Supplemental Material for: Characterization and taphonomic modes of kerogenous films in the Sirius Passet Lagerstätte

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MATERIALS AND METHODS

A total of 14 specimens from 8 samples from the Sirius Passet Lagerstätte were analyzed in this study. The majority of specimens were collected *in situ* from a measured section through the transitional Buen Formation. Raman point spectra were collected using a Horiba LabRAM HR equipped with a 'free space' microscope, using a 532 nm excitation with a maximum power at the sample of 0.8-5 mW, via a 50x LWD microscope objective. The laser was oriented normal to the sample and the instrument was calibrated against the Raman band for Si at ca. 520 cm^{-1}, obtained from a silicon wafer reference. Analyses were done at room temperature. Acquisition of Raman spectra was conducted with the software Labspec6.0. Collection parameters for sample DH074 were uniform, collected at 20 seconds with 2 accumulations to investigate the relative intensity of the D and G bands of the fossils and the

surrounding matrix. The scans for other samples varied from 10 to 30 seconds with 2 to 5 accumulations to obtain a good signal-to-noise ratio and to minimize degradation of carbonaceous material. In total, nearly 150 Raman point spectra were taken across all samples. Raman point spectra were collected on the matrix and on a variety of positions over the fossil specimens. Individual spectral band ratios are listed for samples in Table DR1. For comparison, 3 specimens from the Walcott Quarry Member of the Burgess Shale Lagerstätte were also analyzed and individual spectral band ratios are listed for samples in Table DR2.

Baseline corrections and the deconvolution of spectra were performed with the software program Fityk (Wojdyr, 2010). Individual spectra with a high level of fluorescent background were deemed not sufficiently reliable for deconvolution and were omitted from the final carbon deconvolution analyses. A five-based peak fitting procedure (Lünsdorf et al., 2014; Sforna et al., 2014) was followed to decompose each baseline-corrected spectrum and estimated peak thermal temperatures were calculated using the R_2 ratio Raman geothermometer that is suitable for a peak metamorphic temperature range of 330-650 °C (Beysaac et al., 2002; Sadezsky et al., 2005; Sforna et al., 2014). For the following equations, I = band intensity and A = band area.

$$R_2 = A_{D1}/(A_{D1}+A_{D2}+A_G)$$

$$T\ (°C) = -445 * R_2 + 641\ (\pm 50°C)$$

Other ratios used in Table DR1 to compare the structure and crystallinity of the fossil films and the sedimentary matrix of Sirius Passet samples are below:

$$R_{A1} = (A_{D1}+A_{D2})/A_{D1}+A_{D2}+A_{D3}+A_{D4+}A_G)$$

$$R_{A2} = (A_{D1}+A_{D4})/A_{D2}+A_{D3}+ A_G)$$

$$R_{D3} = I_{D3}/I_{D1}$$

$R_{D4} = I_{D4}/I_{D1}$Energy dispersive spectroscopy (EDS) element mapping was undertaken using a Tescan Mira3 High Resolution Schottky FE-SEM equipped with an Oxford EDS detector at

Lund University, Sweden. Element mapping was performed at an operating voltage of 5 kV and 15 kV. Figured specimens were photographed in wet conditions using a Canon EOS 5D Mark III digital SLR camera. Statistical tests were done in PAST (Hammer et al., 2001). Figured specimens from the Sirius Passet Lagerstätte are deposited in the Natural History Museum of Denmark, Copenhagen (MGUH prefix). Samples from the Burgess Shale Lagerstätte are deposited in the Royal Ontario Museum, Toronto, Canada (ROM prefix).

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List of taxa analyzed.

Sirius Passet Lagerstätte:

1. *Aaveqaspis inesoni*
2. *Kiisortoqia*?
3. *Buenellus higginsi*
4. *Kleptothule rasmusseni* (x3)
5. *Siriocaris trollae*
6. *Pauloterminus spinodorsalis*
7. *Isoxys volucris* (x3)
8. Unidentified priapulid
9. *Pygocirrus butyricampum*
10. Unidentified bivalved arthropod valve

Burgess Shale Lagerstätte:

1. *Marrella splendens*
2. *Micromitra burgessensis*
3. *Pirania muricata*
4. *Nisusia burgessensis*

Sample	Fossil	number	R2	RA1	RA2	ID/IG	AD/AG	RD3	RD4	FWH-D/FWHM-G	FWHMD	FWHMG	Temperature
DH074	*Aaveqaspis*	2	0.517775131	0.530895019	1.131718999	1.00903651	1.217728927	0.024596806	0.027277589	1.20682348	41.004	33.9768	410.5900665
		3	0.531968438	0.541398083	1.180540381	1.028833496	1.286215952	0.006624392	0.01371055	1.250172507	39.859	31.8828	404.274045
		4	0.522292933	0.531478206	1.13437243	0.996143191	1.237370411	0.008286672	0.015382038	1.242163936	38.7539	31.1987	408.5796447
		5	0.533373814	0.546879486	1.206918399	1.124925984	1.308740567	0.016733322	0.020089237	1.163400558	40.3579	34.6896	403.6486529
		6	0.535946319	0.549122095	1.217895329	1.112126055	1.308870594	0.012117777	0.018245069	1.176908787	37.9486	32.2443	402.5038883
		7	0.528768516	0.540713832	1.177291785	1.040583195	1.262094308	0.012322051	0.016303519	1.212874711	38.583	31.8112	405.6980105
		8	0.537151293	0.550268869	1.223550762	1.142864707	1.323301209	0.014444618	0.020682223	1.157879571	39.3796	34.0101	401.9676746
		9	0.517902246	0.527235708	1.115218973	1.022141124	1.205546697	0.007120765	0.015777372	1.179432975	37.4365	31.7411	410.5335005
		10	0.523639944	0.539653805	1.172278194	1.046183634	1.228318634	0.010792613	0.019922555	1.174093909	37.9048	32.2843	407.980225
		11	0.523098248	0.536408861	1.157073154	1.012282483	1.239540329	0.009812178	0.017469255	1.224499646	38.5628	31.4927	408.2212798
		14	0.525001553	0.536769768	1.15875375	0.99464058	1.25569208	0.007945084	0.015362841	1.262459214	39.543	31.3222	407.3743089
		15	0.517135622	0.516971523	1.070271314	0.995191202	1.19922162	0.008932645	0.015210975	1.205018203	37.1048	30.7919	410.8746482
		17	0.528928675	0.542603085	1.18628497	1.050918635	1.274437666	0.012971952	0.019114186	1.212687792	38.0596	31.3845	405.6267395
		19	0.51647977	0.528274504	1.119876939	1.000662414	1.19370266	0.007481508	0.015522723	1.192910273	37.7203	31.6204	411.1665023
		20	0.519364042	0.531946416	1.136507517	1.024321273	1.211989054	0.008859781	0.016574514	1.183215276	37.4335	31.6371	409.8830012
		21	0.539226628	0.551818671	1.231239757	1.101622532	1.327801533	0.010612936	0.016171237	1.205314116	38.4676	31.915	401.0441504
		23	0.538617805	0.554170765	1.243011273	1.139130102	1.327381839	0.008580966	0.019083312	1.165261362	38.6678	33.1838	401.3150768
		24	0.544586821	0.56005584	1.27301574	1.10241335	1.372530692	0.016056892	0.020710476	1.245022899	39.555	31.7705	398.6588645
		25	0.524379236	0.538067401	1.164817988	1.001144718	1.256059188	0.009613937	0.017057331	1.254622551	39.4703	31.4599	407.6512399
	Isoxys	2	0.542515947	0.553649397	1.240391283	1.15728842	1.351502127	0.012064092	0.016596905	1.167819858	39.1403	33.5157	399.5804034
		4	0.527394477	0.540033839	1.174072977	1.064004988	1.253000726	0.012039471	0.017468019	1.177626366	39.2338	33.316	406.3094579
		9	0.53737868	0.544824342	1.19695404	1.146009576	1.322338612	0.005615379	0.011179069	1.153866048	37.4763	32.4789	401.8664873
		10	0.520905832	0.55894731	1.267302805	1.058178442	1.258096729	0.028854412	0.031669874	1.188926627	42.3567	35.626	409.1969049
		11	0.529342378	0.541345474	1.180290269	1.055239995	1.272267064	0.010221784	0.016538733	1.205667681	38.4057	31.8543	405.4426417
DH053	Priapulid	3	0.51481197	0.544174934	1.193824067	0.988512177	1.194387123	0.014574294	0.030323894	1.208267015	37.8805	31.3511	411.9086733
		5	0.53278807	0.551937565	1.231831821	1.129114637	1.278985611	0.019985093	0.02533235	1.13273451	38.2734	33.7885	403.9093089
SP2009 0079	*Isoxys*	3	0.517380745	0.53157116	1.134795971	1.043839968	1.211929548	0.014258341	0.020945103	1.161029189	37.6199	32.4022	410.7655686
		4	0.51263408	0.524720862	1.104026708	1.034153105	1.186634711	0.021200129	0.022962131	1.147445681	39.7715	34.6609	412.8778343
	Isoxys	5	0.51991228	0.529779756	1.12666301	1.068234157	1.224062528	0.008791233	0.016114364	1.145874831	36.9901	32.2811	409.6390353
		6	0.516628024	0.535911841	1.154763012	1.06216796	1.215791083	0.019876532	0.027817462	1.144631862	39.0941	34.1543	411.1005295
	Pauloterminus	7	0.519859643	0.53533789	1.152101446	1.023391632	1.215762516	0.018801628	0.02339786	1.187971605	38.8083	32.6677	409.6624591
		9	0.548648516	0.559924976	1.272339817	1.186975498	1.403665301	0.020581627	0.021780552	1.182555087	41.7967	35.3444	396.8514102
		10	0.502693223	0.528025542	1.118758725	0.995554917	1.154608505	0.038503994	0.04042697	1.159763874	40.3933	34.8289	417.3015159
SP2011 0830	*Siriocaris*	2	0.52444461	0.55476697	1.246014858	1.097527995	1.257170233	0	0.024427107	1.145457158	37.4663	32.7086	407.6221486
		5	0.528741177	0.557592064	1.260357285	1.130289874	1.310783237	0	0.031316831	1.159687814	36.7461	31.6862	405.710176
		6	0.510964274	0.527316	1.115578272	1.095409121	1.195358515	0.018894452	0.024902874	1.09124102	35.9541	32.9479	413.6208983
DH152	*Pygocirrus*	1	0.528906937	0.538890432	1.168681957	1.10145387	1.265434579	0.005417961	0.013892588	1.148874275	37.2812	32.4502	405.6364131
		2	0.528906937	0.538890432	1.168681957	1.10145387	1.265434579	0.005417961	0.013892588	1.148874275	37.2812	32.4502	405.6364131
		5	0.539137255	0.551785444	1.231074352	1.140097597	1.329880697	0.01292764	0.020772143	1.166465083	40.7949	34.9731	401.0839215
		6	0.536130736	0.544627222	1.196003028	1.150693947	1.290121023	0.004702066	0.012320464	1.121171182	37.2619	33.2348	402.4218227
		8	0.552216729	0.567153422	1.310287411	1.237157334	1.408163744	0.010409886	0.019442454	1.138224888	40.0835	35.2158	395.2635555
DH032	*Kiisortoqia?*	7	0.526728235	0.552524456	1.234759	1.050362789	1.233460251	0.007695381	0.025051681	1.174321266	40.2609	34.2844	406.6059354
		9	0.536511771	0.525518226	1.107562512	1.144702337	1.269515241	0.018908405	0.024580521	1.109035268	39.0305	35.1932	402.2522619
		26	0.541120871	0.563676211	1.291875954	1.126922461	1.295632644	0.003814173	0.023367612	1.129662228	39.5314	34.994	400.2012123
		27	0.536511771	0.525518226	1.107562512	1.144702337	1.269515241	0.018908405	0.024580521	1.109035268	39.0305	35.1932	402.2522619
		Fossil Mean	0.527974493	0.541848354	1.184159838	1.077302315	1.266001025	0.013171424	0.020461504	1.176022038	38.7506	32.9782	406.0513504
		Fossil SD	0.010618812	0.01201893	0.057581771	0.06109845	0.057496892	0.007354583	0.005895375	0.0399898	1.3731	1.4097	4.725371376
DH074	Matrix	1	0.516235314	0.543107326	1.188697823	0.987724132	1.204374917	0.01572716	0.026406037	1.219342669	37.9457	31.1198	411.2752853
		2	0.509598012	0.604136784	1.526125086	1.028583221	1.172186366	0	0.024874738	1.139611558	37.3649	32.7874	414.2288846
		3	0.53190552	0.540923643	1.178286867	1.040552774	1.213042296	0	0.013975115	1.233039352	38.0421	30.8523	404.3020438
		4	0.504629567	0.541523488	1.181136818	0.95124099	1.15038329	0.023707245	0.038877433	1.209352611	37.3049	30.847	416.4398428
		6	0.51628357	0.533853793	1.145249675	1.010258539	1.209092721	0.019137132	0.023556567	1.196815104	39.2012	32.7546	411.2538115
		7	0.500300212	0.510566375	1.043177969	1.029547866	1.143220017	0.033257912	0.026659834	1.110406853	36.8423	33.1791	418.3664057
		10	0.494062649	0.515070146	1.062153923	0.891770769	1.08566201	0.013452192	0.024037519	1.217422884	37.2098	30.5644	421.1421211
		11	0.504625415	0.518446159	1.076610991	0.953808989	1.141595659	0.012644352	0.017136674	1.19688399	37.1125	31.0076	416.4416905
		12	0.525001845	0.53728583	1.161161392	1.082946327	1.25403217	0.002307297	0.014757737	1.157979047	35.2043	30.4015	407.3741791
		13	0.51996396	0.531989687	1.136705054	1.031429382	1.214326065	0.007712933	0.020408194	1.177324468	37.8033	32.1095	409.6160379
		14	0.512821302	0.531050124	1.132424063	0.986988868	1.181954042	0	0.017535919	1.197537587	37.1651	31.0346	412.7945207
		15	0.481371114	0.495942773	0.983901723	0.883876599	1.023378361	0.009782094	0.01995682	1.157827651	37.9698	32.794	426.7898543
		16	0.513116158	0.522153229	1.092721059	0.9837879	1.181802406	0.011221193	0.013507113	1.201279173	37.8272	31.4891	412.6633096
		17	0.463738541	0.482243571	0.931410107	0.885094695	0.993676875	0.042333733	0.042027366	1.122678664	38.2555	34.0752	434.6363493
		18	0.515886088	0.522884864	1.095930154	1.008295942	1.194059785	0.005332213	0.017277306	1.184237505	36.387	30.7261	411.4306907
		20	0.525966779	0.542632374	1.186424973	1.022240516	1.248717858	0.01914039	0.023579744	1.118379511	38.5766	34.4933	406.9447834
		21	0.515814024	0.532526103	1.139156876	0.974304069	1.200075571	0.01463687	0.020193367	1.231720909	38.4595	31.2242	411.4627592
		22	0.507114106	0.612737332	1.582226699	0.971255664	1.159767857	0	0.025616405	1.194091655	36.9686	30.9596	415.334223
		23	0.511815428	0.519249502	1.080081048	0.967243927	1.171586669	0.026099363	0.014483153	1.211261619	36.1885	29.8767	413.2421344
		24	0.528630856	0.529619015	1.125936277	1.057112324	1.302120198	0.048310236	0.016926647	1.231773575	37.6802	30.5902	405.7592689
		25	0.516166921	0.527917669	1.118274577	1.00776855	1.208094209	0.008843478	0.017041428	1.198778236	37.9719	31.6755	411.3057199
		26	0.505980627	0.568710318	1.318627228	1.011439877	1.155874467	0	0.027303006	1.142797864	37.1799	32.5341	415.8386211
		27	0.530763058	0.550613096	1.225253986	1.052963173	1.282192069	0.017075315	0.025437432	1.160046534	39.5874	34.1257	404.810439
		28	0.528357185	0.54155131	1.181269182	1.071397969	1.245881069	0.013082682	0.017678163	1.200188968	38.8698	32.3864	405.8810525
DH032	Matrix	22	0.535573101	0.540679505	1.177129065	1.022240516	1.282021043	0.007040863	0.011610915	1.142380794	37.3434	32.6891	402.6699703
DH171	Matrix	6	0.52507698	0.548038726	1.212578948	1.084174917	1.23521942	0	0.019331156	1.13931984	36.5937	32.1189	407.3407438
		7	0.504126737	0.510623226	1.043415326	1.081855824	1.106533433	0	0.016697592	1.022812315	40.2089	39.3121	416.6636022
DH177	Matrix	11	0.528489819	0.534776288	1.149503507	1.047138233	1.259399274	0.008487475	0.015895446	1.202700274	38.144	31.7153	405.8220305
SP2009 0079	Matrix	11	0.512496023	0.523200675	1.097318403	1.037837428	1.177234208	0.02166909	0.019448435	1.134316089	36.7042	32.358	412.93927
		Total Matrix Mean	0.513307273	0.534967342	1.157685821	1.005685516	1.186120839	0.017318237	0.02111163	1.174217493	37.65904138	32.13107931	412.5782636
		Matrix SD	0.0154885	0.026482268	0.133409677	0.05551013	0.071229508	0.012609076	0.006948338	0.04667311	1.050398842	1.817462888	6.892382317
	Total Mean(Fossil and Matrix)		0.520640883	0.538407848	1.170922829	1.041493916	1.226060932	0.015244831	0.020786567	1.175119766	38.20479958	32.5546341	409.314807

Table DR1. Comparison between ratios calculated for carbonaceous matter in a range of fossil films from the Sirius Passet and the host rock, including mean values and Standard Deviation (SD).

	D1	G	D2	D3	D4
Fossil	1351 cm^{-1}	1584 cm^{-1}	1617 cm^{-1}	1458 cm^{-1}	1159 cm^{-1}
Matrix	1349 cm^{-1}	1582 cm^{-1}	1616 cm^{-1}	1470 cm^{-1}	1138 cm^{-1}

Table DR2. Table showing mean peak positions of the five deconvolved carbon bands in the fossil films and the sedimentary matrix in the Sirius Passet.

Sample	Fossil	number	R2	RA1	RA2	ID/IG	AD/AG	RD3	RD4	FWH-D/FWHM-G	FWHMD	FWHMG	Temperature
WQ971082	*Marrella*	1	0.68571151	0.66847579	2.01637098	1.59968128	3.16599534	0.08743333	0.06471861	1.97913857	69.2651	34.9976	335.858378
		2	0.68764912	0.66084617	1.9485145	1.43256313	3.18283298	0.1144719	0.08190769	2.221774897	78.9721	35.5446	334.99614
		3	0.69166836	0.66964528	2.02704918	1.58392959	3.23218451	0.09164823	0.06700108	2.040605721	70.6523	34.6232	333.20758
		5	0.69006368	0.67300603	2.05816034	1.63711137	3.25697621	0.08687138	0.06609356	1.989465288	68.5898	34.4765	333.921661
		6	0.68613317	0.66750096	2.00752747	1.52316218	3.21034943	0.0982615	0.07550201	2.107689305	73.4359	34.8419	335.670741
		7	0.70136621	0.67209721	2.0496843	1.41443106	3.37147598	0.11756436	0.07682452	2.383625183	79.8083	33.4819	328.892035
		9	0.6907172	0.6676936	2.00927093	1.5078863	3.26861339	0.10159374	0.07211596	2.167678794	74.9954	34.5971	333.630848
		10	0.68123097	0.66710698	2.00396809	1.66240822	3.08492822	0.07431045	0.06348111	1.855703065	66.3399	35.7492	337.852219
		11	0.68665972	0.66515161	1.98642615	1.54839038	3.1369073	0.09044428	0.06625645	2.025917547	70.2963	34.6985	335.436425
		12	0.70709295	0.6712746	2.04205268	1.31956904	3.5997675	0.14002523	0.0810791	2.728000987	90.6853	33.2424	326.343639
		13	0.6798258	0.66452445	1.98084317	1.62363563	3.10211998	0.07773334	0.06856247	1.910596243	67.3147	35.2323	338.477518
		14	0.68772321	0.67268916	2.05519974	1.59425537	3.15612284	0.08384215	0.06649072	1.979684195	68.5042	34.6036	334.963172
		15	0.69736596	0.67550801	2.0817402	1.60528875	3.37104854	0.09741884	0.06676458	2.09996401	71.769	34.1763	330.672146
		16	0.69379189	0.67202301	2.04899436	1.69749798	3.31157947	0.08755308	0.0613485	1.950860616	67.0185	34.3533	332.262607
		17	0.68261539	0.66361891	1.97281868	1.5496592	3.05619291	0.09248706	0.07152602	1.972173761	69.7477	35.3659	337.236152
		18	0.69758891	0.66778803	2.01012634	1.40288833	3.41571025	0.1196291	0.07726943	2.434770313	80.9286	33.2387	330.572933
		19	0.68841143	0.66691886	2.00227141	1.56516252	3.15738102	0.08985687	0.06643114	2.017283047	70.0322	34.7161	334.656915
		20	0.68813156	0.66285453	1.96607868	1.39935613	3.19271395	0.10494843	0.07548347	2.281564972	77.8924	34.1399	334.781458
		21	0.69549373	0.67049917	2.03489368	1.57562967	3.34807084	0.09746307	0.06461585	2.124895555	71.7148	33.7498	331.505292
		23	0.69249261	0.6672297	2.00507583	1.36642831	3.1857408	0.11010313	0.07961214	2.331446377	78.7875	33.7934	332.840787
		24	0.69362482	0.67048302	2.03474499	1.5027306	3.24075265	0.10123313	0.07258378	2.156581952	73.189	33.9375	332.336955
		25	0.69488352	0.66727044	2.00544385	1.47897462	3.34494933	0.11363011	0.07842192	2.261664251	78.9452	34.9058	331.776834
	Matrix	1	0.68571151	0.66847579	2.01637098	1.59968128	3.16599534	0.08743333	0.06471861	1.97913857	69.2651	34.9976	335.858378
		2	0.67897773	0.66170953	1.95603956	1.53220753	2.99864344	0.08440769	0.07461125	1.957071462	71.3879	36.4769	338.854912
		3	0.65990011	0.66138133	1.95317444	1.59984323	2.67347665	0.06701526	0.08505597	1.671086935	66.663	39.892	347.344449
		4	0.66998327	0.66550981	1.98962426	1.63524737	2.81666455	0.06320335	0.06906352	1.722475213	65.7393	38.1656	342.857445
		5	0.67781049	0.66310151	1.96825318	1.67462023	3.08671007	0.07529269	0.06551576	1.843230581	66.8807	36.2845	339.374332
		6	0.67493458	0.6707472	2.03717993	1.68722901	2.93777523	0.07004731	0.06945658	1.741183787	64.3942	36.983	340.654114
		7	0.68932344	0.67177101	2.0466535	1.65717757	3.17775604	0.08238833	0.06453279	1.917562949	67.3218	35.108	334.251069
		10	0.68444598	0.66941654	2.0249547	1.61536522	3.12904809	0.07657058	0.0633317	1.937055992	67.6757	34.9374	336.421539
		12	0.68057088	0.66178384	1.95668897	1.60480756	3.03799532	0.076986	0.05765059	1.893059002	66.7521	35.2615	338.14596
	Pirania	6	0.68209866	0.65463481	1.89548578	1.48195296	3.19151319	0.1158493	0.07365926	2.153591722	79.174	36.7637	337.466096
		7	0.68584589	0.66536451	1.98832616	1.52836294	3.47906145	0.120801	0.10231015	2.276333357	82.8599	36.4006	335.798579
		8	0.69316753	0.67182958	2.04719726	1.71776682	3.28387981	0.08843913	0.05924578	1.911717706	65.7975	34.418	332.540448
		9	0.69735167	0.66835568	2.01527855	1.45324732	3.33396635	0.12438612	0.08211029	2.294157548	81.8482	35.6768	330.678506
	Micromitra	2	0.70355025	0.67543554	2.08105204	1.71538847	3.50701654	0.09370158	0.04845442	2.044441439	68.0247	33.273	327.920139
		5	0.69811135	0.66367592	1.97332264	1.39418208	3.4897094	0.14761746	0.08906637	2.503050906	93.3648	37.3004	330.340448
BW951903	*Micromitra*	1	0.67637145	0.6640235	1.97639861	1.53514684	2.87208823	0.11046216	0.06074035	1.870888749	70.5181	37.6923	340.014705
		3	0.69656775	0.67076931	2.03738394	1.54529826	3.37293098	0.10650414	0.06823248	2.182706849	74.042	33.9221	331.027352
	Nisusia	1	0.68768293	0.66430245	1.97887188	1.42053793	3.15831906	0.11340771	0.08098336	2.22332856	78.5542	35.3318	334.981096
		4	0.69346081	0.6685015	2.01660494	1.61883541	3.33340488	0.09775577	0.0607597	2.059146649	70.3248	34.1524	332.409941
		6	0.68148863	0.65851183	1.92835914	1.49602312	3.20418296	0.09757868	0.07198982	2.141800846	75.8341	35.4067	337.73756
	Pirania	3	0.68892033	0.67230038	2.05157509	1.57500921	3.12515062	0.09271899	0.06459868	1.984222726	69.0825	34.8159	334.430455
		5	0.68932449	0.66619912	1.99579799	1.54880002	3.33237726	0.09999196	0.06869789	2.151587598	74.2472	34.5081	334.2506
		6	0.69345743	0.66020841	1.94298042	1.28032641	3.27177888	0.13927511	0.09559869	2.555424897	93.8789	36.7371	332.411444
	Matrix	1	0.6899479	0.66690847	2.00217782	1.58203223	3.17195846	0.09310331	0.06348581	2.004986467	69.0381	34.4332	333.973184
		3	0.69159797	0.66746426	2.0071956	1.59674494	3.25376554	0.09357068	0.06162345	2.0377464	69.6031	34.1569	333.238904
BW951587	*Micromitra*	2	0.69188724	0.65502497	1.89876056	1.39326928	3.38972623	0.1477086	0.09440278	2.432917742	91.5777	37.6411	333.110178
		3	0.6898548	0.66067606	1.9470364	1.36271591	3.20676879	0.11803525	0.05892714	2.353217321	78.4998	33.3585	334.014615
		4	0.69790777	0.66908732	2.02194529	1.47057802	3.27110017	0.10625184	0.05437725	2.224359559	73.197	32.907	330.431044
		5	0.70064331	0.66948095	2.02554422	1.44269312	3.4917073	0.1241539	0.07705668	2.420269094	83.1239	34.3449	329.213726
		6	0.69997693	0.66259394	1.96378791	1.3527301	3.49814611	0.14710458	0.08254696	2.585983004	90.5288	35.0075	329.510265
		7	0.66658058	0.65919237	1.93420658	1.35867521	2.91921521	0.08328721	0.08692935	2.148568504	74.3033	34.5827	344.371644
		8	0.69267678	0.66642046	1.99778579	1.4178891	3.34490864	0.11567624	0.08001385	2.359066633	80.4345	34.0959	332.758833
		9	0.6887582	0.65881841	1.93099051	1.31491281	3.27538705	0.12407707	0.08179166	2.490947022	84.4167	33.8894	334.502601
	Matrix	10	0.68056213	0.66044001	1.94498773	1.51172877	3.13797856	0.09299368	0.07195854	2.075755555	71.5816	34.4846	338.149853
		11	0.68375	0.66455828	1.98114376	1.46557171	3.20998418	0.09752886	0.07766555	2.190259684	73.6569	33.6293	336.731248
	Total Fossil Mean		0.68848145	0.66636632	1.99790161	1.52240768	3.22004393	0.10094469	0.07184655	2.129112731	74.4294088	35.0088053	334.625756

Table DR3. Comparison between ratios calculated for carbonaceous matter in a range of fossil films from the Burgess Shale and the host rock.

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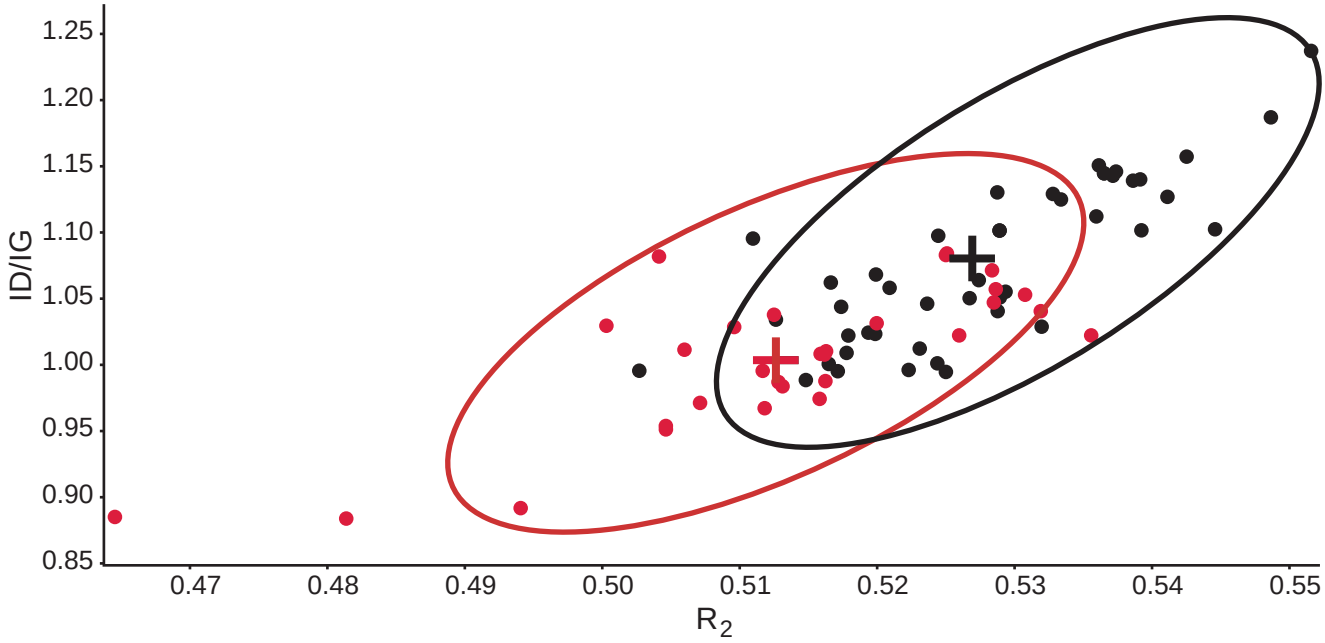

Figure DR1. ID/IG vs R2 ratios. ID/IG vs R2 ratios are generally lower in the matrix (red) compared with the fossil films (black), indicating increased structural order, however the differences are not deemed significant (p value >0.05, Mann-Whitney test).

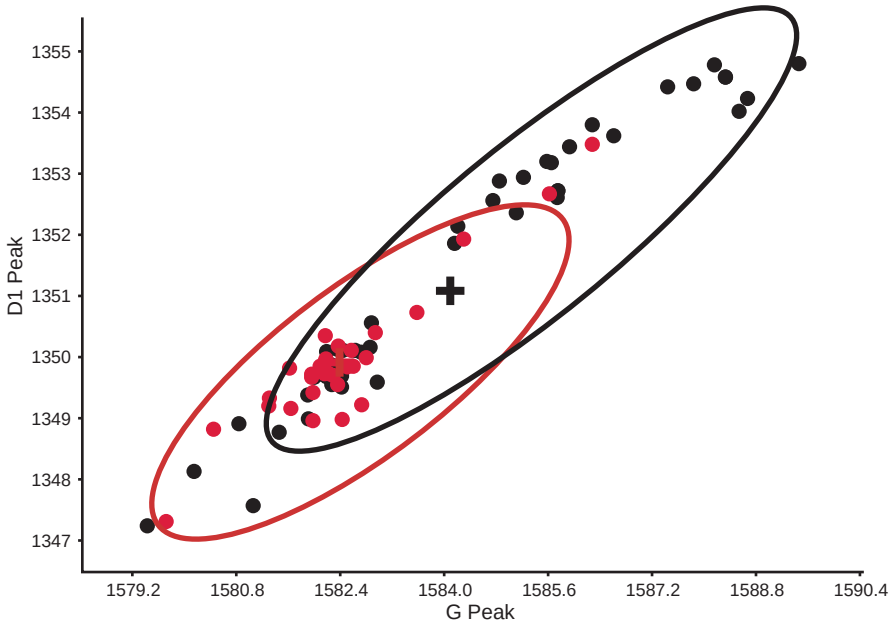

Figure DR2. Peak position of the D1 band and the G band between the fossil films (black) and the matrix (red). Higher structural order tends to result in a downward shift of the G band, as seen in the matrix, compared to the fossil films, however the differences are not deemed significant (p value >0.05, Mann-Whitney test).

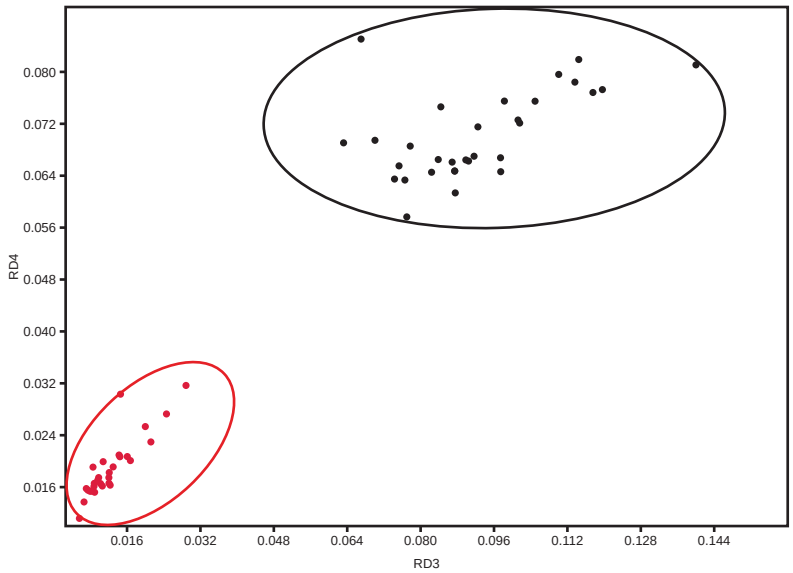

Figure DR3. RD4 vs RD3 ratios from the Sirius Passet (red) and Burgess Shale Lagerstätten (black). The Burgess Shale Lagerstätte displays high mean RD3 and RD4 ratios of 0.10 and 0.071 respectively which correspond to a lower structural order than the mean values displayed by the Sirius Passet Lagerstätte of 0.015 and 0.02. This corresponds well with the higher paleotemperature calculated for the Sirius Passet Lagerstätte.

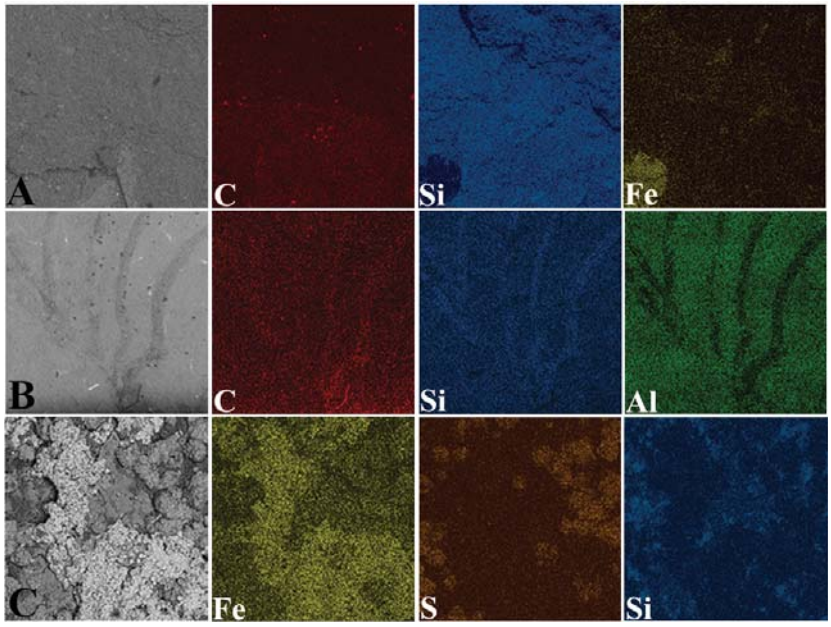

Figure DR4. Examples of SEM-EDS element maps of specimens from the Sirius Passet Lagerstätte. A: Shield of *Isoxys volucris* (Fig. 1I for site of analysis). B: Element of an undescribed priapulid? (Fig. 1H for site of analysis) C: Fe sulphide and oxide coating on a specimen of *Siriocaris trollae* (Fig. 1E for site of analysis). Each image is 2 mm in width.

LEGEND	SAMPLE	Location	Sp	C-C	Quartz	Calcite	Muscovite	Rutile	Anatase	Hematite	Geothite	Pyrite	F-apatite	Sp
Strong (S)	DH074	Aavaqaspis	1	S	U	-	W	S	-	-	-	-	-	1
Weak (W)		Aavaqaspis	2	S	-	-	-	-	-	-	-	-	-	2
Uncertain (U)		Aavaqaspis	3	S	W	-	W	-	-	-	-	-	-	3
Absent (-)		Aavaqaspis	4	S	W	-	W	-	-	-	-	-	-	4
		Aavaqaspis	5	S	-	-	-	-	-	-	-	-	-	5
		Aavaqaspis	6	S	U	-	W	W	-	-	-	-	-	6
		Aavaqaspis	7	S	W	-	W	-	-	-	-	-	-	7
		Aavaqaspis	8	S	-	-	vW	vW	-	-	-	-	-	8
		Aavaqaspis	9	S	W	-	W	-	-	-	-	-	-	9
		Aavaqaspis	10	S	-	-	W	-	-	-	-	-	-	10
		Aavaqaspis	11	S	W	-	vW	-	-	-	-	-	-	11
		Aavaqaspis	12	S	vW	-	vW	-	-	-	-	-	-	12
		Aavaqaspis	13	S	-	-	W	S	-	-	-	-	-	13
		Aavaqaspis	14	S	W	-	W	W	-	-	-	-	-	14
		Aavaqaspis	15	S	W	-	S	-	-	-	-	-	-	15
		Aavaqaspis	16	S	-	-	-	-	-	-	-	-	-	16
		Aavaqaspis	17	S	W	-	W	W	-	-	-	-	-	17
		Aavaqaspis	18	S	W	-	W	-	-	-	-	-	-	18
		Aavaqaspis	19	S	W	-	W	W	-	-	-	-	-	19
		Aavaqaspis	20	S	W	-	vW	-	-	-	-	-	-	20
		Aavaqaspis	21	S	W	-	W	W	-	-	-	-	-	21
		Aavaqaspis	22	S	W	-	vW	-	-	-	-	-	-	22
		Aavaqaspis	23	S	-	-	-	-	-	-	-	-	-	23
		Aavaqaspis	24	S	S	-	W	-	-	-	-	-	-	24
		Aavaqaspis	25	S	S	-	vW	-	-	-	-	-	-	25
	SAMPLE	Location	Sp	C-C	Silica	Calcite	Muscovite	Rutile	Anatase	Hematite	Geothite	Pyrite	F-apatite	Sp
Strong (S)	DH074	Isoxys	1	S	-	-	vW	vW	-	-	-	-	-	1
Weak (W)		Isoxys	2	S	U	-	W	-	-	-	-	-	-	2
Uncertain (U)		Isoxys	3	S	vW	-	vW	-	-	-	-	-	-	3
Absent (-)		Isoxys	4	S	-	-	-	vW	-	-	-	-	-	4
		Isoxys	5	S	-	-	-	-	-	-	-	-	-	5
		Isoxys	6	S	-	-	-	-	-	-	-	-	-	6
		Isoxys	7	S	U	-	vW	-	-	W	-	-	-	7
		Isoxys	8	S	U	-	vW	-	-	W	-	-	-	8
		Isoxys	9	S	-	-	vW	-	-	-	-	-	-	9
		Isoxys	10	S	-	-	-	-	-	-	-	-	-	10
		Isoxys	11	S	-	-	-	-	-	-	-	-	-	11
		Isoxys	12	S	-	-	-	-	-	-	-	-	-	12
		Isoxys	13	S	-	-	-	-	-	-	-	-	-	13
	SAMPLE	Location	Sp	C-C	Silica	Calcite	Muscovite	Rutile	Anatase	Hematite	Geothite	Pyrite	F-apatite	Sp
Strong (S)	DH074	Matrix	1	S	-	-	S	S	-	-	-	-	-	1
Weak (W)		Matrix	2	S	W	-	W	-	-	-	-	-	-	2
Uncertain (U)		Matrix	3	S	W	-	W	-	-	-	-	-	-	3
Absent (-)		Matrix	4	S	U	-	vW	W	-	-	-	-	-	4
		Matrix	5	S	-	-	-	-	-	-	-	-	-	5
		Matrix	6	S	U	-	W	-	-	-	-	-	-	6
		Matrix	7	S	U	-	W	-	-	-	-	-	-	7
		Matrix	8	S	-	-	-	vW	-	-	-	-	-	8
		Matrix	9	S	-	-	W	-	-	-	-	-	-	9
		Matrix	10	S	W	-	vW	-	-	-	-	-	-	10
		Matrix	11	S	W	-	W	-	-	-	-	-	-	11
		Matrix	12	S	S	-	W	-	-	-	-	-	-	12
		Matrix	13	S	-	-	W	-	-	-	-	-	-	13
		Matrix	14	S	W	-	W	-	-	-	-	-	-	14
		Matrix	15	S	W	-	W	-	-	-	-	-	-	15
		Matrix	16	S	W	-	W	-	-	-	-	-	-	16
		Matrix	17	S	-	-	-	-	-	-	-	-	-	17
		Matrix	18	S	W	-	W	-	-	-	-	-	-	18
		Matrix	19	S	-	-	S	S	-	-	-	-	-	19
		Matrix	20	S	W	-	vW	-	-	-	-	-	-	20
		Matrix	21	S	W	-	vW	W	-	-	-	-	-	21
		Matrix	22	S	S	-	W	-	-	-	-	-	-	22
		Matrix	23	S	W	-	W	-	-	-	-	-	-	23
		Matrix	24	S	U	-	W	-	-	-	-	-	-	24
		Matrix	25	S	W	-	W	-	-	-	-	-	-	25
		Matrix	26	S	W	-	W	-	-	-	-	-	-	26
		Matrix	27	S	-	-	W	vW	-	-	-	-	-	27
		Matrix	28	S	U	-	W	-	-	-	-	-	-	28

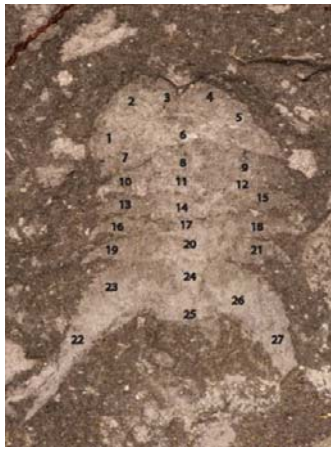

Figure DR5. Raman mineral fingerprinting of analyzed sample. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification.

LEGEND	SAMPLE	Location	Sp	C-C	Quartz	Calcite	Muscovite	Rutile	Anatase	Hematite	Geothite	Pyrite	F-apatite	Sp
Strong (S)	DH032	Kiisortqia?	1	S	W	-	W	-	-	-	-	-	-	1
Weak (W)		Kiisortqia?	5	S	W	-	-	-	-	W	-	-	-	5
Uncertain (U)		Kiisortqia?	6	S	U	-	W	-	-	W	-	-	-	6
Absent (-)		Kiisortqia?	7	S	U	-	W	-	-	W	-	-	-	7
		Kiisortqia?	8	S	U	-	-	-	-	U	-	-	-	8
		Kiisortqia?	9	S	U	-	-	-	-	-	-	-	-	9
		Matrix	12	S	U	-	-	-	-	W	-	-	-	12
		Matrix	14	S	-	-	-	-	-	-	-	-	-	14
		Trilobite	15	S	W	-	-	-	-	W	-	-	-	15
		Trilobite	16	S	W	-	-	-	-	W	-	-	-	16
		Trilobite	18	S	W	-	-	-	-	W	-	-	-	18
		Matrix	20	S	W	-	vW	-	-	W	-	-	-	20
		Matrix	21	S	S	-	W	-	-	-	-	-	-	21
		Matrix	22	S	W	-	W	-	-	-	-	-	-	22
		Matrix	24	S	-	-	vW	-	-	-	-	-	-	24
		Kiisortqia?	25	S	-	-	-	vS	-	-	-	-	-	25
		Kiisortqia?	26	S	W	-	vW	-	-	W	-	-	-	26
		Kiisortqia?	27	S	W	-	vW	-	-	vW	-	-	-	27

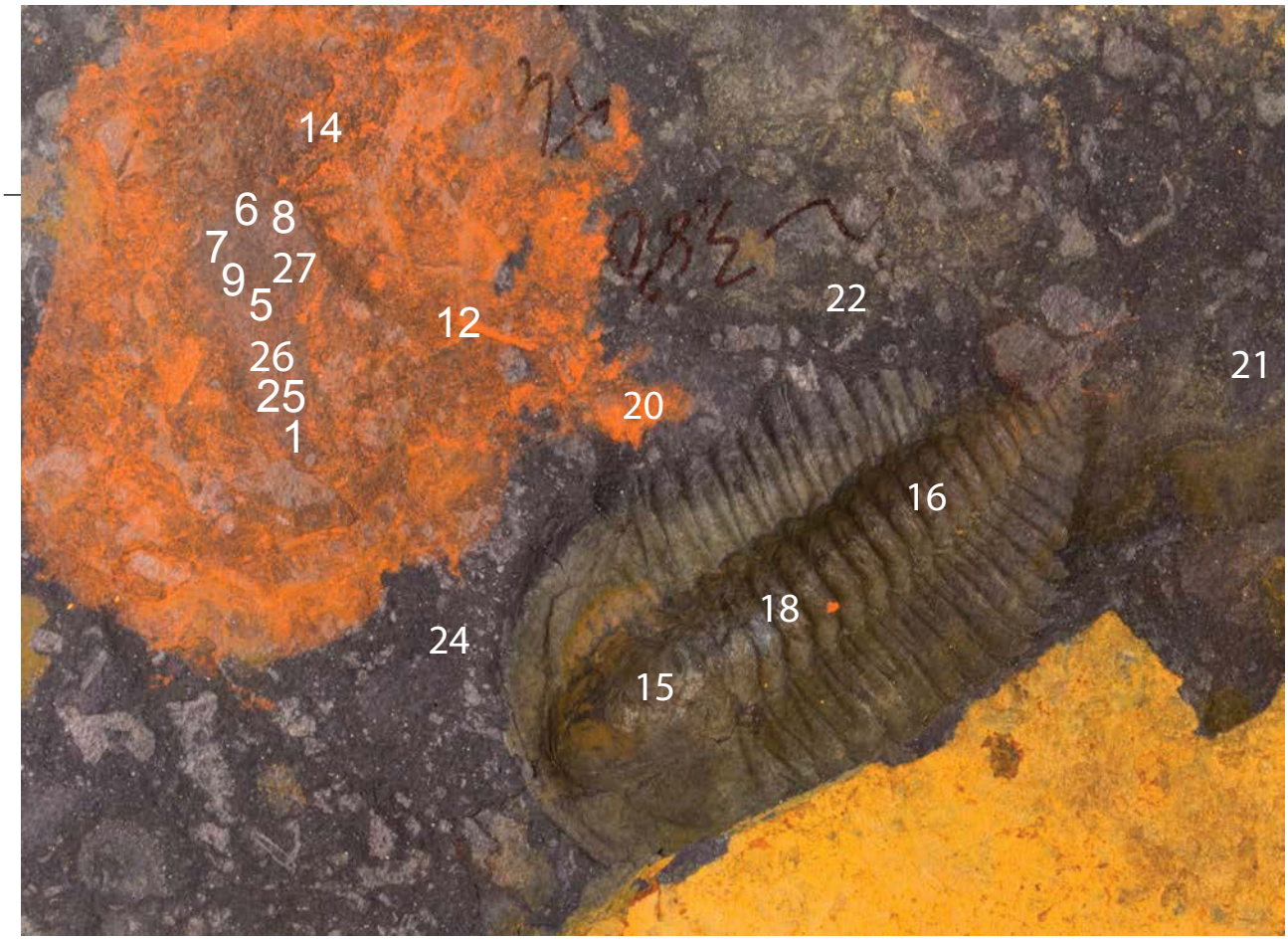

Figure DR6. Raman mineral fingerprinting of analyzed sample. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification.

LEGEND	SAMPLE	Location	Sp	C-C	Quartz	Calcite	Muscovite	Rutile	Anatase	Hematite	Goethite	Pyrite	F-apatite	Sp
Strong (S)	SP 2011_0830	1	1	S	-		-	-	-	-	-	-	-	1
Weak (W)		2	2	S	vW		-	-	-	-	-	-	-	2
Uncertain (U)		3	3	S	-		U	W	-	-	-	-	-	3
Absent (-)		4	4	S	vW		-	-	-	-	-	-	-	4
Very(v)		5	5	S	vW		vW	-	-	-	-	-	-	5
		6	6	S	vW		-	-	-	-	-	-	-	6
		7	7	S	-		-	-	-	S	-	-	-	7
		8	8	W	-		-	-	-	S	-	-	-	8
		9	9	vW	-		-	-	-	-	S	-	-	9

Figure DR7. Raman mineral fingerprinting of analyzed sample. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification.

LEGEND	SAMPLE	Location	Sp	C-C	Quartz	Calcite	Muscovite	Rutile	Anatase	Hematite	Goethite	Pyrite	F-apatite	Sp
Strong (S)	DH152	Pygocirrus	1	S	U	-	W	vW	-	-	-	-	-	1
Weak (W)		Pygocirrus	2	S	U	-	W	W	-	-	-	-	-	2
Uncertain (U)		Pygocirrus	3	S	W	-	W	U	-	-	-	-	-	3
Absent (-)		Pygocirrus	4	S	-	-	-	-	-	-	-	-	-	4
Very(v)		Pygocirrus	5	S	-	-	-	-	-	-	-	-	-	5
		Pygocirrus	6	S	W	-	W	-	-	-	-	-	-	6
		Pygocirrus	7	S	W	-	-	-	-	-	-	-	-	7
		Pygocirrus	8	S	U	-	vW	-	-	-	-	-	-	8
		Pygocirrus	9	S	W	-	W	-	-	-	-	-	-	9

Figure DR8. Raman mineral fingerprinting of analyzed samples. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification.

LEGEND	SAMPLE	Location	Sp	C-C	Quartz	Calcite	Muscovite	Rutile	Anatase	Hematite	Goethite	Pyrite	F-apatite	Sp
Strong (S)	DH177	1	1	S	W	-	W	-	-	-	-	-	-	1
Weak (W)		2	2	S	vW	-	vW	-	-	-	-	-	-	2
Uncertain (U)		5	5	S	vW	-	W	W	-	-	-	-	-	5
Absent (-)		6	6	S	vW	-	W	W	-	-	-	-	-	6
Very(v)		8	8	S	vW	-	vW	-	-	-	-	-	-	8
		9	9	S	vW	-	vW	vW	-	-	-	-	-	9
		10	10	S	W	-	vW	W	-	-	-	-	-	10

LEGEND	SAMPLE	Location	Sp	C-C	Silica	Calcite	Muscovite	Rutile	Anatase	Hematite	Goethite	Pyrite	F-apatite	Sp
Strong (S)	DH171	1	1	S	W	-	W	-	-	-	-	-	-	1
Weak (W)		2	2	S	W	-	W	-	-	-	-	-	-	2
Uncertain (U)		3	3	S	-	-	-	W	-	-	-	-	-	3
Absent (-)		4	4	S	S	-	vW	-	-	-	-	-	-	4
Very(v)		Matrix	6	S	W	-	W	-	-	-	-	-	-	6
		Matrix	7	S	vW	-	S	-	-	-	-	-	-	7

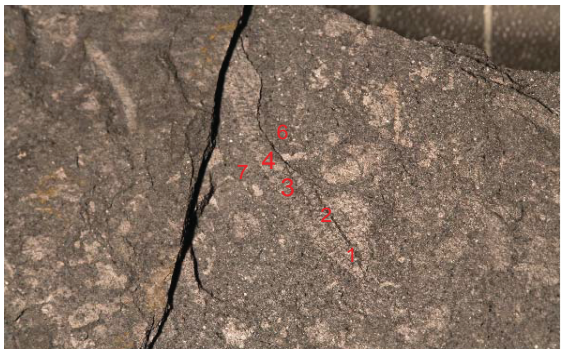

Figure DR9. Raman mineral fingerprinting of analyzed samples. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification. The image corresponding with sample DH177 is on the left hand side of the page.

LEGEND	SAMPLE	Location	Sp	C-C	Silica	Muscovite	Calcite	Rutile	Hematite	Goethite	Pyrite	F-apatite	Sp
Strong (S)	SP 2009_0079	1	1	S	U	vW	-	W	-	-	-	-	1
Weak (W)		2	2	S	S	-	-	-	S	-	-	-	2
Uncertain (U)		3	3	S	W	W	-	-	-	-	-	-	3
Absent (-)		4	4	S	vW	vW	-	-	-	-	-	-	4
Very(v)		5	5	S	vW	vW	-	-	-	-	-	-	5
		6	6	S	-	W	-	W	-	-	-	-	6
		7	7	S	W	W	-	vW	-	-	-	-	7
		8	8	vW	-	-	-	-	S	-	-	-	8
		9	9	S	-	vW	-	-	-	-	-	-	9
		10	10	S	-	W	-	S	-	-	-	-	10
		11	11	S	vW	W	-	-	-	-	-	-	11
		12	12	S	vW	W	-	W	-	-	-	-	12
		13	13	S	U	-	-	S	-	-	-	-	13
		14	14	S	-	vW	-	-	vW	-	-	-	14
		15	15	S	vW	W	-	-	vW	-	-	-	15
		16	16	vW	vW	-	-	-	U	-	-	-	16

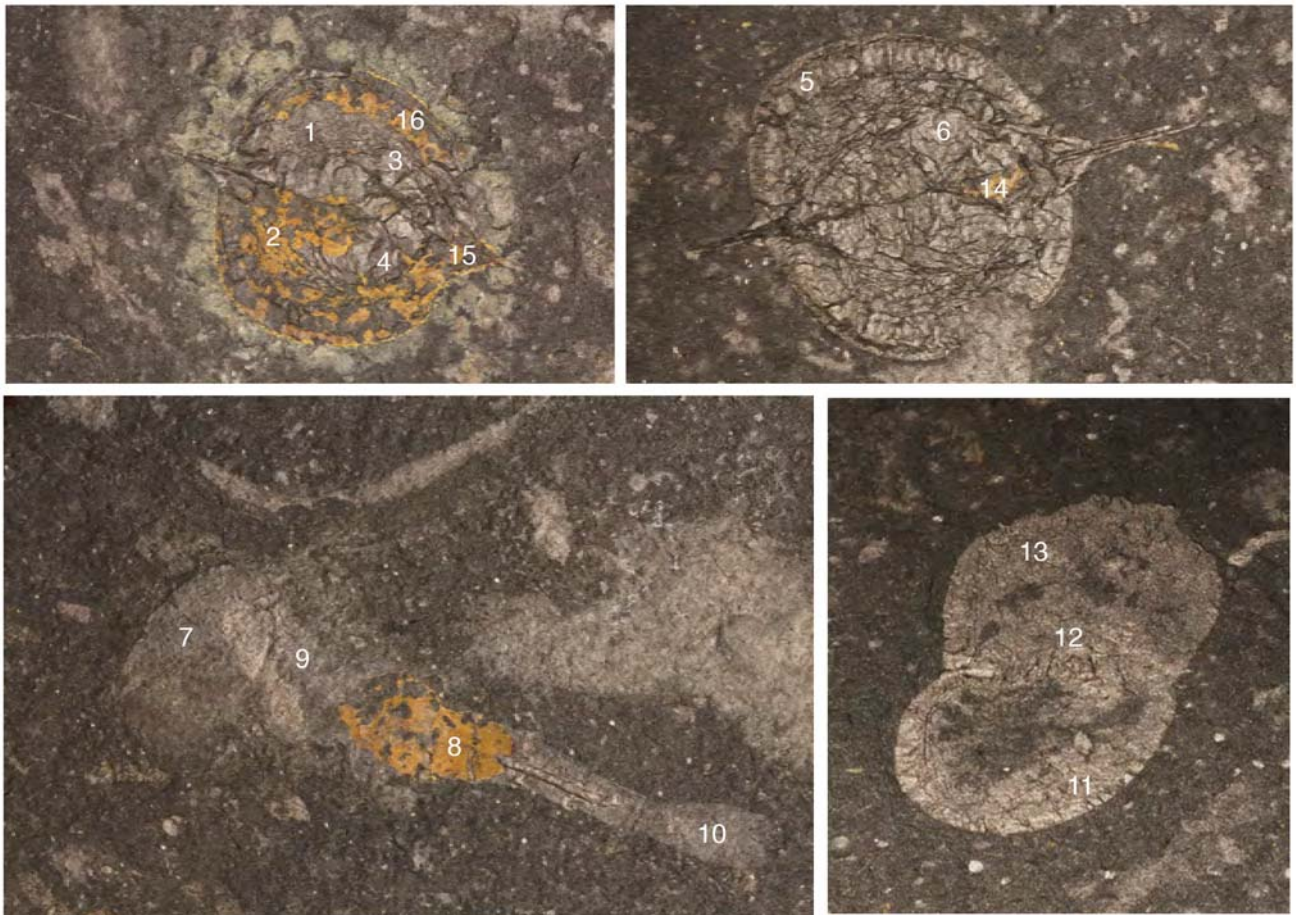

Figure DR10. Raman mineral fingerprinting of analyzed sample. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification.

LEGEND	Plotted	SAMPLE	Location	Sp	C-C	Quartz	Calcite	Kaolinite	Muscovite	Rutile	Anatase	Hematite	Goethite	Pyrite	F-apatite
Strong (S)	1°black	DH053	1	1	S	-	-	-	vW	-	-	U	-	-	-
Weak (W)	2°light blue		2	2	S	vW	-	-	W	W	-	W	-	-	-
Uncertain (U)	3°green		3	3	S	-	-	-	-	S?	-	U	-	-	-
Absent (-)	4°purple		4	4	S	-	-	-	W	S	-	-	-	-	-
	5°dark blue		5	5	S	-	-	-	-	-	-	S	-	-	-
			6	6	S	-	-	-	-	-	-	S	-	-	-

Figure DR11. Raman mineral fingerprinting of analyzed sample. Numbers on supplied images mark localities of Raman spectra. Table indicates the minerals identified (and the strength of the signal) at each location on the sample. Reference spectra from the Crystal Sleuth Raman library (http://rruff.info/) and selected publications were used for mineralogical identification.