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Causes of Different Vivid Colors in Chalcedonies: Kutahya-Turkey

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Chalcedony is a silicate mineral which is a mixture of fibrous quartz (trigonal) and granular moganite (monoclinic) minerals. They are both SiO_2 in composition but differs in crystal system. Chalcedony is widely used as semi-precious gemstone in many countries. It has many different kinds due to their various colors and structures. The colour changes in mineral depends on different causes. Most important causes are transition metal impurities in minerals chemical composition and charge transfer between ions. Different chalcedony types have different colors due to their elemental composition. Chalcedony can be show almost every colour strating from white, black, gray, red, blue, green to brown or a combinations of more than one color in case of agates and jasper formations. Although they have same major oxide compositions,chrysopras (green chalcedony) have Ni which gives the green color and carnelian (orange chalcedony) have Fe+3 which gives the orange color.

Kutahya, Eskisehir, Ankara, Manisa, Balıkesir, Canakkale and Yozgat represent the most cities which chalcedony can be mostly observed in Turkey. In Kutahya, chalcedony occurs in cavity or vein fillings in pyroclastic rocks such as tuff and formed by precipitation of silica bearing fluids in low temperatures. They can be also formed within the hydrothermal alteration zone of ultramafic rocks. Although chalcedonies in Kutahya form under almost same condition, they have various colors within the same unit. To specify the cause of the different colors, chemical analysis and Confocal Raman studies performed on Kutahya chalcedonies. Firstly, samples are crushed to 2 mm. size. After that, different colors of chalcedonies are separated by hand picking under binocular microscope and grouped into different color sets such as white, blue, dark yellow, light orange, dark orange and claret red. Each color set is measured by PED-XRF method to obtain chemical compositions. Also Raman studies performed to identify the effect of Fe element and OH bonds in each color set groups.

Due to chemical results, 'Fe2O_3-TiO_2'assemblage gives claret red-dark orange, only "Fe2O_3"gives claret red, 'Fe2O_3-Ni' assemblage gives orange to claret red, 'Cr-Ni-Co' assemblage gives light orange, 'As' gives yellow, 'Fe2O_3-Cu' assemblage gives claret red to orange, 'As-Zr' and 'Cr2O_3-MgO' assemblage gives blue color to chalcedonies in Kutahya. Also 'Fe' Raman shift is figured in Raman studies in Fe containing orange-claret red colored samples. The vivid colors in all the sets derived from the OH Raman shift bonds of the chalcedony.

Chemical results show that the colour differences in chalcedony is not related with only one element.The mobility and charge of Fe element with some other (Co, Mn, Cu, Cr, Ni etc.) elements also effects the variability of the colour.