|  |  |  |  |
| --- | --- | --- | --- |
| **Table 1: Average amphibole compositions (wt%) and calculated crystallization conditions** |  |  |  |
|   |   |   |   |   |   |   |   |   |   |
|  |  |  |  |  |  |  |  |  |  |
| Intrusion | CShipi | CTuolumne | CMt Princeton | CSoultz-s-F |  | CQitianling | CGuposhan | CMelville-1 | CMelville-2 |
| Location | China | USA | USA | France |  | China | China | Canada | Canada |
| Type | \*Magnesian | \*Magnesian | \*Magnesian | \*Magnesian |  | \*Ferroan | \*Ferroan | \*Ferroan | \*Ferroan |
|  |  |  |  |  |  |  |  |  |  |
| Assemblage | Ttn–Amp–Pl–Kfs–Qtz–Bt–Mag |  | Ttn–Amp–Pl–Kfs–Qtz–Bt–Mag–Ilm |
|   |   |   |   |   |  |   |   |   |   |
|  |  |  |  |  |  |  |  |  |  |
| Analyses | *n = 3*5 | *n = 1*3 | *n = 5* | *n = 1* |  | *n = 2*9 | *n = 2*9 | *n = 3* | *n = 4* |
| Data | This study | S2010 | TH1990 | S2002 |  | This study | This study | E2013 | E2013 |
|  |  |  |  |  |  |  |  |  |  |
| SiO2 | 50.03(0.65) | 47.92(1.31) | 50.48(0.41) | 49.49 |  | 42.33(0.42) | 42.33(0.57) | 40.03(0.72) | 40.44(0.52) |
| TiO2 | 0.67(0.17) | 0.77(0.28) | 0.70(0.10) | 0.46 |  | 1.84(0.31) | 1.67(0.19) | 1.35(0.02) | 1.31(0.05) |
| Al2O3 | 5.27(0.57) | 5.88(0.76) | 5.03(0.37) | 4.97 |  | 7.90(0.25) | 8.13(0.40) | 8.60(0.12) | 8.76(0.16) |
| FeO | 13.79(0.35) | 13.83(0.55) | 11.81(0.77) | 15.39 |  | 23.81(0.84) | 24.96(0.41) | 26.00(0.04) | 25.22(0.55) |
| MnO | 0.49(0.60) | 0.71(0.11) | 0.70(0.11) | 1.00 |  | 0.56(0.05) | 0.92(0.04) | 0.58(0.02) | 0.53(0.03) |
| MgO | 14.76(0.40) | 14.29(0.52) | 15.72(0.76) | 14.07 |  | 6.91(0.50) | 6.03(0.34) | 4.15(0.11) | 4.23(0.04) |
| CaO | 11.66(0.19) | 11.69(0.21) | 12.34(0.19) | 11.50 |  | 10.69(0.20) | 10.88(0.21) | 10.68(0.08) | 11.01(0.19) |
| Na2O | 1.21(0.15) | 1.01(0.15) | 0.87(0.10) | 1.17 |  | 1.81(0.08) | 1.95(0.12) | 1.37(0.12) | 1.40(0.17) |
| K2O | 0.46(0.05) | 0.54(0.12) | 0.44(0.04) | 0.47 |  | 1.29(0.06) | 1.02(0.07) | 1.58(0.01) | 1.51(0.01) |
|  |  |  |  |  |  |  |  |  |  |
| Fe3+/(Fe3++Fe2+)\_23 oxy | 0.25(0.05) | 0.30(0.03) | 0.27(0.06) | 0.21 |  | 0.12(0.03) | 0.13(0.02) | 0.12(0.01) | 0.07(0.02) |
| Al(tot) | 0.93(0.09) | 1.02(0.13) | 0.85(0.06) | 0.90 |  | 1.40(0.05) | 1.49(0.07) | 1.67(0.02) | 1.69(0.02) |
| Equil. Plag (An) | 30(3) | 34(n.d.) | 35(n.d.) | 20 |  | 30(3) | 30(3) | 18(1) | 16(2) |
|  |  |  |  |  |  |  |  |  |  |
| *T* (°C)HB1994\_A | 675(18) | 746(44) | 700(41) | 714 |  | 831(31) | 828(20) | 746(31) | 716(21) |
| *T* (°C)P2016\_E5 | 747(9) | 766(21) | 754(10) | 738 |  | 767(13) | 761(13) | 727(7) | 728(5) |
| *T* (°C)P2016\_E6 | 749(8) | 772(20) | 762(10) | 744 |  | 763(13) | 749(12) | 724(6) | 725(4) |
| *T* (°C)independent | ~660-680 |  -  |  -  |  -  |  | ~650-700 |  -  |  -  |  -  |
| *P* (MPa)M2016 | 167(20) | 188(31) | 150(12) | 151 |  | 307(15) | 318(25) | 382(7) | 387(8) |
| *P* (MPa)independent |  -  | ~180-240 | ~100 |  -  |  | ≥350 |  -  |  ~330 |  ~330 |
|   |   |   |   |   |   |   |   |   |   |
|  |  |  |  |  |  |  |  |  |  |
| E2013 = Erdmann et al. 2013; HB1994 = Holland & Blundy 1994; M2016 = Mutch et al. 2016; P2016 = Putirka 2016; TH1990 = Toulmin III & Hammarstrom 1990; S2010 = Solgadi 2010; S2002 = Stussi et al. 2002; Z2018 = Zhu et al. 2018. Morad et al. (2009) report 1.20 apfu Al for Äspö amphibole, yet no complete oxide data. E5 and E6 = equation 5 and 6. Independent temperature estimates are Zr-in-titanite temperature estimates from Erdmann (unpublished) for the Shipi intrusion and phase-equilibrium experimental constraints from Huang et al. (revised) for the Qitianling intrusion. Independent pressure estimates are from Hammarstrom & Zen (1986) for the Mt Princeton intrusion based on stratigraphy and exhumation rates, from Memeti et al. (2009) for the Tuolumne intrusion, from Huang et al. (revised) for the Qitianling intrusion based on phase-equilibrium constraints, and from Erdmann et al. (2013) for the Melville intrusions based on Grt-Bt compositions and TWQ barometry (Berman 1991, 2007). \* Classification follows Frost et al. (2001). Values in parentheses are standard deviations. |
|
|