Emerald Deposits – A Review

[1]SCHWARZ, D. and [2]GIULIANI, G. [1]Gübelin Gem Lab Ltd., Lucerne, Switzerland, [2]Centre de Recherches Pétrographiques et Géochimiques, Vandoeuvre lès Nancy, France.

Emerald, the green variety of beryl is scarce, because its chromophoric elements (chromium and vanadium) are geochemically not related to beryllium. Sources of chromium and vanadium are mafic-ultramafic igneous rocks, as well as sedimentary formations, like black shales. Sources of Be are aluminous magmas, black shales and metamorphic rocks.

The juxtaposition of Cr/V and Be in nature requires exceptional geological and geochemical conditions. The principal mechanisms responsible for emerald crystallization are fluid/rock interactions, which allow the combination of the incompatible elements.

Formation of most emerald deposits in the world are associated to granitic intrusions. Hydrothermal processes related to granitic-pegmatitic systems led to the crystallization of emeralds in mafic-ultramafic or in (meta-)sedimentary rocks. In general, the mafic-ultramafic hosts of emeralds are schistose rocks of varying composition (e.g. in most African and Brazilian deposits, as well as in the Ural Mountains.) In Eidsvoll/Norway and Emmaville-Torrington/Australia, emeralds are hosted by (meta-)sedimentary rocks.

A second group of emerald deposits is not directly related to granitic intrusions. In these, tectonic phenomena (thrust faults and shear zones) are the controlling factors for the formation of emerald mineralisations. Circulation of fluids along these regional tectonic structures resulted in emerald formation in volcano-sedimentary series (e.g. Santa Terezinha/Brazil; Habachtal/Austria) or in oceanic suture zones (e.g. Swat Valley/Pakistan; Panjsher Valley/Afghanistan). The famous deposits in the Colombian Cordillera Oriental have a unique formation through the thermochemical reduction of evaporitic sulphate brines with the participation of organic matter from the surrounding black shales in the reactions.