Magmatic cassiterite:

For cassiterite crystals from magmatic mineralized systems, the effect of *f*O2 on the speciation of various elements of interest can be estimated using a simple oxide model. The basis for this model are the standard *fO*2 buffer curves frequently referred to in geological systems (magnetite-hematite (MH) through to quartz-iron-fayalite (QIF), labelled along the left of Figure X). For instance, the nickel-nickel oxide (NNO) buffer curve is defined by the reaction:

Eq. 1

Where Keq is the equilibrium constant, and the square brackets denote activity. The *f*O2­ is then calculated via the Gibbs free energy equation assuming equilibrium conditions (∆G=0) and that the activities of Ni and NiO are at unity ([NiO]/[Ni] = 1):

Eq. 2 Eq. 3 Eq. 4 Eq. 5

Where ∆Go is the Gibbs free energy of formation, R is the universal gas constant, and T is temperature. Equation 5 is then solved with the Gibbs function, using standard enthalpies and entropies for each reaction as outlined in table X:

Eq. 6

In this manner, non-standard buffer curves for W4+/W6+ (WO2:WO3), Sn0/Sn4+ (Sn:SnO2), Nb4+/Nb5+ (NbO2:Nb2O5) and Ta0/Ta5+ (Ta:Ta2O5) may also be calculated and compared with the standard suite (labelled along the right of Figure X). Also included in the model are the CH4:CO2 and H2:H2O oxidation reactions.

It is important to note that these fO2-T curves represent the midpoints of speciation reaction curves. If, for a given temperature, the relative activity ratios of each metal-metal oxide pair are plotted against *f*O2, then

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| Name | Reaction | *Keq* |
| MH (magnetite-hematite) |  |  |
| NNO (nickel-nickel oxide) |  |  |
| FMQ (fayalite-magnetite-quartz) |  |  |
| WM (wustite-magnetite) |  |  |
| IW (iron-wustite) |  |  |
| QIF (quartz-iron-fayalite) |  |  |
| WO2:WO3 |  |  |