**Quantitative models linking igneous amphibole composition with magma volatile chemistry**

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**Supplemental Tables 2, 3, 5, 6, 9**

**Supplemental Table 2. Results of O(3) site occupancy calculation. Ref: data source reference (see footnotes). %A: volume percentage amphibole in synthesis product. %G: volume percentage glass in synthesis product. %$H_2O$: wt% water added at beginning of experiment. $K_x$: dehydrogenation equilibrium constant (equation 3, Section 4). $\Delta_{oxo}$: charge increment in calculated formula (equation 2, Section 3).**

| Ref | Run | %A | %G | %$H_2O$ | $T$ (K) | $P$ (kbar) | log $K_x$ | log $f(O_2)$ | $f(H_2O)$ (kbar) | $\Delta_{oxo}$ | log $f(H_2)$ (bar) | [O(3)]$O^{2-}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1446 | 22 | 74 | 5.0 | 1323 | 15.00 | 1.92 | -10.35 | 12.95 | 0.37 | 2.40 | 0.57 |
| 2 | 1951 | 18 | 68.9 | 7.5 | 1298 | 10.00 | 1.31 | -11.23 | 11.71 | 0.39 | 2.61 | 0.49 |
| 2 | 1950 | 17 | 66 | 10.0 | 1323 | 20.00 | 1.73 | -9.82 | 69.04 | 0.29 | 2.86 | 0.43 |
| 3 | 1923 | 16 | 67 | 10.0 | 1323 | 20.00 | 2.47 | -9.82 | 61.81 | 0.43 | 2.82 | 0.64 |
| 3 | 1941 | 21 | 72 | 7.5 | 1323 | 15.00 | 2.28 | -10.35 | 21.14 | 0.36 | 2.61 | 0.60 |
| 3 | 1925 | 12 | 75 | 5.0 | 1323 | 10.00 | 1.95 | -10.93 | 6.08 | 0.42 | 2.36 | 0.62 |
| 4 | 1030C | 13.9 | 48.6 | 1.7 | 1303 | 9.30 | 1.36 | -11.26 | 2.53 | 0.23 | 2.00 | 0.48 |
| 4 | 1000C | 34 | 30.4 | 1.7 | 1273 | 9.30 | 0.98 | -11.63 | 3.73 | 0.03 | 2.11 | 0.32 |
| 4 | 980C | 43.1 | 9.4 | 1.7 | 1253 | 9.30 | 1.09 | -11.89 | 11.94 | -0.12 | 2.59 | 0.22 |
| 5 | 278 | | | 7.1 | 1123 | 3.00 | -0.03 | -12.94 | 2.58 | 0.20 | 1.24 | 0.43 |
| 5 | 283 | | | 6.8 | 1123 | 3.00 | -0.15 | -12.94 | 2.58 | 0.19 | 1.24 | 0.39 |
| 5 | 286 | | | 7.0 | 1123 | 3.00 | -0.82 | -12.94 | 2.58 | 0.03 | 1.24 | 0.23 |
| 5 | 290 | | | 5.0 | 1123 | 3.00 | -0.11 | -12.94 | 2.58 | 0.37 | 1.24 | 0.53 |
| 5 | 291 | | | 4.4 | 1123 | 2.00 | -0.33 | -12.94 | 1.69 | 0.67 | 1.06 | 0.77 |
| 5 | 298 | | | 3.5 | 1073 | 3.00 | -0.97 | -13.96 | 2.41 | 0.29 | 1.19 | 0.43 |
| 5 | 299 | | | 3.9 | 1123 | 2.00 | -0.50 | -12.94 | 1.69 | 0.22 | 1.06 | 0.43 |
| 5 | 300 | | | 4.7 | 1123 | 3.00 | -0.23 | -12.94 | 2.58 | -0.08 | 1.24 | 0.31 |
| 5 | 307 | | | 5.8 | 1123 | 2.00 | -0.43 | -12.94 | 1.69 | 0.12 | 1.06 | 0.36 |
| 5 | 309 | | | 6.5 | 1123 | 2.00 | -0.51 | -12.94 | 1.69 | -0.02 | 1.06 | 0.27 |
| 5 | 313 | | | 6.6 | 1123 | 3.00 | -0.20 | -12.94 | 2.58 | -0.15 | 1.24 | 0.28 |
| 5 | 314 | | | 5.6 | 1123 | 1.85 | 0.11 | -8.94 | 1.57 | 0.02 | -0.97 | 0.74 |
| 5 | 315 | | | 4.4 | 1123 | 1.85 | 0.37 | -8.94 | 1.57 | 0.57 | -0.97 | 1.10 |
| 5 | 316 | | | 6.2 | 1123 | 1.85 | 0.08 | -8.94 | 1.57 | -0.23 | -0.97 | 0.66 |
| 5 | 320 | | | 4.2 | 1073 | 3.00 | -0.52 | -13.96 | 2.41 | 0.35 | 1.19 | 0.52 |
| 5 | 322 | | | 4.4 | 1123 | 2.00 | -0.38 | -12.94 | 1.69 | 0.33 | 1.06 | 0.50 |
| 5 | 323 | | | 4.7 | 1073 | 3.00 | -0.53 | -13.96 | 2.41 | 0.38 | 1.19 | 0.53 |
| 5 | 324 | | | 6.0 | 1123 | 3.00 | -0.08 | -12.94 | 2.58 | 0.26 | 1.24 | 0.48 |
| 5 | 325 | | | 3.6 | 1073 | 2.00 | -0.68 | -13.96 | 1.59 | 0.72 | 1.01 | 0.80 |
| 5 | 326 | | | 4.3 | 1073 | 3.00 | -0.72 | -13.96 | 2.41 | 0.05 | 1.19 | 0.27 |
| 5 | 329 | | | 5.8 | 1123 | 3.00 | -0.64 | -12.94 | 2.58 | -0.20 | 1.24 | 0.17 |
| 5 | 330 | | | 4.4 | 1123 | 2.00 | -0.20 | -12.94 | 1.69 | 0.76 | 1.06 | 0.85 |
| 5 | 331 | | | 4.3 | 1073 | 3.00 | -0.61 | -13.96 | 2.41 | 0.59 | 1.19 | 0.67 |
| 5 | 333 | | | 4.9 | 1123 | 2.00 | -0.28 | -12.94 | 1.69 | 0.04 | 1.06 | 0.36 |
| 5 | B51 | | | 9.6 | 1123 | 2.00 | -0.52 | -12.94 | 1.69 | 0.56 | 1.06 | 0.65 |
| 5 | B52 | | | 9.5 | 1123 | 2.00 | -0.76 | -12.94 | 1.69 | -0.11 | 1.06 | 0.18 |

| 5 | B53 | | | 9.1 | 1123 | 2.00 | -0.66 | -12.94 | 1.69 | -0.14 | 1.06 | 0.18 |
| 5 | B57 | | | 9.8 | 1123 | 3.00 | -0.62 | -12.94 | 2.58 | 0.27 | 1.24 | 0.40 |
| 5 | B58 | | | 9.6 | 1123 | 3.00 | -0.87 | -12.94 | 2.58 | -0.16 | 1.24 | 0.14 |
| 5 | B59 | | | 9.3 | 1123 | 3.00 | -0.81 | -12.94 | 2.58 | -0.12 | 1.24 | 0.14 |
| 6 | RDT-A-1 | | | | 1213 | 1.50 | 0.88 | -10.30 | 1.27 | 0.04 | 0.48 | 0.62 |
| 6 | RDT-A-1 | | | | 1213 | 1.50 | 0.76 | -10.30 | 1.27 | -0.25 | 0.48 | 0.40 |
| 6 | RDT-A-2 | | | | 1213 | 2.10 | 1.38 | -10.30 | 1.75 | -0.32 | 0.62 | 0.49 |

1: Adam and Green (1994) and Hauri et al. (2006).

2: Adam and Green (2006).

3: Adam et al. (2007).

4: McCubbin et al. (2008).

5: Sato et al. (2005).

6: Browne (2005).

**Supplemental Table 3. Experimental and calculated (Sato et al., 2005) amphibole chlorine partitioning coefficients. References as in Supplemental Table 1. $M_{1O}$: one oxygen basis molar weight of melt (Appendix 1). $K_1$, $K_2$: solubility and speciation constants for $H_2O$ in silicate melt (Zhang 1999). $C(H_2O)$: weight fraction $H_2O$ in melt. $[H_2O]_t$: mole fraction total $H_2O$ in melt on one oxygen basis. $[H_2O]_m$: mole fraction molecular $H_2O$ in melt on one oxygen basis. $[OH]$: mole fraction dissociated $H_2O$, as OH, in melt on one oxygen basis. $[Cl]$: mole fraction Cl in melt on one oxygen basis. $X_{Cl}$: Cl in amphibole (apfu). $X_{OH}$: OH in amphibole (apfu). $K_{Cl}$: competitive partition coefficient (equation 5, Section 4).**

| Ref | Run | $M_{1O}$ | $K_1$ | $K_2$ | $C(H_2O)$ (wt%) | $[H_2O]_t$ | $[H_2O]_m$ | $[OH]$ | $[Cl]$ | $[Cl]/[OH]$ | $X_{Cl}/X_{OH}$ | $\ln K_{Cl}$ (meas) | $\ln K_{Cl}$ (calc) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1950 | 37.4 | | 3.36 | 15% | 0.27 | 0.08 | 0.38 | 4.4E-03 | 1.2E-02 | 9.1E-03 | -0.25 | -2.35 |
| 2 | 1951 | 37.5 | | 2.98 | 11% | 0.20 | 0.05 | 0.30 | 1.8E-02 | 5.9E-02 | 1.1E-02 | -1.68 | -2.16 |
| 3 | 1923 | 35.9 | | 3.36 | 15% | 0.25 | 0.07 | 0.37 | 4.4E-03 | 1.2E-02 | 6.5E-03 | -0.62 | -2.24 |
| 3 | 1925 | 36.2 | | 3.36 | 6% | 0.12 | 0.02 | 0.21 | 4.7E-03 | 2.3E-02 | 8.0E-03 | -1.03 | -2.18 |
| 3 | 1941 | 36.3 | | 3.36 | 10% | 0.18 | 0.04 | 0.29 | 5.2E-03 | 1.8E-02 | 9.3E-03 | -0.64 | -2.14 |
| 1 | 1446 | 36.7 | | 3.36 | 6% | 0.12 | 0.02 | 0.21 | 6.6E-04 | 3.2E-03 | 1.1E-02 | 1.27 | -2.28 |
| 4 | 980C | 36.2 | | 4.82 | 13% | 0.23 | 0.05 | 0.36 | 1.3E-02 | 3.6E-02 | 1.4E-02 | -0.96 | -1.03 |
| 4 | 1000C | 36.9 | | 5.38 | 4% | 0.08 | 0.01 | 0.16 | 8.2E-03 | 5.2E-02 | 1.4E-02 | -1.35 | -1.21 |
| 4 | 1030C | 36.8 | | 6.30 | 3% | 0.06 | 0.00 | 0.12 | 4.9E-03 | 4.1E-02 | 1.1E-02 | -1.30 | -1.57 |
| 5 | 278 | 32.7 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 7.0E-04 | 4.1E-03 | 2.6E-03 | -0.45 | -0.50 |
| 5 | 283 | 33.1 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.2E-03 | 7.2E-03 | 4.3E-03 | -0.52 | -0.62 |
| 5 | 286 | 33.0 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.9E-03 | 1.1E-02 | 6.6E-03 | -0.52 | -0.55 |
| 5 | 290 | 32.9 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.8E-03 | 1.1E-02 | 6.6E-03 | -0.48 | -0.52 |
| 5 | 291 | 32.6 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 1.6E-03 | 1.1E-02 | 8.4E-03 | -0.25 | -0.44 |
| 5 | 298 | 32.6 | 2.48E-05 | 0.55 | | 0.14 | 0.06 | 0.16 | 1.7E-03 | 1.1E-02 | 1.5E-02 | 0.35 | 0.32 |
| 5 | 299 | 32.8 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 1.9E-03 | 1.2E-02 | 8.4E-03 | -0.39 | -0.26 |
| 5 | 300 | 32.7 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.7E-03 | 9.9E-03 | 1.1E-02 | 0.09 | -0.02 |
| 5 | 307 | 32.8 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 1.8E-03 | 1.2E-02 | 7.1E-03 | -0.51 | -0.44 |
| 5 | 309 | 32.8 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 2.0E-03 | 1.3E-02 | 5.4E-03 | -0.89 | -0.51 |
| 5 | 313 | 32.8 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.9E-03 | 1.1E-02 | 6.7E-03 | -0.52 | -0.10 |
| 5 | 314 | 33.0 | 2.5E-05 | 0.66 | | 0.11 | 0.04 | 0.14 | 1.5E-03 | 1.1E-02 | 6.5E-03 | -0.49 | -0.71 |
| 5 | 315 | 32.7 | 2.5E-05 | 0.66 | | 0.11 | 0.04 | 0.14 | 1.5E-03 | 1.0E-02 | 6.9E-03 | -0.38 | -0.71 |
| 5 | 316 | 33.0 | 2.5E-05 | 0.66 | | 0.11 | 0.04 | 0.14 | 1.6E-03 | 1.1E-02 | 5.1E-03 | -0.75 | -0.56 |
| 5 | 320 | 32.7 | 2.48E-05 | 0.55 | | 0.14 | 0.06 | 0.16 | 1.5E-03 | 9.6E-03 | 1.1E-02 | 0.17 | 0.33 |
| 5 | 322 | 32.8 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 1.2E-03 | 8.2E-03 | 3.9E-03 | -0.74 | -0.39 |
| 5 | 323 | 32.8 | 2.48E-05 | 0.55 | | 0.14 | 0.06 | 0.16 | 1.3E-03 | 8.1E-03 | 7.9E-03 | -0.02 | 0.15 |
| 5 | 324 | 33.1 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.5E-03 | 9.0E-03 | 6.0E-03 | -0.41 | -0.35 |
| 5 | 325 | 32.5 | 2.8E-05 | 0.55 | | 0.12 | 0.04 | 0.14 | 1.1E-03 | 7.7E-03 | 8.6E-03 | 0.11 | 0.18 |
| 5 | 326 | 32.7 | 2.48E-05 | 0.55 | | 0.14 | 0.06 | 0.16 | 3.9E-04 | 2.4E-03 | 1.8E-03 | -0.31 | -0.10 |
| 5 | 329 | 33.1 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 1.4E-03 | 8.1E-03 | 4.6E-03 | -0.57 | -0.31 |
| 5 | 330 | 32.9 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 1.4E-03 | 9.1E-03 | 6.0E-03 | -0.42 | -0.55 |
| 5 | 331 | 32.4 | 2.48E-05 | 0.55 | | 0.14 | 0.06 | 0.16 | 1.3E-03 | 8.2E-03 | 6.9E-03 | -0.17 | -0.05 |
| 5 | 333 | 33.0 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 1.2E-03 | 8.0E-03 | 4.7E-03 | -0.53 | -0.27 |
| 5 | B51 | 32.9 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 2.2E-03 | 1.5E-02 | 9.1E-03 | -0.49 | -0.51 |
| 5 | B52 | 33.0 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 4.6E-03 | 3.1E-02 | 1.1E-02 | -1.07 | -0.64 |
| 5 | B53 | 33.1 | 2.46E-05 | 0.66 | | 0.12 | 0.04 | 0.15 | 6.6E-03 | 4.4E-02 | 1.4E-02 | -1.19 | -0.63 |
| 5 | B57 | 32.9 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 2.4E-03 | 1.4E-02 | 6.6E-03 | -0.75 | -0.52 |
| 5 | B58 | 33.0 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 4.3E-03 | 2.5E-02 | 1.0E-02 | -0.91 | -0.57 |

| 5 | B59 | 33.0 | 2.22E-05 | 0.66 | | 0.14 | 0.06 | 0.17 | 6.6E-03 | 3.9E-02 | 1.1E-02 | -1.27 | -0.79 |
| 6 | RDT-A-1 | 33.0 | 2.08E-05 | 0.87 | | 0.10 | 0.03 | 0.14 | 7.0E-04 | 4.9E-03 | 8.9E-03 | 0.60 | -1.14 |
| 6 | RDT-A-1 | 33.0 | 2.08E-05 | 0.87 | | 0.10 | 0.03 | 0.14 | 7.0E-04 | 4.9E-03 | 8.6E-03 | 0.57 | -1.30 |
| 6 | RDT-A-2 | 33.3 | 1.99E-05 | 0.87 | | 0.12 | 0.04 | 0.16 | 1.3E-03 | 8.0E-03 | 1.3E-03 | -1.82 | -1.28 |

**Supplemental Table 5.  Calculated ln $K_{Cl}$ (equation 5, Section 4) for a variety of natural amphiboles.**

| Reference | Sample | ln $K_{Cl}$ D8 | ln $K_{Cl}$ D3 | ln $K_{Cl}$ L8 | ln $K_{Cl}$ L3 |
|---|---|---|---|---|---|
| Luhr (2002) | Col-99AH1 | -1.10 | -1.74 | -1.53 | -1.13 |
| | Col-99AH2 | -0.83 | -1.81 | -1.22 | -0.93 |
| | Col-99B | -1.20 | -1.82 | -1.52 | -1.23 |
| Miller et al. (1999) | Host | -1.34 | -0.98 | -0.14 | -1.02 |
| | Enclave | -1.45 | -1.58 | -0.76 | -0.83 |
| Shane et al. (2007) | Cumm910 | 0.30 | -1.40 | 6.25 | -2.57 |
| | Cumm9121 | 0.32 | -1.24 | 3.88 | -2.45 |
| | Cummi913 | 0.53 | -1.14 | 3.08 | -2.45 |
| | Cumm939 | 0.22 | -1.47 | 3.16 | -2.44 |
| | Cumm9161 | 0.30 | -1.23 | 9.55 | -2.37 |
| | Cumm9172 | 0.48 | -1.30 | 3.84 | -2.48 |
| | Cumm9171 | 0.58 | -1.12 | 3.28 | -2.56 |
| | Cumm8602 | 0.46 | -1.30 | 4.96 | -2.54 |
| | Hbl5592 | -1.39 | -1.06 | 0.15 | -1.28 |
| | Hbl9172 | -0.20 | 0.00 | 0.57 | -0.20 |
| | Hbl9171 | -0.76 | -0.51 | 0.11 | -0.32 |
| | Hbl8602 | -0.48 | -0.32 | 0.57 | -0.23 |
| | Hbl8602 | -1.27 | -1.11 | 0.06 | -1.45 |
| Wolf and Eichelberger (1997) | 92MHR9-1 | -1.03 | -1.47 | -1.06 | -0.77 |
| | 92MHR6-1 | -1.26 | -1.21 | -0.82 | -1.17 |
| | 92MHR6-1 | -1.26 | -1.21 | -0.82 | -1.17 |
| Browne (2005) | 92MHR6-1 | -0.90 | -0.96 | -0.67 | -0.52 |
| | 92MHR9-1 | -0.88 | -1.72 | -0.18 | -0.65 |
| | 92MHR20-1 | -1.10 | -1.18 | -0.56 | -1.00 |
| | 92MHR20-1 | -1.52 | -2.06 | -0.70 | -0.98 |
| | 92MHR12-1 | -1.38 | -1.35 | -0.85 | -1.36 |
| Browne (2005) Syntheses | RDT-A-1 | -0.78 | -1.41 | -0.50 | -0.57 |
| | RDT-A-1 | -1.38 | -1.81 | -1.24 | -0.95 |
| | RDT-A-2 | -0.84 | -1.83 | -1.00 | -1.18 |
| Ridolfi et al. (2008) | e-2-amp-3 | -1.68 | -1.31 | -1.00 | -0.98 |
| | RE-8-amp1 | -1.49 | -1.14 | -0.90 | -0.84 |
| | 2-84-6TOR-l1 | -1.46 | -1.36 | -0.83 | -0.64 |

**Supplemental Table 6.** Comparison of oxo-components calculated from chlorine partitioning (Section 5) and amphibole redox (Section 4), assuming water saturation (Section 6). Column labels are the same as for Supplemental Tables 2 and 3. Samples are the same as in Supplemental Table 5. Best matches are in bold. Poor matches, and especially negative values for $^{[O(3)]}O^{2-}$ from the Cl partitioning calculation, signify that the assumption of water saturation is incorrect (see text).

| Sample | $T$ (K) | $P$ (kbar) | log $K_s$ | log $f(O_2)$ | $f'(H_2O)$ (kbar) | $C(H_2O)$ (wt%) | $[H_2O]_t$ | $[H_2O]_m$ | [OH] | ln $K_{Cl}$ | $^{[O(3)]}O^{2-}$ | log $f(H_2)$ | $^{[O(3)]}O^{2-}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Chlorine partitioning (Section 5, S.Tab. 3) | | | | | | | Redox (Section 4, ST 2) | |
| Col-99AH1 | 1253 | 1.2 | 0.14 | -7.85 | 1.08 | 4.06% | 7.29% | 2.42% | 9.74% | -1.13 | -2.73 | -0.476 | 0.66 |
| Col-99AH2 | 1253 | 1.2 | 0.87 | -7.85 | 1.08 | 4.06% | 7.29% | 2.42% | 9.74% | -0.93 | -0.58 | -0.476 | 0.85 |
| Col-99B | 1253 | 1.2 | -0.04 | -7.85 | 1.08 | 4.05% | 7.27% | 2.41% | 9.72% | -1.23 | -4.05 | -0.476 | 0.58 |
| Host | 1098 | 2.0 | -1.17 | -17.88 | 1.64 | 6.02% | 10.31% | 4.59% | 11.43% | -1.02 | -6.23 | 3.253 | 0.02 |
| Enclave | 1098 | 2.0 | 0.32 | -15.01 | 1.64 | 6.25% | 10.80% | 4.92% | 11.77% | -0.83 | -9.40 | 1.820 | 0.14 |
| Cumm910 | 1039 | 2.3 | -2.96 | -13.79 | 1.68 | 6.87% | 11.67% | 5.82% | 11.70% | -2.57 | -24.66 | 0.552 | 0.19 |
| Cumm9121 | 1039 | 2.3 | -2.83 | -13.79 | 1.68 | 6.87% | 11.71% | 5.82% | 11.71% | -2.45 | -8.44 | 0.552 | 0.17 |
| Cummi913 | 1039 | 2.3 | -2.82 | -13.79 | 1.68 | 6.87% | 11.66% | 5.81% | 11.70% | -2.45 | -3.52 | 0.552 | 0.17 |
| Cumm939 | 1039 | 2.3 | -2.71 | -13.79 | 1.68 | 6.87% | 11.68% | 5.83% | 11.71% | -2.44 | -10.77 | 0.552 | 0.19 |
| Cumm9161 | 1039 | 2.3 | -2.80 | -13.79 | 1.68 | 6.90% | 11.73% | 5.86% | 11.74% | -2.37 | -13.23 | 0.552 | 0.11 |
| Cumm9172 | 1039 | 2.3 | -2.85 | -13.79 | 1.68 | 6.80% | 11.59% | 5.76% | 11.66% | -2.48 | -4.86 | 0.552 | 0.19 |
| Cumm9171 | 1039 | 2.3 | -2.96 | -13.79 | 1.68 | 6.89% | 11.71% | 5.85% | 11.73% | -2.56 | -8.78 | 0.552 | 0.18 |
| Cumm8602 | 1039 | 2.3 | -2.95 | -13.79 | 1.68 | 6.80% | 11.57% | 5.75% | 11.65% | -2.54 | -17.96 | 0.552 | 0.14 |
| Hbl5592 | 1039 | 2.3 | -1.83 | -13.79 | 1.68 | 6.98% | 11.83% | 5.96% | 11.83% | -1.28 | -3.30 | 0.552 | 0.20 |
| Hbl9172 | 1039 | 2.3 | -1.52 | -13.79 | 1.68 | 6.80% | 11.59% | 5.76% | 11.66% | -0.20 | -2.57 | 0.552 | 0.24 |
| Hbl9171 | 1039 | 2.3 | -1.39 | -13.79 | 1.68 | 6.89% | 11.71% | 5.85% | 11.73% | -0.32 | -3.25 | 0.552 | 0.32 |
| Hbl8602 | 1039 | 2.3 | -1.51 | -13.79 | 1.68 | 6.80% | 11.57% | 5.75% | 11.65% | -0.23 | -2.11 | 0.552 | 0.28 |
| Hbl8602 | 1039 | 2.3 | -1.66 | -13.79 | 1.68 | 6.80% | 11.57% | 5.75% | 11.65% | -1.45 | -2.06 | 0.552 | 0.16 |
| **92MHR9-1** | **1215** | **1.5** | **0.90** | **-9.55** | **1.38** | **4.77%** | **8.44%** | **3.15%** | **10.59%** | **-0.77** | **0.88** | **0.153** | **0.51** |
| 92MHR6-1 | 1118 | 1.5 | -0.93 | -11.00 | 1.28 | 5.21% | 8.98% | 3.74% | 10.48% | -1.17 | -4.86 | -0.081 | 0.34 |
| 92MHR6-1 | 1118 | 1.5 | -0.93 | -11.00 | 1.28 | 5.17% | 8.98% | 3.74% | 10.48% | -1.17 | -7.04 | -0.081 | 0.34 |
| 92MHR6-1 | 1118 | 1.5 | -0.75 | -11.00 | 1.28 | 5.29% | 9.08% | 3.80% | 10.55% | -0.52 | -17.88 | -0.081 | 0.42 |
| **92MHR9-1** | **1215** | **1.5** | **1.17** | **-9.55** | **1.38** | **4.78%** | **8.50%** | **3.18%** | **10.65%** | **-0.65** | **0.59** | **0.153** | **0.73** |
| 92MHR20-1 | 1118 | 1.5 | -0.69 | -11.00 | 1.28 | 5.26% | 9.05% | 3.78% | 10.53% | -1.00 | -1.22 | -0.081 | 0.33 |
| 92MHR20-1 | 1118 | 1.5 | 0.71 | -11.00 | 1.28 | 5.26% | 9.05% | 3.78% | 10.53% | -0.98 | -1.76 | -0.081 | 0.43 |
| 92MHR12-1 | 1118 | 1.5 | -1.22 | -11.00 | 1.28 | 5.25% | 9.03% | 3.77% | 10.52% | -1.36 | -11.56 | -0.081 | 0.37 |
| RDT-A-1 | 1213 | 1.5 | 0.88 | -10.30 | 1.27 | 4.66% | 8.21% | 3.01% | 10.40% | -0.57 | -2.67 | 0.478 | 0.62 |
| RDT-A-1 | 1213 | 1.5 | 0.76 | -10.30 | 1.27 | 4.66% | 8.21% | 3.01% | 10.40% | -0.95 | -4.00 | 0.478 | 0.40 |
| **RDT-A-2** | **1213** | **2.1** | **1.38** | **-10.30** | **1.75** | **5.36%** | **9.48%** | **3.77%** | **11.42%** | **-1.18** | **1.21** | **0.617** | **0.49** |
| e-2-amp-3 (averaged glass) | 1123 | 2.4 | -0.63 | -9.94 | 2.03 | 6.60% | 11.37% | 5.22% | 12.30% | -0.98 | -0.99 | -0.362 | 0.50 |
| e-2-amp-3 (Glass2) | 1123 | 2.4 | -0.63 | -9.94 | 2.03 | 6.48% | 11.14% | 5.06% | 12.14% | -0.98 | -0.45 | -0.362 | 0.50 |
| RE-8 (Glass3) | 1123 | 2.4 | -0.59 | -9.94 | 2.03 | 6.64% | 11.44% | 5.27% | 12.35% | -0.84 | -0.95 | -0.362 | 0.49 |
| RE-8 | 1123 | 2.4 | -0.59 | -9.94 | 2.03 | 6.57% | 11.33% | 5.20% | 12.28% | -0.84 | -0.63 | -0.362 | 0.49 |
| 2-84-6TOR-l1 | 1123 | 2.4 | -0.14 | -9.94 | 2.03 | 6.37% | 11.14% | 5.07% | 12.15% | -0.64 | -3.08 | -0.362 | 0.61 |

**Supplemental Table 9. Results of combined calculation for H$_2$O-undersaturated conditions on natural amphiboles (Section 6). Column labels are the same as for Supplemental Tables 2 and 3. Samples are the same as Supplemental Tables 5 and 6. See Supplemental Tables 6 and 8 for additional calculation input data. Best matches from Supplemental Table 6 (i.e. the cases where the assumption of H$_2$O saturation was most reasonable) are in bold.**

| Sample | [Cl] | $^{[O(3)]}O^{2-}$ | $Fe^{3+}$ | OH | $a$(H$_2$O) | $f$(H$_2$O) (kbar) | [OH] | [H$_2$O]$_t$ | $C$(H$_2$O) (wt%) |
|---|---|---|---|---|---|---|---|---|---|
| Col-99AH1 | 0.001 | 0.791 | 0.763 | 1.194 | 0.052 | 0.056 | 0.025 | 0.014 | 0.7% |
| Col-99AH2 | 0.001 | 0.993 | 0.920 | 0.997 | 0.120 | 0.130 | 0.038 | 0.022 | 1.2% |
| Col-99B | 0.001 | 0.706 | 0.766 | 1.277 | 0.035 | 0.038 | 0.021 | 0.011 | 0.6% |
| Host | 0.001 | 0.507 | 0.652 | 1.331 | 0.027 | 0.044 | 0.019 | 0.010 | 0.6% |
| Enclave | 0.004 | 0.222 | 0.511 | 1.564 | 0.019 | 0.031 | 0.016 | 0.009 | 0.5% |
| Cumm910 | 0.002 | 0.226 | 0.111 | 1.747 | 0.004 | 0.007 | 0.008 | 0.004 | 0.2% |
| Cumm9121 | 0.002 | 0.217 | 0.137 | 1.768 | 0.028 | 0.047 | 0.020 | 0.011 | 0.6% |
| Cummi913 | 0.002 | 0.230 | 0.144 | 1.762 | 0.104 | 0.174 | 0.037 | 0.023 | 1.3% |
| Cumm939 | 0.002 | 0.238 | 0.140 | 1.744 | 0.018 | 0.030 | 0.016 | 0.009 | 0.5% |
| Cumm9161 | 0.002 | 0.163 | 0.193 | 1.817 | 0.014 | 0.023 | 0.014 | 0.008 | 0.4% |
| Cumm9172 | 0.002 | 0.238 | 0.134 | 1.752 | 0.064 | 0.108 | 0.030 | 0.018 | 1.0% |
| Cumm9171 | 0.002 | 0.222 | 0.119 | 1.765 | 0.026 | 0.044 | 0.019 | 0.011 | 0.6% |
| Cumm8602 | 0.002 | 0.231 | 0.111 | 1.744 | 0.007 | 0.012 | 0.010 | 0.005 | 0.3% |
| Hbl5592 | 0.002 | 0.279 | 0.243 | 1.696 | 0.107 | 0.180 | 0.038 | 0.024 | 1.3% |
| Hbl9172 | 0.002 | 0.352 | 0.357 | 1.584 | 0.124 | 0.209 | 0.041 | 0.026 | 1.5% |
| Hbl9171 | 0.002 | 0.423 | 0.286 | 1.521 | 0.087 | 0.146 | 0.034 | 0.021 | 1.2% |
| Hbl8602 | 0.002 | 0.388 | 0.321 | 1.561 | 0.150 | 0.251 | 0.045 | 0.029 | 1.6% |
| Hbl8602 | 0.002 | 0.254 | 0.328 | 1.731 | 0.187 | 0.314 | 0.050 | 0.033 | 1.9% |
| **92MHR9-1** | **0.002** | **0.737** | **1.073** | **1.256** | **0.952** | **1.310** | **0.119** | **0.093** | **5.3%** |
| 92MHR6-1 | 0.001 | 0.439 | 0.484 | 1.539 | 0.048 | 0.062 | 0.024 | 0.013 | 0.7% |
| 92MHR6-1 | 0.001 | 0.440 | 0.485 | 1.538 | 0.026 | 0.033 | 0.018 | 0.010 | 0.5% |
| 92MHR6-1 | 0.001 | 0.508 | 0.410 | 1.170 | 0.003 | 0.004 | 0.006 | 0.003 | 0.2% |
| **92MHR9-1** | **0.002** | **0.920** | **0.889** | **1.067** | **0.476** | **0.654** | **0.081** | **0.055** | **3.1%** |
| 92MHR20-1 | 0.001 | 0.463 | 0.647 | 1.525 | 0.225 | 0.288 | 0.050 | 0.032 | 1.8% |
| 92MHR20-1 | 0.001 | 0.550 | 0.993 | 1.436 | 0.146 | 0.187 | 0.040 | 0.024 | 1.4% |
| 92MHR12-1 | 0.001 | 0.445 | 0.323 | 1.435 | 0.011 | 0.014 | 0.011 | 0.006 | 0.3% |
| RDT-A-1 | 0.001 | 0.760 | 0.725 | 1.222 | 0.058 | 0.074 | 0.027 | 0.015 | 0.8% |
| RDT-A-1 | 0.001 | 0.512 | 0.764 | 1.232 | 0.039 | 0.050 | 0.022 | 0.012 | 0.7% |
| **RDT-A-2** | **0.001** | **0.797** | **1.117** | **1.109** | **1.000** | **1.752** | **0.181** | **0.180** | **10.6%** |
| e-2-amp-3 | 0.001 | 0.671 | 0.578 | 1.192 | 0.163 | 0.330 | 0.051 | 0.032 | 1.8% |
| Glass2 | 0.002 | 0.680 | 0.587 | 1.184 | 0.242 | 0.490 | 0.062 | 0.041 | 2.3% |
| RE8-Glass3 | 0.001 | 0.670 | 0.627 | 1.195 | 0.169 | 0.342 | 0.052 | 0.033 | 1.8% |
| RE-8-amp1 | 0.001 | 0.676 | 0.633 | 1.189 | 0.214 | 0.433 | 0.058 | 0.038 | 2.1% |
| 2-84-6TOR-l1 | 0.001 | 0.786 | 0.687 | 1.102 | 0.041 | 0.083 | 0.027 | 0.015 | 0.8% |