

Table S1. Results of GC–MS analysis of volatiles extracted by mechanical shock crushing of olivines from experiment 4-36-21 in the olivine–serpentine–anthracene–FeNi system at 1100 °C and 2.0 GPa.

Formula	Name	¹ CAS/(NIST)	² MW	4-36-21	
				³ RT, min	⁴ A, %
Aliphatic hydrocarbons					
Paraffins					
CH4	Methane	74-82-8	16	1.68	22.978
C2H6	Ethane	74-84-0	30	2.38	0.842
C3H8	n-Propane	74-98-6	44	4.15	0.015
C4H10	n-Butane	106-97-8	58	6.03	0.003
C5H12	2-Methylbutane	78-78-4	72	7.76	0.283
C5H12	n-Pentane	109-66-0	72	8.39	0.003
C6H14	n-Hexane	110-54-3	86	11.76	0.010
C7H16	n-Heptane	142-82-5	100	15.75	0.011
C8H16	3-Methyleneheptane	1632-16-2	112	19.23	0.008
C8H18	n-Octane	111-65-9	114	19.83	0.020
C9H20	n-Nonane	111-84-2	128	23.68	0.020
C10H22	n-Decane	124-18-5	142	27.28	0.112
C11H24	n-Undecane	1120-21-4	156	30.56	0.021
C12H26	5-Propylnonane	998-35-6	170	32.11	0.052
C12H26	n-Dodecane	112-40-3	170	33.67	0.021
C13H28	n-Tridecane	629-50-5	184	37.37	0.064
C14H30	n-Tetradecane	629-59-4	198	42.06	0.094
C15H32	n-Pentadecane	629-62-9	212	51.01	0.207
C16H34	n-Hexadecane	544-76-3	226	65.03	0.283
C17H36	n-Heptadecane	629-78-7	240	87.58	0.315
C18H38	n-Octadecane	593-45-3	254	123.05	0.224
Olefins					
C3H6	Propene	115-07-1	42	3.98	0.012
C4H8	2-Methyl-1-propene	115-11-7	56	5.53	0.065
C4H8	1-Butene	106-98-9	56	5.85	0.038
C4H8	(E)-2-Butene	624-64-6	56	5.93	0.013
C4H8	2-Butene	107-01-7	56	6.05	0.024
C4H8	(Z)-2-Butene	590-18-1	56	6.16	0.008
C5H10	1-Pentene	109-67-1	70	8.13	0.033
C5H8	1,4-Pentadiene	591-93-5	68	8.28	0.007
C5H8	Isoprene	78-79-5	68	8.36	0.009
C5H8	(E)-1,3-Pentadiene	2004-70-8	68	8.56	0.005
C5H8	1,3-Pentadiene	1574-41-0	68	8.63	0.003
C5H8	(Z)-1,3-Pentadiene	1574-41-0	68	8.84	0.006
C6H12	1-Hexene	592-41-6	84	11.44	0.042
C6H10	1,4-Hexadiene	592-45-0	82	11.61	0.004
C6H10	(3E)-1,3-Hexadiene	592-48-3	82	11.89	0.005
C6H10	(2E,4E)-2,4-Hexadiene	592-46-1	82	12.22	0.003
C6H10	(Z)-3-Methyl-1,3-pentadiene	2787-45-3	82	12.41	0.002
C6H10	(E)-3-Methyl-1,3-pentadiene	2787-43-1	82	12.54	0.016
C6H10	(Z),(Z)-2,4-Hexadiene	6108-61-8	82	12.81	0.007
C7H14	1-Heptene	592-76-7	98	15.40	0.011
C7H14	3-Methyl-3-hexene	3404-65-7	98	15.54	0.013
C7H14	2-Methyl-2-hexene	2738-19-4	98	15.64	0.016
C8H16	1-Octene	111-66-0	112	19.52	0.011

C ₉ H ₁₈	1-Nonene	124-11-8	126	23.40	0.020
C ₁₀ H ₂₀	1-Decene	872-05-9	140	27.03	0.009
C ₁₁ H ₂₂	1-Undecene	821-95-4	154	30.36	0.018
C ₁₂ H ₂₄	9-Methyl-1-undecene	74630-41-4	168	31.86	0.035
C ₁₂ H ₂₄	1-Dodecene	112-41-4	168	33.47	0.016
C ₁₃ H ₂₆	1-Tridecene	2437-56-1	182	37.14	0.074
C ₁₆ H ₃₂	1-Hexadecene	629-73-2	224	64.30	0.079
Cyclic hydrocarbons					
<i>Arenes</i>					
C ₆ H ₆	Benzene	71-43-2	78	12.31	0.092
C ₇ H ₈	Toluene	108-88-3	92	16.70	0.068
C ₈ H ₁₀	Ethylbenzene	100-41-4	106	20.72	0.018
C ₈ H ₁₀	p-Xylene	106-42-3	106	20.98	0.072
C ₈ H ₁₀	o-Xylene	95-47-6	106	21.07	0.014
C ₈ H ₁₀	m-Xylene	108-38-3	106	21.30	0.016
C ₈ H ₈	Styrene	100-42-5	104	21.62	0.013
C ₉ H ₁₂	Propylbenzene	103-65-1	120	24.53	0.008
C ₁₀ H ₁₄	p-Cymene	99-87-6	134	27.34	0.012
C ₉ H ₁₂	1-Ethyl-4-methylbenzene	622-96-8	120	27.76	0.025
C ₁₀ H ₁₄	o-Cymene	527-84-4	134	27.99	0.024
C ₁₀ H ₁₄	Butylbenzene	104-51-8	134	28.88	0.071
C ₁₀ H ₁₄	m-Cymene	535-77-3	134	28.89	0.147
C ₁₁ H ₁₆	Pentylbenzene	538-68-1	148	31.79	0.021
C ₁₂ H ₁₈	Hexylbenzene	1077-16-3	162	35.02	0.021
C ₁₄ H ₂₂	Octylbenzene	2189-60-8	190	46.99	0.027
C ₁₅ H ₂₄	Nonylbenzene	1081-77-2	204	57.45	0.040
<i>Polycyclic aromatic hydrocarbons (PAH)</i>					
C ₁₀ H ₈	Naphthalene	91-20-3	128	31.82	0.006
C ₁₁ H ₁₀	1-Methylnaphthalene	90-12-0	142	33.77	0.006
C ₁₁ H ₁₀	2-Methylnaphthalene	91-57-6	142	34.29	0.005
C ₁₄ H ₁₀	Phenanthrene	85-01-8	178	84.30	0.030
Oxygenated hydrocarbons					
<i>Alcohols</i>					
C ₂ H ₆ O	Ethanol	64-17-5	46	6.33	0.071
C ₃ H ₈ O	Isopropyl Alcohol	67-63-0	60	7.96	0.020
C ₄ H ₁₀ O	1-Butanol	71-36-3	74	12.72	0.207
C ₅ H ₆ O ₂	2-Furanmethanol	98-00-0	98	19.22	0.021
C ₆ H ₆ O	Phenol	108-95-2	94	24.53	0.055
C ₇ H ₈ O	2-Methylphenol	95-48-7	108	25.83	0.008
C ₇ H ₈ O	3-Methylphenol	108-39-4	108	27.19	0.011
C ₇ H ₈ O	4-Methylphenol	106-44-5	108	28.03	0.032
C ₈ H ₁₈ O	2-Ethyl-1-hexanol	104-76-7	130	27.79	0.364
C ₈ H ₁₆ O	1-Ethylcyclohexanol	1940-18-7	128	28.11	0.006
C ₈ H ₁₈ O	2-Propyl-1-pentanol	58175-57-8	130	28.68	0.039
C ₉ H ₁₈ O	1-Isopropylcyclohexanol	3552-01-0	142	29.59	0.010
C ₉ H ₁₈ O	2-Hexylallyl alcohol	37114-55-9	142	31.17	0.026
C ₁₀ H ₂₀ O	Cyclodecanol	1502-05-2	156	31.57	0.228
C ₁₂ H ₂₆ O	1-Dodecanol	112-53-8	186	42.61	0.114
C ₁₂ H ₂₆ O	5-Dodecanol	10203-33-5	186	43.01	0.040
C ₁₃ H ₂₈ O	1-Tridecanol	112-70-9	200	51.17	0.175
C ₁₃ H ₂₈ O	7-Tridecanol	927-45-7	200	51.74	0.047
C ₁₄ H ₂₈ O	1-Octyl-1-cyclohexanol	5770-04-7	212	69.96	0.025
<i>Ethers and esters</i>					

C ₅ H ₈ O ₂	Methyl methacrylate	80-62-6	100	14.24	0.068
C ₄ H ₆ O ₂	Butyrolactone	96-48-0	86	20.77	0.099
C ₅ H ₈ O ₂	γ-Pentalactone	108-29-2	100	23.35	0.010
C ₅ H ₈ O ₂	δ-Valerolactone	542-28-9	100	26.44	0.218
C ₆ H ₁₀ O ₂	γ-Hexalactone	695-06-7	114	27.28	0.051
C ₇ H ₁₂ O ₂	γ-Methyl-γ-caprolactone	2865-82-9	128	29.33	0.007
C ₉ H ₁₈ O ₂	Hexanoic acid propyl ester	626-77-7	158	30.31	0.013
C ₇ H ₁₂ O ₂	γ-Heptalactone	105-21-5	128	30.84	0.030
C ₇ H ₁₂ O ₄	Dimethyl pentanedioate	1119-40-0	160	30.92	0.033
C ₁₀ H ₂₀ O	2-Pentyltetrahydro-2H-pyran	x	156	32.56	0.052
C ₈ H ₁₄ O ₂	γ-Octalactone	104-50-7	142	34.24	0.034
C ₈ H ₁₄ O ₂	δ-Octalactone	698-76-0	142	35.19	0.007
C ₁₁ H ₂₂ O ₂	Hexyl n-valerate	1117-59-5	186	37.27	0.118
C ₉ H ₁₆ O ₂	γ-Nonalactone	104-61-0	156	38.53	0.062
C ₉ H ₁₆ O ₂	δ-Nonalactone	3301-94-8	156	39.90	0.009
C ₁₀ H ₁₈ O ₂	γ-Decalactone	706-14-9	170	44.08	0.118
C ₁₁ H ₁₄ O ₂	2-Phenoxytetrahydropyran	4203-50-3	178	45.06	0.069
C ₁₁ H ₂₀ O ₂	γ-Undecalactone	104-67-6	184	54.44	0.050
C ₁₁ H ₂₀ O ₂	δ-Undecalactone	710-04-3	184	55.60	0.007
C ₉ H ₈ O ₄	Monomethyl phthalate	4376-18-5	180	55.64	0.147
C ₁₂ H ₂₂ O ₂	γ-Dodecalactone	2305-05-7	198	71.44	0.133
C ₁₂ H ₂₂ O ₂	δ-Dodecalactone	713-95-1	198	76.32	0.071
C ₁₃ H ₂₄ O ₂	γ-Tridecalactone	x	212	97.20	0.058
Aldehydes					
C ₂ H ₄ O	Acetaldehyde	75-07-0	44	5.21	0.152
C ₃ H ₄ O	2-Propenal	107-02-8	56	7.16	0.031
C ₃ H ₆ O	n-Propanal	123-38-6	58	7.48	0.441
C ₄ H ₆ O	2-Methyl-2-propenal	78-85-3	70	9.56	0.068
C ₄ H ₈ O	2-Methylpropanal	78-84-2	72	9.59	0.015
C ₄ H ₈ O	n-Butanal	123-72-8	72	10.37	0.034
C ₄ H ₆ O	3-Butenal	7319-38-2	70	10.72	0.010
C ₅ H ₈ O	2-Methyl-2-butenal	1115-11-3	84	13.22	0.053
C ₅ H ₈ O	3-Methyl-2-butenal	107-86-8	84	13.37	0.008
C ₅ H ₁₀ O	3-Methylbutanal	590-86-3	86	13.49	0.014
C ₅ H ₁₀ O	n-Pentanal	110-62-3	86	14.47	0.051
C ₅ H ₈ O	(E)-2-Pentenal	1576-87-0	84	16.70	0.026
C ₅ H ₄ O ₂	2-Furaldehyde	98-01-1	96	17.24	0.004
C ₅ H ₄ O ₂	3-Furaldehyde	498-60-2	96	18.10	0.216
C ₆ H ₁₂ O	n-Hexanal	66-25-1	100	18.75	0.054
C ₇ H ₁₄ O	n-Heptanal	111-71-7	114	22.86	0.046
C ₆ H ₆ O ₂	5-Methyl-2-furancarboxaldehyde	620-02-0	110	23.13	0.028
C ₇ H ₆ O	Benzaldehyde	100-52-7	106	23.80	0.123
C ₈ H ₁₆ O	2-Ethylhexanal	123-05-7	128	25.31	0.102
C ₈ H ₁₆ O	n-Octanal	124-13-0	128	26.66	0.058
C ₉ H ₁₈ O	n-Nonanal	124-19-6	142	30.14	0.096
C ₁₀ H ₂₀ O	n-Decanal	112-31-2	156	33.34	0.079
C ₁₁ H ₂₂ O	n-Undecanal	112-44-7	170	35.80	0.030
C ₉ H ₁₀ O ₂	2-Methyl-4-methoxybenzaldehyde	52289-54-0	150	37.04	0.006
C ₁₂ H ₂₄ O	n-Dodecanal	112-54-9	184	41.62	0.104
C ₁₃ H ₂₆ O	n-Tridecanal	10486-19-8	198	50.44	0.112
C ₁₁ H ₂₀ O ₃	6-(2-Oxanyloxy)hexanal	x	200	55.20	0.036
C ₁₄ H ₂₈ O	n-Tetradecanal	124-25-4	212	62.91	0.075

C ₁₅ H ₃₀ O	n-Pentadecanal	2765-11-9	226	86.83	0.160
C ₁₆ H ₃₂ O	n-Hexadecanal	629-80-1	240	120.02	0.129
Ketones					
C ₃ H ₆ O	2-Propanone	67-64-1	58	7.54	0.476
C ₄ H ₆ O	2-Butenone	78-94-4	70	10.18	0.032
C ₄ H ₆ O ₂	2,3-Butanedione	431-03-8	86	10.46	0.018
C ₄ H ₈ O	2-Butanone	78-93-3	72	10.56	0.031
C ₅ H ₁₀ O	2-Pentanone	107-87-9	86	14.25	0.025
C ₅ H ₈ O	Cyclopentanone	120-92-3	84	16.95	0.014
C ₆ H ₁₂ O	2-Hexanone	591-78-6	100	18.52	0.006
C ₇ H ₁₄ O	3-Heptanone	106-35-4	114	22.26	0.013
C ₆ H ₈ O	2-Cyclohexen-1-one	930-68-7	96	22.51	0.007
C ₇ H ₁₄ O	2-Heptanone	110-43-0	114	22.58	0.009
C ₈ H ₁₄ O	2-Methyl-1-hepten-6-one	10408-15-8	126	25.56	0.040
C ₈ H ₁₄ O	4-Methyl-3-hepten-2-one	22319-25-1	126	25.70	0.030
C ₈ H ₁₆ O	2-Octanone	111-13-7	128	26.34	0.117
C ₉ H ₁₈ O	2-Nonanone	821-55-6	142	29.83	0.014
C ₁₀ H ₂₀ O	2-Decanone	693-54-9	156	33.04	0.016
C ₁₁ H ₂₂ O	2-Undecanone	53452-70-3	170	35.34	0.050
C ₈ H ₄ O ₃	1,3-Isobenzofurandione	85-44-9	148	35.59	0.292
C ₁₁ H ₂₂ O	5-Undecanone	33083-83-9	170	36.60	0.048
C ₁₂ H ₂₄ O	2-Dodecanone	6175-49-1	184	40.88	0.132
C ₁₃ H ₂₂ O	(5E)-6,10-Dimethyl-5,9-undecadien-2-one	3796-70-1	194	45.05	0.294
C ₁₃ H ₂₆ O	3-Tridecanone	1534-26-5	198	49.24	0.094
C ₁₃ H ₂₆ O	2-Tridecanone	593-08-8	198	49.96	0.068
C ₁₄ H ₂₈ O	2-Tetradecanone	2345-27-9	212	62.08	0.069
C ₁₃ H ₁₆ O ₂	1-(4-Methylphenyl)hexane-2,5-dione	x	204	78.88	0.024
C ₁₅ H ₃₀ O	2-Pentadecanone	2345-28-0	226	83.33	0.471
C ₁₆ H ₃₂ O	2-Hexadecanone	18787-63-8	240	116.40	0.093
Carboxylic acids					
C ₂ H ₄ O ₂	Acetic acid	64-19-7	60	11.24	0.676
C ₃ H ₆ O ₂	n-Propanoic acid	79-09-4	74	15.09	0.040
C ₄ H ₈ O ₂	n-Butanoic acid	107-92-6	88	18.82	0.211
C ₅ H ₁₀ O ₂	3-Methylbutanoic acid	503-74-2	102	21.80	0.024
C ₅ H ₁₀ O ₂	n-Pentanoic acid	109-52-4	102	22.73	0.141
C ₆ H ₁₂ O ₂	n-Hexanoic acid	142-62-1	116	26.28	0.399
C ₇ H ₁₄ O ₂	n-Heptanoic acid	111-14-8	130	29.64	0.128
C ₈ H ₁₆ O ₂	n-Octanoic acid	124-07-2	144	32.74	0.246
C ₉ H ₁₈ O ₂	n-Nonanoic acid	112-05-0	158	36.09	0.208
C ₁₀ H ₂₀ O ₂	n-Decanoic acid	334-48-5	172	41.02	0.233
C ₁₁ H ₂₂ O ₂	n-Undecanoic acid	112-37-8	186	49.01	0.015
C ₁₂ H ₂₄ O ₂	n-Dodecanoic acid	143-07-7	200	60.98	0.303
C ₁₃ H ₂₆ O ₂	Tridecanoic acid	638-53-9	214	83.50	0.032
C ₁₄ H ₂₈ O ₂	3-Methyltridecanoic acid	x	228	103.00	0.084
C ₁₄ H ₂₈ O ₂	n-Tetradecanoic acid	544-63-8	228	114.10	0.270
Heterocyclic compounds					
Dioxanes					
C ₄ H ₈ O ₂	1,4-Dioxane	123-91-1	88	13.49	0.003
C ₄ H ₈ O ₂	1,3-Dioxane	505-22-6	88	17.47	0.003
Furans					
C ₄ H ₄ O	Furan	110-00-9	68	7.11	0.013
C ₅ H ₆ O	2-Methylfuran	534-22-5	82	10.08	0.027
C ₅ H ₆ O	3-Methylfuran	930-27-8	82	10.36	0.011

C ₆ H ₈ O	2-Ethylfuran	3208-16-0	96	13.79	0.009
C ₆ H ₆ O	2-Vinylfuran	1487-18-9	94	14.55	0.002
C ₇ H ₁₀ O	2-Propylfuran	4229-91-8	110	17.77	0.003
C ₇ H ₁₀ O	2-Ethyl-5-methylfuran	1703-52-2	110	21.72	0.006
C ₈ H ₁₂ O	2-Butylfuran	4466-24-4	124	21.93	0.007
C ₉ H ₁₄ O	2-Pentylfuran	3777-69-3	138	25.75	0.025
C ₁₀ H ₁₆ O	2-Hexylfuran	3777-70-6	152	29.29	0.005
C ₁₁ H ₁₈ O	2-Heptylfuran	3777-71-7	166	32.54	0.004
C ₁₂ H ₂₀ O	2-Octylfuran	4179-38-8	180	34.62	0.013
C ₁₃ H ₂₂ O	2-Nonylfuran	4179-38-8	194	39.85	0.019
C ₁₄ H ₂₄ O	2-Decylfuran	83469-85-6	208	47.73	0.008
C ₁₅ H ₂₆ O	2-Undecylfuran	x	222	60.02	0.006
C ₁₆ H ₂₈ O	2-Dodecylfuran	75308-12-2	236	79.98	0.009
Nitrogenated compounds					
N ₂	Nitrogen	7727-37-9	28	1.65	12.659
CHNO	Hydrogen isocyanate	75-13-8	43	6.36	0.536
C ₂ H ₃ N	Acetonitrile	75-05-8	41	6.81	0.190
C ₃ H ₅ N	Propanenitrile	107-12-0	55	9.34	0.009
C ₄ H ₅ N	1H-Pyrrole	109-97-7	67	14.45	0.023
C ₅ H ₅ N	Pyridine	110-86-1	79	15.35	0.022
C ₂ H ₅ NO	Acetamide	60-35-5	59	16.07	0.048
C ₅ H ₉ N	Pentanenitrile	110-59-8	83	17.32	0.022
C ₃ H ₅ NO ₂	2-Oxo-propanamide	631-66-3	87	17.37	0.007
C ₄ H ₆ N ₂	1-Methyl-1H-pyrazole	930-36-9	82	18.04	0.019
C ₆ H ₉ N	2,3-Dimethyl-1H-pyrrole	600-28-2	95	18.22	0.007
C ₆ H ₇ N	2-Methylpyridine	109-06-8	93	18.63	0.006
C ₆ H ₇ N	3-Methylpyridine	108-99-6	93	20.33	0.005
C ₆ H ₇ N	4-Methylpyridine	108-89-4	93	20.48	0.004
C ₃ H ₄ N ₂	1H-Pyrazole	288-13-1	68	22.78	0.014
C ₇ H ₅ N	Benzonitrile	100-47-0	103	24.60	0.011
C ₄ H ₅ NO ₂	Succinimide	123-56-8	99	28.73	0.041
C ₈ H ₁₅ N	Octanenitrile	124-12-9	125	29.19	0.009
C ₇ H ₁₅ NO	Enanthamide	628-62-6	129	34.42	0.015
C ₈ H ₁₇ NO	Octanamide	629-01-6	143	38.37	0.017
C ₉ H ₁₉ NO	Nonanamide	1120-07-6	157	44.66	0.014
C ₁₀ H ₂₁ NO	Decanamide	2319-29-1	171	54.40	0.024
Sulfonated compounds					
H ₂ S	Hydrogen sulfide	7783-06-4	34	2.71	0.015
COS	Carbonyl sulfide	463-58-1	60	3.38	0.006
O ₂ S	Sulfur dioxide	7446-09-5	64	4.70	0.772
CH ₄ S	Methanethiol	74-93-1	48	5.43	0.006
CS ₂	Carbon disulfide	75-15-0	76	7.66	0.032
C ₂ H ₆ S	Dimethyl sulfide	75-18-3	62	7.66	0.007
C ₄ H ₄ S	Thiophene	110-02-1	84	12.07	0.004
C ₂ H ₆ S ₂	Dimethyl disulfide	624-92-0	94	15.09	0.003
C ₅ H ₆ S	2-Methylthiophene	554-14-3	98	16.20	0.007
C ₅ H ₆ S	3-Methylthiophene	616-44-4	98	16.55	0.004
C ₆ H ₈ S	2-Ethylthiophene	872-55-9	112	21.12	0.007
C ₆ H ₈ S	3-Ethylthiophene	1795-01-3	112	21.45	0.010
C ₈ H ₁₂ S	2-(1,1-Dimethylethyl)-thiophene	1689-78-7	140	27.76	0.007
C ₈ H ₁₂ S	3-Butylthiophene	34722-01-5	140	28.41	0.007
C ₉ H ₁₄ S	2-Pentylthiophene	4861-58-9	154	31.59	0.007
C ₉ H ₁₄ S	3-Pentylthiophene	102871-31-8	160	31.84	0.004

C ₁₀ H ₁₆ S	2-Hexylthiophene	18794-77-9	168	34.20	0.005
C ₁₀ H ₁₆ S	3-Hexylthiophene	1693-86-3	168	34.72	0.008
C ₁₁ H ₁₈ S	2-Heptylthiophene	18794-78-0	182	39.27	0.004
C ₁₃ H ₂₂ S	2-Nonylthiophene	57754-07-1	210	56.90	0.005
Inorganic compounds					
Oxides					
CO ₂	Carbon dioxide	124-38-9	44	1.73	0.387
H ₂ O	Water	7732-18-5	18	3.31	46.813
Noble gases					
Ar	Argon	7440-37-1	40	1.68	0.262

Note: ¹CAS/(NIST) – unique numerical identifier of chemical compounds included in the register Chemical Abstracts Service (<https://www.cas.org>) или NIST number (a unique number given to each spectrum in the NIST archive); ²MW – nominal mass; ³RT – retention time; ⁴A – normalized area (the area ratio of the individual gas mixture components to the sum of the areas of all the components in the chromatogram).