APPENDIX 3

1. The calculation procedure after Triboulet (1992) assumes conversion of microprobe analyses of amphiboles (in wt.%) to 23 oxygens (Papike et al., 1974) as follows: four Si atoms on the T2 site, remaining silica with Al^{IV} to T1 (Si + Al^{IV} = 4), remaining Al, Ti, Fe^{3+}, Fe^{2+}, Mn and Mg to M4 (Ca+Na^{M4} = 2), left over Na and K to A site (A = 1 pfu) with vacancy.

Next step involved calculations of particular vectors activities of amphiboles edenite, tremolite, pargasite, hastingsite) and comparison with appearing as mutual parageneses of chlorite and epidote and their activities [ln(K_d)], regarding: XAl^{3+}, XMg and XFe^{3+} values.

2. Conventional thermobarometry proposed by Bhadra and Bhattacharya (2007) contributes two empirical equations:

$$P_1[kbar] = [-9.326 + 0.01462T - RT\ln K_{ideal} - 98.698X_{Na}^{A} - 33.213X_{K}^{A} - \\ -20.338X_{Na}^{M4} - 39.101X_{Fe^{2+}}^{M13} + 100.392X_{Al}^{M2} + 131.03X_{Fe^{2+}}^{M2} + 82.479X_{Fe^{3+}}^{M2} \\ -118.653X_{Al}^{T1} - 2RT\ln\gamma_{Ab}]/(-\Delta V)$$

$$P_2[kbar] = [-1.869 + 0.0076T - RT\ln K_{ideal} - 102.692X_{Na}^{A} - 35.251X_{K}^{A} - \\ -15.969X_{Na}^{M4} - 40.499X_{Fe^{2+}}^{M13} + 93.069X_{Al}^{M2} + 130.75X_{Fe^{2+}}^{M2} + 74.226X_{Fe^{3+}}^{M2} \\ -104.402X_{Al}^{T1} - 2RT\ln\gamma_{Ab}]/(-\Delta V)$$

where:

$$K_{ideal} = \left[\frac{16(X_{Na}^{A})(X_{Al}^{T1})}{(X_{\square}^{A})(X_{Si}^{T1})(X_{Ab})}\right]^2 , \quad RT\ln\gamma_{Ab} = W_{C1}(1 - X_{Ab})^2$$

and W_{C1} ~ 1.0 (Holland and Powell, 1992).

3. Calibrated geothermobarometer after Zenk and Schulz (2004) involves the following equations:

$$T[K] = \frac{4701}{1.825 - \ln(\frac{8}{15.5} - \frac{Si_{Am}}{sum_{Kat}} + 0.07531)}$$ and

$$P[kbar]=\frac{-425-1719\left(\frac{XAl_M}{XAl_M+\frac{Fe^{3+}}{2.763}}+2.75T[K]+1.987T[K]\ln(XAl_M)\right)+1}{1000}$$

where $XAl_M = (Si_{Am} + Al_{Am} – 8)/2.763$ and sum_{Kat} is the sum of cations using 13eCNK recalculation method.

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[1] **Mg-Chl + 4SiO_2 + 4Cal + 5H_2O = Ep (Ps_{30-40}) + Act + 4CO_2 + 7.5H_2^+**

[$Mg_4Fe^{2+}Al(Si_3Al)O_{10}(OH)_8 + 4SiO_2 + 4CaCO_3 + 5H_2O = Ca_2Fe_{0,3}^{3+}Al_2O(SiO_4)(Si_2O_7)(OH) + Ca_2(Mg_4Fe_{0,7}^{2+})Si_8O_{22}(OH)_2 + 4CO_2 + 7,5H_2^{+}$]

[2] **Ep (Ps_{30-40}) + Act + 2Ab + 2Rt + CO_2 + H_2O = Mg-Hbl + Olg + Ab(2) + Ilm + Ttn(IIA) + Cal + 8H_2O**

[$Ca_2Fe_{0.3}^{3+}Al_2O(SiO_4)(Si_2O_7)(OH) + Ca_2(Mg_4Fe_{0.7}^{2+})Si_8O_{22}(OH)_2 + 2NaAlSi_3O_8 + 2TiO_2 + CO_2 + H_2O = Ca_2Mg_4Al(AlSi_7O_{22})(OH)_2 + (Na_{0.8}Ca_{0.2})AlSi_4O_8 + NaAlSi_3O_8 + FeTiO_3 + CaTiSiO_5 + CaCO_3 + 8H_2O$]

[3] $20Ca_2Fe_{0.3}^{3+}Al_2O(SiO_4)(Si_2O_7)(OH) + 8H_2O = 20Ca_2Fe_{0.2-0.1}^{3+}Al_2O(SiO_4)(Si_2O_7)(OH) + 2Fe^{2+}Fe_2^{3+}O_4 + 8H_2^+$

Stoichiometric variance of Fe^{2+} might be due to the increasing temperature and growing oxygen fugacity (fO_2), which caused substantial acceleration of the oxidation rate from Fe^{2+} to Fe^{3+}. During metamorphism the whole iron content could be oxidized so that the reaction may be simplified:

[3'] **10Ep(Ps_{30-40}) + 4H_2O = 10Ep(Ps_{10-20}) + Mag + 4H_2^+**

[$10Ca_2Fe_{0.3}Al_2O(SiO_4)(Si_2O_7)(OH) + 4H_2O = 10Ca_2Fe_{0.2-0.1}Al_2O(SiO_4)(Si_2O_7)(OH) + Fe_3O_4 + 4H_2^+$]

[4] **Mg-Chl + Act + Czo + 3Ep + Rt = 3.5Ts + 3Cal + Ilm + 2SiO_2 + 3.5H_2^+**

[$Mg_4Al(Si_3Al)O_{10}(OH)_8 + Ca_2Mg_3Fe_{0.6}Si_8O_{22}(OH)_2 + Ca_2Al_3Si_3O_{12}(OH) + 3Ca_2Al_2Fe(Si_2O_7)(SiO_4)O(OH) + TiO_2 = 3.5Ca_2(Mg_2Al_2)(AlSi_6O_{22})(OH)_2 + 3CaCO_3 + FeTiO_3 + 2SiO_2 + 3.5H_2^+$]

[5] **Mg-Hbl + 4Rt + 2Cal + 4H_2O = Mg-Chl + 4Ttn(IIIA) + 2CO_2 + H_2^+**

[$Ca_2Mg_4Al(AlSi_7O_{22})(OH)_2 + 4TiO_2 + 2CaCO_3 + 4H_2O = Mg_4Al(Si_3Al)O_{10}(OH)_8 + 4CaTiSiO_5 + 2CO_2 + H_2^+$]

[6] **Ts + Ep + Ab(IIM) + Rt + 3SiO$_2$ + CO$_2$ + 8H$_2^+$ + 5Mg^{2+} = Brs + Ilm + Czo/Ep + Mg-Chl + Cal + 4H$_2$O**

[*$Ca_2(Mg_3Al_2)(Al_2Si_6O_{22})(OH)_2 + Ca_2Fe^{3+}_{0.4}Al_2Si_3O_{12}(OH) + NaAlSi_3O_8 + TiO_2 + 3SiO_2 + CO_2 + 8H^{2+} + 5Mg^{2+} = (Na, Ca)(Mg_3Al_2)(AlSi_7O_{22})(OH)_2 + FeTiO_3 + Ca_2Fe^{3+}_{0.1}Al_2Si_3O_{12}(OH) + Mg_5Al(Si_3Al)O_{10}(OH)_8 + CaCO_3 + 4H_2O$*]