Welcome students. This lecture deals with the course of Mineralogy in the subject of Geology. It's a semester five course dealing with bachelor of science for third year students. The syllabus which will be involved in this is part of unit 1 and the module name is description of mineral group pyroxene 1. I am Meghana Devli, Assistant Professor Department of Geology, Parvatibai Chowgule College. In this session we will be dealing with the structure, the chemical composition and classification with respect to the pyroxene group of minerals.By the end of the session the student will be able to correlate crystal symmetry and chemical composition with respect to the pyroxene group of minerals. Also, they'll be able to classify pyroxenes based on their chemical composition. The pyroxene group of minerals is one of the most important rock-forming silicate minerals. Now let's see what happens within the structure or how the structure forms for all the pyroxenes. In all the members of the pyroxene group the fundamental unit structure is SiO_4 tetrahedra and these are linked together vertically into chains.So you see over here these are the SiO_4 and they're linked with each other vertically along the c axis with those immediately above and below the chain.You see this tetrahedra and this tetrahedra over here they are linked by the presence of this oxygen in between. Also, you see that they are alternately pointing so you have one over here, another over here and this is the one oxygen which is shared by the two adjacent or neighboring tetrahedras. When viewing the direction of the c axis each chain has an appearance as in figure 2 and the chain is bonded by the shape of isosceles trapezium. So if you just demarcate all these are apices of the oxygens. Vertically below you will see that you get a view which is like this.When you have two tetrahedras placed immediately next to each other and the view will be something like this. So you have one two three four five so like this there can be numerous chains which are aligned when you observe it along the c axis or when you observe it from this end.The unit of the pattern in the pyroxene chains consists of Si_2O_6 and the balance is provided by the divalent cations that is basically Fe, Mg. and occasionally by the presence of Ca. So these are ferromagnesian and therefore the dominating cations which are associated with the crystal structure are basically Fe^{2+} and Mg^{2+}. So Si_206 is over here that you get to see one and two so one Si from here another Sifrom here and oxygens one two three four five six. This will go to the next one. Now the pyroxenes crystallizes one of the crystal systems, that it could be either orthorhombic or they could be monoclinic. Those crystallizing in the orthorhombic systems are called orthopyroxenes and those crystallizing in the monoclinic system are clinopyroxenes. Infinite one-dimensional SiO_3 chains extend along the crystallographic c-axis. Each silicate tetrahedron shares two oxygens with the other tetrahedra to form chains with two left two participating strongly in the bonds with other atoms. Chains are stacked so as to point in alternate directions along the a and the b directions producing the diagnostic cleavage intersecting at 87 - 93 degrees. So here you've got two sets of cleavage which are approximately meeting with each other at 90 degrees forming the weaker bonds. So along this you will have the cleavage directions and they will intersect to form approximately 90 degrees.When the chemical composition that is the general formula for the pyroxenes is $W_{1-p} XY_{1+p} Si_2O_6$. 1 minus p means it can be less than 1 and 1 plus p means it can be more than one. So the w site is usually occupied by Ca whereas the X site is occupied by Mg Fe, Mn, Li. The Y can be occupied by Al, Fe^{3+}, Cr^{3+}, Ti^{4+} and obviously the Z sites as your usual Si and also at places can be replaced by aluminium. Now the classification of pyroxenes as we know that pyroxenes as orthopyroxenes crystallize in the orthorhombic system whereas chloropyroxines crystallize in the monoclinic system.

Now the classification of orthopyroxenes.

The orthopyroxenes do not contain more than five percent Wollastonite.That means if we consider a three point triangle the apex of that is occupied by a mineral Wollastonite at one end, it will be enstatite and the other end and it will be Ferrosilite.Now pyroxenes in any case will occupy only 50 percent of that triangle. so it is a classification based on trapezium and not of a triangle. So this series is usually divided as follows enstatite which is Ferrosilite(Fs) 0 to 12

Bronzite: (Fs) 12 to 13 30
hypersthene Fs: 32 to 50
ferro hypersthene Fs: 50 to 70
Eulite Fs 70 to 88
Ferrosilite Fs 88 to 100 percent

So this ferrocellite which is 100 is used.That means this is used as a classification basis. Enstatite is the Mg rich ferrosilite is the Fe rich.Now over here if you just see that all of the places you have the 30 50 and 70 which is arbitrary. Now 12 and 88 are specific because there is a change in the optic sign with respect to those minerals.

The classification of clinopyroxenes

The clinopyroxenes contain between five to fifty percent of Wollastonite component.So zero to five percent is orthopyroxene and five to fifty is the clinopyroxenes. Now these clinopyroxenes are divided into three series, that is the pigeonite series, the augite-ferro augite series and the diopside-hedenbergite series.The pigeonite consists of five to fifteen percent Wollastonite, the augite-ferro sugite consists of Wollastonite between 15 and 45 percent with a sub-series of sub calcic augite and subcalcic ferro augite which is the standard between 15 and 25 percent. The diopside hedenbergite series contains between 45 to 50 wollastonite. so zero to five percent is orthopyroxene and five to fifty is clinopyroxenes.Within that five to fifteen is pigeonite, 15 - 45 is augite - ferro augite and 45 to 50 is diopside - hedenbergite series.Further to that the sodic pyroxenes cannot be classified or cannot be placed in that trapezium. so they have a classification all separate. in this you have the Aegirine which is NaFepyroxene. The Jadeite are the jades which are part of the Jadeite Component; it's a NaAl pyroxene and their sodic pyroxenes. Now the composition between the agerine and augites are called agerine augites. While omphacite lies compositionally between agerine-jadeite and hedenbergite. It is a high pressure sodium pyroxene.Again further references for this session is deer howie zussman an Introduction to rock forming mineral and dana's textbook of mineralogy. thank you.