QUARTZ TWINS BY JAPAN LAW AND NATIVE COPPER

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Mineralogical Almanac have already published the articles on the subject of how the mineralizing solution movement influences the habit of growing crystal (Kantor, 2014; 2015; 2016$_1$; 2016$_2$). Let us continue this topic considering quartz twins by Japan law and an intriguing native copper specimen from Dzhezkazgan, Central Kazakhstan.

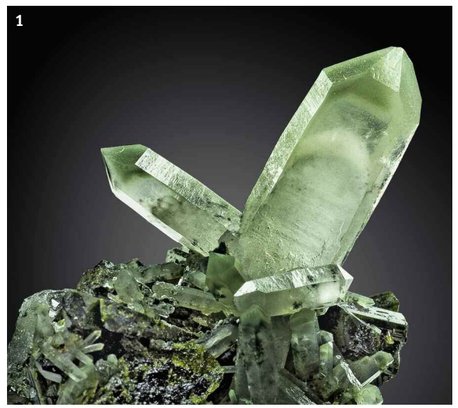
It is to be recalled that to provide a crystal growth it is necessary and appropriate that the "construction material" would be delivered to the crystal and then adsorbed (consumed) by it. The delivery is provided by the means of mass transfer – moving solution by flowing or/and convection and diffusion of particles. The adsorption is provided by the solution supersaturation. The crystal growth rate is always limited with the slowest link of this sequence. In some cases it is delivery while in others adsorption.

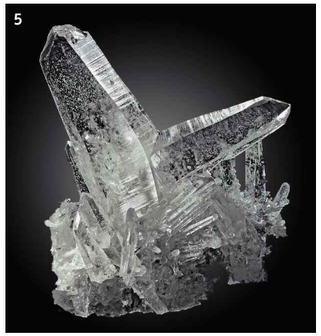
The adsorption rate hinges on the extent of the solution supersaturation. The higher the supersaturation, the faster is adsorption, i.e. amalgamation of new particles with the crystal. As to the delivery rate, it depends on the method of mass transfer. A growing crystal is fed in either of the two modes: the kinetic mode with solution flowing or convection as the main delivery method and the diffusion mode when the solution is motionless and the material is delivered by means of diffusion.

In the kinetic mode, the mass transfer usually outruns adsorption; so the latter's rate constrains the crystal growth rate. In diffusion mode is conversely: the mass transfer lags behind adsorption thus constraining the growth rate.

1. **Quartz**, twin by Japan law. Height 2.2 cm. Green Monster Mountain, Alaska, USA.

2. **Quartz**, twin by Japan law, 2.4 cm wide. Dashkesan, Azerbaijan.





3. **Quartz**, twin by Japan law. 1.8 cm wide. Dashkesan, Azerbaijan.

4. **Quartz**, twin by Japan law, 2.2 cm wide. Green Monster Mountain, Alaska, USA.

5. **Quartz**, twin by Japan law, 6 cm wide. Pasto Bueno. Ancash Dep., Peru.

How all this affects the habits of the quartz twins by the Japan law? Their morphology is pretty diverse. V-like (*Fig.* 1) and X-like Japan twins (*Fig.* 2) occur in nature as well as ordinary (*Fig.* 3) and flattened ones (*Fig.* 4). When a twin is growing in a crystal group, it may outrun the individual crystals (*Fig.* 5) but may not differ in its size. And all of them differ greatly from their theoretical idealized model (*Fig.* 6). The existent Japan twins are the eloquent witnesses for their growth conditions.

The V-like Japan twins took their shape by the same cause why most individual crystals have only one termination of two. This is because a crystal or a twin grows upright or in an inclined position towards its matrix with only one end being free. The opposite end cannot develop because of the matrix. To be able to develop by both ends it must "lie" on the matrix. However, lying position is a special particular case, one of many possible positions for the seed crystal to take on the matrix. At any other position, a crystal with the only one termination or a V-like twin develops from the seed crystal. The probability of a particular case is much less than the composite probability of all the rest cases. That is why X-like quartz twins by Japan law are much rarer than the V-like ones.

The flattened habit of many Japan twins is a result of influence of the reentrant angle between its individuals. The both individuals' outer fields of force are act-

6. Ideal quartz twin by Japan law and drawings of some real twins.