Module B. Colour from the Cosmos

Lesson 15: Beryl Geology and Geography

*Metamorphic*

Historically, gem beryl occurrences have been dominantly ascribed to igneous-related sources because it is easy to recognize where and how beryllium enrichment occurs in these environments. However, the discovery and subsequent investigation of what were then termed as "anomalous" beryl occurrences has proven that beryl can form from Be-enriched rocks undergoing regional metamorphism. Furthermore, Be can also be mobilized from these sources and concentrated to the point where an occurrence is economic to mine. Overall controls for metamorphic beryl follow similar guidelines (i.e., source-transport-deposition) as magmatic occurrences.

Like the magmatic model, metamorphic beryl may or may not be associated with quartz veins and hydrothermal fluids. In the metamorphic-hydrothermal sub-model, hydrothermal fluids dominantly encompass those deposits where beryllium is sourced, transported, and deposited as beryl. Beryl deposits have also been found with no associated quartz veins. In this metamorphic sub-model, the ***in situ*** mineralogical transformation was solely due to metamorphism (high pressure and temperature).

The most famous and valuable of all emeralds were deposited following the metamorphic-hydrothermal model. The emerald deposits of Colombia formed from the interaction of Be-rich hydrothermal fluids with Cr-bearing host rocks during large scale tectonic activity at a convergent margin boundary. This process is similar to the magmatic-hydrothermal setting discussed in the previous section, except that the hydrothermal fluids did not originate from a hot magmatic source but rather were a sedimentary brine forced out from their host rock. Consequently, this sets the Colombian emeralds apart from other emeralds not only for their superior quality, but also for such an unusual geologic environment.

A few other settings in the world (Uinta Mountains in USA, Mackenzie Mountains in Canada, Fianel Region in Germany) have given rise to a similar scenario, but none have produced the number, quality, and size of the stones found in Colombia.

This specimen is from Colombia and shows the beautiful gemmy emerald crystals hosted in quartz vein with clasts of black shale. This specimen is exhibited at the [UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

This specimen, still in its host, is also from Colombia and shows a natural "high polish" on the top basal termination of the crystal. This specimen is exhibited at the [UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

Other examples of gem beryl formation in metamorphic environments are the schist-hosted emeralds of Swat Valley (Pakistan) and Habachtal Region (Austria). In these locations, Be-enriched host rock is juxtaposed next to Cr-rich rock through tectonic faulting and shearing. As the two different reservoirs grind past one another, their components are selectively released and able to chemically mix allowing the formation of new Cr-bearing beryl (i.e., emerald). Sometimes quartz veins with beryl can be generated from this tectonic activity as well.