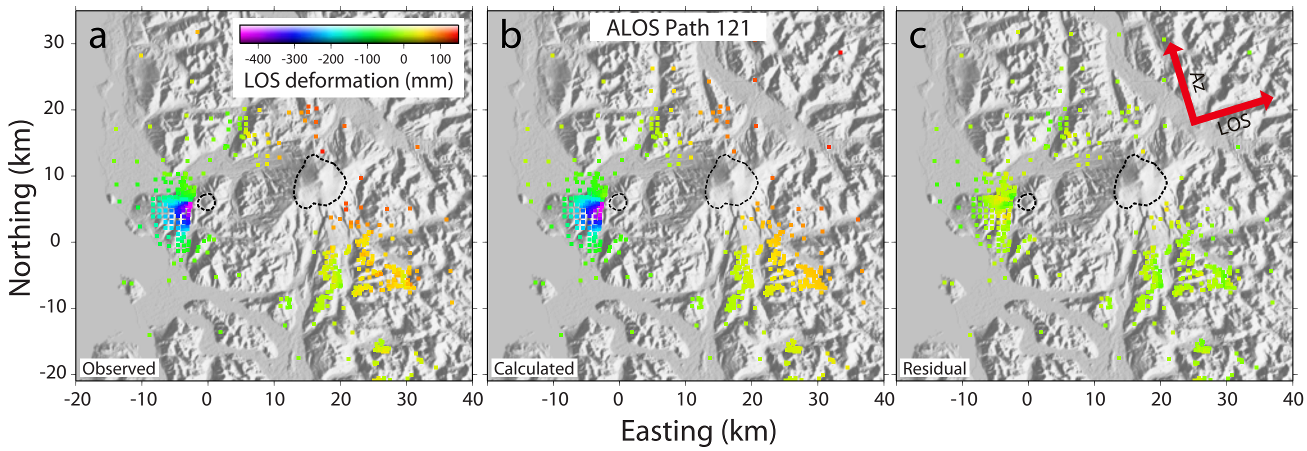

Figure S1 | Comparison of Quadtree parsed data from the ascending path 121 interferogram shown in Fig. 1b and model fit. a, Observed data from Fig. 1b interferogram. **b**, Calculated values for the model shown in Figs. 2c and d. **c**, Residual, observed data (**a**) minus calculated (**b**).

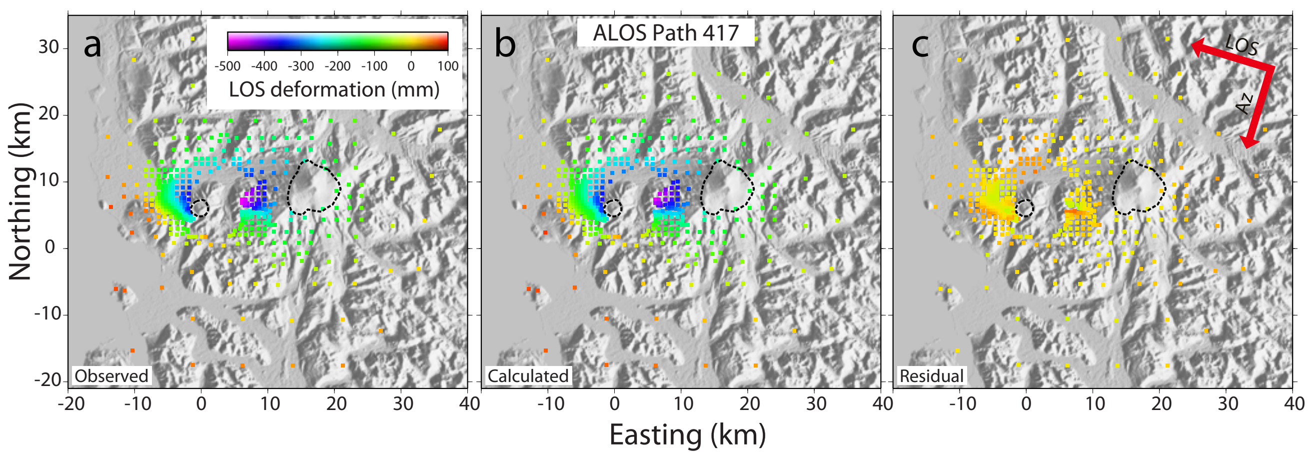

Figure S2 | Comparison of Quadtree parsed data from the ascending path 417 interferogram shown in Fig. 1d and model fit. a, Observed data from Fig. 1d interferogram. **b**, Calculated values for the model shown in Figs. 2c and d. **c**, Residual, observed data (**a**) minus calculated (**b**).

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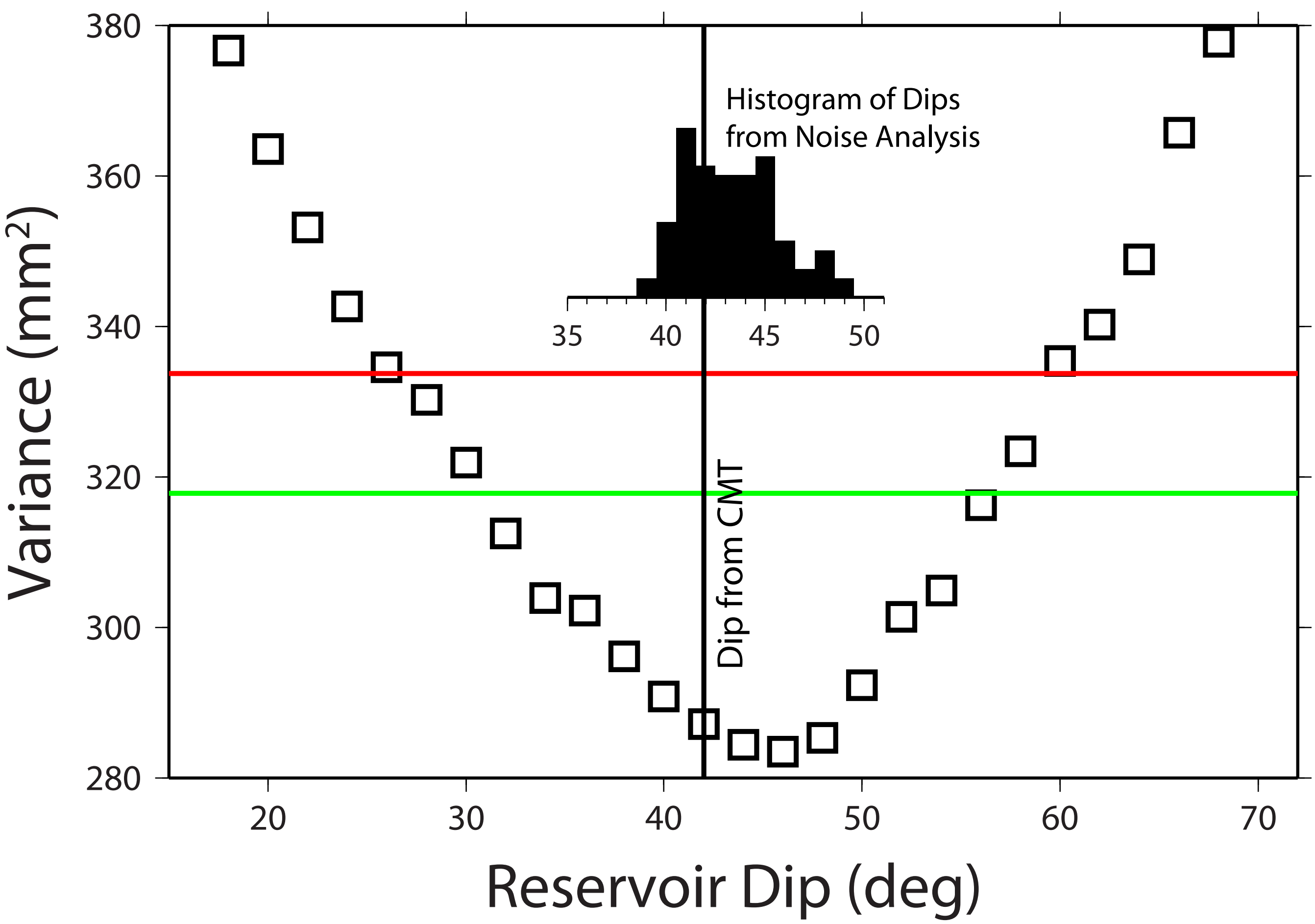

Figure S3 | Variance of residual versus dip of the rhyolite reservoir. Each square symbol shows the variance of the residual for the optimal model where the dip of the reservoir has been held constant while all other parameters for the three deformation sources have been allowed to vary. The result is a well developed minimum near ~45 degrees. With the approximation that the quadtree data points are independent we use an F-test to find the variance that is significantly (at 95% probablility) greater than the variance at the minimum-- the green line shows this variance level. Under this approximation, the dip of the reservoir is between about 31 and 57 degrees. To test the robustness of this estimate, we assume that the number of degrees of freedom is actually half as much as we find for the quadtree data -- the red line shows the resulting 95% level. This results in an estimate for the dip of the reservoir of about 26 to 60 degrees. The dip of a collapsing body that could produce the earthquake in CMT #2 (Table I, Fig. 3c) is about 42 degrees, as indicated by the vertical black line. For comparison, the histogram shows a narrower range of dips that represents optimal models that fit 100 perturbations to the data using the noise covariance matrix[32,33] as discussed in the Methods section.

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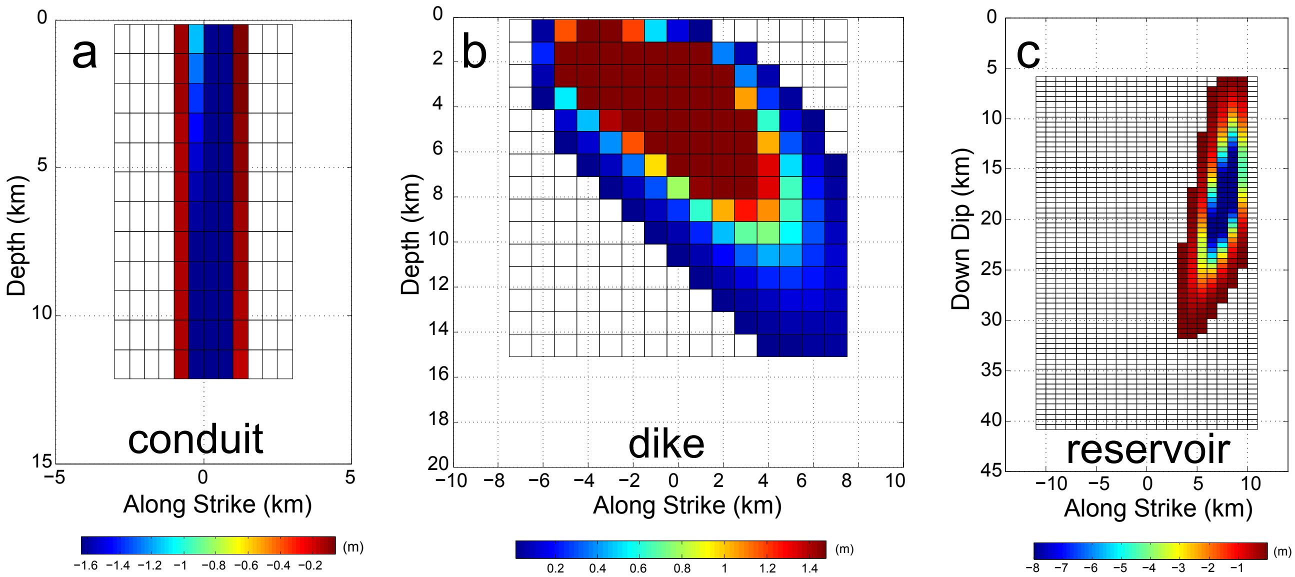

Figure S4 | Details of the three deformation sources shown in Figs. 2c & d, that show the versatility of the 2-D Weibull distribution as defined by Myrhaug and Rue[22]. For each source, cells allowed to be involved in opening (or closing) are outlined with solid black lines. **a**, The conduit. **b**, The dike. **c**, The reservoir.

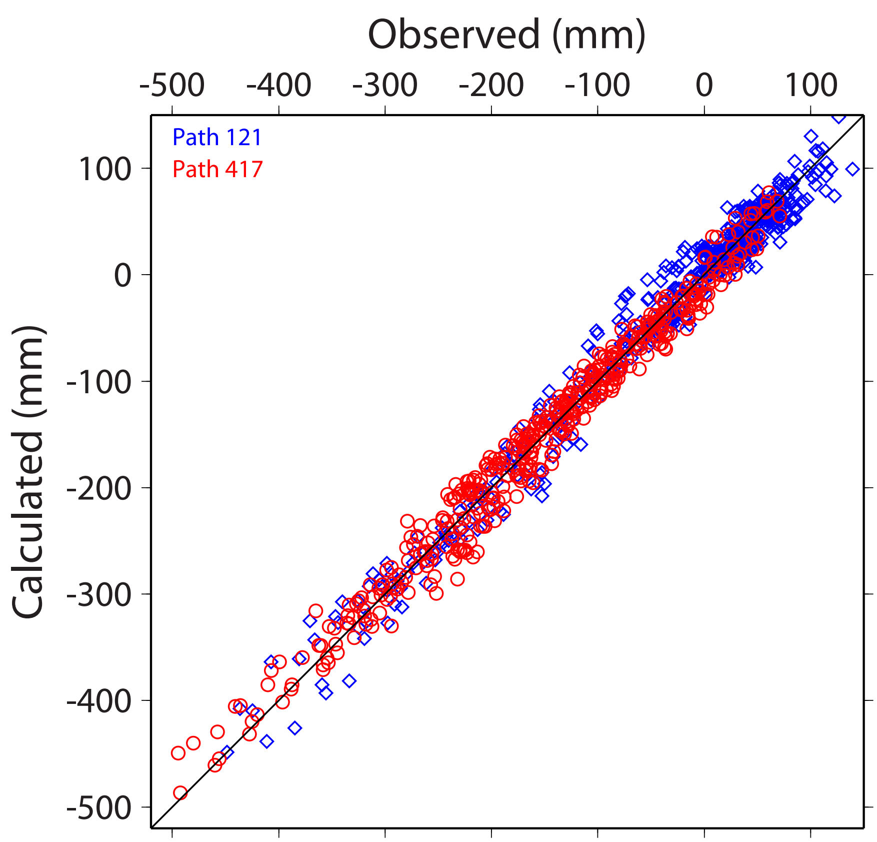

Figure S5 | Scatter plot showning fit of model in Figs. 2c & d to data. The red circles show the quadtree data for the descending Path 417 data (Figs. 1d & S2) and calculated for the model. The blue diamonds show the quadtree data for the ascending Path 121 data (Fig. 1b & S1) and calculated values for the model. If the model fit the data perfectly, all the symbols would plot on the diagonal line.

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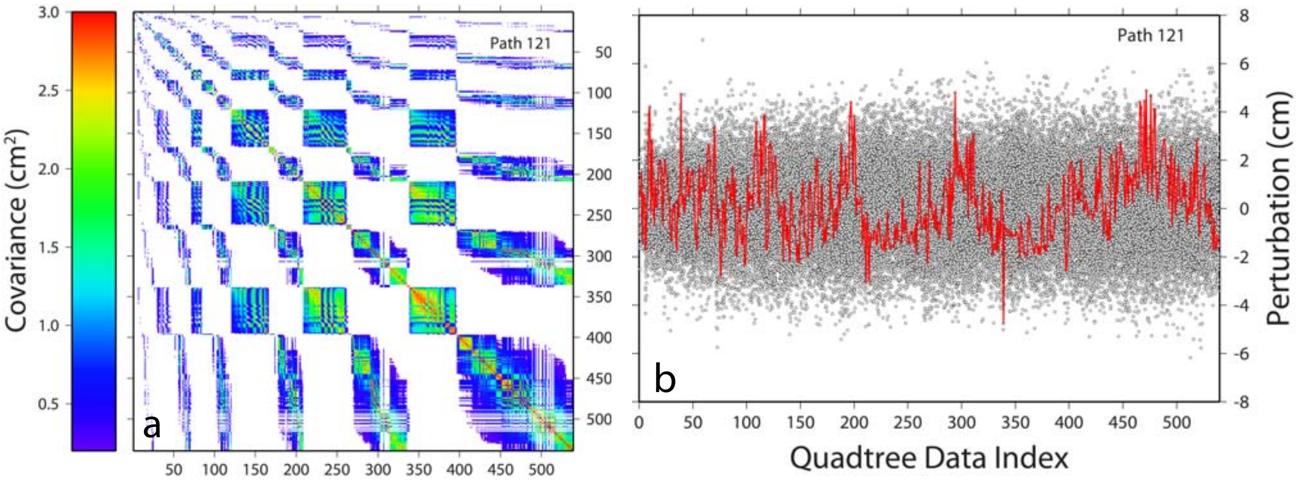

Figure S6 | Noise covariance and resulting perturbations for the 539 quadtree data points in the interferogram in Figs. 1b & S1. a, The covariance matrix for the quadtree data points drawn from the covariance matrix for the full interferogram using the methods in refs. 26 and 32. We used a simple exponential function (see Methods section) as in ref. 33, as an approximation to the observed covariance function with σ^2 = 3.0145 cm^2 and α = 0.29. **b**, One hundred perturbations to the quadtree data used in 100 inversions of the data shown in the histogram in Fig. S3. The red line shows a single realization of the perturbations for all 539 quadtree points.

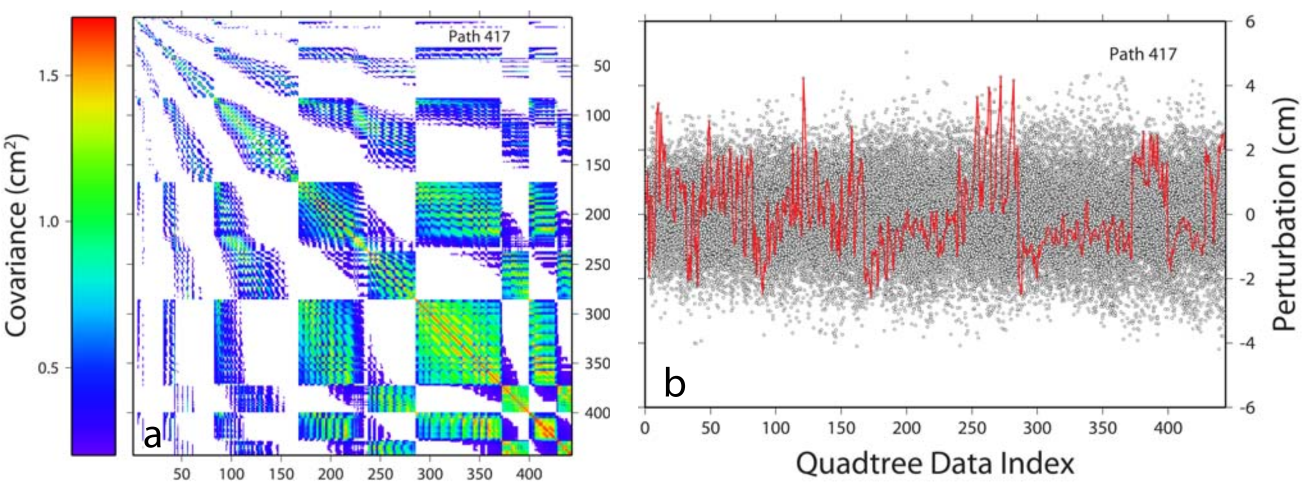

Figure S7 | Noise covariance and resulting perturbations for the 443 quadtree data points in the interferogram in Figs. 1d & S2. a, The covariance matrix for the quadtree data points drawn from the covariance matrix for the full interferogram using the methods in refs. 26 and 32. We used a simple exponential function (see Methods section), as in ref. 33, as an approximation to the observed covariance function with σ^2 = 1.6894 cm^2 and α = 0.21. **b**, One hundred perturbations to the quadtree data used in 100 inversions of the data shown in the histogram in Fig. S3. The red line shows a single realization of the perturbations for all 443 quadtree points.