

Source rock evaluation of the ENRECA-3 well; Bach Long Vi Island, Song Hong Basin, Vietnam

A contribution to the ENRECA cooperation project between
GEUS, VPI, HUMG, HUS and IGN

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1. Introduction

This report presents source rock data of the syn-rift section penetrated by the ENRECA-3 core well located on Bach Long Vi Island, an inverted Neogene structure in the northeastern Song Hong Basin (Gulf of Tonkin) (Fig. 1) (Andersen et al., 2005; Fyhn et al., 2012). The coordinates of the well position are 20° 07' 39.4"N, 107° 43' 49.4"E (WGS-84).

The ENRECA-3 well drilled almost 500 m of syn-rift deposits with a core recovery of 99%. The deposits consist of recurrent deep lacustrine facies with dominance of mudstones. In the upper part of the well the mudstones are light to dark grey, whereas they are laminated black and light brownish in the lower part (Fig. 2). During a visit to Vietnam Petroleum Institute (VPI), Hanoi, in June 2012, a total of 167 core samples were collected from the mudstones for source rock quality analysis at the Laboratory for Organic Geochemistry and Petrology at the Geological Survey of Denmark and Greenland (GEUS), Copenhagen. This sample set was later supplemented with an additional 17 mudstone samples. Furthermore, eleven samples from two core pieces from the deeper part (452.12–452.25 m and 488.87–488.95 m) of the well were collected for a detailed analysis of the black/light brownish layers of the laminated mudstones. Hence, in total 195 core samples of mudstones were available.

The source rock quality of the samples was analysed by Source Rock Analyzer (Rock-Eval) pyrolysis, and total organic carbon (TOC), total carbon (TC) and total sulphur (TS) determinations. The results (data) are listed in tables and standard plots are shown.

2. Samples and Methods

2.1 Samples

Sampling focused on the mudstones in the core well. Identification of mudstones was guided by a sedimentological core description log. The 195 samples were collected from base (499.83 m) to top (9.38 m) of the well. The sampling was designed to cover the numerous mudstone intervals in the penetrated section and to reflect the various types of mudstones (mudstone facies).

2.2. Organic geochemical screening analyses

The content of total organic carbon (TOC, wt.%), total carbon (TC, wt.%) and total sulphur (TS, wt.%) in the core samples was determined by combustion in a LECO CS-200 induction furnace. Approximately 50 mg of powdered (<250 µm) sample material was used for each TC/TS determination. For each TOC determination carbonate-bonded carbon in about 300 mg sample was removed by HCl treatment before combustion. Approximately 50 mg of powdered (<250 µm) sample material was used for combustion.

Approximately 100 mg of each sample was crushed to <250 µm before pyrolysis in a Humble Instruments and Services Source Rock Analyzer (SRA) system. The SRA yields similar data as the Rock-Eval instrument: S_1 , free hydrocarbons in the sample; S_2 , hydrocarbons generated by decomposition of the kerogen; T_{max} , temperature at maximum S_2 generation. The Hydrogen Index (HI) [$S_2/TOC \times 100$] and the Production Index (PI) [S_1/S_1+S_2] were calculated.

The screening data of the samples are shown in Tables 1 and 2.

3. Results and Discussion

The TOC content of the samples range from 0.65–6.97 wt.% and averages 2.70 wt.% (Tables 1 and 2). The TOC content seems to be highest in the lower approximately 80 m (below ~417 m), where TOC generally exceeds 3 wt.%, averaging 3.47 wt.%. Figure 3 shows the slight increase in TOC content in the deepest part of the well. The TC content is overall very similar to the TOC content, implying non-calcareous mudstones (Table 1). However, in the deeper part of the well characterised by black and light brownish alternating mudstones the results are likely biased towards the black mudstones as these principally were sampled. Detailed analysis of the two core pieces shows that the light brownish mudstones are leaner in TOC (0.65–1.77 wt.%) and considerably more calcareous (TC content: 5.57–8.59 wt.%) (Table 2).

The TS content varies from 0.04–0.80 wt.% (Fig. 4), apart from one sample (sample 23354; 483.06 m) having a value of 2.30 wt.%. In order to rule out possible analysis errors, a reanalysis of the sample was carried out yielding, however, almost identical result. The TS value of sample 23354 could suggest influence of saline water, but no certain conclusions can be drawn from only one sample. The average TS content is low (0.22) (Tables 1 and 2), which combined with the TOC values corresponds to fresh water depositional conditions (Berner and Raiswell, 1984).

The HI values of the mudstones vary from 127–751 mg HC/g TOC, but an average HI of 557 mg HC/g TOC indicates dominantly high values (Fig. 5; Tables 1 and 2). The high HI values are present throughout the 500 m penetrated section, with a tendency to slightly higher values below approximately 400 m (Fig. 6). However, as already mentioned sampling in the lower part of the well focused on the black mudstones. The analysis of the black and light brownish layers in the two core pieces from 452.12–452.25 m and 488.87–488.95 m shows, however, a difference in the source rock potential between the two mudstone types (Figs. 5 and 7; Table 2). The results demonstrate that the black mudstones are rich oil-prone source rocks, whereas the light brownish mudstones can possess an excellent petroleum generation potential (core piece: 452.12–452.25 m), but the generation potential can also be poor (core piece: 452.12–452.25 m, average HI only 150 mg HC/g TOC).

The high values are comparable to the HI values of outcrop samples from Bach Long Vi Island and the seabed around the island (Fig. 1) (Petersen et al., 2004 and new unpublished data). Rocks with HI values >300 mg HC/g TOC are conventionally considered as oil-prone (Peters and Cassa, 1994). The S₂ pyrolysis yields range from 2.46–33.73 mg HC/g rock, but with the majority of samples having S₂ yields >12 mg HC/g rock (Tables 1 and 2). This is also reflected in an average

pyrolysis yield of 15.39 mg HC/g rock. S_2 pyrolysis yields above 12 mg HC/g rock correspond to excellent petroleum generation potential (Bordenave et al., 1993) (Fig. 7).

Hence, the mudstones constitute overall highly oil-prone, potential source rocks. In the lower part of the penetrated section the black mudstones constitute excellent source rocks, whereas the light brownish mudstones have varying source rock potential. Based on the T_{max}/HI -plot, the kerogen in the mudstones can mainly be classified as Type I to Type I-II (Fig. 5). Type III kerogen is also present in some of the mudstones. The overall high TOC content in the mudstones further emphasizes the good source rock quality as a TOC content >1.5 wt.% is considered as excellent for Type I kerogen (Bordenave et al., 1993).

The oil window for Type I kerogen ranges from 440–450°C (Bordenave et al., 1993). The T_{max} values of the ENRECA-3 well average 431°C showing, that the mudstones are thermally immature (Tables 1 and 2). This is furthermore supported by PI values ranging from 0.01–0.04 (average 0.02) (Tables 1 and 2). The PI generally increases from approximately 0.1 to 0.4–0.6 from the onset of oil generation and through the oil window (Bordenave et al., 1993; Peters and Cassa, 1994). The thermal immaturity of the mudstones demonstrates that petroleum generation has not occurred, and the HI values are thus representing the original source rock potential of the mudstones. Consequently the amount of free hydrocarbons (S_1 yields) in the mudstones is inferior, and the total generation potential as described by S_1+S_2 is thus largely equal to the S_2 yields (Tables 1 and 2).

4. Conclusion

The syn-rift mudstones in the ENRECA-3 well constitute thermally immature and generally organic-rich, highly oil-prone source rocks containing Type I and Type I-II kerogen. The light brownish mudstones in the lower part of the well appear to be of poorer source rock quality than the black mudstones. The source rock data confirm and are comparable to previously analysed outcrop samples of mudstone from Bach Long Vi Island and from the seabed around the island.

5. References

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6. Figure and Table Captions

Fig. 1. Map of the island of Bach Long Vi with indication of previously analysed outcrop and seabed samples.

Fig. 2. Cores of mudstones drilled by the ENRECA-3 well. **A** Black and light brownish alternating mudstones with thin, fine-grained sandstones (light grey) in the interval 450–455 m. The black mudstones are exceptional good petroleum source rocks, whereas the light brownish mudstones have varying generation potential. **B** Light grey mudstones in the interval 90–95 m. The mudstones are highly oil-prone.

Fig. 3. The content of TOC through the ENRECA-3 well (data from the two core pieces not included).

Fig. 4. The content of TS through the ENRECA-3 well (data from the two core pieces not included). Sample 23354 (483.06 m) having a TS content of 2.30 wt.% has been omitted from the plot in order to avoid suppression of all other values.

Fig. 5. HI versus T_{\max} plot showing a predominance of oil-prone Type I and Type I-II kerogen in the mudstones. Red dots refer to the core pieces from 452.12–452.25 m and 488.87–488.95 m: high HI values are derived from the black mudstone layers, whereas the lower HI values are from the brownish mudstone layers.

Fig. 6. HI values through the ENRECA-3 well showing dominantly high values with maximum values exceeding 700 mg HC/g TOC (data from the two core pieces not included).

Fig. 7. S_2 versus TOC plot showing that the mudstones generally can be classified as excellent petroleum source rocks. Red dots refer to the two core piece from 452.12–452.25 m and 488.87–488.95 m: highest values correspond to the black mudstones, whereas the lower values are from the light brownish mudstones.

Table 1. Organic geochemical screening data from the ENRECA-3 well.

Table 2. Organic geochemical screening data of light and black mudstones in the two core pieces.

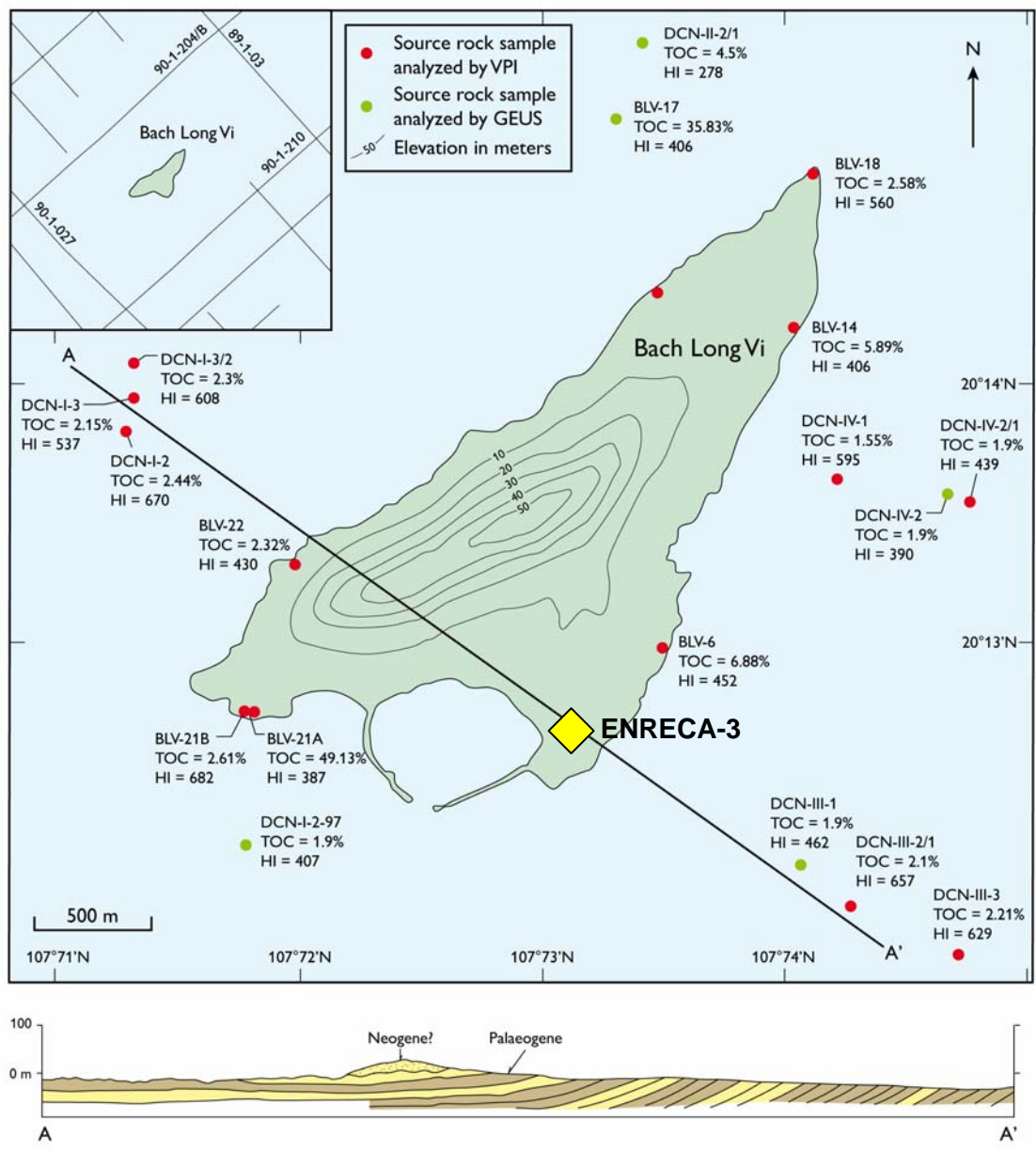


Figure 1



Figure 2A

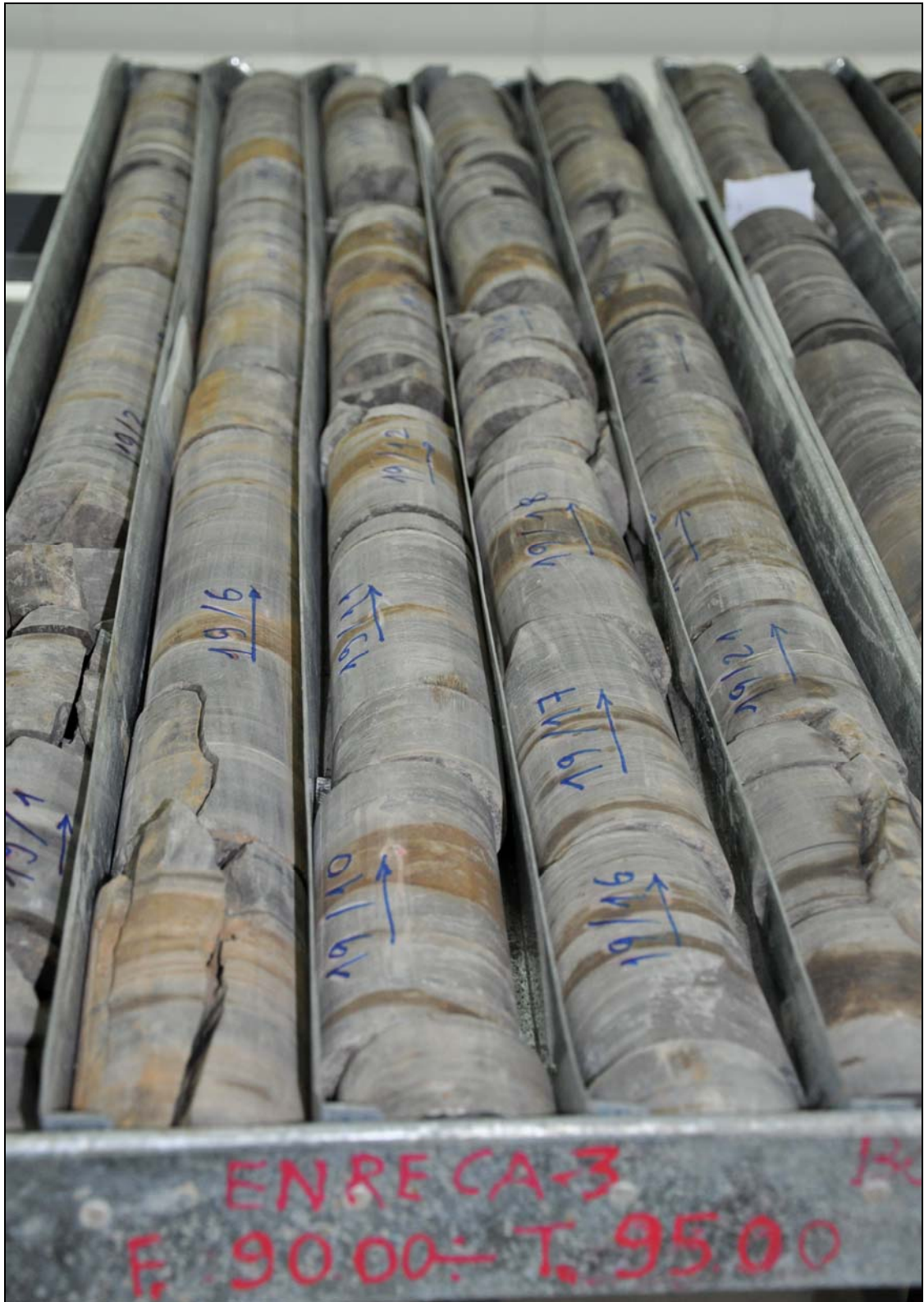


Figure 2B

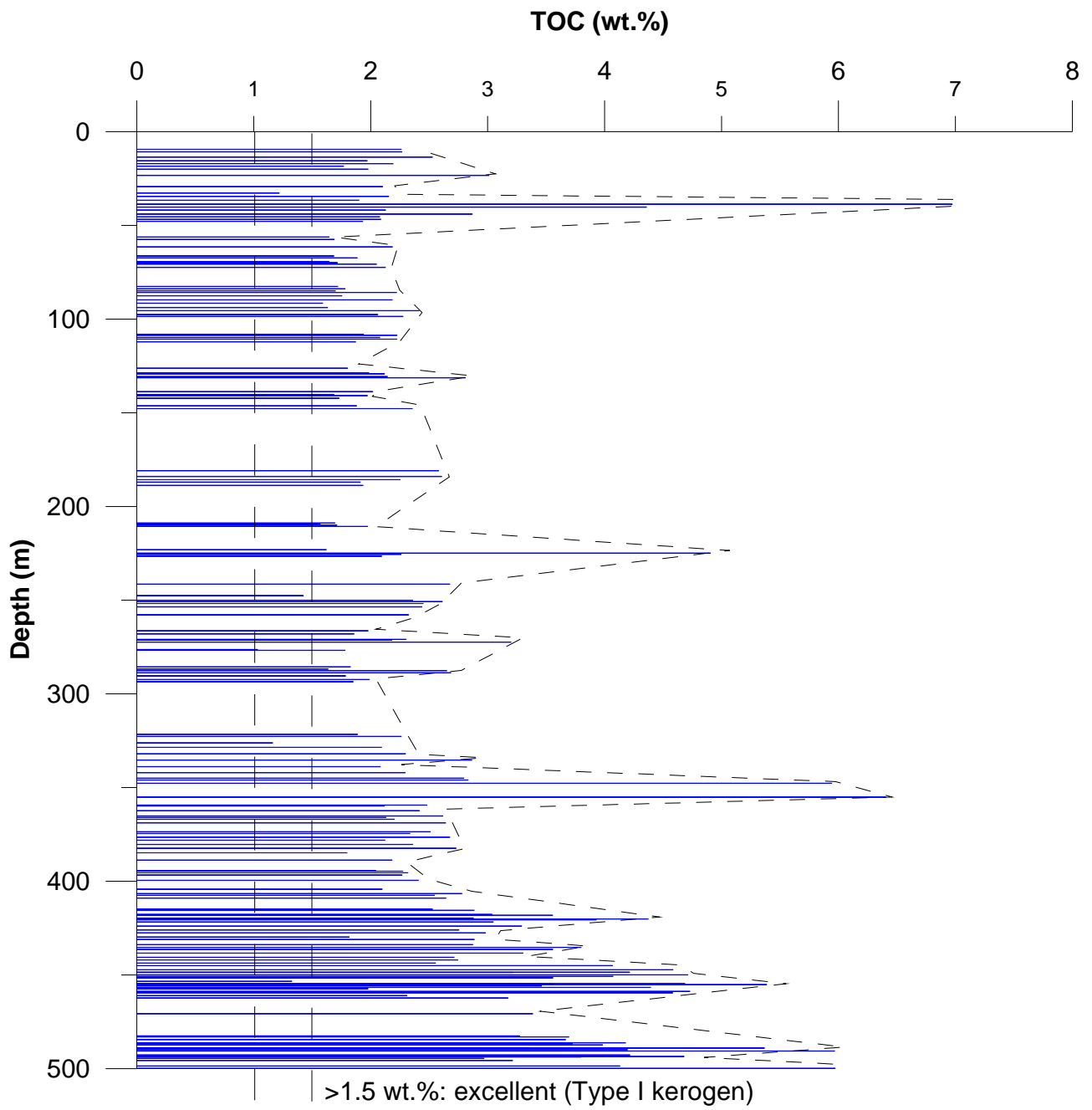


Figure 3

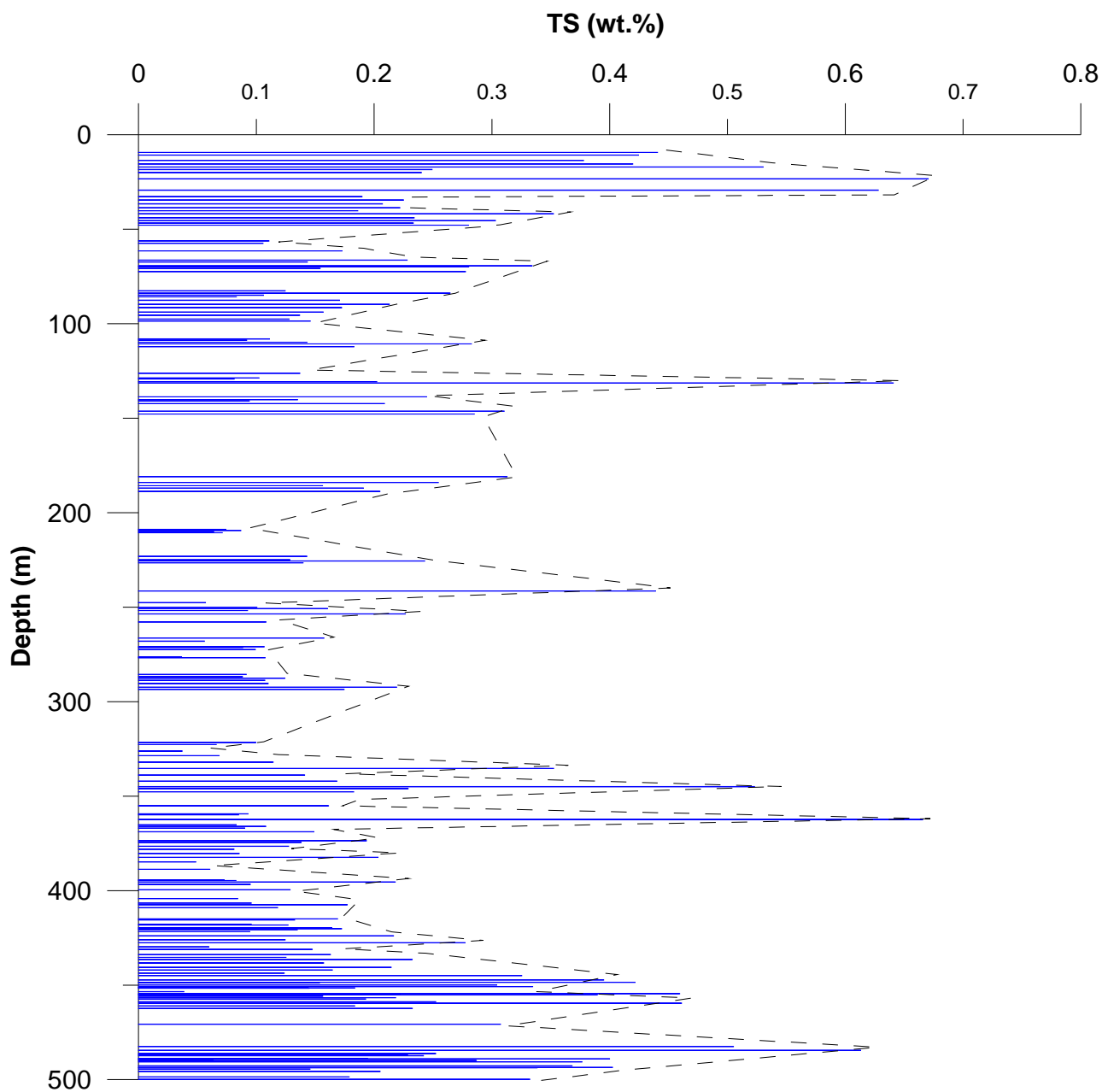


Figure 4

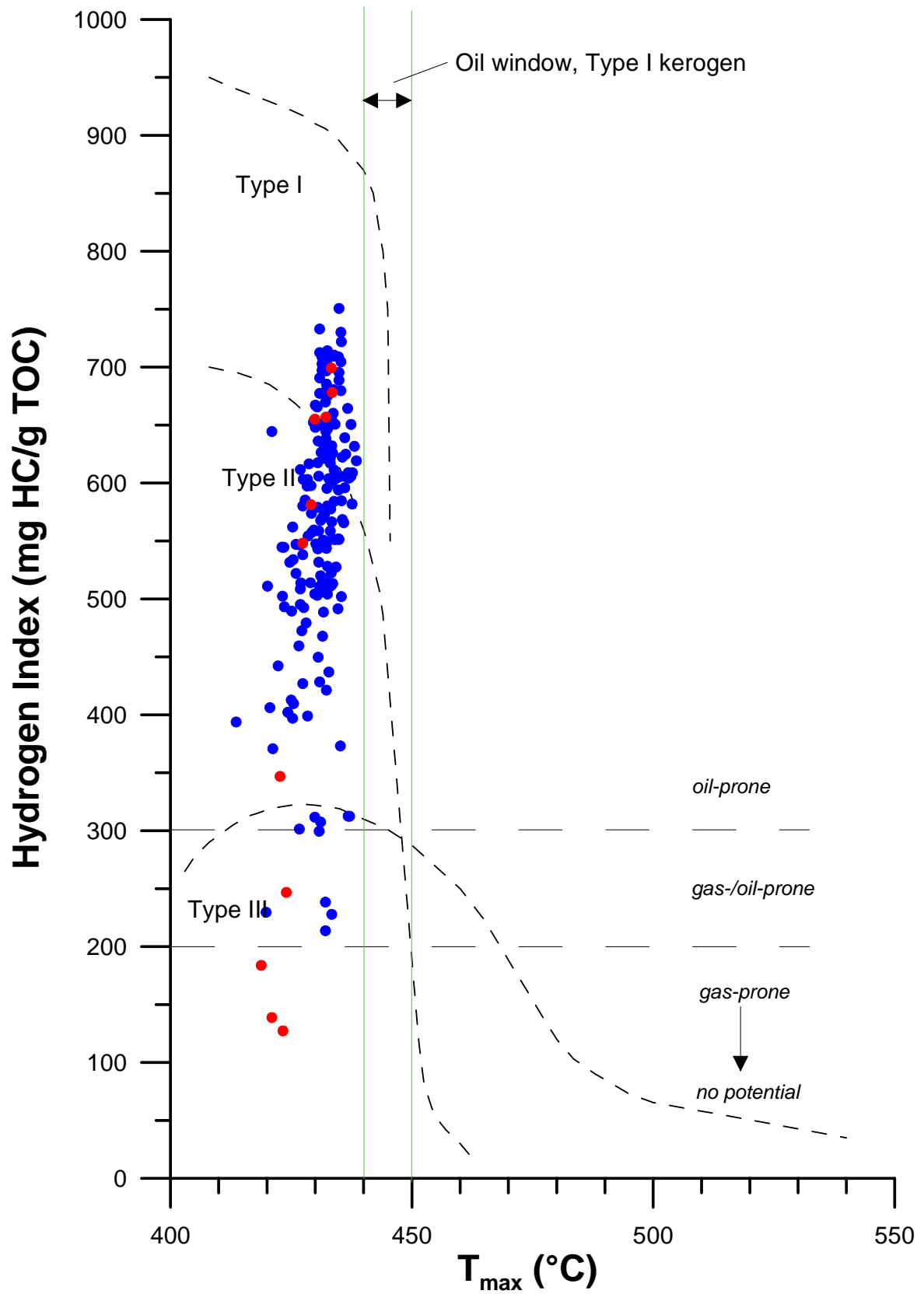


Figure 5

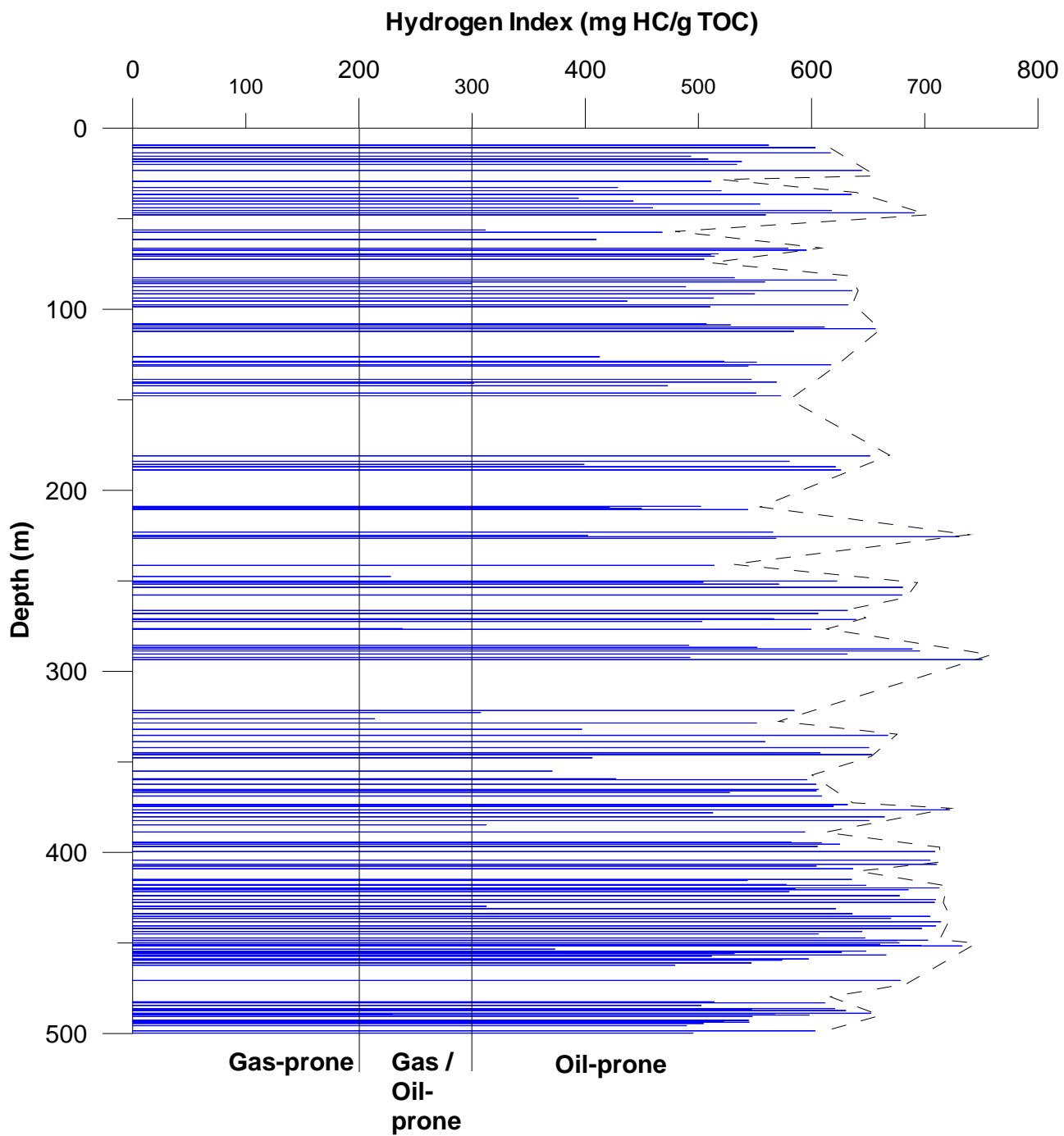


Figure 6

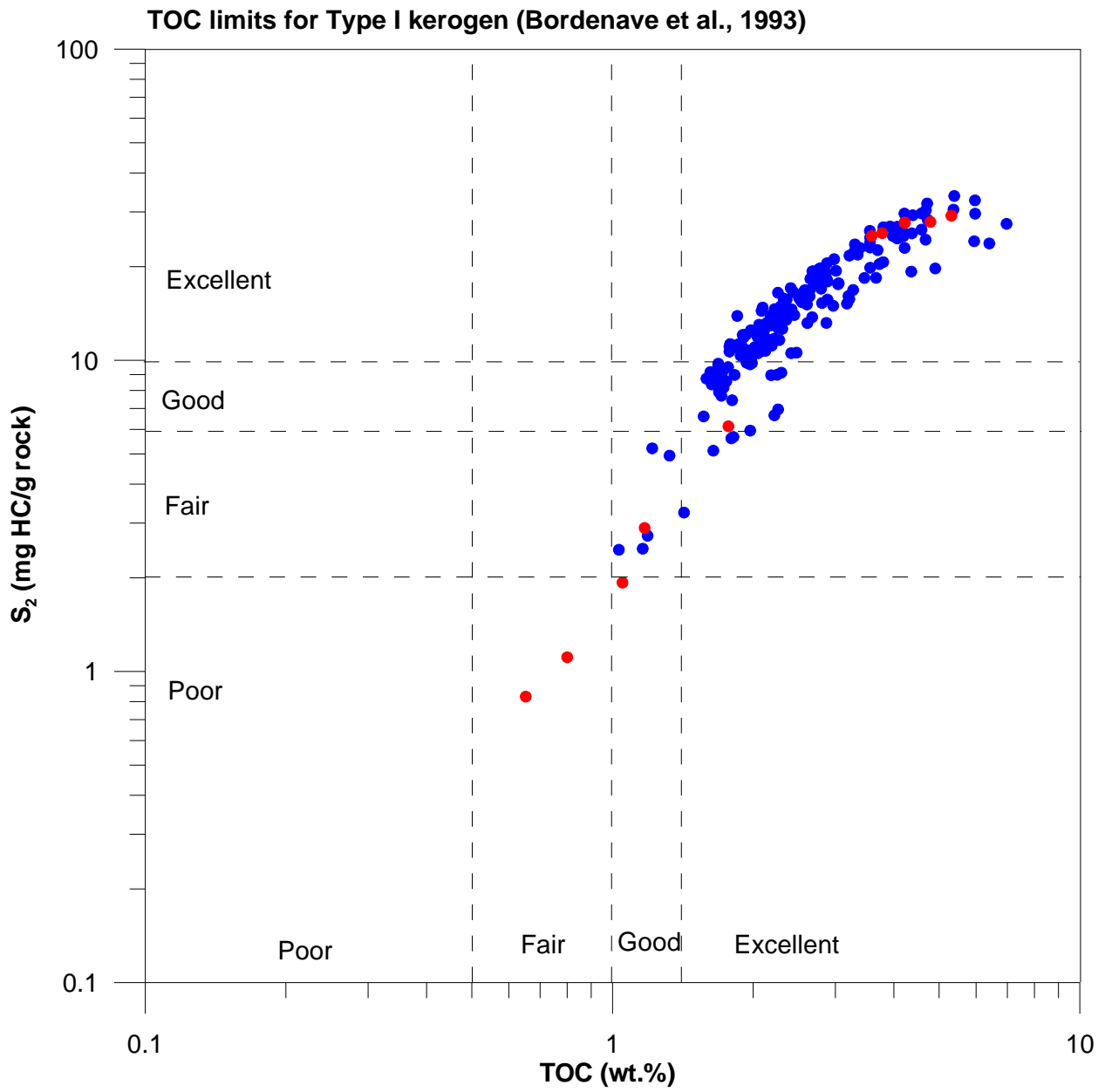


Figure 7

Table 1.

Lab. no.	Lithology	Core box	Depth m	TOC	TC	TS	T _{max} °C	S ₁	S ₂	S ₁ +S ₂	HI	PI
				wt. %				mg HC/g rock				
22795	silty mudstone	box no 2	9,38	2,26	3,09	0,44	425	0,34	12,70	13,04	562	0,03
22796	silty mudstone	box no 3	10,73	2,26	2,55	0,42	428	0,32	13,66	13,98	603	0,02
22797	silty mudstone	box no 3	13,56	2,53	2,59	0,38	429	0,28	15,58	15,86	617	0,02
22798	mudstone	box no 4	15,50	1,97	2,64	0,42	424	0,22	9,71	9,93	493	0,02
22799	mudstone	box no 4	17,11	2,19	2,11	0,53	427	0,30	11,14	11,44	509	0,03
22800	mudstone	box no 4	18,42	1,77	1,80	0,25	427	0,18	9,51	9,69	538	0,02
22801	mudstone	box no 4	19,98	1,98	2,12	0,24	425	0,20	10,55	10,75	534	0,02
22802	silty mudstone	box no 5	23,36	3,01	3,97	0,67	421	0,72	19,39	20,11	644	0,04
22803	mudstone	box no 6	29,33	2,10	2,92	0,63	420	0,29	10,74	11,03	511	0,03
22804	silty mudstone	box no 7	32,76	1,22	1,21	0,19	431	0,08	5,21	5,29	428	0,02
22805	silty mudstone	box no 7	34,53	2,15	2,18	0,23	431	0,19	11,19	11,38	520	0,02
22806	silty mudstone	box no 8	36,56	1,90	1,87	0,21	432	0,22	12,06	12,28	635	0,02
22807	silty mudstone	box no 8	38,65	6,97	6,98	0,22	414	0,48	27,45	27,93	394	0,02
22808	silty mudstone	box no 9	40,27	4,36	4,26	0,19	422	0,28	19,27	19,55	442	0,01
22809	silty mudstone	box no 9	41,81	2,13	2,59	0,35	429	0,23	11,79	12,02	554	0,02
22810	mudstone	box no 9	43,97	2,87	2,87	0,23	427	0,20	13,18	13,38	459	0,01
22811	mudstone	box no 10	45,41	2,08	2,25	0,30	431	0,23	12,82	13,05	617	0,02
22812	mudstone	box no 10	46,75	2,08	2,24	0,23	431	0,23	14,40	14,63	691	0,02
22813	mudstone	box no 10	47,88	1,93	2,08	0,28	430	0,20	10,80	11,00	560	0,02
22814	silty mudstone	box no 12	56,20	1,64	1,68	0,11	430	0,10	5,12	5,22	312	0,02
22815	silty mudstone	box no 12	57,47	1,69	1,67	0,11	432	0,12	7,90	8,02	468	0,01
22816	silty mudstone	box no 13	61,45	2,18	2,24	0,17	426	0,13	8,95	9,08	410	0,01
22817	(silty) mudstone	box no 14	66,36	1,68	1,79	0,23	431	0,22	9,75	9,97	579	0,02
22818	(silty) mudstone	box no 14	67,36	1,88	1,83	0,14	432	0,20	11,22	11,42	595	0,02
22819	(silty) mudstone	box no 14	69,37	1,64	1,67	0,33	432	0,21	8,51	8,72	518	0,02
22820	(silty) mudstone	box no 14	69,94	1,72	1,79	0,28	431	0,16	8,76	8,92	511	0,02
22821	(silty) mudstone	box no 15	70,71	2,05	1,99	0,15	432	0,23	10,54	10,77	514	0,02
22822	(silty) mudstone	box no 15	72,43	2,12	2,11	0,28	431	0,19	10,73	10,92	505	0,02
22823	(silty) mudstone	box no 17	82,60	1,72	1,94	0,12	431	0,21	9,13	9,34	532	0,02
22824	(silty) mudstone	box no 17	83,83	1,78	1,80	0,26	432	0,22	11,07	11,29	622	0,02
22825	(silty) mudstone	box no 17	84,91	1,70	1,70	0,11	433	0,17	9,48	9,65	559	0,02
22826	mudstone	box no 18	85,79	2,22	2,19	0,08	431	0,09	6,65	6,74	300	0,01
22827	mudstone	box no 18	87,60	1,75	1,79	0,17	432	0,16	8,56	8,72	489	0,02
22828	(silty) mudstone	box no 18	89,73	2,18	2,31	0,21	431	0,25	13,88	14,13	636	0,02
22829	(silty) mudstone	box no 19	91,49	1,59	1,54	0,17	433	0,20	8,73	8,93	550	0,02
22830	(silty) mudstone	box no 19	93,83	1,63	1,63	0,16	434	0,12	8,37	8,49	513	0,01
22831	(silty) mudstone	box no 20	95,51	2,41	2,28	0,14	433	0,12	10,54	10,66	437	0,01
22832	mudstone	box no 20	97,56	2,06	1,92	0,13	433	0,23	13,02	13,25	632	0,02
22833	mudstone	box no 20	98,59	2,28	2,22	0,15	433	0,13	11,61	11,74	510	0,01
22834	mudstone	box no 22	108,08	1,94	2,24	0,11	432	0,17	9,82	9,99	507	0,02
22835	mudstone	box no 22	108,65	2,22	2,23	0,09	433	0,15	11,75	11,90	528	0,01
22836	mudstone	box no 22	109,82	2,08	2,00	0,14	434	0,25	12,70	12,95	611	0,02
22837	mudstone	box no 23	110,71	2,22	2,23	0,28	433	0,34	14,60	14,94	656	0,02
22838	mudstone	box no 23	112,17	1,87	1,93	0,18	434	0,21	10,92	11,13	584	0,02
22839	silty mudstone	box no 26	126,22	1,80	2,37	0,14	425	0,17	7,44	7,61	413	0,02
22840	silty mudstone	box no 26	128,70	1,98	1,94	0,10	433	0,18	10,36	10,54	523	0,02
22841	silty mudstone	box no 26	129,23	2,12	2,11	0,08	434	0,20	11,67	11,87	551	0,02
22842	silty mudstone	box no 27	130,67	2,14	2,21	0,20	433	0,30	13,22	13,52	617	0,02
22843	silty mudstone	box no 27	131,37	2,81	2,68	0,64	431	0,36	15,27	15,63	544	0,02
22844	mudstone	box no 28	138,71	2,02	2,10	0,24	431	0,23	11,02	11,25	547	0,02
22845	silty mudstone	box no 29	140,20	1,68	1,74	0,14	431	0,20	9,58	9,78	569	0,02
22846	silty mudstone	box no 29	140,81	1,97	1,96	0,09	427	0,10	5,94	6,04	301	0,02
22847	silty mudstone	box no 29	142,24	1,73	1,97	0,21	427	0,25	8,17	8,42	473	0,03
22848	silty mudstone	box no 30	146,29	1,88	1,94	0,31	432	0,29	10,35	10,64	551	0,03
22849	silty mudstone	box no 30	147,78	2,36	2,30	0,29	432	0,28	13,49	13,77	573	0,02
22850	silty mudstone	box no 37	180,95	2,58	2,66	0,31	431	0,36	16,81	17,17	652	0,02
22851	silty mudstone	box no 37	183,99	2,61	2,50	0,25	433	0,21	15,12	15,33	580	0,01
22852	silty mudstone	box no 38	185,71	2,25	2,23	0,16	428	0,16	8,98	9,14	399	0,02
22853	silty mudstone	box no 38	186,98	1,91	1,96	0,19	433	0,27	11,86	12,13	621	0,02
22854	silty mudstone	box no 38	188,76	1,93	1,93	0,20	434	0,24	12,10	12,34	626	0,02
22855	mudstone	box no 42	208,85	1,69	1,66	0,07	435	0,12	8,49	8,61	502	0,01
22856	mudstone	box no 42	209,41	1,57	1,89	0,09	432	0,13	6,60	6,73	421	0,02
22857	silty mudstone	box no 43	210,01	1,71	2,10	0,06	431	0,13	7,69	7,82	450	0,02
22858	silty mudstone	box no 43	210,63	1,97	2,31	0,07	432	0,16	10,73	10,89	544	0,01
22859	mudstone	box no 45	223,06	1,62	1,71	0,14	436	0,08	9,16	9,24	566	0,01
22860	silty mudstone	box no 45	224,90	4,90	4,85	0,13	424	0,40	19,72	20,12	402	0,02
22861	mudstone	box no 46	225,57	2,26	2,21	0,24	435	0,26	16,49	16,75	730	0,02

Table 1. Continued

Lab. no.	Lithology	Core box	Depth m	TOC	TC	TS	T _{max}	S ₁	S ₂	S ₁ +S ₂	HI	PI
				wt. %			°C	mg HC/g rock				
22862	mudstone	box no 46	226,55	2,09	2,07	0,14	436	0,16	11,90	12,06	568	0,01
22863	silty mudstone	box no 49	241,46	2,68	3,10	0,44	429	0,26	13,75	14,01	514	0,02
22864	mudstone	box no 50	247,61	1,42	1,51	0,06	433	0,04	3,24	3,28	228	0,01
22865	mudstone	box no 51	250,10	2,36	2,41	0,10	436	0,20	14,68	14,88	622	0,01
22866	mudstone	box no 51	250,76	2,61	2,74	0,16	433	0,19	13,17	13,36	504	0,01
22867	mudstone	box no 51	251,78	2,45	2,70	0,09	432	0,20	13,98	14,18	571	0,01
22868	mudstone	box no 51	253,56	2,44	2,53	0,23	434	0,30	16,58	16,88	681	0,02
22869	mudstone	box no 52	257,85	2,32	2,28	0,11	435	0,21	15,79	16,00	680	0,01
22870	mudstone	box no 54	266,31	1,98	2,32	0,16	432	0,15	12,49	12,64	632	0,01
22871	mudstone	box no 54	267,98	1,86	1,81	0,06	435	0,10	11,24	11,34	606	0,01
22872	mudstone	box no 55	270,93	2,30	2,41	0,11	433	0,15	13,04	13,19	566	0,01
22873	mudstone	box no 55	271,33	2,18	2,19	0,09	436	0,12	13,92	14,04	639	0,01
22874	mudstone	box no 55	272,40	3,20	3,13	0,10	430	0,21	16,09	16,30	503	0,01
22875	silty mudstone	box no 56	276,31	1,03	1,05	0,04	432	0,06	2,46	2,52	238	0,02
22876	silty mudstone	box no 56	276,76	1,78	1,78	0,11	433	0,16	10,67	10,83	599	0,01
22877	mudstone	box no 58	285,61	1,83	1,78	0,09	435	0,06	8,97	9,03	492	0,01
22878	mudstone	box no 58	286,73	1,63	1,62	0,09	435	0,07	9,02	9,09	552	0,01
22879	mudstone	box no 58	287,63	2,65	2,65	0,12	435	0,19	18,25	18,44	689	0,01
22880	mudstone	box no 58	288,72	2,68	2,72	0,11	435	0,17	18,67	18,84	695	0,01
22881	mudstone	box no 59	290,40	1,79	1,82	0,11	433	0,19	11,27	11,46	631	0,02
22882	mudstone	box no 59	292,33	1,99	2,85	0,22	428	0,21	9,79	10,00	492	0,02
22883	mudstone	box no 59	293,48	1,85	1,97	0,17	435	0,19	13,88	14,07	751	0,01
22884	mudstone	box no 65	321,61	1,88	1,89	0,10	435	0,11	11,02	11,13	585	0,01
22888	(silty) mudstone	box no 67	322,70	2,26	2,15	0,07	431	0,12	6,95	7,07	307	0,02
22885	mudstone	box no 66	326,18	1,16	1,17	0,04	432	0,03	2,48	2,51	214	0,01
22886	mudstone	box no 66	328,55	2,09	2,03	0,07	435	0,11	11,53	11,64	551	0,01
22887	(silty) mudstone	box no 67	332,01	2,30	3,18	0,11	425	0,12	9,12	9,24	397	0,01
22889	(silty) mudstone	box no 68	335,36	2,86	3,14	0,35	430	0,28	19,10	19,38	667	0,01
22890	mudstone	box no 68	338,81	2,08	2,35	0,14	431	0,15	11,63	11,78	559	0,01
22891	mudstone	box no 69	342,06	2,29	2,34	0,17	437	0,16	14,92	15,08	651	0,01
22892	mudstone	box no 69	344,99	2,80	2,81	0,52	434	0,25	16,98	17,23	607	0,01
22893	mudstone	box no 70	345,99	2,83	2,91	0,23	434	0,33	18,50	18,83	653	0,02
22894	mudstone	box no 70	347,72	5,94	5,88	0,18	421	0,50	24,13	24,63	406	0,02
22895	silty mudstone	box no 72	355,08	6,40	6,33	0,16	421	0,43	23,74	24,17	371	0,02
22896	silty mudstone	box no 72	359,31	2,48	3,25	0,09	427	0,12	10,58	10,70	427	0,01
22897	mudstone	box no 72	359,83	2,12	2,18	0,08	436	0,09	12,61	12,70	596	0,01
22898	silty mudstone	box no 73	362,32	2,42	2,49	0,67	433	0,31	14,59	14,90	604	0,02
22899	(silty) mudstone	box no 74	365,16	2,61	2,62	0,08	437	0,16	15,84	16,00	606	0,01
22900	mudstone	box no 74	365,96	2,13	2,27	0,11	437	0,14	12,87	13,01	604	0,01
22901	mudstone	box no 74	366,90	2,20	2,40	0,09	434	0,15	11,61	11,76	528	0,01
22902	mudstone	box no 74	368,85	2,64	2,63	0,15	438	0,19	16,07	16,26	609	0,01
22903	mudstone	box no 75	373,60	2,51	2,43	0,19	438	0,18	15,84	16,02	632	0,01
22904	mudstone	box no 75	374,48	2,34	2,30	0,14	439	0,18	14,46	14,64	619	0,01
22905	mudstone	box no 76	376,52	2,68	2,76	0,13	435	0,32	19,32	19,64	722	0,02
22906	mudstone	box no 76	378,07	2,12	2,56	0,08	431	0,21	10,87	11,08	513	0,02
22907	mudstone	box no 77	380,35	2,36	2,41	0,09	437	0,18	15,67	15,85	664	0,01
22908	mudstone	box no 77	382,38	2,73	2,83	0,20	434	0,28	17,77	18,05	651	0,02
22909	mudstone	box no 77	384,79	1,80	1,88	0,05	437	0,12	5,61	5,73	312	0,02
22910	silty mudstone	box no 78	388,70	2,18	2,23	0,06	435	0,22	12,96	13,18	594	0,02
22911	mudstone	box no 79	394,33	2,04	2,03	0,07	438	0,16	11,89	12,05	582	0,01
22912	mudstone	box no 79	394,62	2,27	2,29	0,08	437	0,21	13,84	14,05	609	0,01
22913	mudstone	box no 80	395,46	2,32	2,41	0,22	436	0,22	14,48	14,70	625	0,01
22914	mudstone	box no 80	396,65	2,27	2,33	0,09	437	0,19	13,72	13,91	605	0,01
22915	(silty) mudstone	box no 80	399,50	2,41	2,58	0,13	435	0,27	17,06	17,33	709	0,02
22916	mudstone	box no 81	404,24	2,10	2,32	0,08	435	0,19	14,77	14,96	705	0,01
22917	(silty) mudstone	box no 82	406,56	2,78	2,79	0,10	434	0,32	19,74	20,06	710	0,02
22918	(silty) mudstone	box no 82	407,50	2,54	2,35	0,18	434	0,21	15,37	15,58	604	0,01
22919	silty mudstone	box no 82	408,99	2,64	3,26	0,12	431	0,26	16,81	17,07	636	0,02
22920	(silty) mudstone	box no 83	414,89	2,53	2,91	0,17	432	0,30	16,06	16,36	635	0,02
22921	(silty) mudstone	box no 84	415,48	2,88	3,22	0,13	431	0,28	15,67	15,95	543	0,02
22922	(silty) mudstone	box no 84	417,70	3,04	2,95	0,10	433	0,23	17,55	17,78	578	0,01
22923	(silty) mudstone	box no 84	418,19	3,56	3,65	0,13	432	0,27	23,04	23,31	648	0,01
22924	mudstone	box no 84	419,63	2,88	3,10	0,16	431	0,29	20,50	20,79	713	0,01
22925	mudstone	box no 85	420,19	4,37	5,25	0,17	428	0,32	25,59	25,91	585	0,01
22926	(silty) mudstone	box no 85	420,62	3,93	4,08	0,13	432	0,25	26,92	27,17	685	0,01
22927	(silty) mudstone	box no 85	421,72	3,05	3,53	0,09	427	0,28	17,68	17,96	580	0,02
22928	(silty) mudstone	box no 85	423,90	3,29	3,37	0,22	432	0,47	22,30	22,77	678	0,02

Table 1. Continued

Lab. no.	Lithology	Core box	Depth m	TOC	TC	TS	T _{max} °C	S ₁	S ₂	S ₁ +S ₂	HI	PI
				wt. %		mg HC/g rock						
22929	mudstone	box no 86	425,99	2,75	2,85	0,12	434	0,36	19,53	19,89	709	0,02
22930	(silty) mudstone	box no 86	427,54	2,98	3,37	0,28	431	0,40	21,13	21,53	709	0,02
22931	(silty) mudstone	box no 86	429,73	1,81	1,81	0,06	437	0,11	5,67	5,78	313	0,02
22932	(silty) mudstone	box no 87	431,07	2,89	3,20	0,15	432	0,32	17,93	18,25	621	0,02
22933	(silty) mudstone	box no 87	433,86	2,87	3,03	0,16	432	0,38	18,27	18,65	636	0,02
22934	(silty) mudstone	box no 88	435,30	3,80	3,93	0,13	432	0,48	26,77	27,25	705	0,02
22935	(silty) mudstone	box no 88	436,41	3,56	3,83	0,23	432	0,54	23,82	24,36	670	0,02
22936	(silty) mudstone	box no 88	438,28	3,30	3,32	0,16	433	0,47	23,58	24,05	714	0,02
22937	(silty) mudstone	box no 89	440,56	2,71	2,88	0,21	432	0,29	19,24	19,53	710	0,01
22938	(silty) mudstone	box no 89	442,02	2,74	2,81	0,16	431	0,38	19,12	19,50	697	0,02
22939	(silty) mudstone	box no 89	443,68	2,55	2,71	0,12	432	0,35	16,46	16,81	645	0,02
22940	(silty) mudstone	box no 90	445,01	4,07	4,42	0,33	431	0,50	24,64	25,14	606	0,02
22941	(silty) mudstone	box no 90	447,24	4,58	4,64	0,39	433	0,63	29,66	30,29	647	0,02
23344	n.i.	box nr. 90	448,48	4,21	4,24	0,42	431	0,55	29,61	30,16	703	0,02
22942	(silty) mudstone	box no 90	448,69	3,21	3,25	0,15	433	0,39	21,70	22,09	675	0,02
23345	n.i.	box nr. 90	449,92	4,71	4,87	0,30	431	0,61	31,92	32,53	677	0,02
22943	(silty) mudstone	box no 91	450,78	4,07	4,17	0,33	434	0,38	26,88	27,26	660	0,01
23346	n.i.	box nr. 91	451,18	2,25	2,27	0,14	432	0,28	14,34	14,62	638	0,02
22944	(silty) mudstone	box no 91	451,48	3,56	3,59	0,18	432	0,47	24,79	25,26	697	0,02
23347	n.i.	box nr. 91	451,62	3,55	3,66	0,14	431	0,52	26,05	26,57	733	0,02
23348	n.i.	box nr. 91	453,41	1,32	1,39	0,04	435	0,08	4,94	5,02	373	0,02
23349	n.i.	box nr. 91	454,50	4,68	4,81	0,46	430	0,47	30,36	30,83	648	0,02
22945	(silty) mudstone	box no 91	454,80	3,56	3,88	0,22	429	0,29	19,84	20,13	558	0,01
23350	n.i.	box nr. 92	455,16	5,39	5,78	0,39	431	0,50	33,73	34,23	626	0,01
22946	(silty) mudstone	box no 92	455,88	3,46	4,84	0,16	425	0,29	18,39	18,68	532	0,02
23351	n.i.	box nr. 92	456,63	4,39	4,71	0,22	430	0,70	29,24	29,94	666	0,02
22947	(silty) mudstone	box no 92	457,32	1,98	1,99	0,19	433	0,18	10,11	10,29	512	0,02
23352	n.i.	box nr. 92	458,80	4,73	5,93	0,25	428	0,87	28,25	29,12	597	0,03
22948	silty mudstone	box no 92	459,53	4,58	5,71	0,46	429	0,72	26,30	27,02	574	0,03
23353	n.i.	box nr. 93	461,00	2,31	3,26	0,18	427	0,46	12,62	13,08	547	0,04
22949	silty mudstone	box no 93	462,29	3,17	3,76	0,23	428	0,39	15,21	15,60	479	0,03
22950	silty mudstone	box no 95	470,72	3,39	3,76	0,31	432	0,39	22,97	23,36	678	0,02
22951	silty mudstone	box no 97	482,51	3,27	4,28	0,51	427	0,35	16,82	17,17	514	0,02
23354	n.i.	box nr. 97	483,06	3,69	4,47	2,30	427	0,69	22,59	23,28	612	0,03
22952	silty mudstone	box no 97	484,48	3,66	5,19	0,61	423	0,72	18,41	19,13	502	0,04
22953	(silty) mudstone	box no 98	486,27	4,18	4,29	0,25	433	0,69	25,92	26,61	620	0,03
23355	n.i.	box nr. 98	486,77	3,72	5,42	0,23	426	0,55	20,37	20,92	547	0,03
22954	(silty) mudstone	box no 98	487,34	3,98	4,14	0,24	432	0,62	25,09	25,71	630	0,02
23356	n.i.	box nr. 98	488,85	3,35	3,40	0,19	430	0,42	21,84	22,26	652	0,02
22955	(silty) mudstone	box no 98	489,02	5,37	5,67	0,40	431	0,69	30,47	31,16	568	0,02
22956	(silty) mudstone	box no 98	489,56	1,19	6,88	0,06	420	0,11	2,73	2,84	230	0,04
23357	n.i.	box nr. 99	489,88	4,19	4,47	0,29	429	0,55	25,07	25,62	598	0,02
22957	(silty) mudstone	box no 99	490,61	5,97	6,59	0,38	430	0,89	32,67	33,56	547	0,03
23358	n.i.	box nr. 99	492,70	4,22	5,67	0,37	424	0,73	22,96	23,69	545	0,03
22958	(silty) mudstone	box no 99	493,48	4,68	5,79	0,40	426	0,80	24,42	25,22	522	0,03
23359	n.i.	box nr. 99	493,73	3,80	4,90	0,34	423	0,54	20,68	21,22	545	0,03
22959	(silty) mudstone	box no 99	494,46	2,97	3,08	0,15	430	0,44	14,97	15,41	504	0,03
22960	(silty) mudstone	box no 100	495,66	3,21	4,62	0,21	425	0,56	15,72	16,28	489	0,03
23360	n.i.	box nr. 100	498,54	4,13	4,66	0,18	428	0,63	24,91	25,54	603	0,02
22961	(silty) mudstone	box no 100	499,83	5,97	7,88	0,33	427	1,06	29,57	30,63	495	0,03

Table 2.

Lab. no.	Lithology	Core box	Depth m	TOC	TC wt. %	TS	T _{max} °C	S ₁ S ₂ S ₁ +S ₂			HI	PI
								mg HC/g rock				
23292	black mdst	box no 91	452,13	3,59	3,39	0,21	433	0,53	25,08	25,61	699	0,02
23293	brownish mdst	box no 91	452,16	1,77	5,57	0,08	423	0,22	6,14	6,36	347	0,03
23294	black mdst	box no 91	452,18	3,78	3,91	0,25	434	0,55	25,61	26,16	678	0,02
23295	brownish mdst	box no 91	452,20	1,17	7,35	0,05	424	0,09	2,89	2,98	247	0,03
23296	black mdst	box no 91	452,24	4,22	4,33	0,26	432	0,62	27,71	28,33	657	0,02
23361	black mdst	box nr. 98	488,87	4,79	5,30	0,28	429	0,68	27,84	28,52	581	0,02
23362	brownish mdst	box nr. 98	488,89	0,80	8,59	0,07	421	0,03	1,11	1,14	139	0,03
23363	black mdst	box nr. 98	488,90	4,22	4,44	0,20	430	0,62	27,68	28,3	655	0,02
23364	brownish mdst	box nr. 98	488,92	1,05	8,35	0,80	419	0,08	1,93	2,01	184	0,04
23365	black mdst	box nr. 98	488,93	5,31	6,19	0,24	427	0,80	29,13	29,93	548	0,03
23366	brownish mdst	box nr. 98	488,95	0,65	8,36	0,25	423	0,02	0,83	0,85	127	0,02