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The Journal of Gemmology

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The geological context of gems in the Velasco Pegmatitic District, Argentina

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Abstract: The Velasco Pegmatitic District is located in the Velasco range, La Rioja province, northwestern Argentina. The Velasco range is made up of several granitic units of different petrography, magmatic evolution and age among which are the Huaco and Sanagasta granites. The pegmatites in the Velasco district have a spatial and genetic relationship with these granites and belong to the rare-element class, beryl type, beryl-columbite-phosphate subtype. The pegmatites are usually zoned and the K-feldspar zone is generally the most important for gem-quality beryl. Heliodor and aquamarine varieties are present and these crystals can be cut to yield products of attractive beauty. Other beryl crystals with poor transparency can be utilized for cabochons or tumble polished. Rock-crystal and rose-quartz are also present in some pegmatites from the Velasco district.

Keywords: aquamarine, gemstone, heliodor, pegmatite, rock crystal, rose quartz, Velasco range

Introduction

The Velasco range is located in the central region of La Rioja province, northwestern Argentina *(Figure 1)*. It is the largest mountainous unit of the geological province of the Sierras Pampeanas, which is characterized by large volumes of crystalline rocks of several origins and ages.

Beryl-bearing pegmatites are found in the Huaco Granite (Toselli *et al.*, 2000) and in the Sanagasta Granite (Grosse and Sardi, 2005). For this reason, each granite is considered a lithological guide to possible gem occurrences (Sardi, 2005). Both granites have mainly porphyroid textures, without signs of deformation. Their outcrops occupy much of the central-north and central-east zones of the Velasco batholith *(Figure 2)*. The Huaco Granite covers 620 km² and the Sanagasta Granite 240 km² (Grosse and Sardi, 2005), and the Huaco Granite contains more Be-pegmatites than does the Sanagasta Granite.

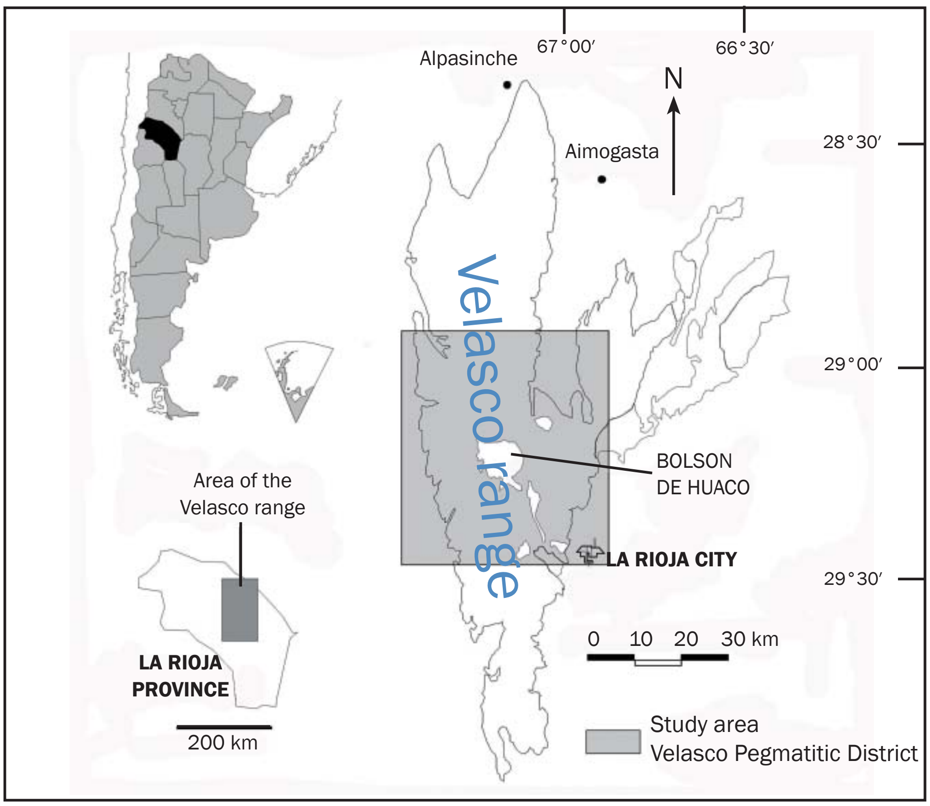

Figure 1: Location of the study area. On the right is the outline of the Velasco Range, and the indicated study area.

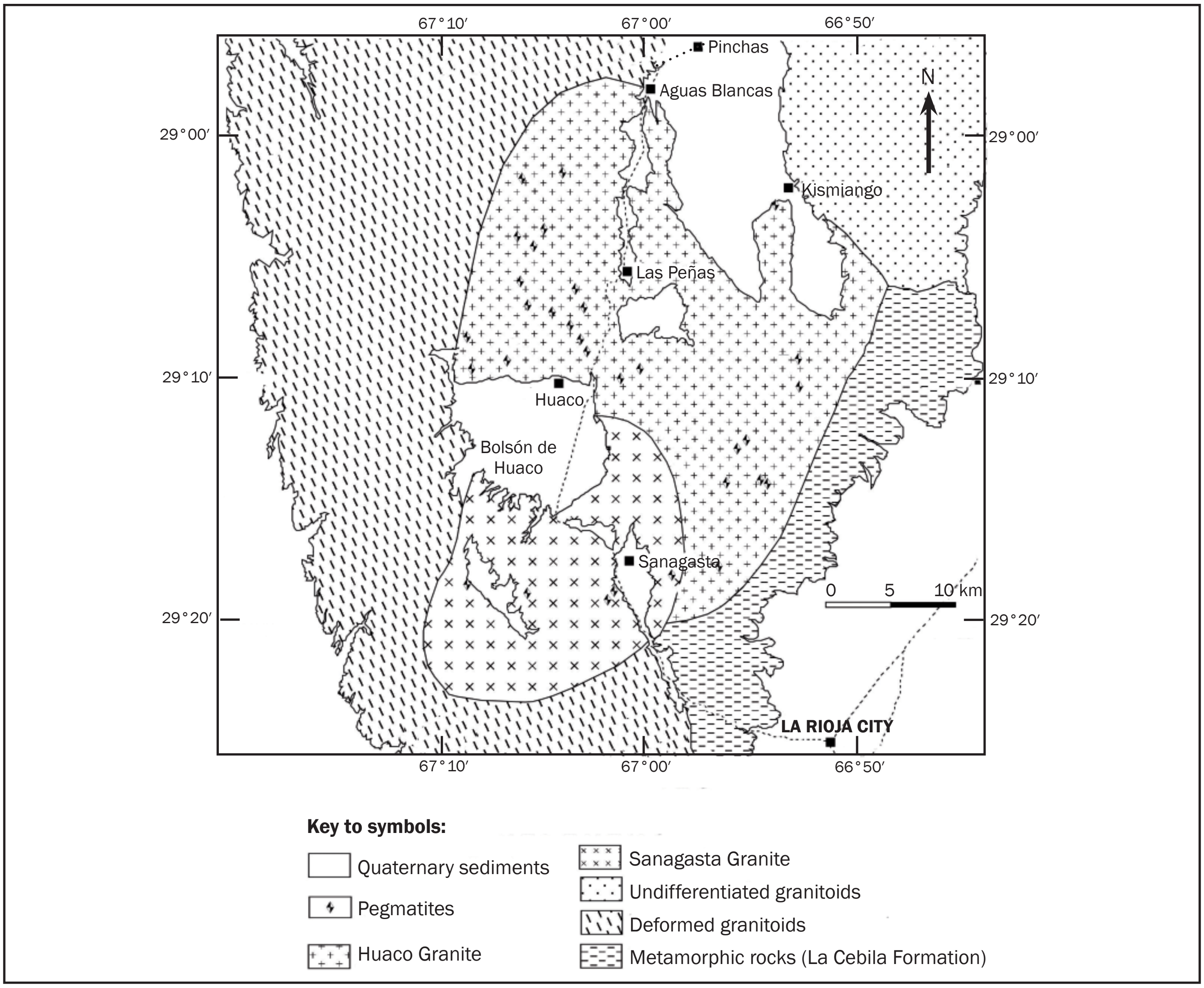

Figure 2: Simplified geological map of the Velasco Pegmatitic District. Modified from Sardi and Grosse (2005). Bolson de Huaco is an area which is a topographic depression covered with Quaternary sediments.

The pegmatites lie in the Velasco District of the Pampean Pegmatitic Province as defined by Galliski (1994). Herrera (1968), in a local classification, grouped the pegmatites from the Pampean Pegmatitic Province into four categories following a course of fractionation from 'type 1', barren pegmatites with oligoclase, to 'type 4', highly evolved with Li mineralization. In this case, the pegmatites from Velasco District correspond to the 'type 3' which is characterized, in general, by a simple zonal structure, by high diversity and abundance of accessory minerals, and by the appearance of a phase of substitution of potassium by sodium. Subsequently, they have been classified, according to Cerný (1991) as belonging to rare elements class; beryl type and beryl-columbite-phosphate subtype (Galliski, 1994; Sardi and Grosse, 2005).

The aim of this communication is to record some gem-quality minerals in the pegmatites. Most are beryl, and of lesser importance is quartz. Beryl is an accessory mineral in the Velasco pegmatites and has been extracted only sporadically and in an inconsistent manner during the last century. At the moment only gem-quality stones are being recovered. Mineralogical and gemmological studies of such deposits in the area are very scarce, and the data presented below are preliminary, and represent a beginning for more detailed research.

Geological setting

The Velasco range consists of a mixture of Palaeozoic granitic rocks of different origins and evolutions. Such rocks of I-type affiliation in the south and granitoids of S-type affiliation towards the centre and north of the range can clearly be distinguished (Toselli *et al.,* 2002, 2005; Bellos, 2005). In the south, the granitoids are granodioritic and tonalitic with hornblende and magnetite as accessory minerals, and per- and meta-aluminous tendencies in their compositions; while in the north, the rocks are shallow magmatic porphyroid granites with two micas, and with a per-aluminous character. The plutons in the centre and north of the

Velasco range comprise the Aimogasta Carboniferous Batholith (Toselli *et al.,* 2006) and they are intrusive into deformed orthogneisses of Ordovician age and also commonly into protomylonites and mylonites of Ordovician to Devonian age (Toselli *et al.,* 2006).

On the east flank of the Velasco range, the La Cebila Formation is represented by sporadic outcrops of meta-pelites and meta-psammites. These sediments are of Upper Precambrian – Lower Cambrian age (Aceñolaza *et al.,* 2000), and their metamorphic grade does not exceed greenschist facies. In the extreme north of the range, contact metamorphic rocks appear whose mineral association indicates nearby shallow-level granitic intrusions (Rossi *et al.,* 1997).

The Huaco (Toselli *et al.,* 2000) and Sanagasta (Grosse and Sardi, 2005) Granites make up the whole of the Aimogasta Carboniferous batholith. Petrographically, their main characteristic is a porphyroid texture with megacrysts of perthitic microcline, in some places making up to 50 % of the rock (Sardi *et al.,* 2002). These megacrysts are white in the Huaco and pink in the Sanagasta Granites. The Sanagasta granite's K-feldspar megacrysts are occasionally mantled by plagioclase generating a Rapakivi-like texture (Grosse and Sardi, 2005; Grosse *et al.,* 2008). Another difference is that the Sanagasta Granite has a higher biotite/muscovite ratio than the Huaco Granite. The matrix is essentially composed of quartz, microcline, plagioclase, biotite and muscovite. The geochemical studies made by Grosse *et al.* (2008) indicate the granites to be silica-rich, potassium-rich, ferroan and alkali-calcic to slightly calc-alkalic. U-Pb monazite age determinations on Huaco and Sanagasta Granites indicate Lower Carboniferous crystallization ages and the isotopic and geochemical studies indicate a mainly crustal source, possibly similar to the Ordovician peraluminous metagranitoids which are nearby (Grosse *et al.,* 2008).

Velasco District pegmatites

The Velasco District has numerous pegmatite bodies that are developed immediately north, east and south of Bolsón de Huaco (see explanation in the caption of *Figure 2*). The area of the Velasco Pegmatitic District is occupied by the Huaco and Sanagasta Granites and the Be-pegmatites have a spatial relation with them *(Figure 2)*. These bodies present more or less homogeneous characteristics as to their structures and mineral composition. According to Sardi *et al.* (2002), their contacts with the granitic host-rock are sharp.

The lengths of the pegmatites are no greater than 250 m and most consist of a marginal-external zone, an intermediate zone and core of quartz (Sardi, 2005). The marginal-external zone wraps around the coarse-grained minerals in the pegmatite. It is aplitic and/or equigranular fine- to medium-grained leucogranite and is composed of quartz, microcline, plagioclase, tourmaline, muscovite, biotite, apatite, and topaz (Sardi, 2005). The intermediate zone contains mainly quartz with microcline and/or plagioclase, with microcline being the more common; perthitic and graphic textures are also common. The accessory minerals in this zone are muscovite, scarce biotite, apatite, triplite, beryl and tourmaline (Sardi, 2005). Herrera (1971) and Ricci (1971) had already reported garnet, fluorite, columbite-tantalite and wolframite which can be added to this list. The core of the pegmatite is massive quartz, usually grey but some is pink. Here, the accessory minerals are very scarce: tourmaline, muscovite and beryl (Sardi, 2005).

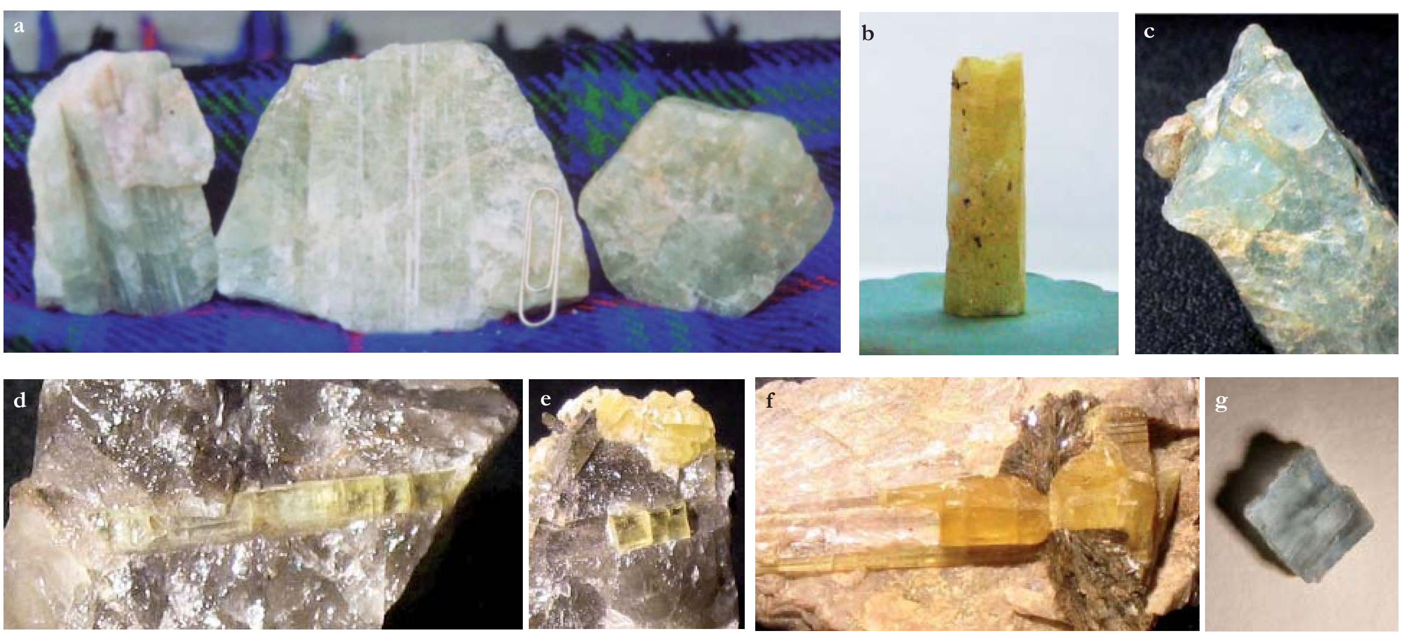

Figure 3: Beryl from the Velasco Pegmatitic District.
Milky beryl: (a) Green and pale green beryl; the left and centre fragments show striated faces, and in the one on the left a hexagonal contour is visible. Width of image 12.2 cm. (b) Idiomorphic yellow beryl. Width of image 3.2 cm. (c) Pale blue (turquoise colour) beryl – aquamarine. Width of image 0.6 cm.
Translucent and transparent beryl: (d and e) Heliodor varieties, associated with grey quartz. Width of images: 1.5 cm and 0.6 cm respectively); (f) Heliodor with feldspar and mica. Width of image: 1.7 cm. (g) Fragment of aquamarine. Width of image 1.8 cm.

The geological context of gems in the Velasco Pegmatitic District, Argentina

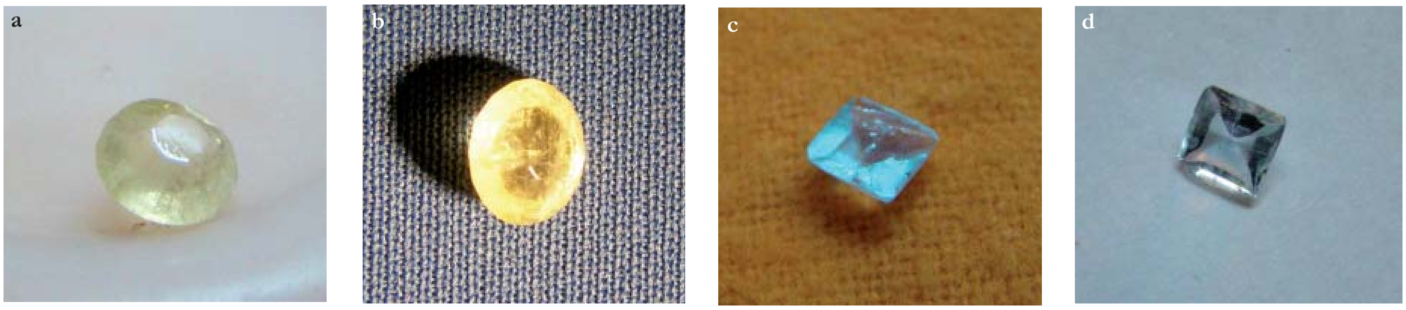

Figure 4: Faceted examples of heliodor and aquamarine. (a and b) Heliodor, 7 mm long, on different backgrounds and under different lights; weight 0.615 ct. (c and d) Aquamarine, 5 mm square, on different backgrounds and under different lights. Weight 1.279 ct.

Gemstones

Beryl

Beryl is generally concentrated in the intermediate zones associated with anhedral quartz, clusters of muscovite and K-feldspar (Sardi, 2005). Most beryls are green, yellow and pale blue *(Figures 3a, b and c)* but varieties of colourless beryl are very scarce and are associated mainly with quartz. The beryls are idiomorphic, and have vitreous lustre and conchoidal fracture. According to Sardi (2005), most are well-developed hexagonal prisms, some with vertically striated faces *(Figure 3a)*. The most common forms are first-order prisms and basal pinacoids, although some crystals appear wedge-shaped. The mineral size is variable. Transverse sections of the crystals measure up to 6 cm and the longest crystals are up to 12 cm. When the mineral is associated with muscovite, beryl is thin and long, but in association with grey quartz it is thicker. A poor cleavage can be present parallel to (0001). Only rarely does it have inclusions of other minerals such as tourmaline, quartz and muscovite.

The economic importance of beryl from the Velasco Pegmatitic District lies in its gem quality (Sardi, 2005). The yellow variety of beryl, heliodor, has total transparency, scarce fractures and is free of inclusions of other minerals *(Figures 3d, e and f)*; pale green and pale blue aquamarine *(Figure 3g)* reach lengths of about 3 cm. The almost total absence of fractures in heliodor and aquamarine can permit their cutting and polishing to give beautiful and attractive stones *(Figures 4a, b, c and d)*. Some gem-quality crystals of beryl may be so embedded in quartz that it is difficult to extract them without fracturing; these may be more desirable and valuable for mineral collectors as heliodor or aquamarine in matrix. Goshenite is very scarce and small in size relative to heliodor, and thus is less important.

Non-gem-quality crystals of beryl are of greater size and range from translucent or semi-translucent to milky. They have only minor commercial value, and some may be cabochon cut or polished by tumbling. Gem-quality crystals are considered to have originated in the later stages of cooling and crystallization of the pegmatitic cavity and may be secondary or recrystallized.

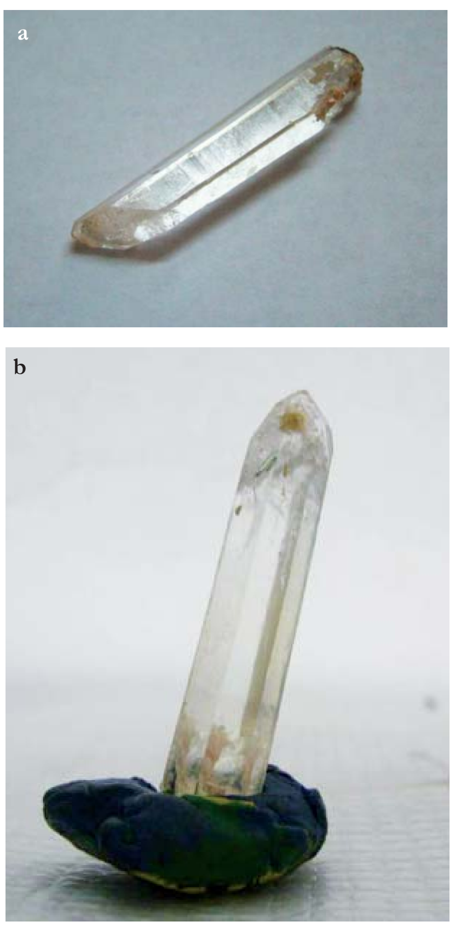

Figure 5: (a and b) Typical rock crystal, 42 mm long, on different backgrounds and under different lights; weight 4.2252 g; (c) A specimen of rose quartz, 96 mm high, with a rough top and polished sides.

Quartz

There is more than one generation of quartz in the pegmatites and the gem-quality quartz is considered to have been formed during the later pegmatitic (or hydrothermal) stage. The variety rock crystal has been found in the intermediate zone of the pegmatites in association with K-feldspar. It is colourless, entirely transparent, idiomorphic with hexagonal contours and without inclusions. Crystals reach 4.2 cm in length and 1 cm in width *(Figure 5a and b)*. Rose quartz has been found in pegmatites in the Sanagasta Granite, generally forming part of the core-quartz of the pegmatites *(Figure 5c)*. It is coarsely crystalline and in some is very transparent and free of inclusions. The quartz gems are secondary in importance to the beryl.

Conclusions

At present, gem-quality beryl and quartz can be recovered from the pegmatites of the Velasco District (Argentina). Most of the gem beryl occurs in idiomorphic prisms of yellow, green or pale blue, in sizes up to 12 cm in length, and with different degrees of transparency. Some crystals of heliodor and aquamarine are large enough to have commercial value. The formation of the gems is attributed to crystallization in the late stages of pegmatitic evolution. Future studies, especially of a thermometric nature, could yield further insight into their origin. Gem-quality quartz in these pegmatites occurs as rock crystal and rose quartz.

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