Moonstones

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Moonstones are gems that appear to have a ghostly, shimmering glow floating around inside the material, often bluish in colour. Ancient Romans thought that a moonstone was made of moonlight, hence the name. The characteristic shimmering reflection is called 'adularescence' or the 'schiller effect' and arises due to the optical heterogeneity in the moonstone (Figure 1). A moonstone is made up of crystallites of three different feldspars. They are present in different moonstones to different extents. Generally the most dominant component is the monoclinic potash feldspar (orthoclase). The next important component is the triclinic soda feldspar (albite). Incidentally these two feldspars are similar in chemical composition though they have different crystal structures. The third component that exists in very small amounts is the triclinic lime feldspar (anorthite). It may be mentioned here that this feldspar is an isomorph of soda feldspar. In a moonstone these three feldspar crystallites are interwoven inside the medium.

The spectacular schiller effect is best seen at a particular setting of the stone. At this setting, the direction of the incident light and the direction of observation make equal angles with a particular direction in the stone which is often called the schiller axis. Further, these three directions are in one plane. When either the stone or the direction of incident light is altered the direction in which schiller is most conspicuous also shifts. The schiller is in the nature of a diffusion of light spread over a very wide range of angles. It is largely due to scattering from particles smaller in size compared to the wavelength of light. It is not due to Bragg reflection from a set of planes perpendicular to the schiller axis. It has been suggested that the scattering particles are crystallites of soda feldspar segregating from potash feldspar principally along the 100 planes of the potash feldspar crystal. In this plane, the crystallites spread more along the *c*-axis than along the *b*-axis. Thus the moonstone is a single crystal with the schiller axis perpendicular to the (100) plane of potash feldspar. Generally we see schiller as an elliptical patch of blue light. When the moonstone is rotated this pattern rotates with it.

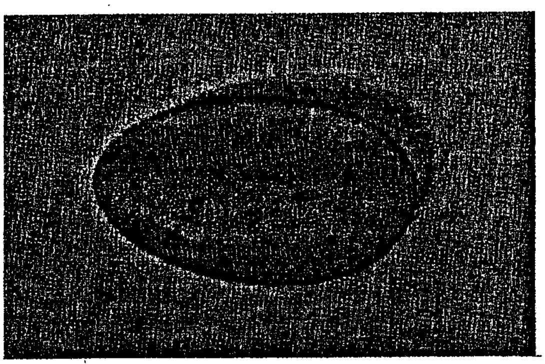

Figure 1. An example of a moonstone exhibiting schiller. The large bright elliptical patch seen in the middle of the stone is due to the schiller effect.

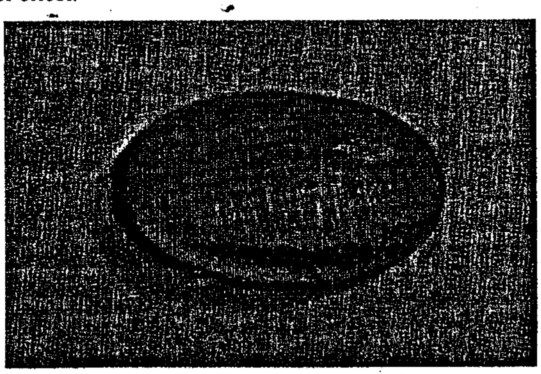

Figure 2. A cut and polished yellow labradorite.

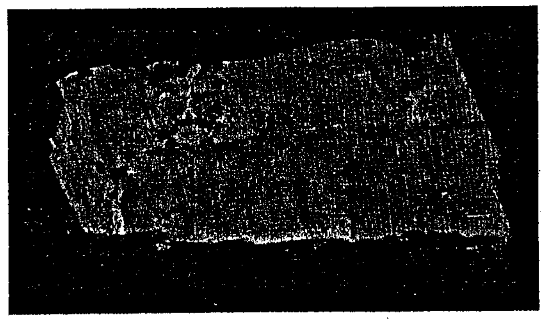

Figure 3. An uncut labradorite exhibiting a brilliant deep blue colour.

Interestingly, labradorites (Figure 2) are also made of the same three feldspars. Like moonstones they also exhibit diffusion of incident light over a wide range of angles about what appears to be the direction of reflection. The important difference when compared to moonstones is in the rich variety of colours scattered by it. The colour of the strongly scattered light varies from material to material. There are labrodarites with colours from deep blue to red (Figure 3). It is worth recalling here that soda and lime feldspars are isomorphous and hence can form solid solutions. Studies indicate that in labradorites the basic host structure is the lime-soda feldspar solid solution with segregation of potash feldspar crystallites in the form of platelets.