



The Colors of Minerals March 21, 2015 9:00AM – 4:00 PM

Colorado School of Mines, Berthoud Hall, Room 241

COST: Friends members \$40, non-members \$50, Students \$25

Speakers:

George Rossman Professor of Mineralogy

Division of Geological and Planetary Sciences, California Institute of Technology

Joseph Smyth University of Colorado

Mineral Physics: crystal structure controls on physical and chemical properties of minerals as related to the structure and composition of the Earth's mantle

Roger Clark USGS

Optical effects of nano-materials. Nano-sized particles (less than about 200 nm diameter) can have a profound effect on color and spectral properties from the UV to the IR even when present in parts per million abundances.

Pete Modreski USGS

Mineral Properties

This workshop presents information about the causes of color in minerals and provides illustrations of many examples. The common causes are metal ions, intervalence charge transfer, ionizing radiation, physical effects, and band gaps.

1) **Metal ions** cause the color of many common and uncommon minerals.

2) **Intervalence Charge Transfer**, involving metal ions in mixed oxidation states is another important factor in the coloration of minerals. Most commonly, we encounter minerals with the $\text{Fe}^{2+} - \text{Fe}^{3+}$ interaction and with the $\text{Fe}^{2+} - \text{Ti}^{4+}$ interaction.

3) Colors from natural **ionizing radiation** are frequently encountered in nature. Most common minerals have had a long history of exposure to ionizing radiation from natural radiation sources in rocks. A variety of minerals can also be colored by artificial irradiation which enters the commercial market in the form of colored gemstones.

4) **Physical effects** such as diffraction also cause colors in minerals. The color of gem opal is the result of diffraction as is the color of certain crystals of labradorite feldspar.

5) Semiconducting minerals have **band gaps** which often result in intense colors. Numerous sulfides are examples of this.