Supplementary Material

1 SUPPLEMENTARY TABLES

Tables S1 and S2 show the relative chain strength and annealing time values used to obtain the results presented in Table II of the main text. Table S3 shows the relative chain strength values used to obtain the results presented in Tables III and IV of the main text. Tables S4 and S5 show statistics on the embeddings used to pick the random ones from, and statistics on all generated embeddings, respectively. The embeddings were generated with `dwave-ocean-sdk` version 6.2.0 installed including the package `minorminer` version 0.2.10.

Table S1. Relative chain strength (RCS) and annealing time (AT) used during data acquisition for DW_2000Q_6 and Advantage2_prototype1.1.

		DW_2000_Q	Advantage2 prototype 1.1
G_1	RCS	0.40	-
	AT [μs]	20.00	2.88
G_2	RCS	0.45	0.48
	AT [μs]	41.38	52.73
G_3	RCS	0.67	0.67
	AT [μs]	1777.89	225.77
G_4	RCS	0.81	0.86
	AT [μs]	626.95	225.77

Table S2. Relative Chain Strength (RCS) and Annealing Time (AT) values used during data acquisition from Advantage_System 4.1, 5.2 and 6.1.

		Advantage System 4.1	Advantage System 5.2	Advantage System 6.1
G_1	AT [μs]	100	100	100
G_2	RCS	0.40	0.40	0.44
	AT [μs]	202.47	144.44	188.89
G_3	RCS	0.50	0.60	0.56
	AT [μs]	1616.26	166.67	288.89
G_4	RCS	0.67	0.58	0.71
	AT [μs]	626.61	322.22	200.0
G_5	RCS	0.57	0.76	0.64
	AT [μs]	1919.21	322.22	166.67
G_6	RCS	0.89	0.80	0.82
	AT [μs]	1656.65	122.22	533.33
G_7	RCS	1.16	0.82	0.87
	AT [μs]	1899.02	1466.67	677.78

Table S3. Relative chain strength (RCS) used during data acquisition for Advantage_system4.1 and Advantage2_prototype1.1 for random and improved embeddings.

	Advantage_system4.1	Advantage2 prototype 1.1
G_2^{rand}	0.550	0.450
G_2^{imp}	0.425	0.450
G_3^{rand}	0.440	0.425
G_3^{imp}	0.465	0.435
G_4^{rand}	0.360	0.450
G_4^{imp}	0.325	0.400
G_5^{rand}	0.340	n.a.
G_5^{imp}	0.300	n.a.
G_6^{rand}	0.320	n.a.
G_6^{imp}	0.300	n.a.
G_7^{rand}	0.300	n.a.
G_7^{imp}	0.300	n.a.

Table S4. Statistics on the 30 generated embeddings from which the random embeddings are picked. Shown are the average qubit number with standard deviation, the minimal and maximal qubit numbers, the qubit number of the used random embedding and the seed which was used to generate the random embedding.

	average	min.	max.	used	seed
Advantage2_prototype1.1					
G_2	38.33 ± 1.47	37	42	37	26
G_3	129.10 ± 6.77	118	145	126	28
G_4	346.60 ± 17.29	324	393	333	25
Advantage_system4.1					
G_2	41.57 ± 1.54	39	45	44	14
G_3	144.60 ± 5.21	134	154	142	19
G_4	404.60 ± 19.24	372	438	438	10
G_5	974.33 ± 70.65	899	1254	935	26
G_6	1985.50 ± 117.84	1825	2287	1971	7
G_7	3632.30 ± 146.54	3358	4029	3635	8

2 SUPPLEMENTARY FIGURES

Figures S1 to S3 show possible minor embeddings of the G_1 graph which match the labeling of the qubits used for the (ideal) quantum annealing simulations to produce Fig. 5 of the main text. Figure S4 shows a possible embedding onto the Pegasus graph which does not require minor embedding (i.e., each logical variable is mapped onto a single physical qubit).

Table S5. Statistics on all generated embeddings. Shown are the average qubit number with standard deviation, the minimal and maximal qubit numbers, the seed which generated the embedding with the minimal qubit number and the total number of generated embeddings per instance.

	average	min.	max.	seed of min.	total
Advantage2_prototype1.1					
G_2	38.03 ± 1.61	33	45	402	500
G_3	127.44 ± 7.56	112	157	75	500
G_4	346.41 ± 18.54	307	417	380	400
Advantage_system4.1					
G_2	42.32 ± 1.92	38	49	60	500
G_3	145.85 ± 7.72	129	209	297	500
G_4	406.03 ± 21.47	360	480	203	400
G_5	964.95 ± 54.46	870	1254	222	300
G_6	1991.86 ± 104.12	1801	2398	89	200
G_7	3638.62 ± 135.09	3292	4029	41	100

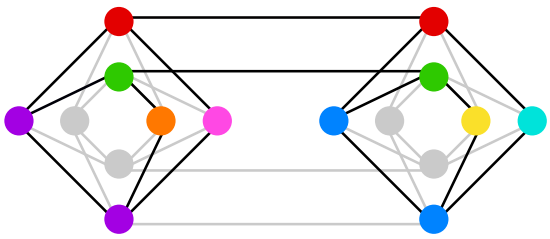

Figure S1. Possible embedding of the G_1 graph onto the Chimera topology requiring 12 qubits.

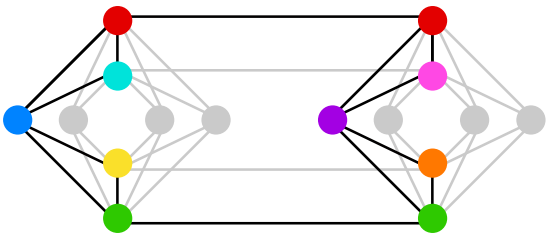

Figure S2. Possible 10-qubit embedding of the G_1 graph onto a modified Chimera topology including a few of the triangular connections of the Pegasus topology.

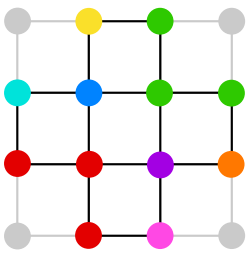

Figure S3. Possible embedding of the G_1 graph onto a square lattice using 12 qubits.

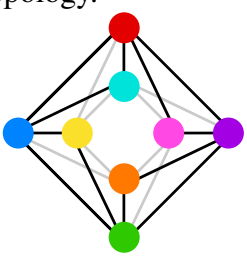

Figure S4. Possible embedding of the G_1 graph onto the Pegasus topology.