Triple oxygen isotope silica-water fractionation as a single mineral thermometer from a hydrothermal plant Hellisheidi, Iceland

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High precision $\delta^{17}O$-$\delta^{18}O$ measurements of silica can be used as an empirical single mineral thermometer in $\Delta^{17}O$-$\delta^{18}O$ space[1], constraining the $\Delta^{17}O$ and $\delta^{18}O$ values of the water from which the sample precipitated. The silica geothermometer is tested using amorphous silica samples accumulated over 6 months from water in the Hellisheidi hydrothermal power plant in Iceland. Four silica samples and two water samples were collected from temperatures ranging from 60°C-118°C.

The oxygen istope composition of the 60°C and 118°C water sample was the same, as expected (Table). The negative $\Delta^{17}O$ value is outside the average meteoric water $\Delta^{17}O$ value of 0.03‰[3], suggesting fluid-rock interaction has altered the composition of the meteoric fluid towards the $\Delta^{17}O$ value of basalt (~-0.06‰).

The triple oxygen isotope analyses of the silica show that the silica precipitated in equilibrium with the water and the single mineral thermometer can estimate the temperature of formations to ±10°C.

Sample	$\delta^{17}O'$ (Silica)	$\delta^{18}O'$ (Silica)	$\delta^{17}O'$ (Water)	$\delta^{18}O'$ (Water)	Temp (Measured)	Temp (Calc)
R.9	11.97	22.87	-2.85	-5.45	60	63
R.5	11.73	22.40	n.d	n.d	70	65
R.10	11.49	21.92	n.d	n.d	75	80
F.1	7.48	14.30	-3.03	-5.77	118	95

The following data were obtained:
The $\Delta^{17}O$ fractionation changed by 0.03‰ between the 60°C and 118°C sample, significantly greater than our standard error of analysis (±0.007‰). The single mineral thermometer was independently verified and suggests robust applications in geochemistry thermometry.

[1] Sharp et al. (2015), *GCA*, in review. [2] Meier et al. (2014) *Mineral Mag* **78**, 1381-1389. [3] Luz & Barkan (2010) *GCA* **74**, 6276-8286.