Mineralogy and petrogenesis of the gem-bearing pegmatites of the Shigar valley, Skardu, Northern Pakistan

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Shigar valley is located about 32 km north of Skardu, the head quarter of the Baltistan, and is the gateway for most of the expeditions to the K-2 in the northern areas of Pakistan. This valley has the plenty of pegmatite intrusions, hosting the various types of gemstones, which are being excavated by the local miners for aquamarine, goshenite, topaz, tourmaline and fluorite etc. These gemstones, especially aquamarine, are now marketed internationally.

These pegmatites were mapped and sampled during two field seasons for the sack of their mineralogy, internal structure, and petrogenesis. The field and various analytical techniques have revealed that these pegmatites are not only diverse in their mineralogy, classification, internal structure but on the basis of present data their petrogenetic linkage is also in ambiguity. On the basis of field features and petrographic studies, these pegmatites have been classified into two types as: (1) simple and (2) complex or zoned pegmatites. These pegmatites have further been classified into four sub-classes on the basis of presence or absence of various accessory minerals and gemstones.

Petrogenetic studies of the Shigar valley pegmatites have been carried out on the basis of major, trace and rare earth elements chemistry. These studies suggest that these pegmatites are the separate magmatic pulses generated probably from the metapelites of the Karakoram Metamorphic Complex (KMC) along the axis of the active thrust fault known as the Main Karakoram Thrust (MKT). Although, other post-collisional plutonic units of the Karakoram Batholith such as the Baltoro Plutonic Unit and the Mango Gusar Unit are exposed in the vicinity of the Shigar valley but the aerial extent, field features, and the geochemical data suggest that these pegmatites have no correlation with the off shoots of above-mentioned plutonic units. These pegmatites are of collisional tectonic settings and have been formed after the collision of Indian plate with the Eurasian plate.

Mineralogy and petrography of phosphate minerals from pegmatites of the Conselheiro Pena district, Minas Gerais, Brazil

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In Brazil occurs one of the most important pegmatite provinces in the world, the Eastern Brazilian Pegmatite Province (EBPP). This province is located at the Eastern side of the Saõ Francisco craton, mainly in the state of Minas Gerais, as well as the states of Bahia, Espírito Santo and Rio de Janeiro. The Conselheiro Pena district forms part of the EBPP where two intrusions crosscut the basement rocks and its cover: the Galiléia and Urucum magmatic suites which belong to the G1 and G2 supersuites, respectively. In September 2008, we visited several pegmatites located in the Conselheiro Pena district, between Galiléia and Mendes Pimentel, in order to investigate the petrography of phosphate minerals and their relationships with associated silicates. All the pegmatites intrude the garnet-, biotite-, and sillimanite-bearing schists of the São Tomé Formation (Rio Doce group, Late Proterozoïc). Preliminary results obtained from this study will be presented in this paper and allow to better characterize the chemistry and petrography of phosphates and to elaborate the genetic sequence of these minerals.

Phosphate minerals form nodular masses which can reach 2 meters in diameter. Two kinds of phosphate associations occur:

I) Masses showing dendritic or/and skeletic textures involving feldspar and several secondary phosphate minerals.

II) Fresh massive triphylite only altered by vivianite, which give its bluish colour to the phosphate.

Petrographic observations, X-ray diffraction measurements, and electron-microprobe analyses were performed on the phosphates, to confirm their identification, calculate their unit-cell parameters and to characterize their chemistry. The only primary phosphate mineral is triphylite, $Li(Fe^{2+},Mn^{2+})PO_4$, which progressively oxidizes to ferrisicklerite, $Li_{<1}(Fe^{3+},Mn^{2+})PO_4$, and heterosite, $(Fe^{3+},Mn^{3+})PO_4$, following the so-called "Quensel-Mason" sequence. In association I, ferrisicklerite is frequently replaced by several secondary phosphates like barbosalite, tavorite, hureaulite, cyrilovite, leucophosphite, phosphosiderite, minerals of the jahnsite group and minerals of the rockbridgeite-frondelite series. In association II, triphylite is directly replaced by vivianite along cleavage planes. A similar genetic sequence is generally observed in pegmatites of the Conselheiro Pena district, except in the northern part where brazilianite-bearing pegmatites occur. In this area, qingheiite-(Fe^{2+}) (IMA 2009-076), $Na_2Fe^{2+}MgAl(PO_4)_3$, has been described and is produced by reaction between triphylite and albite.

Even if triphylite is the only primary phosphate mineral, it shows interesting chemical variations within the district, with $Fe_{tot}/(Fe_{tot}+Mn)$ ranging from 0.56 to 0.74, and $Fe_{tot}/(Fe_{tot}+Mg)$ ranging from 0.83 to 1.00. A correlation between the chemical composition and the unit-cell parameters of triphylite-type phosphates will also be discussed, with an emphasis on the incorporation of Mg into triphylite from Sapucaia.