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Gas-in-fluid inclusion analysis on cores and cuttings from Dingo 2 and Magee 1, Amadeus Basin, NT

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Chris Boreham, Prince Palatty and Jacob Sohn

Department of Industry, Innovation and Science
Minister for Resources and Northern Australia: Senator the Hon Matthew Canavan
Assistant Minister for Science, Jobs and Innovation: Senator The Hon Zed Seselja
Secretary: Dr Heather Smith PSM

Geoscience Australia
Chief Executive Officer: Dr James Johnson
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1 Rationale

Ongoing collaborative research projects between the Onshore Energy Branch, Geoscience Australia and NTGS are designed to produce pre-competitive information to assist with the evaluation of the petroleum prospectivity of onshore Northern Territory basins. The Amadeus Basin is a proven gas producing province from Ordovician reservoirs in the Mereenie and Palm Valley gas fields. Non-commercial gas is known from other exploration wells from older reservoirs. However, access to natural gases from these wells for analysis is limited so a pilot study was undertaken to see if gas could be extracted from fluid inclusions within know reservoir intervals in two of these wells: Dingo 2 and Magee 1.

This data release contains the results of hydraulic crushing of selected rock fractions from the two well and on-line analysis of the released C_1−C_5 gaseous hydrocarbons by gas chromatography mass spectrometry (Sohn et al., 2014). This work was carried out in the Isotope and Organic Geochemistry, and Inorganic Geochemical Laboratories at Geoscience Australia and was undertaken as part of the Australian Source Rock Study Project.

Samples were taken between the 14th and 17th May 2016 at the Core Facilities and Technical Support, Department of Resources, Northern Territory Geological Survey, Alice Springs. All rocks analysed in this study are listed in Table 1.

All remaining rocks, powders and residues are held at Geoscience Australia.

2 Method summary

Rock samples were obtained from cores and cuttings from Dingo 2 and Magee 1 petroleum wells from above, within and below the known reservoir intervals reported in the respective well completion reports. These samples were washed with distilled water to be free of surface contamination and dried at 50°C overnight. The dried material was completely enclosed within a purple nitrile glove and then broken down into smaller pieces using progressive blows of a hammer against a steel base. The resulting smaller-sized material was allowed to pass first through a 1.4 mm and then through a 0.3 mm metal gauze sieve. The material that did not pass through the 1.4 mm sieve was again wrapped in a nitrile glove and the process repeated until the entire sample passed through the top sieve.

The 0.3−1.4 mm fraction was used for further analysis. Various sub-fraction and treatments were applied to see what level of sampling processing is required to produce reliable results. These processes included: separation of the material into magnetic and non-magnetic fractions, treatment with hydrogen peroxide (fresh H_2O_2 was added after 2 days and repeated until effervescence had stopped) to oxidise and remove organic matter, and solvent extraction (soxhlet extraction with dichloromethane for 48 hrs) to remove free bitumen.

For the detection of gaseous hydrocarbons released on application of hydraulic pressure, 0.5–2g of rock was used in an on-line gas chromatography mass spectrometry setup described in Sohn et al. (2014). Briefly, a weighed sample was added to a hydraulic press cell and then connected to a nafion tube assembly (to remove moisture) through to a heated (50 °C) transfer line into the split injection

port (held at 150 °C; split ratio 20:1) of a split injector of an Agilent 5973 gas chromatograph mass spectrometer. A constant helium flow of 20 ml min^{-1} was maintained through the on-line setup to the injection port. After 10 minutes of flushing the system the analysis was commenced by applying hydraulic pressure at 2500 psi to the sample for 5 minutes. The released gases were cryo-focused (liquid N_2) onto a 2 m pre-column (PoraBond 0.5 mm OD) connected to a narrow-bore fused silica capillary column (60 m DB5, 1 μm film thickness). The C_1–C_5 gaseous hydrocarbons were eluted from the column combination throughout an oven temperature program from 30 °C held for 10 minutes then 20 °C min^{-1} to 200 °C. Individual gaseous hydrocarbons were detected in single ion monitoring mode (m/z 15 for methane, m/z 30 for ethane and m/z 43 for iso-butane, n-butane, iso-pentane and n-pentane). Calibration was carried out against Certified Reference Materials from BOC's '2000 ppm vol/vol' gravimetric mixture of C_1–C_5 gaseous hydrocarbons in a helium balance.

3 Results

Table 1 lists the sample details and Table 2 the yield (ng/g rock) of methane, ethane, propane, iso-butane, n-butane, iso-pentane and n-pentane (C_1−C_5 gaseous hydrocarbons) released upon crushing by the application of hydraulic pressure on the sieved sample.

Table 1. Sample details from Dingo 2 and Magee 1 wells

SampleNo	SampleID	Well name	Formation	top m	base m	Type*
2550569	20160023	Dingo 2	Arumbera Sandstone	2950	2955	cuttings
2550570	20160024	Dingo 2	Arumbera Sandstone	2960	2965	cuttings
2550571	20160025	Dingo 2	Arumbera Sandstone	2970	2975	cuttings
2550572	20160026	Dingo 2	Arumbera Sandstone	2980	2985	cuttings
2550573	20160027	Dingo 2	Arumbera Sandstone	2985	2990	cuttings
2550563	20160017	Dingo 2	Arumbera Sandstone	2988.00		core
2550564	20160018	Dingo 2	Arumbera Sandstone	2989.00		core
2550574	20160028	Dingo 2	Arumbera Sandstone	2990	2995	cuttings
2550565	20160019	Dingo 2	Arumbera Sandstone	2990.80		core
2550575	20160029	Dingo 2	Arumbera Sandstone	2995	3000	cuttings
2550576	20160030	Dingo 2	Arumbera Sandstone	3000	3005	cuttings
2550577	20160031	Dingo 2	Arumbera Sandstone/Julie Formation	3005	3010	cuttings
2550578	20160032	Dingo 2	Julie Formation	3015	3020	cuttings
2550566	20160020	Dingo 2	Julie Equivalent	3021.78		core
2550579	20160033	Dingo 2	Julie Formation	3025	3030	cuttings
2550580	20160034	Dingo 2	Julie Formation	3035	3040	cuttings
2550567	20160021	Dingo 2	Julie Equivalent	3036.15		core
2550568	20160022	Dingo 2	Julie Equivalent	3040.15		core
2550581	20160035	Dingo 2	Pertatataka/Julie formations	3045	3050	cuttings
2550582	20160036	Dingo 2	Pertatataka Formation	3055	3060	cuttings
2550583	20160037	Dingo 2	Pertatataka Formation	3065	3070	cuttings
2550584	20160038	Dingo 2	Pertatataka Formation	3075	3080	cuttings
2550585	20160039	Dingo 2	Pertatataka Formation	3080	3085	cuttings
2561198	20160066	Magee 1	lower Gillian Mbr - Heavitree Quartzite	2341	2344	cuttings
2561199	20160067	Magee 1	Heavitree Quartzite	2344	2347	cuttings
2561200	20160068	Magee 1	Heavitree Quartzite - Basement	2347	2350	cuttings

* core = horizontal core plug

Table 2. Yield of C_1−C_5 gaseous hydrocarbons

SampleNo	SampleID	Well name	methane ng/g rock	ethane ng/g rock	propane ng/g rock	iso-butane ng/g rock	n-butane ng/g rock	iso-pentane ng/g rock	n-pentane ng/g rock	Comment
2550569	20160023	Dingo 2	296.66	4.00	1.81	0.23	0.69	0.26	0.61	soxhlet extraction
2550570	20160024	Dingo 2	112.74	2.32	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550571	20160025	Dingo 2	174.48	3.25	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550572	20160026	Dingo 2	296.32	3.66	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550573	20160027	Dingo 2	311.79	4.03	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550563	20160017	Dingo 2	543.13	12.24	3.07	0.36	0.79	0.69	0.98	soxhlet extraction
2550564	20160018	Dingo 2	512.48	3.60	1.53	0.17	0.43	0.45	0.66	soxhlet extraction
2550574	20160028	Dingo 2	138.72	1.77	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550565	20160019	Dingo 2	14.86	3.75	0.82	0.31	0.55	1.39	0.16	soxhlet extraction
2550575	20160029	Dingo 2	286.69	2.97	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550576	20160030	Dingo 2	188.79	2.69	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550577	20160031	Dingo 2	266.70	3.41	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550578	20160032	Dingo 2	386.44	6.80	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550566	20160020	Dingo 2	690.34	11.49	2.61	0.34	0.73	0.21	0.53	soxhlet extraction
2550579	20160033	Dingo 2	772.99	5.36	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550580	20160034	Dingo 2	1413.30	105.23	68.14	26.01	26.97	12.17	5.72	soxhlet extraction
2550567	20160021	Dingo 2	9373.11	1097.29	955.31	327.89	436.59	239.21	215.66	soxhlet extraction
2550568	20160022	Dingo 2	2979.45	481.88	422.71	141.21	171.82	94.70	73.74	soxhlet extraction
2550581	20160035	Dingo 2	933.54	22.09	3.45	1.36	1.88	1.49	1.25	soxhlet extraction
2550582	20160036	Dingo 2	795.03	16.46	3.38	0.85	1.11	0.64	0.39	soxhlet extraction
2550583	20160037	Dingo 2	676.31	17.85	0.00	0.00	0.00	0.00	0.00	soxhlet extraction
2550584	20160038	Dingo 2	370.71	15.37	3.86	0.46	0.73	0.21	0.20	soxhlet extraction
2550585	20160039	Dingo 2	369.82	15.71	2.43	0.41	0.68	0.31	0.12	soxhlet extraction
2561198	20160066	Magee 1	361.31	131.77	129.28	69.03	77.35	317.52	420.55	Magnetic
2561198	20160066	Magee 1	257.55	65.00	86.07	23.17	26.50	0.00	10.76	Magnetic H_2O_2 treated soxhlet extraction
2561198	20160066	Magee 1	0.00	279.85	272.11	138.35	183.21	90.80	110.34	Non-magnetic H_2O_2 treated soxhlet extraction
2561199	20160067	Magee 1	0.00	92.32	92.75	37.80	47.56	27.67	26.83	Magnetic, soxhlet extraction
2561199	20160067	Magee 1	62.50	123.48	117.37	29.72	60.88	15.99	33.83	Magnetic H_2O_2 treated soxhlet extraction
2561200	20160068	Magee 1	0.00	88.80	179.81	42.72	52.95	41.77	48.52	Magnetic solvent extraction
2561200	20160068	Magee 1	7.98	5468.53	59.20	70.09	21.84	29.50	0.00	Magnetic H_2O_2 treated soxhlet extraction
2561200	20160068	Magee 1	24.94	1518.22	272.09	231.99	114.19	154.06	55.76	Non-magnetic H_2O_2 treated soxhlet extraction

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