

Geographic and Compositional Classification of Garnets
Using Laser-Induced Breakdown Spectroscopy (LIBS)

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ABSTRACT:

The ability to geographically identify the source of natural gems plays an important role in determining if these stones may have originated from a politically unstable area. Garnet is a semi-precious silicate mineral of variable composition that has been used as a gemstone since the Bronze Age. Using Laser-Induced Breakdown Spectroscopy, an analytical technique for real-time chemical analysis, we have applied statistical classification techniques to LIBS data for a large suite of garnets of different composition which originated from different places around the world. Each LIBS spectrum contains measured light intensities between 200 and 880 nm collected over 13,600 channels in a CCD spectrometer. The Matlab[®] program was used to perform a high-dimensional principle components analysis (HDPCA) on the data set. Individual garnet LIBS spectra were grouped according to the similarities in the linear combination of their principle components. Because of the large volume of data and the ability of Matlab[®] to display results in multiple dimensions, an accurate model could be created that was able to successfully classify unknown garnet samples of a specific composition type according to their geographic origin.

KEYWORDS: Garnet, Principle Components Analysis, LIBS, geographic classification.

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