Trapped and sheltered inside other crystals, mineral inclusions preserve fundamental and otherwise lost information on the geological history of our planet. In the last decade, quartz inclusions in garnet have become a fundamental tool to estimate pressure and temperature of metamorphic rocks at the time of inclusion entrapment. In these approaches, as well as in all other applications, inclusions are regarded as immutable objects and the possibility of a change in their shape has never been considered.

With a detailed characterization of samples from greenschist and granulite facies, performed by optical and electron microscopy, EBSD, X-ray tomographic microscopy, laser Raman spectroscopy and FIB serial slicing, we show that after being trapped with irregular (“scalloped”) shape in low-temperature rocks, quartz inclusions in garnet from granulites formed at 750-900 °C and various pressures acquired a polyhedral “negative crystal” shape imposed by the host garnet, and almost exclusively defined by the facets of dodecahedron and icositetrahedron. A similar behaviour is also observed in biotite inclusions. The 3-fold and 4-fold morphological symmetry axes of the polyhedral negative crystals are parallel to corresponding crystallographic axes in the host garnet.

The systematic presence of a fluid film at the quartz-garnet boundary is not supported by Raman and FIB investigation.

Strengthened by microstructures indicating the process of “necking down” of polycrystalline quartz inclusions, our data support that - like in fluid inclusions changing shape to negative crystals - shape maturation of mineral inclusions occurs by temperature-assisted dissolution-precipitation via grain boundary diffusion. This process tends to minimize the surface free energy of the host-inclusion system by forming energetically favored facets and by decreasing the inclusion surface/volume and aspect ratios.

Optical investigation of numerous samples of worldwide provenance suggests that the negative
Crystal shape of quartz inclusions in garnet from granulites is a widespread microstructure that underpins a systematic phenomenon so far overlooked.