American Mineralogist, Volume 106, pages 1797–1808, 2021

The origin of trapiche-like inclusion patterns in quartz from Inner Mongolia, China

Gabriela A. Farfan[1,*], John Rakovan[2], Michael R. Ackerson[1], Benjamin J. Andrews[1,†], and Jeffrey E. Post[1]

[1]Department of Mineral Sciences, Smithsonian Institution, Washington, D.C. 20560, U.S.A.
[2]Department of Geology and Environmental Earth Science, Miami University, Oxford, Ohio, 45056, U.S.A.

Abstract

Fibrous amphibole and clay mineral inclusions that form striking trapiche-like star patterns within quartz crystals from Inner Mongolia, China, present a challenge to uncover how these crystals grow and incorporate inclusions in a geological context. We propose that the patterns formed as a result of protogenic clay (ferrosaponite or nontronite) inclusions that were preferentially trapped on rough surfaces during quartz crystal growth. The rough surface texture of these crystals is the result of multiple growth centers during 2D nucleation and spread and split crystal formation. Observations via optical microscopy, cathodoluminescence, and three-dimensional micro-CT scanning highlight how the exterior surface textures on the termination of a complete quartz crystal mimic its interior inclusion patterns. Cathodoluminescence images, as well as varying aluminum concentrations along a core-to-exterior transect in a quartz crystal slice, suggest that the formation fluid underwent a heterogeneous chemical history. Measurements of Ti and observations of fluid inclusions suggest the quartz formed at a temperature of under 348 °C. This study presents the details surrounding split crystal growth in quartz in a natural geological setting, which has implications for inspiring new materials and may serve as an indicator for turbid and highly supersaturated formation fluid conditions in geological formations.

Keywords: Split crystal growth, quartz, inclusion incorporation, trapiche-like, Huanggang deposit, micro-CT scanning