iC_4 isotope value is larger than indicated by repeated analysis of the laboratory standard gas mixture.

The molecular composition related to the carbon isotope variation in methane from the sample is plotted in Figure 1 (Schoell, 1983), the carbon and hydrogen variations in methane are plotted in Figure 2 (Schoell, 1983) and the carbon isotope variation in ethane related to the carbon isotope variation in methane in Figure 3 (Schoell, 1983).

.e.

Table 1 Volume composition of a gas sample (normalised values) from well 6706/11-1

Sample	IFE no GEO	C_1 %	C_2 %	C_3 %	iC_4 %	nC_4 %	iC_5 %	nC_5 %	CO_2 %	ΣC_1- C_5 %	Wet-ness	iC_4/ nC_4
3740m, bottle no 606	980391	98.3	1.0	0.30	0.07	0.17	0.04	0.04	0.04	100.0	0.02	0.40

Table 2 Isotopic composition of a gas sample from well 6706/11-1

Sample	IFE no GEO	C_1 $\delta^{13}C$ ‰ PDB	C_1 δD ‰ SMOW	C_2 $\delta^{13}C$ ‰ PDB	C_3 $\delta^{13}C$ ‰ PDB	iC_4 $\delta^{13}C$ ‰ PDB	nC_4 $\delta^{13}C$ ‰ PDB	CO_2 $\delta^{13}C$ ‰ PDB	CO_2 $\delta^{18}O$ ‰ PDB
3740m, bottle no 606	980391	-34.9	-177	-31.0	-28.0	-25.8	-27.5	-17.1	-9.1

4 Literature

James, A.T. (1983). Correlation of natural gas by use of carbon isotopic distribution between hydrocarbon components. *The American Association of Petroleum Geologists Bulletin*, **67**, 1176-1191.

Robert, P. (1985) methods and means of paleothermal analysis. *Organic methamorphism and Geothermal History*, Elf-Aquitaine and D. Reidel Publishing Company.

Schoell, M. (1983). Genetic characterisation of natural gases. *The American Association of Petroleum Geologists Bulletin*, **67**,2225-2238.

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Summary

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Table 1. Vitrinite reflectance data table well 6706/11-1

Analysis type:	Vitrinite reflectance
Well:	6706/11-1
Number of samples:	13
Time period for analysis:	oct-98
Analysis performed by:	Kristine Aasgaard, Institutt for energiteknikk
Analysis ordered by:	Saga Petroleum

IFE sample code	Depth (mRKB)	Sample type	Lithology	Vitr. refl. (%Rm)	Stand. dev	Number of readings	Sample description	Sample quality	Sample prep
981146	3744.6	CORE	clyst	0.54	0.06	6	-oo--+	P	HF
981147	3749.5	CORE	clyst	0.51	0.07	15	ooo--+	M	HF
981149	3129.27	CORE	clyst	0.38	0.05	7	-oo--+	P	HF
981150	3133 02	CORE	clyst	0.42	0.04	25	ooo-o+	M	HF
981151	3135.3	CORE	clyst	0.39	0.05	14	-±o--+	P	HF
981152	3136.2	CORE	clyst	0.43	0 06	23	ooo-o+	M	HF
981153	3115.27	CORE	clyst	0.37	0 05	24	ooo--+	M	HF
981154	3121 23	CORE	clyst	0.40	0.04	23	ooo-o+	M	HF
981155	2321 08	CORE	sst/clyst	0.25	0 03	15	-oo--+	M	HF
981156	2299.2	CORE	sst/clyst	0.23	0 04	4	-oo--+	P	HF
981157	2303 48	CORE	clyst	0 26	0 02	20	oooo-+	M	HF
981158	2308.37	CORE	sst	barren	-	-	-	-	HF
981159	2297 5	CORE	clyst/sst	barren	-	-	-	-	HF

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	Client Geolab Nor/Statoil	**Revision number**
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Summary

Distribution

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1 Introduction

This report gives the result of routine vitrinite reflectance analyses of 37 samples from well 6706/11-1 offshore Norway.

2 Material

The material was provided from the client as 25 cuttings samples, 8 side wall cores and 4 core chips. Information on lithology in well 6706/11-1 was provided from the client and is plotted in table 1.

3 Analytical techniques

3.1 Preparation

The cuttings samples were treated with hydrochloric and hydrofluoric acid prior to further preparation. The aim was to avoid soft and expanding mineral phases in order to ensure good polishing quality. The sample material resulting from the acid treatment and the untreated core chips were embedded in an epoxy resin to make briquettes, ground flat and polished using 0.25 micron diamond paste and magnesium oxide as the two final steps.

3.2 Analysis

The analytical equipment being used was a Zeiss MPM 03 photometer microscope equipped with an Epiplan-Neofluar 40/0.90 oil objective. The sensitive measuring spot was kept constant for all measurements at about 2.5 micron in diameter. The measurements were made through a green band pass filter (546 nm) and in oil immersion (refractive index 1.515 at 18°C). The readings were made without a polarizer and using a stationary stage. This procedure is called measurement of random reflectance (%Rm). The photometer is calibrated daily against a standard of known reflectance (%Rm= 0.588) and routinely (daily) checked against two other standards of significant different

reflectances (%Rm=0.879 and 1.696). A deviation from these values of less than ±0.01 and ±0.02 respectively is considered as acceptable. The calibration is routinely checked during the course of measurements at least every hour, and a deviation of less than ±0.005 is considered as acceptable.

For each sample at least 20 points were measured if possible, and quality ratings are given to various important aspects which may affect the measurements. These aspects are abundance of vitrinite, uncertainties in the identification of indigenous vitrinite, type of vitrinite, particle size, particle surface quality and abundance of pyrite.

3.3 Presentation of results

The raw data from the measurements are presented in appendix for each sample both as tabulated data and histograms. A true vitrinite population is selected among the readings based on observations made during the measurements, and arithmetic mean values and standard deviation are calculated for this population and other populations. A quality rating is given to the true population. The results are listed in table 1. Figure 1 shows a vitrinite reflectance versus depth plot.

Table 1. Vitrinite reflectance data table

Analysis type:	Vitrinite reflectance
Well:	6706/11-1
Number of samples:	37
Time period for analysis:	jun-98
Analysis performed by:	Kristine Aasgaard, Institutt for energiteknikk
Analysis ordered by:	Geolab Nor

IFE sample code	Depth (m)	Sample type	Lithology	Vitr refl (%Rm)	Stand dev	Number of readings	Sample description	Sample quality	Sample prep
980549	1663	DC	CLYST	0 21	0 03	12	-o--o+	P	HF
980550	1669	DC	CLYST	0 23	0 04	15	-o -o+	P	HF
980551	1678	DC	CLYST	0 22	0 03	23	ooo o+	M	HF
980552	1693	DC	CLYST	0 25	0 04	13	oo o+	P	HF
980553	1700	DC	CLYST	0 22	0 03	20	ooo o+	M	HF
980554	1800	DC	CLYST	0 27	0 04	22	ooo-o+	M	HF
980555	1850	DC	CLYST	0 27	0 04	17	ooo-o+	M	HF
980556	1900	DC	CLYST	0 24	0 04	20	ooo o+	M	HF
980557	1950	DC	CLYST	0 28	0 06	20	ooo o+	M	HF
980558	2000	DC	CLYST	0 28	0 05	21	ooo--+	M	HF
980559	2050	DC	CLYST	0 27	0 03	15	-oo o+	M	HF
980560	2100	DC	CLYST	0 31	0 06	22	ooo-o+	M	HF
980561	2150	DC	CLYST	0 30	0 05	20	ooo o+	M	HF
980562	2200	DC	CLYST	0 31	0 06	20	ooo--+	M	HF
980563	2255	DC	CLYST	0 32	0 04	21	ooo--+	M	HF
980564	2307 32	CORE	CLYST	0 23	0 04	13	oo--o	M	bulk
980565	2317 56	CORE	CLYST	0 24	0 04	8	-oo-oo	P	bulk
980566	2360 5	SWC	CLYST/SST	0 36	0 07	23	o±o-o+	P	HF
980567	2375	DC	CLYST	0 30	0 06	20	ooo-o+	M	HF

Table 1. Vitrinite reflectance data table, continued

IFE sample code	Depth (m)	Sample type	Lithology	Vitr refl (%Rm)	Stand dev.	Number of readings	Sample description	Sample quality	Sample prep
980568	2608	SWC	SST/CLYST	0 36	0 06	22	ooo-o+	M	HF
980569	2861	SWC	CLYST	0 4	0 06	20	ooo-o+	M	HF
980570	2975	DC	SST/CLYST	0 33	0 06	21	ooooo+	G	HF
980571	3025	DC	CLYST	0 36	0 04	21	ooo-o+	M	HF
980572	3075	DC	CLYST	0 38	0 06	20	ooo-o+	M	HF
980573	3114 28	CORE	CLYST	0 42	0 05	12	-oo-o+	M	bulk
980574	3126 05	CORE	CLYST	0 45	0 07	14	-oo o+	M	bulk
980575	3225	DC	CLYST	0 41	0 05	20	ooo-o+	M	HF
980576	3400	DC	CLYST	0 48	0 05	15	-oo o+	M	HF
980577	3450	DC	CLYST	0 49	0 06	23	ooo-o+	M	HF
980578	3600	DC	CLYST	0 54	0 05	5	-oo--+	P	HF
980579	3684	SWC	CLYST	0 53	0 07	21	ooo-o+	M	HF
980580	3774	SWC	CLYST	0 52	0 05	20	ooo-o+	M	HF
980581	3894	SWC	CLYST	0 53	0 06	22	ooo--+	M	HF
980582	3950	DC	CLYST	0 56	0 07	22	ooo-o+	M	HF
980583	4063	SWC	CLYST	0 55	0 06	21	ooo--+	M	HF
980584	4299	DC	CLYST	0 63	0 07	15	o±o--+	p	HF
980585	4308	SWC	CLYST	barren	-	-	-	-	HF

Legend to vitrinite reflectance data table

SST	sandstone
SLST	siltstone
CLYST	claystone
SH	shale
LST	limestone
COAL	coal
HF	sample treated with hydroflouric acid prior to epoxy resin embedding
DCM	sample treated with dichloromethane prior to epoxy resin embedding
bulk	untreated sample prior to epoxy resin embedding
G	Good quality sample
M	Moderate quality sample
P	Poor quality sample
st	Sample is stained

oooooo	Sample description:	1	Abundance of vitrinite
123456		2	Identification of vitrinite
		3	Type of vitrinite
		4	Vitrinite fragment size
		5	Vitrinite surface quality
		6	Abundance of pyrite

-	may give too low vitrinite reflectance sample value
o	reliable vitrinite reflectance sample value
+	may give too high vitrinite reflectance sample value