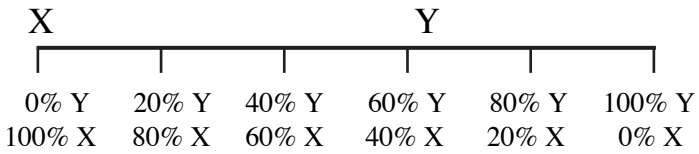
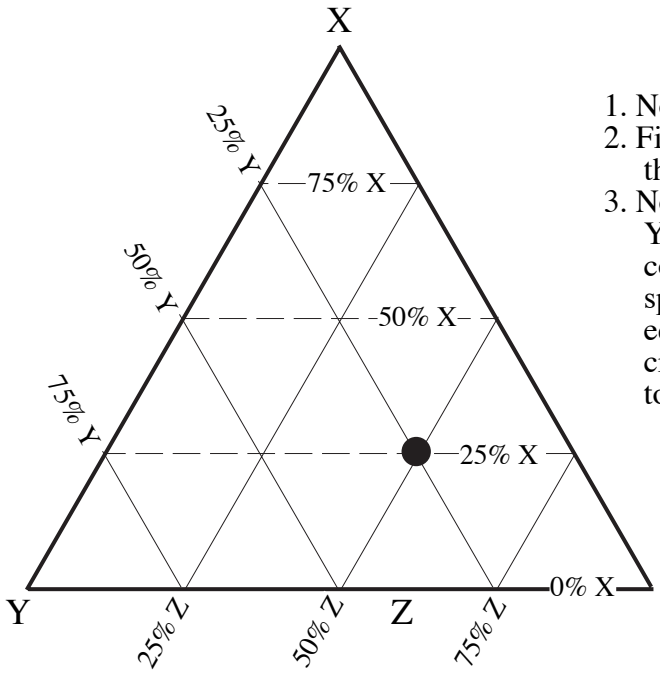
Representing Compositions of a Solid Solution Series

It's often convenient to have a shorthand for representing compositions in a solid solution series since such series are common in many mineral groups. For example, if we have a mineral with the general composition $(X,Y)_2SiO_4$ (such as olivine) where X and Y are divalent cations that may freely substitute for one another, then any composition in this series can be represented along the compositional line shown below. Note that the cations are first normalized so that they sum to 100%. As a shorthand notation we often refer to compositions by the percentage of one of the components. For example, in the olivine series we refer to the percentage of the Mg endmember (forsterite, Fo). So a composition with 80% of the cations being Mg would be Fo80.



Representing Compositions on a Ternary Diagram

As an example consider a mineral (like a pyroxene) with a composition $(X,Y,Z)_2Si_2O_6$ where X,Y,Z are all divalent cations that may substitute for one another. We can represent the relative abundance of these cations on a ternary diagram by the following steps. First, normalize X,Y,Z so that they sum to 100%. Since each apex (e.g. X) of the equilateral triangle represents 100% of that component, we can construct a series of lines parallel to the opposite edge of the triangle (Y-Z) that will represent compositions with equal amounts of the X component. These are shown by the dashed lines in the figure below. An analogous set of lines can be drawn for the other two components. This grid will allow us to plot the composition.



Example: $(X_{0.5}Y_{0.5}Z_{1.0})Si_2O_6$

1. Normalize X,Y,Z to 100% X=25%,Y=25%, Z=50%
2. Find the line of all compositions with X = 25%, i.e. the dashed line labelled 25% X.
3. Now locate the point along this line at which the Y = 25% line crosses. This is where the above composition plots. Note that the Z value at this spot corresponds to 50%, as it should. You could equally well have used the Z value to find this crossing point since the three values must sum to 100%.