SIMS $\delta^{18}O$ OF STROMATOLITIC CHERTS AND SANDSTONES IN THE 3.4 GA STRELLEY POOL FORMATION: IMPLICATIONS FOR PALEOARCHEAN $\delta^{18}O$ VALUES.

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Introduction: We present in-situ SIMS measurements of $\delta^{18}O_{qtz}$ and petrographic observations investigating the micro-textures of quartz from the ~3.4 Ga Strelley Pool Formation (SPF) basal sandstone and stromatolitic cherts within the Pilbara Craton, Western Australia. Stromatolitic cherts of the SPF are carbonates replaced by quartz as evidenced by replacement fronts in the outcrops, relict dolomite and ankerite rhombs, carbonate shaped cavities, quartz pseudomorphs after carbonate, and paleoenvironmental evidence [1]. Bulk $\delta^{18}O_{qtz}$ (~2 mg/per sample) from samples collected in 2001 at the Trendall locality in cm-scale crosscutting hydrothermal veins range from 15 to 16‰, while bedded cherts are 17 to 26‰ VSMOW. In-situ SIMS measurements (~10 µm dia. beam) reveal a 7 to 31‰ range in bedded cherts. Without taking the relative timing of the textural generations into account these data seemingly disagree with studies suggesting that $\delta^{18}O_{qtz}$ measurements are less than 21‰ for Paleoarchean cherts and that higher $\delta^{18}O_{qtz}$ are only found in younger cherts [2–4]. Using transmitted light microscopy and SEM (BSE & CL) this study describes several textures and generations of quartz and associated µm-scale $\delta^{18}O_{qtz}$ trends not previously reported in the SPF using traditional bulk analysis techniques at mm-scale.

Quartz Textures: SPF microquartz typically occurs as 2-10 µm crystals in both the basal sandstone cements and stromatolitic Trendall samples. Mesoquartz is similar to microquartz but has coarser 20 µm to 50 µm crystals. Megaquartz crystals are greater than 50 µm and have sharp extinction with definitive planar crystal boundaries. This study identifies two generations of megaquartz: cross-cutting vein megaquartz and euhedral megaquartz surrounding cavities. Chalcedony occurs as fracture and cavity filling cements. Detrital quartz grains in the SPF basal sandstone are medium to coarse and rounded to sub-rounded. Figure 1 summarizes the SIMS in-situ $\delta^{18}O_{qtz}$ for these textures which represent different generations of quartz formation.

Conclusions: These data provide textural and isotopic evidence of zonation reflecting temperatures, timing, and fluid sources of SPF quartz generations. Detrital quartz grains have $\delta^{18}O_{qtz}$ ~ 10 to 14‰. Petrographic observations suggest microquartz is the earliest diagenetic generation of quartz in the SPF, limiting maximum Paleoarchean $\delta^{18}O_{qtz}$ to ~ 21‰. Low $\delta^{18}O$ microquartz may be affected by varying degrees of hydrothermal alteration. Microquartz cements in the basal sandstone reveal tightly constrained and lower $\delta^{18}O_{qtz}$ ~ 13.9 ‰. Mesoquartz could form via coarsening through diagenesis or hydrothermal alteration from a microquartz precursor. Chalcedony occasionally pseudomorphs rhombic cavities and fractures, which suggests an association with hydrothermal or diagenetic alteration. Vein megaquartz crosscuts all aforementioned quartz generations except cavity megaquartz. Finally late euhedral cavity megaquartz forms with in situ $\delta^{18}O_{qtz}$ up to 31‰ and bulk measurments up to 26‰. Cavity megaquartz petrogenesis is consistent with Paleogene lateritic alteration. None of these quartz generations formed as a direct precipitate from Archean seawater. The generally low $\delta^{18}O_{qtz}$ reflects different stages of diagenesis and alteration during the Archean; high $\delta^{18}O_{qtz}$ in the late forming generations results from weathering processes during the Paleogene.

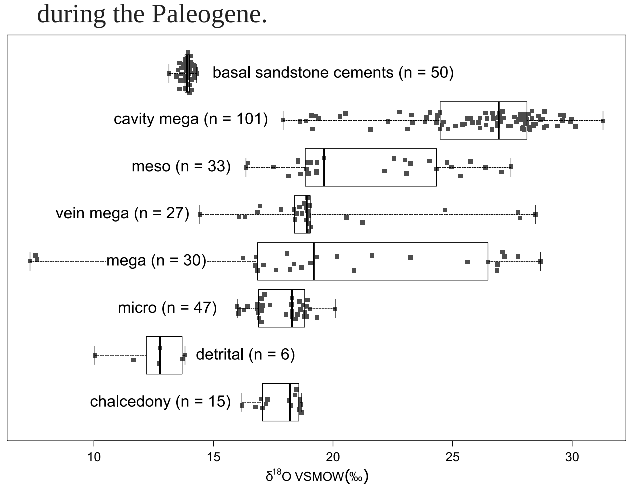

Figure 1 - $\delta^{18}O_{qtz}$ by texture type from in-situ SIMS measurements. Symbols: dark vertical lines within boxes = medians, boxes = inner quartile range, whiskers = range, points = $\delta^{18}O_{qtz}$ data points. Precision is better than ± 0.35 ‰, 2SD for all SIMS analyses.

References: [1] Van Kranendonk M.J. (2006) *EarthSci. Rev.* 74, 197. [2] Robert F. and Chaussidon M. (2006) *Nature* 443, 969. [3] Knauth L.P. (2005) *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 219, 53. [4] Perry Jr. E.C and Lefticariu L. (2007) *Treatise Geochem.* 1–21.