Supplementary



Figure S1. Carbon analysis for recovered Fe-C samples by electron microprobe. (**a**,**b**) Back scattered electron images for recovered samples from Run# PC1659 and PC1647. (**c**,**d**) Carbon count rates as a function of carbon content; count rates (counts per second) for each standard are average of more than 20 measurements made on randomly selected spots on each standard using an electron beam with 12 keV accelerating voltage, 30 nA current, and a diameter of 1 micron; Counts rates for each sample are average of more than 40 randomly selected spots under the same analytical conditions.



Figure S2. Back scattered electron images for unsuccessful synthesis runs. (**a**) inhomogeneous recovered sample due to the lack of enough heating time; (**b**) quenched texture from a melt product.



Figure S3. The length of lattice constant *a* as a function of pressure for Fe, Fe-0.31C, and Fe-1.37C.



Figure S4. Unit cell volume of bcc- and hcp-Fe as a function of carbon content at ambient condition. Blue symbols are for hcp-Fe in this study; the open symbols are data from literature results that were summarized in Fei and Brosh (2014) [1]; black and green dash lines are linear fitting for bcc- and hcp-Fe data reported by Fei and Brosh (2014) [1].

Table S1. Compression data for pure-Fe, Fe-0.31C and Fe-1.37C in bct structure using Au as the pressure calibrant.

P _{Au} (GPa)	Fe	Fe-0.31C	Fe-1.37C
	a (Å)	a (Å)	a (Å)
0.5(1)	2.868(1)	2.867(2)	2.864(1)
1.0(1)	2.866(2)	2.865(2)	2.860(2)
2.3(1)	2.863(2)	2.862(1)	2.858(2)
3.5(2)	2.856(2)	2.854(2)	2.851(2)
5.1(2)	2.851(2)	2.848(2)	2.845(2)
6.6(1)	2.842(2)	2.839(1)	2.836(2)
7.8(2)	2.836(1)	2.833(2)	2.828(2)
9.2(3)	2.829(2)	2.827(2)	2.821(2)
10.8(2)	2.822(2)	2.821(2)	2.815(2)
12.7(3)	2.815(2)	2.813(2)	2.808(2)
14.4(2)	2.805(2)	2.805(2)	2.799(2)

Compression data for Pure-Fe RUN#1 16.5(2) 2.450 0.003 3.940 0.003 20.811 9.012 18.5(2) 2.450 0.003 3.932 0.005 20.439 9.074 19.9(3) 2.445 0.003 3.922 0.003 20.304 9.135 21.0(2) 2.440 0.004 3.911 0.004 20.115 9.221 24.3(3) 2.433 0.003 3.878 0.004 19.514 9.505 33.5(3) 2.408 0.004 3.880 0.005 19.383 9.569 35.5(3) 2.403 0.004 3.882 0.005 19.262 9.629 37.1(4) 2.399 0.003 3.847 0.003 19.173 9.673 38.5(3) 2.396 0.004 3.832 0.003 18.879 9.824 Compression data for Pure-Fe RUN#2 25.9 (2) 2.428 0.003 3.892 0.011 19.871 9.334 37.6(4)	P _{Ne} (GPa)	a (Å)	Δa (Å)	c (Å)	Δc (Å)	V (Å3)	Density (g/cm ³)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	i	Со	mpressio	n data fo	or Pure-F	e RUN#1	, ,
18.5(2) 2.450 0.003 3.932 0.005 20.439 9.074 19.9(3) 2.445 0.003 3.922 0.003 20.304 9.135 21.0(2) 2.440 0.004 3.915 0.004 20.185 9.188 22.4(3) 2.433 0.003 3.902 0.004 20.003 9.272 27.0(2) 2.425 0.004 3.890 0.004 19.652 9.438 31.7(4) 2.413 0.003 3.870 0.004 19.551 9.505 33.5(3) 2.408 0.004 3.860 0.005 19.383 9.569 35.5(3) 2.408 0.004 3.847 0.003 19.173 9.673 38.5(3) 2.396 0.004 3.847 0.003 18.879 9.824 Compression data for Pure-Fe RUN#2 25.9 (2) 2.428 0.003 3.820 0.001 19.871 9.334 37.6(4) 2.397 0.003 3.826 0.001 19.871 <t< td=""><td>16.5(2)</td><td>2.456</td><td>0.003</td><td>3.940</td><td>0.003</td><td>20.581</td><td>9.012</td></t<>	16.5(2)	2.456	0.003	3.940	0.003	20.581	9.012
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	18.5(2)	2.450	0.003	3.932	0.005	20.439	9.074
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	19.9(3)	2.445	0.003	3.922	0.003	20.304	9.135
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	21.0(2)	2.440	0.004	3.915	0.004	20.185	9.188
24.3(3) 2.433 0.003 3.902 0.004 20.003 9.272 27.0(2) 2.425 0.004 3.890 0.004 19.810 9.362 30.0(4) 2.413 0.003 3.878 0.004 19.514 9.505 33.5(3) 2.408 0.004 3.860 0.005 19.383 9.569 35.5(3) 2.403 0.004 3.842 0.005 19.101 9.710 39.6(4) 2.396 0.003 3.847 0.005 19.101 9.710 39.6(4) 2.394 0.004 3.847 0.003 18.879 9.824 Compression data for Pure-Fe RUN*2 25.9 (2) 2.428 0.003 3.892 0.001 19.871 9.334 37.6(4) 2.398 0.001 3.845 0.003 19.148 9.686 49.8(4) 2.371 0.003 3.866 0.004 17.559 10.557 86.9(7) 2.282 0.003 3.636 0.004 16.354	22.4(3)	2.437	0.003	3.911	0.004	20.115	9.221
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	24.3(3)	2 433	0.003	3.902	0.004	20.003	9.272
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	27.0(2)	2 425	0.004	3 890	0.004	19 810	9.362
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	30.0(4)	2.120	0.003	3 878	0.004	19.652	9.438
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	31.7(4)	2.117	0.003	3 870	0.004	19 514	9 505
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	335(3)	2.110	0.000	3 860	0.001	10 383	9.569
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	35 5(3)	2.400	0.004	3.852	0.005	19 262	9.629
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	33.3(3)	2.403	0.004	2.052	0.003	19.202	9.029
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	37.1(4)	2.399	0.003	2.047	0.005	19.175	9.675
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	36.5(3)	2.390	0.004	3.04Z	0.005	19.101	9.710
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	39.6(4)	2.394	0.004	3.837	0.005	19.044	9.739
Compression data for Pure-Fe RUN#2 Compression data for Pure-Fe RUN#2 25.9 (2) 2.428 0.003 3.892 0.001 19.871 9.334 37.6(4) 2.398 0.001 3.845 0.003 19.148 9.686 49.8(4) 2.371 0.003 3.806 0.004 18.531 10.009 74.6(5) 2.329 0.004 3.738 0.004 17.559 10.557 86.9(7) 2.313 0.004 3.713 0.004 16.486 11.250 117.1(7) 2.276 0.004 3.636 0.004 16.324 11.430 126.1(9) 2.258 0.005 3.614 0.001 15.956 11.624 Compression data for Fe-0.31C RUN#1 16.2(2) 2.461 0.004 3.943 0.005 20.681 8.868 18.7(2) 2.453 0.003 3.922 0.004 20.304 9.032 22.2(3) 2.444 0.003 3.878 0.004	41.2(4)	2.390	0.003	3.832	0.003	18.956	9.784
Compression data for Pure-Fe ROI%22 25.9 (2) 2.428 0.003 3.892 0.001 19.871 9.334 37.6(4) 2.398 0.001 3.845 0.003 19.148 9.686 49.8(4) 2.371 0.003 3.806 0.004 18.531 10.009 74.6(5) 2.329 0.004 3.738 0.004 17.559 10.557 86.9(7) 2.313 0.004 3.738 0.004 16.486 11.250 117.1(7) 2.282 0.003 3.656 0.004 16.486 11.250 117.1(7) 2.276 0.004 3.630 0.006 16.128 11.500 135.6(9) 2.258 0.005 3.614 0.001 15.956 11.624 Compression data for Fe-0.31C RUN#1 16.2(2) 2.461 0.003 3.929 0.003 2.039 8.946 19.8(3) 2.448 0.003 3.920 0.004 2.046 9.149 27.(2)	43.5(4)	2.387	0.003	3.826	0.003	18.879	9.824
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	25.0.(2)	2 429	npressic	a ata fo	or Fure-F	10.971	0.224
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	23.9 (2) 27.6(4)	2.428	0.003	3.892	0.001	19.871	9.334
$4_{2.6(4)}$ 2.371 0.003 3.006 0.004 18.531 10.009 $74.6(5)$ 2.329 0.004 3.738 0.004 17.559 10.557 $86.9(7)$ 2.313 0.004 3.713 0.004 17.202 10.782 $111.9(7)$ 2.282 0.003 3.656 0.004 16.486 11.250 $117.1(7)$ 2.276 0.004 3.646 0.004 16.354 11.341 $121.7(8)$ 2.27 0.003 3.636 0.004 16.227 11.430 $126.1(9)$ 2.265 0.004 3.630 0.006 16.128 11.500 $135.6(9)$ 2.258 0.005 3.614 0.001 15.956 11.624 Compression data for Fe-0.31C RUN#1 $16.2(2)$ 2.461 0.004 3.943 0.005 20.681 8.868 $18.7(2)$ 2.445 0.003 3.929 0.003 20.390 8.946 $19.8(3)$ 2.448 0.003 3.922 0.004 20.004 9.032 $22.2(3)$ 2.441 0.003 3.914 0.004 20.949 9.032 $22.2(3)$ 2.441 0.003 3.871 0.004 19.846 9.241 $30.7(4)$ 2.419 0.003 3.876 0.004 19.430 9.438 $36.4(4)$ 2.401 0.003 3.863 0.004 19.430 9.438 $36.4(4)$ 2.401 0.003 3.848 0.003 19.210	37.0(4)	∠.398 2.271	0.001	3.845 2.807	0.003	19.148	7.000 10.000
74.6(3) 2.329 0.004 3.738 0.004 17.359 10.357 86.9(7) 2.313 0.004 3.713 0.004 17.202 10.782 111.9(7) 2.282 0.003 3.656 0.004 16.486 11.250 117.1(7) 2.276 0.003 3.636 0.004 16.227 11.430 126.1(9) 2.265 0.004 3.630 0.006 16.128 11.500 135.6(9) 2.258 0.005 3.614 0.001 15.956 11.624 Compression data for Fe-0.31C RUN#1 16.2(2) 2.461 0.004 3.943 0.005 20.681 8.868 18.7(2) 2.453 0.003 3.929 0.003 20.390 8.994 21.0(2) 2.448 0.003 3.929 0.004 20.198 9.080 24.7(3) 2.435 0.003 3.944 0.004 20.198 9.080 24.7(3) 2.427 0.003 3.871 0.004 19.846 9.241 30.7(4) 2.419 0.003 <t< td=""><td>49.8(4)</td><td>2.3/1</td><td>0.003</td><td>3.806</td><td>0.004</td><td>18.531</td><td>10.009</td></t<>	49.8(4)	2.3/1	0.003	3.806	0.004	18.531	10.009
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	74.6(5)	2.329	0.004	3.738	0.004	17.559	10.557
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	86.9(7)	2.313	0.004	3.713	0.004	17.202	10.782
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	111.9(7)	2.282	0.003	3.656	0.004	16.486	11.250
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	117.1(7)	2.276	0.004	3.646	0.004	16.354	11.341
126.1(9)2.2650.0043.6300.00616.12811.500135.6(9)2.2580.0053.6140.00115.95611.624Compression data for Fe-0.31C RUN#116.2(2)2.4610.0043.9430.00520.6818.86818.7(2)2.4530.0033.9340.00420.5008.94619.8(3)2.4480.0033.9290.00320.3908.99421.0(2)2.4450.0033.9220.00420.3049.03222.2(3)2.4410.0033.9140.00420.1989.08024.7(3)2.4350.0033.9040.00420.0469.14927.2(2)2.4270.0033.8910.00419.8469.24130.7(4)2.4190.0033.8780.00419.6529.33232.4(4)2.4140.0033.8710.00419.4309.43836.4(4)2.4050.0033.8630.00419.3159.49537.9(3)2.4010.0033.8480.00319.2109.54639.6(4)2.3970.0033.8390.00419.0549.62542.3(4)2.3910.0033.8290.00418.9099.698Compression data for Fe-0.31C RUN#225.9(2)2.4310.0033.8510.00419.2599.52249.7(4)2.3760.0043.8110.00417.60110.41986.5(7)2.315 <td>121.7(8)</td> <td>2.27</td> <td>0.003</td> <td>3.636</td> <td>0.004</td> <td>16.227</td> <td>11.430</td>	121.7(8)	2.27	0.003	3.636	0.004	16.227	11.430
135.6(9)2.2580.0053.6140.00115.95611.624Compression data for Fe-0.31C RUN#116.2(2)2.4610.0043.9430.00520.6818.86818.7(2)2.4530.0033.9340.00420.5008.94619.8(3)2.4480.0033.9290.00320.3908.99421.0(2)2.4450.0033.9220.00420.3049.03222.2(3)2.4410.0033.9140.00420.1989.08024.7(3)2.4350.0033.9040.00420.0469.14927.2(2)2.4270.0033.8910.00419.8469.24130.7(4)2.4190.0033.8780.00419.6529.33232.4(4)2.4140.0033.8710.00419.5359.38834.4(3)2.4100.0033.8630.00419.4309.43836.4(4)2.4050.0033.8560.00419.3159.49537.9(3)2.4010.0033.8430.00419.1229.59140.8(4)2.3940.0033.8390.00319.0069.64943.7(4)2.3880.0033.8290.00418.9099.698Compression data for Fe-0.31C RUN#225.9(2)2.4310.0033.8510.00419.2599.52249.7(4)2.3760.0043.7150.00317.24310.635Compression da	126.1(9)	2.265	0.004	3.630	0.006	16.128	11.500
Compression data for Fe-0.31C RUN#116.2(2)2.4610.0043.9430.00520.6818.86818.7(2)2.4530.0033.9240.00420.5008.94619.8(3)2.4480.0033.9290.00320.3908.99421.0(2)2.4450.0033.9220.00420.3049.03222.2(3)2.4410.0033.9140.00420.1989.08024.7(3)2.4350.0033.9040.00420.0469.14927.2(2)2.4270.0033.8910.00419.8469.24130.7(4)2.4190.0033.8780.00419.6529.33232.4(4)2.4140.0033.8710.00419.5359.38834.4(3)2.4100.0033.8630.00419.4309.43836.4(4)2.4050.0033.8560.00419.3159.49537.9(3)2.4010.0033.8480.00319.2109.54639.6(4)2.3970.0033.8390.00419.0549.62542.3(4)2.3910.0033.8290.00418.9099.698Compression data for Fe-0.31C RUN#225.9(2)2.4310.0033.8510.00419.2599.52249.7(4)2.3760.0043.7150.00319.2419.43375.5(5)2.330.0043.7440.00417.60110.41986.5(7)2.315 <td< td=""><td>135.6(9)</td><td>2.258</td><td>0.005</td><td>3.614</td><td>0.001</td><td>15.956</td><td>11.624</td></td<>	135.6(9)	2.258	0.005	3.614	0.001	15.956	11.624
16.2(2) 2.461 0.004 3.943 0.005 20.681 8.868 $18.7(2)$ 2.453 0.003 3.934 0.004 20.500 8.946 $19.8(3)$ 2.448 0.003 3.929 0.003 20.390 8.994 $21.0(2)$ 2.445 0.003 3.922 0.004 20.304 9.032 $22.2(3)$ 2.441 0.003 3.914 0.004 20.198 9.080 $24.7(3)$ 2.435 0.003 3.904 0.004 20.046 9.149 $27.2(2)$ 2.427 0.003 3.891 0.004 19.846 9.241 $30.7(4)$ 2.419 0.003 3.878 0.004 19.652 9.332 $32.4(4)$ 2.419 0.003 3.871 0.004 19.430 9.438 $36.4(4)$ 2.405 0.003 3.866 0.004 19.315 9.495 $37.9(3)$ 2.401 0.003 3.848 0.003 19.210 9.546 $39.6(4)$ 2.397 0.003 3.839 0.004 19.054 9.625 $42.3(4)$ 2.394 0.003 3.829 0.004 18.909 9.698 Compression data for Fe-0.31C RUN#2 $25.9(2)$ 2.431 0.003 3.851 0.004 19.259 9.522 $49.7(4)$ 2.376 0.004 3.811 0.004 19.259 9.522 $49.7(4)$ 2.376 0.004 3.715 0.003 17.243 10.6		Co	mpressio	n data fo	or Fe-0.31	C RUN#1	
18.7(2) 2.453 0.003 3.934 0.004 20.500 8.946 $19.8(3)$ 2.448 0.003 3.929 0.003 20.390 8.994 $21.0(2)$ 2.445 0.003 3.922 0.004 20.304 9.032 $22.2(3)$ 2.441 0.003 3.914 0.004 20.198 9.080 $24.7(3)$ 2.435 0.003 3.904 0.004 20.046 9.149 $27.2(2)$ 2.427 0.003 3.891 0.004 19.846 9.241 $30.7(4)$ 2.419 0.003 3.878 0.004 19.652 9.332 $32.4(4)$ 2.414 0.003 3.871 0.004 19.535 9.388 $34.4(3)$ 2.410 0.003 3.863 0.004 19.430 9.438 $36.4(4)$ 2.405 0.003 3.856 0.004 19.315 9.495 $37.9(3)$ 2.401 0.003 3.848 0.003 19.210 9.546 $39.6(4)$ 2.397 0.003 3.839 0.004 19.054 9.625 $42.3(4)$ 2.394 0.003 3.829 0.004 19.999 9.698 Compression data for Fe-0.31C RUN#2 $25.9(2)$ 2.431 0.003 3.896 0.003 19.941 9.197 $37.5(4)$ 2.403 0.003 3.851 0.004 19.259 9.522 $49.7(4)$ 2.376 0.004 3.715 0.003 17.243 10.6	16.2(2)	2.461	0.004	3.943	0.005	20.681	8.868
19.8(3)2.4480.0033.9290.00320.3908.99421.0(2)2.4450.0033.9220.00420.3049.03222.2(3)2.4410.0033.9140.00420.1989.08024.7(3)2.4350.0033.9040.00420.0469.14927.2(2)2.4270.0033.8910.00419.8469.24130.7(4)2.4190.0033.8780.00419.6529.33232.4(4)2.4140.0033.8710.00419.5359.38834.4(3)2.4100.0033.8630.00419.4309.43836.4(4)2.4050.0033.8560.00419.3159.49537.9(3)2.4010.0033.8480.00319.2109.54639.6(4)2.3970.0033.8390.00419.0549.62542.3(4)2.3910.0033.8390.00419.0549.62542.3(4)2.3910.0033.8290.00418.9099.698Compression data for Fe-0.31C RUN#225.9(2)2.4310.0033.8510.00419.2599.52249.7(4)2.3760.0043.7150.00317.24310.635Compression data for Fe-1.37C RUN#116.2(2)2.4660.0033.9450.00320.7758.501	18.7(2)	2.453	0.003	3.934	0.004	20.500	8.946
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	19.8(3)	2.448	0.003	3.929	0.003	20.390	8.994
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	21.0(2)	2.445	0.003	3.922	0.004	20.304	9.032
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	22.2(3)	2.441	0.003	3.914	0.004	20.198	9.080
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	24.7(3)	2.435	0.003	3.904	0.004	20.046	9.149
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	27.2(2)	2.427	0.003	3.891	0.004	19.846	9.241
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	30.7(4)	2.419	0.003	3.878	0.004	19.652	9.332
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	32.4(4)	2.414	0.003	3.871	0.004	19.535	9.388
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	34.4(3)	2.410	0.003	3.863	0.004	19.430	9.438
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	36.4(4)	2.405	0.003	3.856	0.004	19.315	9.495
39.6(4) 2.397 0.003 3.843 0.004 19.122 9.591 40.8(4) 2.394 0.003 3.839 0.004 19.054 9.625 42.3(4) 2.391 0.003 3.839 0.003 19.006 9.649 43.7(4) 2.388 0.003 3.829 0.004 18.909 9.698 Compression data for Fe-0.31C RUN#2 25.9(2) 2.431 0.003 3.896 0.003 19.941 9.197 37.5(4) 2.403 0.003 3.851 0.004 19.259 9.522 49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	37.9(3)	2.401	0.003	3.848	0.003	19.210	9.546
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	39.6(4)	2.397	0.003	3.843	0.004	19.122	9.591
42.3(4) 2.391 0.003 3.839 0.003 19.006 9.649 43.7(4) 2.388 0.003 3.829 0.004 18.909 9.698 Compression data for Fe-0.31C RUN#2 25.9(2) 2.431 0.003 3.896 0.003 19.941 9.197 37.5(4) 2.403 0.003 3.851 0.004 19.259 9.522 49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	40.8(4)	2.394	0.003	3.839	0.004	19.054	9.625
43.7(4) 2.388 0.003 3.829 0.004 18.909 9.698 Compression data for Fe-0.31C RUN#2 25.9(2) 2.431 0.003 3.896 0.003 19.941 9.197 37.5(4) 2.403 0.003 3.851 0.004 19.259 9.522 49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.744 0.004 17.601 10.419 86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	42.3(4)	2.391	0.003	3.839	0.003	19.006	9.649
Compression data for Fe-0.31C RUN#2 25.9(2) 2.431 0.003 3.896 0.003 19.941 9.197 37.5(4) 2.403 0.003 3.851 0.004 19.259 9.522 49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.744 0.004 17.601 10.419 86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	43.7(4)	2.388	0.003	3.829	0.004	18.909	9.698
25.9(2) 2.431 0.003 3.896 0.003 19.941 9.197 37.5(4) 2.403 0.003 3.851 0.004 19.259 9.522 49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.744 0.004 17.601 10.419 86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501		Co	mpressio	n data fo	or Fe-0.31	C RUN#2	
37.5(4) 2.403 0.003 3.851 0.004 19.259 9.522 49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.744 0.004 17.601 10.419 86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	25.9(2)	2.431	0.003	3.896	0.003	19.941	9.197
49.7(4) 2.376 0.004 3.811 0.004 18.631 9.843 75.5(5) 2.33 0.004 3.744 0.004 17.601 10.419 86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	37.5(4)	2.403	0.003	3.851	0.004	19.259	9.522
75.5(5) 2.33 0.004 3.744 0.004 17.601 10.419 86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	49.7(4)	2.376	0.004	3.811	0.004	18.631	9.843
86.5(7) 2.315 0.004 3.715 0.003 17.243 10.635 Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	75.5(5)	2.33	0.004	3.744	0.004	17.601	10.419
Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501	86.5(7)	2.315	0.004	3.715	0.003	17.243	10.635
Compression data for Fe-1.37C RUN#1 16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501							
16.2(2) 2.466 0.003 3.945 0.003 20.775 8.501		Co	mpressio	n data fo	or Fe-1.37	'C RUN#1	
	16.2(2)	2.466	0.003	3.945	0.003	20.775	8.501

Table S2. Compression data for pure-Fe, Fe-0.31C and Fe-1.37C in hcp phases using Ne as the pressure calibrant.

18.8(2)	2.458	0.003	3.934	0.003	20.583	8.580
20.6(3)	2.452	0.003	3.925	0.004	20.436	8.642
21.2(2)	2.450	0.004	3.919	0.003	20.372	8.669
22.4(3)	2.444	0.003	3.916	0.003	20.256	8.718
24.5(3)	2.441	0.003	3.909	0.004	20.162	8.759
27.5(2)	2.429	0.003	3.898	0.004	19.917	8.867
31.1(4)	2.419	0.004	3.886	0.005	19.692	8.968
33.1(4)	2.415	0.004	3.880	0.005	19.597	9.012
35.2(3)	2.409	0.004	3.870	0.005	19.449	9.080
37.2(4)	2.406	0.004	3.862	0.005	19.361	9.122
39.0(3)	2.401	0.004	3.856	0.005	19.250	9.174
40.5(4)	2.397	0.004	3.849	0.005	19.151	9.221
41.8(4)	2.394	0.004	3.844	0.005	19.079	9.257
43.2(4)	2.392	0.004	3.840	0.005	19.027	9.282
44.7(4)	2.386	0.003	3.836	0.003	18.912	9.338
	Cor	npressio	n data fo	r Fe-1.37	'C RUN#2	
26.1(2)	2.4348	0.001	3.906	0.002	20.055	8.806
37.5(4)	2.405	0.003	3.864	0.004	19.356	9.124
49.7(4)	2.377	0.004	3.822	0.004	18.699	9.445
76.1(5)	2.332	0.005	3.751	0.004	17.665	9.997
87.2(7)	2.315	0.004	3.720	0.004	17.267	10.228
97.5(7)	2.301	0.003	3.699	0.004	16.959	10.414
109.0(7)	2.285	0.004	3.673	0.004	16.607	10.634

Table S3. Thermoelastic parameters used for modeling the density of hcp-Fe, Fe-0.31C and Fe-1.37C along an adiabatic geotherm with T_{ICB} = 5000, 6000 and 7000 K.

Vibrational Grüneisen parameter	$\gamma_{vib} = \gamma_0 (\rho_0 / \rho)^q, \gamma_0 = 1.74, q = 0.78$
Electronic Grüneisen parameter	$\gamma_e = 2$
Vibrational specific heat	$C_{V,vib} = 9nR(\frac{\theta_D}{T})^{-3} \int_0^{\frac{\theta_D}{T}} \frac{x^4 e^x}{(e^x - 1)^2} dx, \ \theta_D = 422 \text{ K}, \ R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Electronic specific heat	$C_{Ve} = \beta_0 (\rho_0 / \rho)^k T, \beta_0 = 0.07 J k g^{-1} K^{-2}, k = 1.4$

Reference

1. Fei, Y.; Brosh, E. Experimental study and thermodynamic calculations of phase relations in the Fe–C system at high pressure. *Earth Planet. Sci. Lett.* **2014**, *408*, 155–162.