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Synthetic fluid inclusions as recorders of microfracture healing and overgrowth formation rates

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ABSTRACT

Aqueous fluid inclusions have been synthesized within fluorite microfractures (T = 200 °C, P = P_{sat}, t < 30 days), quartz microfractures, and quartz overgrowths (T = 400 to 300 °C, P = 400 bars, t < 20 days). The experiments were designed to determine the time necessary to form the inclusions, within a minute in a fluorite host, and within a day in a quartz host. The results permit estimation of the time needed to heal microfractures or create overgrowths, which is accomplished by measuring the melting temperature (T_m) of the inclusions in fluorite and the homogenization temperature (T_h) of the inclusions in quartz.

For the fluorite experiments, the results show that fluorite/NH_4Cl solution equilibrium took 82 hours. Moreover, the healing process appears to be an irregular process along the microfracture. Fluorite experiments mimic boiling processes occurring in natural hydrothermal or epithermal systems and show how a boiling fluid may be progressively salted during vaporization and trapped as fluid inclusions.

For the experiments involving quartz, the quartz/H_2O-NaCl solution equilibrium was reached on the first day for synthetic quartz and on the sixth day for natural quartz. This difference is linked to the hydration state of the two types of quartz. The decrease in T_h of synthetic fluid inclusions from the core-overgrowth boundary to the external part of the quartz overgrowth shows that the growth of quartz is a progressive and protracted process, which involves a silica oversaturated solution.