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Supplemental Material

Appendix 1. Fluid inclusion data (1 file, 5 tabs).

Tab 1. Homogenization Temperatures (Th) and Final Melting Temperatures of Ice (Tm ice) for GFS-5-Crystal-C, consisting of mostly all-liquid aqueous inclusions trapped in calcite. Inclusions occur as a three-dimensional patch in the core of a large (2mm) zoned crystal and are interpreted as possibly primary or secondary.

Tab 2. Homogenization Temperatures (Th) and Final Melting Temperatures of Ice (Tm ice) for GFS-5-LPCV-4, consisting of mostly all-liquid aqueous inclusions trapped in a late perpendicular calcite vein (LPCV) that cuts across the sample. Inclusions occur as a three-dimensional patch in an unzoned crystal. Inclusions are 2 to 18 μm . The inclusions are interpreted as possibly primary.

Tab 3. GFS-5-Crystal-A, consisted entirely of 13 all-liquid aqueous inclusions trapped in calcite. Inclusions occur as a three-dimensional array parallel to growth zoning in a large calcite crystal. Inclusions are 3 to 12 μm long, elongated and irregularly shaped with their long axis oriented obliquely to growth zonation. Inclusions are consistent with a primary origin.

Tab 4. GFS-5-Crystal-B, consisted entirely of tens of mostly all-liquid aqueous inclusions trapped in calcite. Inclusions occur as a three-dimensional array, without nearby growth zoning in the calcite. Inclusions are 2 to 20 μm long and irregularly shaped. Inclusions are consistent with a possibly primary or secondary origin.

Tab 5. GFS-5-LPCV (crystals 1, 2, and 3).

Appendix 2. U-Pb data table, including standards (and T-W plots).

Tab 1. Plot Data.

Tab 2. Calcite GFS5.

Appendix 3. GFS-5 optic axis stereoplots. Lower hemisphere projection of calcite optic axes for fault gouge fillings 1-8 (A) and the late-stage filling 9 (B) with the thin section photo (C; XP light).

C

Appendix 3: Lower hemisphere projection of calcite optic axes for fault gouge fillings 1-8 (A) and the late-stage filling 9 (B) with the thin section photo (C; XP light). In A, Vein1=Blue, Vein2=Brown, Vein3=Cyan, Vein4=Green, Vein5=Magenta, Vein6=Orange, Vein7=Purple, Vein8=Red.