APPENDIX

Behavior of binary loop widths with composition and temperature

This Appendix is addressed to the silent question raised by Figure 2 in the main text, namely: What is our expectation in viewing a plot of loop width versus temperature (or composition)? Of course, one knows that a binary loop begins and ends at zero width, and fattens to a maximum width somewhere near the middle. Therefore a plot of loop width against either composition or temperature will be a curve that is concave down to zero at both ends. What is less commonly considered is that the partition coefficient $D = X_1^S/X_1^L$ as defined in relation to linear partitioning is in part a transform of the loop width from a difference to a ratio, and that the intercept K_D defines a characteristic loop width, from fat at low values of K_D to thin at high values (obviously becoming a single line if $K_D = 1.0$). The loops calculated throughout this paper are defined by the measured plagioclase crystal composition and the plagioclase component of the oxygen norm of the liquid composition.

In Figure A1 are plotted the breakdown of Figure 2 into its seven component parts, each a separate bulk composition. The labels in the figures are shorthand versions of the compositions studied by Thy et al. (2006). The first array, *Am1*, is uniquely athermal at a nearly constant value of the loop width. All the others show some variation with temperature, mostly scattered.

The experimental behavior of loop widths is characterized in Figure A2a, derived from a linear partitioning treatment of the system Di-An-Ab (Morse, 1997). The *X*-axis is given in the plagioclase crystal composition and also in temperature, normalized to the range along the diopside - plagioclase cotectic. The dotted curve shows the temperature dependence of the loop width, while the solid curve refers to the plagioclase composition. The rectangle near the crests of the curves simply calls attention to the composition range of the Thy et al. experiments. The curves are concave-down throughout except near the Ab end where the temperature is not well known. From the crest region, it is clear that for this composition range, the curves are very similar and that for temperature is centered almost symmetrically on the middle of the composition range. Therefore, we should expect to find equilibrium arrays consistent with the concave-down temperature curve.

Now looking back at Figure A1, we are disappointed, for although several bulk compositions show tendencies toward concave-down, there is no consistency in absolute loop width and none of the arrays are centered on the middle temperature. Seen all together, as in Figure 2, they appear to fill a space randomly over a wide range of *T* and *X*. This result, with the separate graphs shown here, supports a failure to demonstrate stable equilibrium.

Another experimental test

Reality comes to visit in the form of Figure A2b, for which the data were regressed with a correlation coefficient of $R^2 = 0.80$ in the linear partitioning plot of Morse et al. (2004). Here the regression is converted to loop widths using the linear partitioning equation. Although it is true that the data cluster about the equation, as they must, the deviations are certainly magnified relative to the linear result, and that is undoubtably a normal feature of plotted loop widths, contributing to the scatter in Figure 2 of this paper. The alternative formal test of the quality of data is the linear partitioning plot used in Figures 5 and 6 of the paper, and this plot is useful in showing where the good data lie near the baseline, and the weaker data farther from the baseline.

Also of note is the reduced value of the maximum loop width in this high-pressure array compared to Figure A2a, as is consistent with the higher value of K_D.

Summary

The analytical study of loop widths plotted against temperature or crystal composition affords a better understanding of their use in evaluating the reliability and self-consistency of experimental data. Although data from a linear regression that appear reasonably good in one plot may look worse in the plot of loop widths, the scatter in Figure 2 is great enough to declare a lack of evidence for reliably stable equilibrium. This characteristic is not unique in kind among a experiments listed in the wider database, but it appears to be singular in degree.

Captions to Appendix Figures

Figure A1. Breakdown of data in Figure 2 to the individual data sets listed by Thy et al. (2006). The *Y* axes are loop widths X_{An}^{S} - X_{An}^{L}, and the *X* axes are temperature in °C. Except for the flat array of set *Am1*, these each show individual scatter contributing materially to the whole, and they fail to show repeated maxima near the midpoint of the temperature range.

Figure A2. (A) Analytical behavior of plagioclase loop width with temperature and composition as shown in the system Di-An-Ab with linear partitioning (Morse, 1997). The temperature - based relationship is plotted as the dotted line, and that for composition as the solid line. The region of interest in the studies by Thy et al. (2006) is indicated by the box centered on An_{60}. (B) Data recalculated from the regression in Fig. 16 of Morse et al. (2004), with the corresponding equation for the loop width calculated from the linear partitioning equation A1 (below). The linear regression has the correlation coefficient R^2 = 0.80, but in this plot the scatter is visually magnified. It appears that plagioclase loops are always maximized in width near An_{60}.

$$LoopWidth = X_2^S - X_2^L, where$$
$$X_2^L = 1 - X_1^L = 1 - (X_1^S / (0.524 \cdot X_2^S + X_1^S)) \quad \text{(A1)}$$

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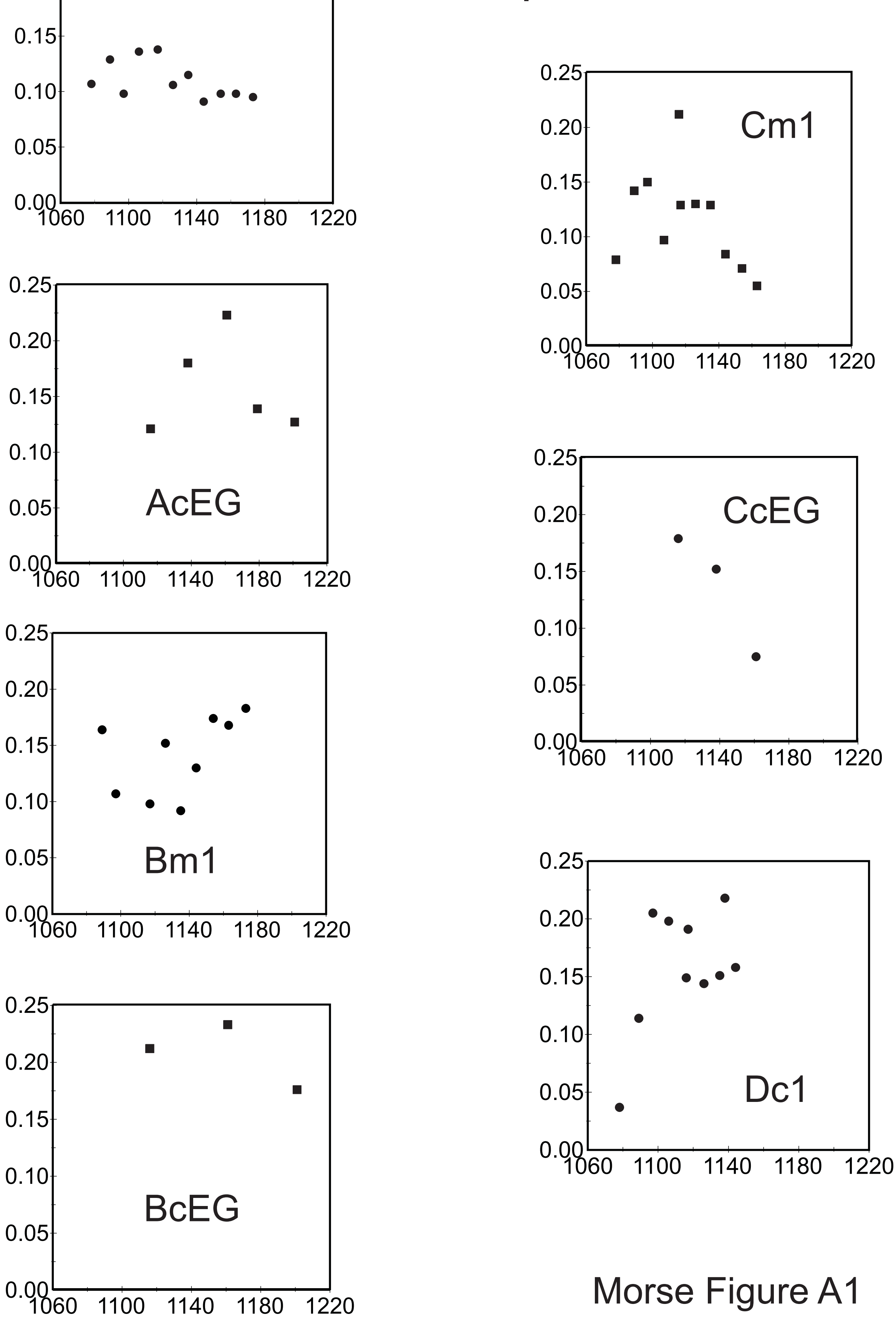
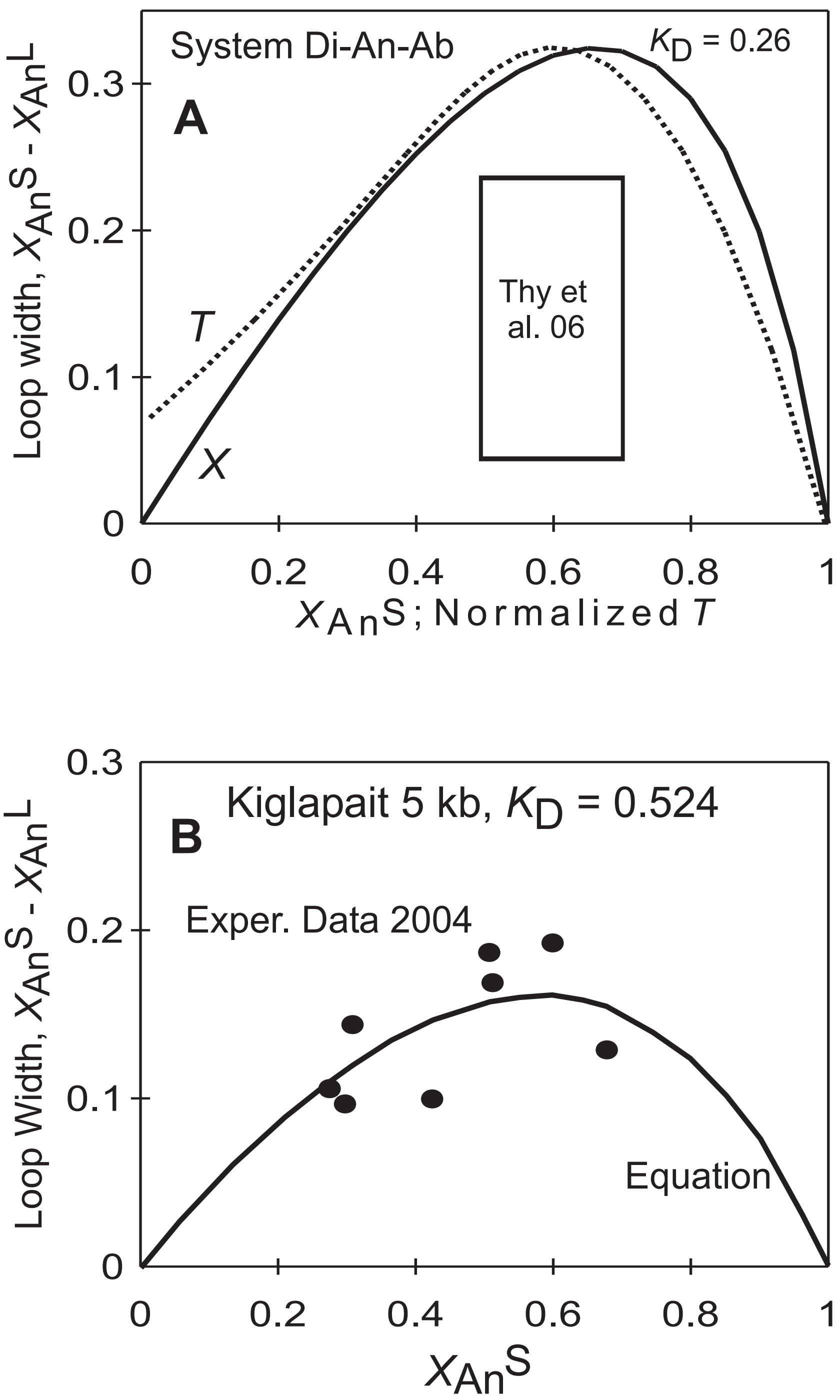


Morse Figure A1



Morse Figure A2