ELECTRONIC APPENDIX 3: OXYGEN ISOTOPE ERROR PROPAGATION

In carrying out error propagation on $\delta^{18}O$ values, errors from drift corrections and instrumental mass fractionation (IMF) were taken into account in addition to analytical precision. Gaussian distributions of uncertainties were assumed around single $\delta^{18}O$ and anorthite content measurements (with standard deviation of the distribution equal to the estimated precision on each measurement), and around the means of repeat analyses of $\delta^{18}O$ and anorthite in a plagioclase zone (with standard deviation of each distribution equal to the standard error on the mean). Such distributions are considered reasonable since, when taking normalised data from all groups of repeat analyses on plagioclase standards, the $^{18}O/^{16}O$ and anorthite data correspond well to Gaussian distributions. From the assumed distributions, values were randomly drawn for use in the drift corrections, calculation of the IMF, and finally in Equation 2 for calculation of a $\delta^{18}O$ value for a particular plagioclase zone. This process was repeated 2000 times to produce near-Gaussian distributions of calculated $\delta^{18}O$ values for each plagioclase zone. The 2σ values from each of these sets of 2000 $\delta^{18}O$ values are reported in Electronic Appendix 1, and are plotted as error bars in Figure 9.

In detail, the procedure for calculating a plagioclase $\delta^{18}O$ value in each simulation was as follows. Firstly, to assess the contribution of error from the drift correction, a 3rd-order polynomial or straight line was fitted to the (distributed) mean $^{18}O/^{16}O$ values of the groups of 5 analyses of the $An_{31.4}$ standard performed during the session, fitted as a function of mean analysis number; *i.e.* the $^{18}O/^{16}O$ value for each group was randomly drawn from the appropriate distribution around the mean of the group (the mean values of each group of five analyses on the $An_{31.4}$ standard are plotted in Figure A1). The polynomial fit was applied for the 28th September session only, the linear fits for the latter two sessions. This approach

produced a different $^{18}O/^{16}O$ *v* s. analysis number fit for every simulation. However, to allow better for the error inherent from assuming the polynomial or linear fit, one of the groups of analyses on the $An_{31.4}$ standard was missed out, at random, from each fit. The mismatch between the modelled $^{18}O/^{16}O$ value (using the line of fit) for the missing group, at the appropriate analysis number, and the mean $^{18}O/^{16}O$ observed for this group was calculated and recorded.

Next in each simulation, the data from the Borgarhraun samples and from the other standards ($An_{3.7}$ and $An_{89.6}$) were drift-corrected using the line of fit for the drift, and adding or subtracting (either, at random, for each simulation) the calculated mismatch described in the previous paragraph. The magnitude of the drift correction was calculated relative to the mean $^{18}O/^{16}O$ of the group of five analyses on the $An_{31.4}$ standard performed at the start of the session.

The IMF *v* s. anorthite regression line (IMF = $aX_{An} + b$, where *a* and *b* are constants) was then defined, using the drift-corrected $An_{3.7}$, $An_{31.4}$ and $An_{89.6}$ standard data, selecting the IMF values for the standards at random from the distributions around the mean IMF values of repeat $^{18}O/^{16}O$ analyses, and selecting the anorthite values similarly. In this way an IMF-anorthite line with unique coefficients, *a* and *b*, was calculated for each simulation, itself dependent on the specific drift fit and correction that were calculated earlier for the simulation. Subsequently in each simulation, the equation of this IMF *v* s. anorthite line was used in order to provide an IMF value for the Borgarhraun plagioclase zone in question; this was carried out using an anorthite value for the plagioclase zone, drawn at random from the appropriate distribution.

The calculated IMF value for the Borgarhraun plagioclase zone was finally used in Equation 2 with a randomly-drawn value from the distribution of measured, drift-corrected $^{18}O/^{16}O$ ratios around the mean of each zone, to provide a final $\delta^{18}O$ value for the simulation. This

procedure was followed in each of 2000 simulations for each Borgarhraun plagioclase zone. The 2σ errors from the 2000 $\delta^{18}O$ values calculated for each zone are reported in Electronic Appendix 1.