

Supplementary Materials for

Experimental evidence supports mantle partial melting in the asthenosphere

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- fig. S3. Seismic profiles of V_P , V_S , and $100/Q_S$ compared with empirical profiles, calculated for various melt fractions, based on the experimental results from this study and for an anelasticity attenuation factor $\alpha = 0.26$ (30).
- fig. S4. Ultrasonic signal recorded at 30 MHz.
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Supplementary Materials:

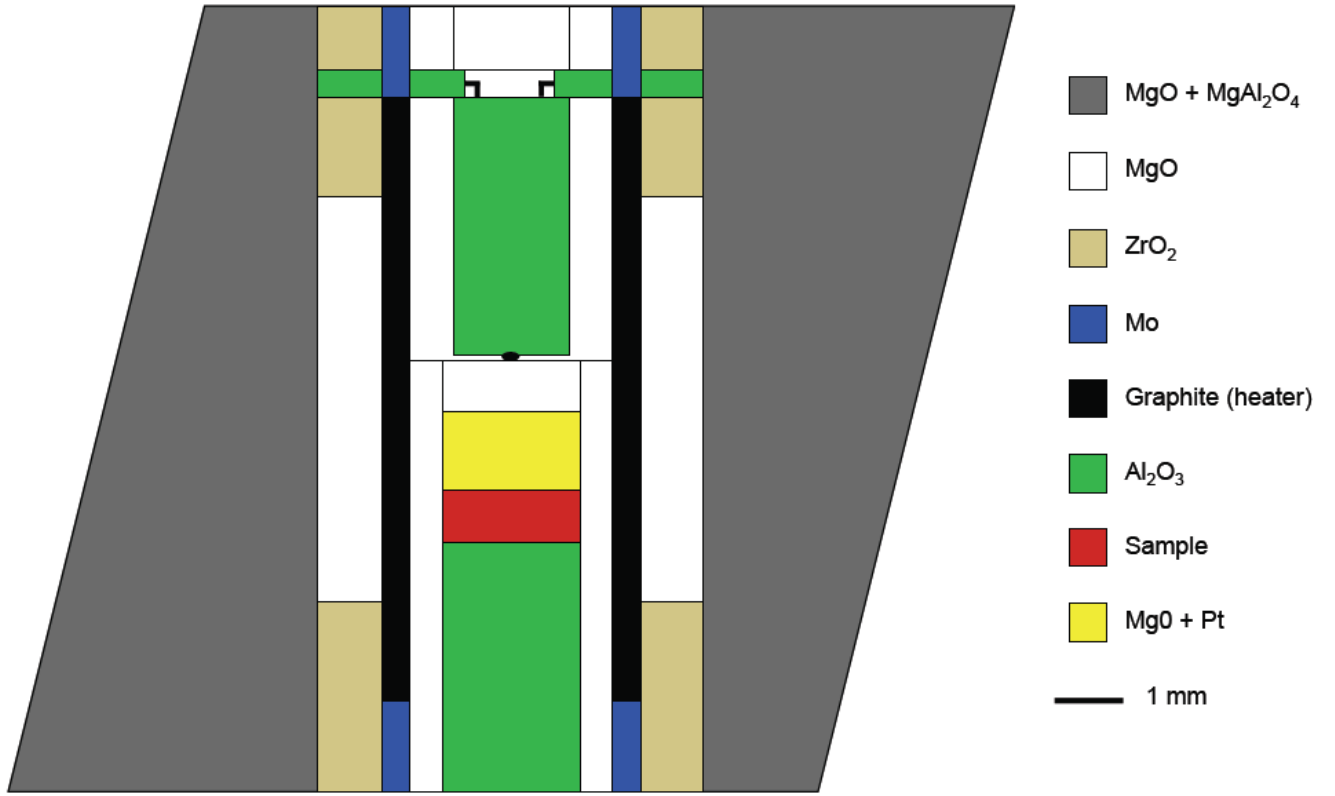


fig. S1. Schematic drawing of the cell assembly used in the multianvil experiments.

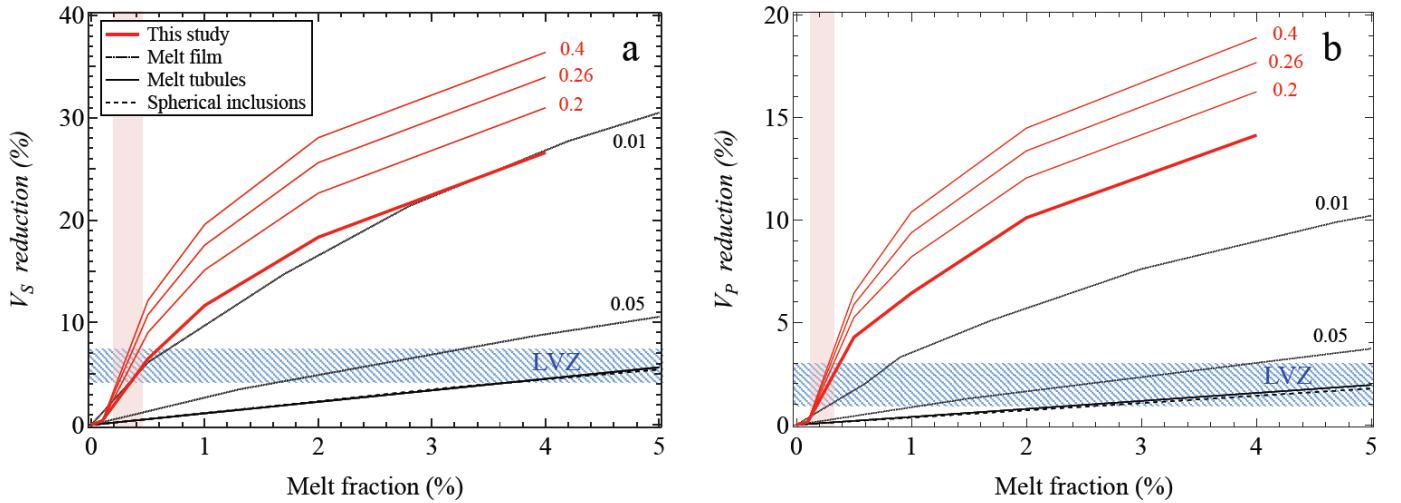


fig. S2. Reduction of (a) S - and (b) P -wave velocities as a function of melt fraction. We report our experimental results (thick red lines) together with the estimated seismic values taking in account the contribution of anelastic effect for various α values (thin red lines). We also report data from a previous study addressing the effect of melt geometry between melt films (for melt film with aspect ratios of 0.01 and 0.05), melt tubules and spherical inclusions (Black lines) (71). The blue shaded areas show the range of seismic velocity depressions reported for the LVZ (11).

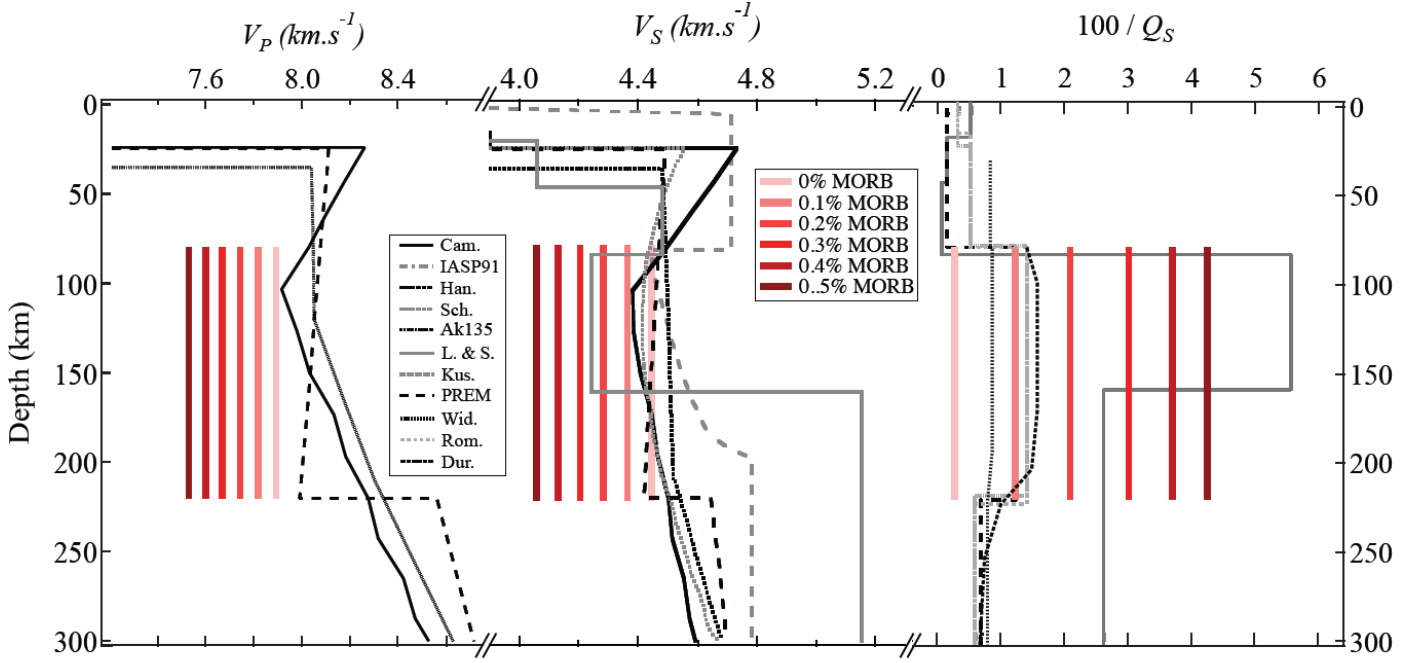


fig. S3. Seismic profiles of V_P , V_S , and $100/Q_S$ compared with empirical profiles, calculated for various melt fractions, based on the experimental results from this study and for an anelasticity attenuation factor $\alpha = 0.26$ (30). In our experiments, the solid phase is olivine, in contrast with peridotite in the upper mantle, which certainly disables a direct quantitative comparison between experimental and seismic trends for V_P and V_S . Only the variation with melt fraction of V_P , V_S , attenuation factor and V_P/V_S ratio can eventually be used for comparison with global seismic profiles (35–37, 39–41) (see Fig. 5) and regional seismic profiles (43–46).

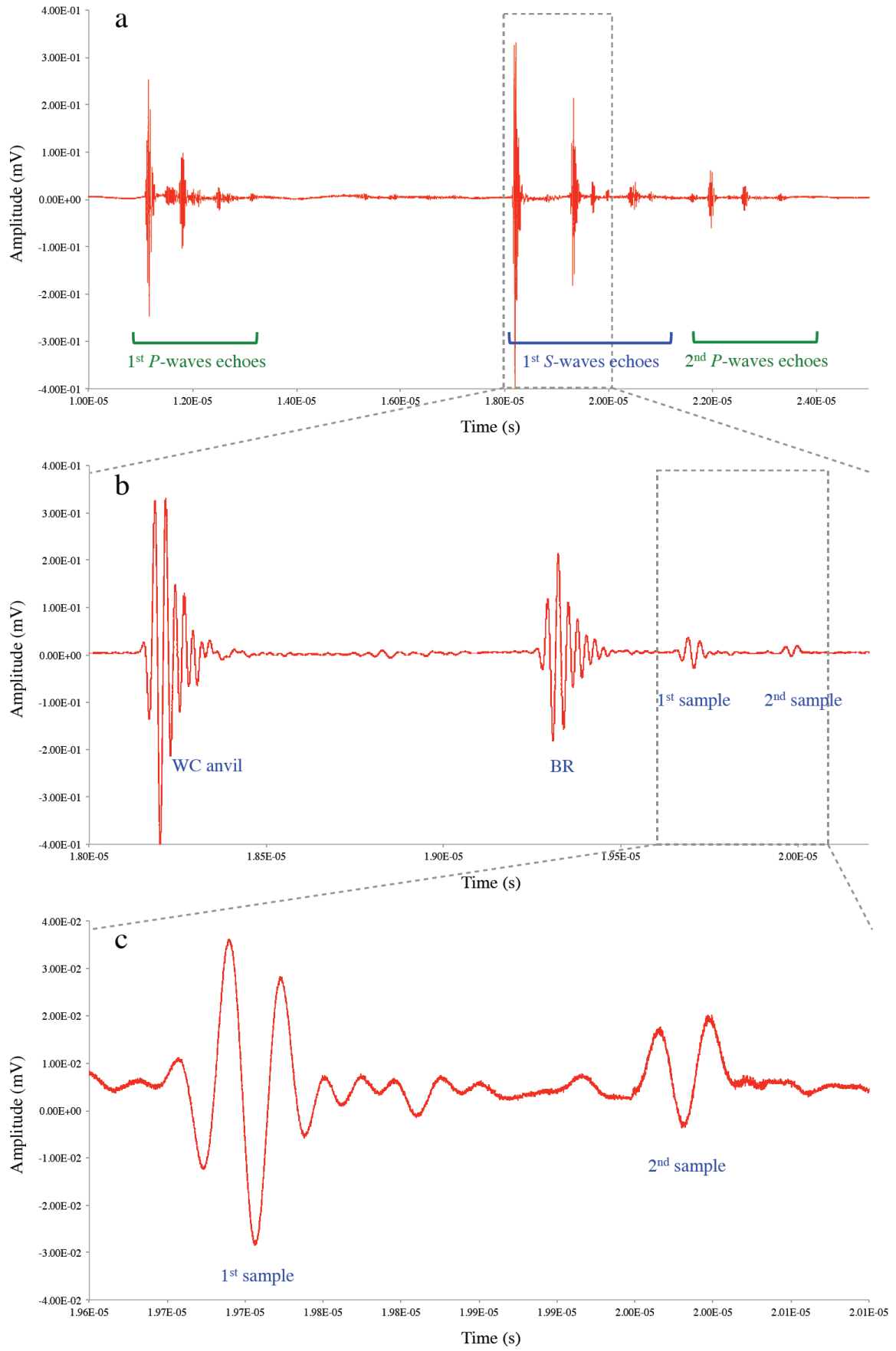


fig. S4. Example of ultrasonic signal recorded at 30 MHz (a) and used to determine the amplitude of the first and second *S*-waves echoes corresponding to the sample (b and c).

table S1.

Sample	P (GPa)	T (K)	V_P (km.s ⁻¹)	ΔV_P	Amp V_P (mV)	Δ Amp V_P	100/ Q_P	V_S (km.s ⁻¹)	ΔV_S	Amp V_S (mV)	Δ Amp V_S	100/ Q_S	Anneal (min)
SC	2.5	300	8.57(5)		0.37		0.29	4.89(3)		0.34		0.29	
SC	2.5	378	8.53(5)		0.37		0.29	4.86(3)		0.34		0.29	
SC	2.5	476	8.48(5)		0.37		0.29	4.83(3)		0.34		0.29	
SC	2.5	575	8.43(5)		0.37		0.29	4.80(3)		0.34		0.29	
SC	2.5	683	8.38(5)		0.37		0.29	4.76(3)		0.34		0.29	
SC	2.5	773	8.34(6)		0.37		0.29	4.73(3)		0.34		0.29	
SC	2.5	873	8.29(6)		0.37		0.29	4.70(4)		0.34		0.29	
SC	2.5	973	8.24(6)		0.37		0.29	4.66(4)		0.34		0.29	
SC	2.5	1073	8.20(7)		0.37		0.29	4.63(4)		0.34		0.29	
SC	2.5	1173	8.15(7)		0.37		0.29	4.60(4)		0.34		0.29	
SC	2.4	1273	8.10(7)		0.37		0.29	4.57(4)		0.34		0.29	
SC	2.4	1573	7.96(8)		0.37		0.29	4.47(5)		0.34		0.29	
SC	2.4	1623	7.93(8)	0.00	0.37	0.00	0.29	4.47(5)	0.00	0.34	0.00	0.29	0
SC	2.4	1623	7.93(8)	0.00	0.37	0.00	0.29	4.47(5)	0.00	0.34	0.00	0.29	30
SC	2.4	300	8.57(5)		0.37		0.29	4.89(3)		0.34		0.29	quenched
0.1%MORB	2.5	300	8.57(5)		0.37		0.29	4.88(3)		0.34		0.29	
0.1%MORB	2.5	376	8.53(5)		0.37		0.29	4.86(3)		0.34		0.29	
0.1%MORB	2.5	480	8.48(5)		0.37		0.29	4.82(3)		0.34		0.29	
0.1%MORB	2.5	577	8.43(5)		0.37		0.29	4.79(3)		0.34		0.29	
0.1%MORB	2.5	675	8.39(5)		0.37		0.29	4.76(3)		0.34		0.29	
0.1%MORB	2.5	777	8.34(6)		0.37		0.29	4.72(3)		0.34		0.29	
0.1%MORB	2.5	890	8.28(6)		0.37		0.29	4.69(4)		0.34		0.29	
0.1%MORB	2.5	980	8.24(6)		0.37		0.29	4.66(4)		0.34		0.29	
0.1%MORB	2.5	1078	8.19(7)		0.37		0.29	4.63(4)		0.34		0.29	
0.1%MORB	2.4	1177	8.15(7)		0.37		0.29	4.59(4)		0.34		0.29	
0.1%MORB	2.4	1277	8.10(7)		0.37		0.29	4.56(4)		0.34		0.29	
0.1%MORB	2.4	1324	8.08(8)		0.37		0.29	4.54(5)		0.34		0.29	
0.1%MORB	2.4	1375	8.05(8)		0.37		0.29	4.53(5)		0.34		0.29	
0.1%MORB	2.4	1421	8.03(8)		0.37		0.29	4.51(5)		0.34		0.29	
0.1%MORB	2.4	1474	8.00(8)		0.37		0.29	4.49(5)		0.34		0.29	
0.1%MORB	2.4	1520	7.98(8)		0.37		0.29	4.48(5)		0.34		0.29	

0.1%MORB	2.4	1576	7.95(8)		0.37		0.29	4.46(5)		0.34		0.29	
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	0
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	5
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	10
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	15
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	20
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	25
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	30
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	35
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	40
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	45
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	50
0.1%MORB	2.4	1623	7.92(8)	0.15	0.37	0.00	0.29	4.45(5)	0.48	0.34	0.00	0.29	55
0.5%MORB	2.4	300	8.56(5)		0.36		0.43	4.89(3)		0.32		0.94	
0.5%MORB	2.4	376	8.52(5)		0.36		0.43	4.86(3)		0.32		0.94	
0.5%MORB	2.4	477	8.47(5)		0.36		0.43	4.83(3)		0.32		0.94	
0.5%MORB	2.4	575	8.42(5)		0.36		0.43	4.80(3)		0.32		0.94	
0.5%MORB	2.4	678	8.37(5)		0.36		0.43	4.76(3)		0.32		0.94	
0.5%MORB	2.4	783	8.32(6)		0.36		0.43	4.73(3)		0.32		0.94	
0.5%MORB	2.4	876	8.28(6)		0.36		0.43	4.70(4)		0.32		0.94	
0.5%MORB	2.4	978	8.23(6)		0.36		0.43	4.66(4)		0.32		0.94	
0.5%MORB	2.4	1073	8.19(7)		0.36		0.43	4.63(4)		0.32		0.94	
0.5%MORB	2.4	1177	8.14(7)		0.36		0.43	4.60(4)		0.32		0.94	
0.5%MORB	2.4	1273	8.09(7)		0.36		0.43	4.57(4)		0.32		0.94	
0.5%MORB	2.4	1323	8.07(8)		0.36		0.43	4.55(5)		0.32		0.94	
0.5%MORB	2.4	1373	8.04(8)		0.36		0.43	4.53(5)		0.32		0.94	
0.5%MORB	2.4	1423	8.02(8)		0.36		0.43	4.52(5)		0.32		0.94	
0.5%MORB	2.4	1473	7.99(8)		0.36		0.43	4.50(5)		0.32		0.94	
0.5%MORB	2.4	1523	7.97(8)		0.36		0.43	4.48(5)		0.32		0.94	
0.5%MORB	2.4	1573	7.95(8)		0.36		0.43	4.47(5)		0.32		0.94	
0.5%MORB	2.4	1623	7.82(8)	1.41	0.36	2.70	0.43	4.45(5)	0.37	0.32	5.88	0.94	0
0.5%MORB	2.4	1623	7.79(8)	1.81	0.35	5.41	0.86	4.41(5)	1.28	0.32	5.88	0.94	5
0.5%MORB	2.4	1623	7.71(8)	2.82	0.34	8.11	1.29	4.32(5)	3.30	0.30	11.76	1.87	10
0.5%MORB	2.4	1623	7.62(8)	3.96	0.33	10.81	1.72	4.23(5)	5.31	0.27	20.59	3.28	15
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.20(5)	5.98	0.25	26.47	4.21	20

0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	25
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	30
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	35
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	40
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	45
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	50
0.5%MORB	2.4	1623	7.59(8)	4.33	0.33	10.81	1.72	4.18(5)	6.43	0.25	26.47	4.21	55
1%MORB	2.4	300	8.55(5)		0.36		0.43	4.88(3)		0.31		1.40	
1%MORB	2.4	373	8.51(5)		0.36		0.43	4.85(3)		0.31		1.40	
1%MORB	2.4	473	8.46(5)		0.36		0.43	4.82(3)		0.31		1.40	
1%MORB	2.4	573	8.42(5)		0.36		0.43	4.79(3)		0.31		1.40	
1%MORB	2.4	673	8.37(5)		0.36		0.43	4.75(3)		0.31		1.40	
1%MORB	2.4	773	8.32(6)		0.36		0.43	4.72(3)		0.31		1.40	
1%MORB	2.4	880	8.27(6)		0.36		0.43	4.69(4)		0.31		1.40	
1%MORB	2.4	978	8.22(6)		0.36		0.43	4.65(4)		0.31		1.40	
1%MORB	2.4	1078	8.17(7)		0.36		0.43	4.62(4)		0.31		1.40	
1%MORB	2.4	1176	8.13(7)		0.36		0.43	4.59(4)		0.31		1.40	
1%MORB	2.4	1273	8.08(7)		0.36		0.43	4.56(4)		0.31		1.40	
1%MORB	2.4	1323	8.06(8)		0.36		0.43	4.54(5)		0.31		1.40	
1%MORB	2.4	1373	8.03(8)		0.36		0.43	4.52(5)		0.31		1.40	
1%MORB	2.4	1427	8.01(8)		0.36		0.43	4.51(5)		0.31		1.40	
1%MORB	2.4	1475	7.98(8)		0.36		0.43	4.49(5)		0.31		1.40	
1%MORB	2.4	1528	7.96(8)		0.36		0.43	4.47(5)		0.31		1.40	
1%MORB	2.4	1577	7.93(8)		0.36		0.43	4.46(5)		0.31		1.40	
1%MORB	2.4	1625	7.90(8)	0.43	0.30	18.92	3.01	4.44(5)	0.61	0.27	20.59	3.28	0
1%MORB	2.4	1625	7.67(8)	3.33	0.30	18.92	3.01	4.18(5)	6.43	0.23	32.35	5.15	5
1%MORB	2.4	1625	7.50(8)	5.47	0.30	18.92	3.01	4.02(5)	10.01	0.22	35.29	5.62	10
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	15
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	20
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	25
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	30
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	35
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	40
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	45
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	50

1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	55
1%MORB	2.4	1625	7.42(8)	6.48	0.30	18.92	3.01	3.95(5)	11.58	0.21	38.24	6.09	60
1%MORB	2.4	300	8.57(5)		0.35		0.86	4.87(3)		0.30		1.87	quenched
2%MORB	2.5	300	8.54(5)		0.35		0.86	4.87(3)		0.32		0.94	
2%MORB	2.5	380	8.50(5)		0.35		0.86	4.84(3)		0.32		0.94	
2%MORB	2.5	478	8.45(5)		0.35		0.86	4.81(3)		0.32		0.94	
2%MORB	2.5	587	8.40(5)		0.35		0.86	4.77(3)		0.32		0.94	
2%MORB	2.5	679	8.35(5)		0.35		0.86	4.74(3)		0.32		0.94	
2%MORB	2.5	787	8.30(6)		0.35		0.86	4.71(3)		0.32		0.94	
2%MORB	2.5	878	8.26(6)		0.35		0.86	4.68(4)		0.32		0.94	
2%MORB	2.5	978	8.21(6)		0.35		0.86	4.64(4)		0.32		0.94	
2%MORB	2.5	1079	8.16(7)		0.35		0.86	4.61(4)		0.32		0.94	
2%MORB	2.5	1191	8.11(7)		0.35		0.86	4.57(4)		0.32		0.94	
2%MORB	2.5	1271	8.07(7)		0.35		0.86	4.55(4)		0.32		0.94	
2%MORB	2.5	1378	8.02(8)		0.35		0.86	4.51(5)		0.32		0.94	
2%MORB	2.5	1423	8.00(8)		0.35		0.86	4.50(5)		0.32		0.94	
2%MORB	2.5	1473	7.97(8)		0.35		0.86	4.48(5)		0.32		0.94	
2%MORB	2.5	1528	7.95(8)		0.35		0.86	4.46(5)		0.32		0.94	
2%MORB	2.5	1578	7.92(8)		0.35		0.86	4.45(5)		0.32		0.94	
2%MORB	2.5	1631	7.41(8)	6.60	0.29	21.62	3.44	3.97(5)	11.13	0.20	41.18	6.55	0
2%MORB	2.5	1631	7.13(8)	10.13	0.29	21.62	3.44	3.65(5)	18.30	0.17	50.00	7.96	5
2%MORB	2.5	1631	7.13(8)	10.13	0.29	21.62	3.44	3.65(5)	18.30	0.17	50.00	7.96	10
2%MORB	2.5	1631	7.13(8)	10.13	0.29	21.62	3.44	3.65(5)	18.30	0.17	50.00	7.96	15
2%MORB	2.5	300	8.57(5)		0.34		1.29	4.86(3)		0.30		1.87	quenched
4%MORB	2.4	300	8.51(5)		0.34		1.29	4.86(3)		0.30		1.87	
4%MORB	2.4	376	8.49(5)		0.34		1.29	4.83(3)		0.30		1.87	
4%MORB	2.4	478	8.44(5)		0.34		1.29	4.80(3)		0.30		1.87	
4%MORB	2.4	582	8.39(5)		0.34		1.29	4.76(3)		0.30		1.87	
4%MORB	2.4	674	8.35(5)		0.34		1.29	4.73(3)		0.30		1.87	
4%MORB	2.4	779	8.30(6)		0.34		1.29	4.70(3)		0.30		1.87	
4%MORB	2.4	880	8.26(6)		0.34		1.29	4.67(4)		0.30		1.87	
4%MORB	2.4	977	8.20(6)		0.34		1.29	4.63(4)		0.30		1.87	
4%MORB	2.4	1077	8.15(7)		0.34		1.29	4.60(4)		0.30		1.87	
4%MORB	2.4	1176	8.11(7)		0.34		1.29	4.57(4)		0.30		1.87	
4%MORB	2.4	1275	8.06(7)		0.34		1.29	4.54(4)		0.30		1.87	

4%MORB	2.4	1313	8.04(8)		0.34		1.29	4.52(5)		0.30		1.87	
4%MORB	2.4	1379	8.01(8)		0.34		1.29	4.50(5)		0.30		1.87	
4%MORB	2.4	1422	7.99(8)		0.34		1.29	4.49(5)		0.30		1.87	
4%MORB	2.4	1477	7.96(8)		0.34		1.29	4.47(5)		0.30		1.87	
4%MORB	2.4	1529	7.94(8)		0.34		1.29	4.45(5)		0.30		1.87	
4%MORB	2.4	1576	7.91(8)		0.34		1.29	4.44(5)		0.30		1.87	
4%MORB	2.4	1624	7.25(8)	8.62	0.28	24.32	3.87	3.77(5)	15.61	0.19	44.12	7.02	0
4%MORB	2.4	1624	6.81(8)	14.17	0.28	24.32	3.87	3.28(5)	26.58	0.15	55.88	8.89	5
4%MORB	2.4	1624	6.81(8)	14.17	0.28	24.32	3.87	3.28(5)	26.58	0.15	55.88	8.89	10
4%MORB	2.4	1624	6.81(8)	14.17	0.28	24.32	3.87	3.28(5)	26.58	0.15	55.88	8.89	15