Mineralogical Society of America, Friends of Mineralogy Symposium, Tucson, Arizona. February, 1981.

Origin of Color in Pegmatite Minerals

George R Rossman
Division of Geological and Planetary Sciences
California Institute of Technology
Pasadena, California 91125

ABSTRACT

The colors of many attractive minerals in gem pegmatites appear to be due, in part, to a history of exposure to ionizing radiation. Tourmaline is green from Fe^{2+}, pink from Mn^{2+}, and much deeper red from Mn^{3+}. Radiation in the laboratory can transform Mn^{2+} to Mn^{3+} to suggesting the possibility that the same process happens in nature. Manganese and radiation are also involved in the coloration of kunzite. Lavender kunzite arises from Mn^{3+} Exposure to intense radiation turns the crystal green. This change is believed to involve the formation of Mn. Kunzites which are blue when mined but which fade upon exposure to light demonstrate the occurrence of radiation induced oxidation in the pegmatite veins.

Beryl is blue from Fe^{2+} but turns golden yellow with radiation due to the formation of Fe^{3+}. Green beryl contains both Fe^{2+} and Fe^{3+} It is not known whether yellow beryl forms directly from Fe^{3+} or first incorporates Fe^{2+} which is subsequently oxidized by radiation.

Blue and brown topaz are produced by radiation. No chemical cause of the colors is known, although a correlation with hydrogen ion concentration and color zones has been observed. A correlation with the concentration and structural site of hydrogen ion has also been observed with amethyst. Amethyst color involves both iron and radiation. It has yet to be determined if smokey quartz, a radiation induced color involving aluminum ions, also shows correlations with hydrogen ion. Amazonite feldspar is generated by irradiation of feldspar containing lead, but factors other than just lead concentration are involved.

Garnets in the pyrope-almandine-spessartite series owe their colors to Mn^{2+} and Fe^{2+}. They are one of the few pegmatite minerals for which radiation has not been associated with color.