

Supporting Information for:

Proposed identification criteria of the Martian lower crust and mantle excavated by the Isidis impact.

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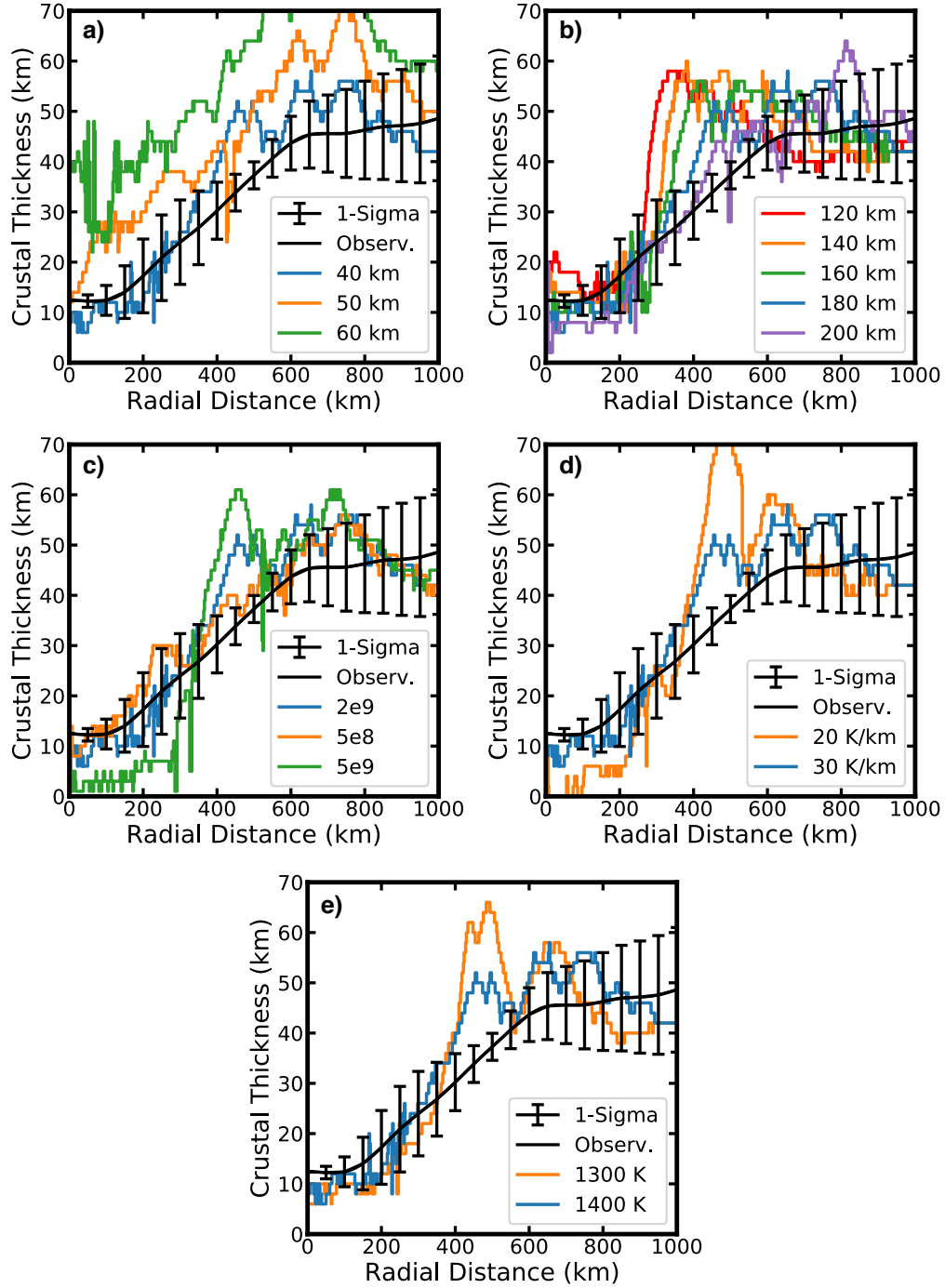


Figure S1. Comparison of observed crustal thickness with all iSALE simulations. The black solid line is the azimuthally averaged observed crustal thickness. Error bars show ± 1 standard deviation (1σ) of crustal thickness values within each radial bin, representing the azimuthal variability at each radius. Observed crustal thickness anomalies derived from the inversion of the NASA GMM-3 Bouguer gravity field from degree 2 up to degree 1002.

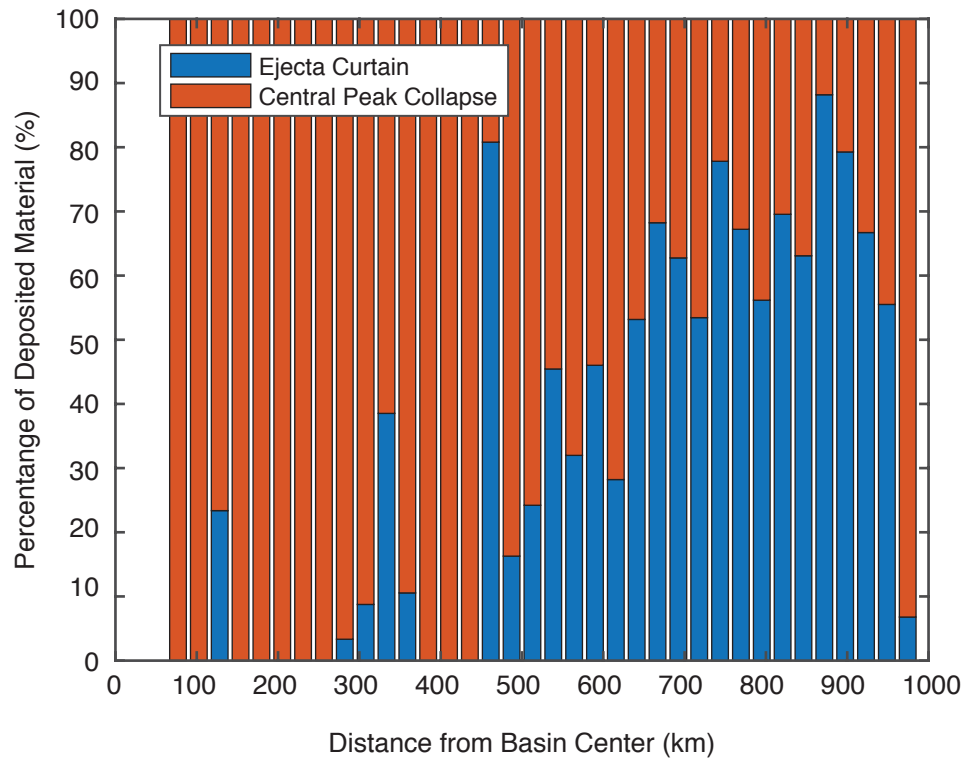


Figure S2. Histogram plot showing the percentage of all excavated mantle material deposited via the central peak collapse (orange); or ejecta curtain (blue). The results are from our best-fit 2D run.

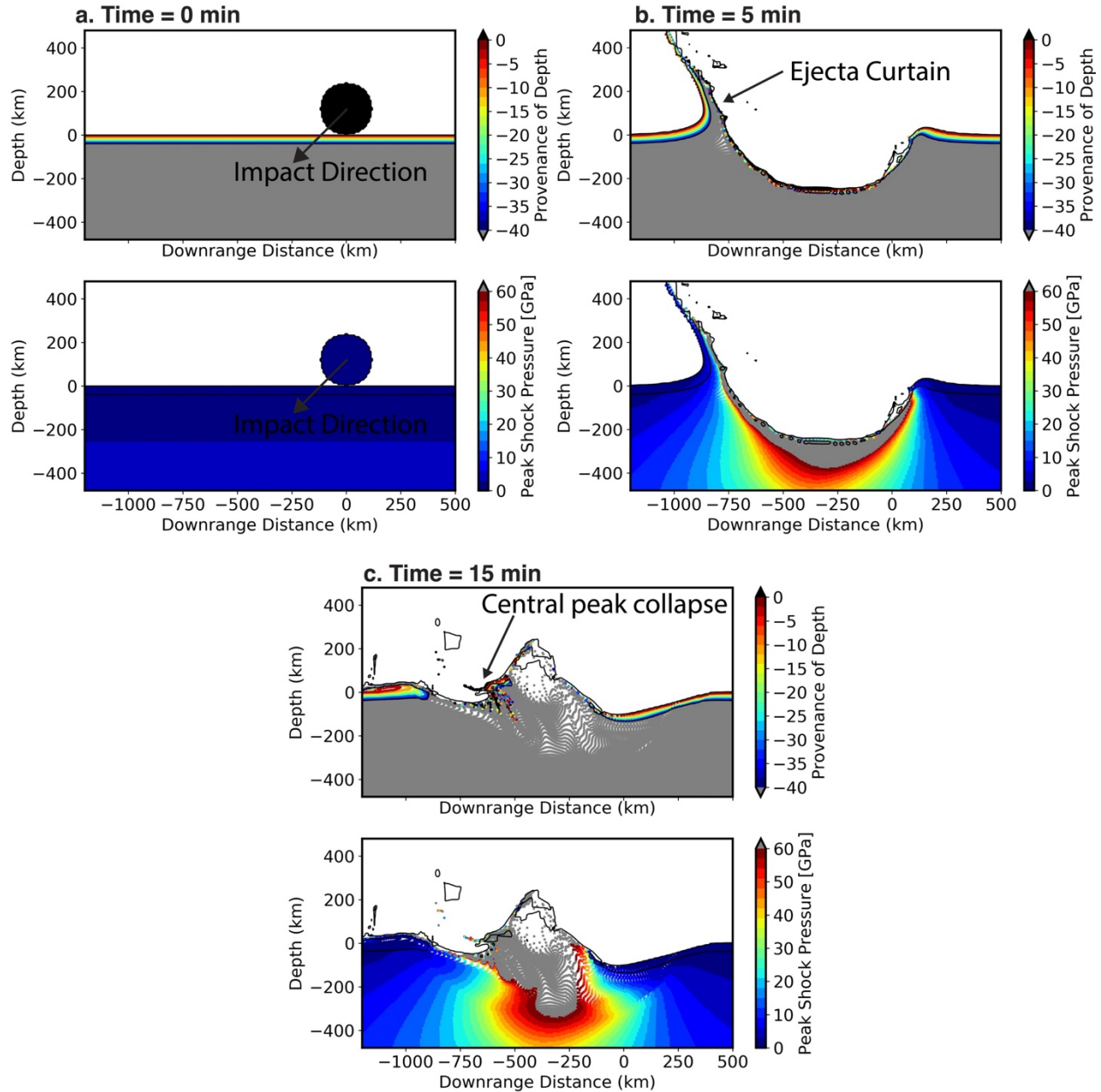


Figure S3. Cross section of 3D iSALE Lagrangian tracer particle for the front facing tracers. Output from a 240 km diameter dunite impactor with an impact velocity of 12 km/s, 45° impact angle, geothermal gradient of 30 K/km, and pre-impact crustal thickness of 40 km. Color indicates crust while gray indicates mantle material. Tracers from >40 km depth are plotted on top of other tracers to emphasize mantle material.

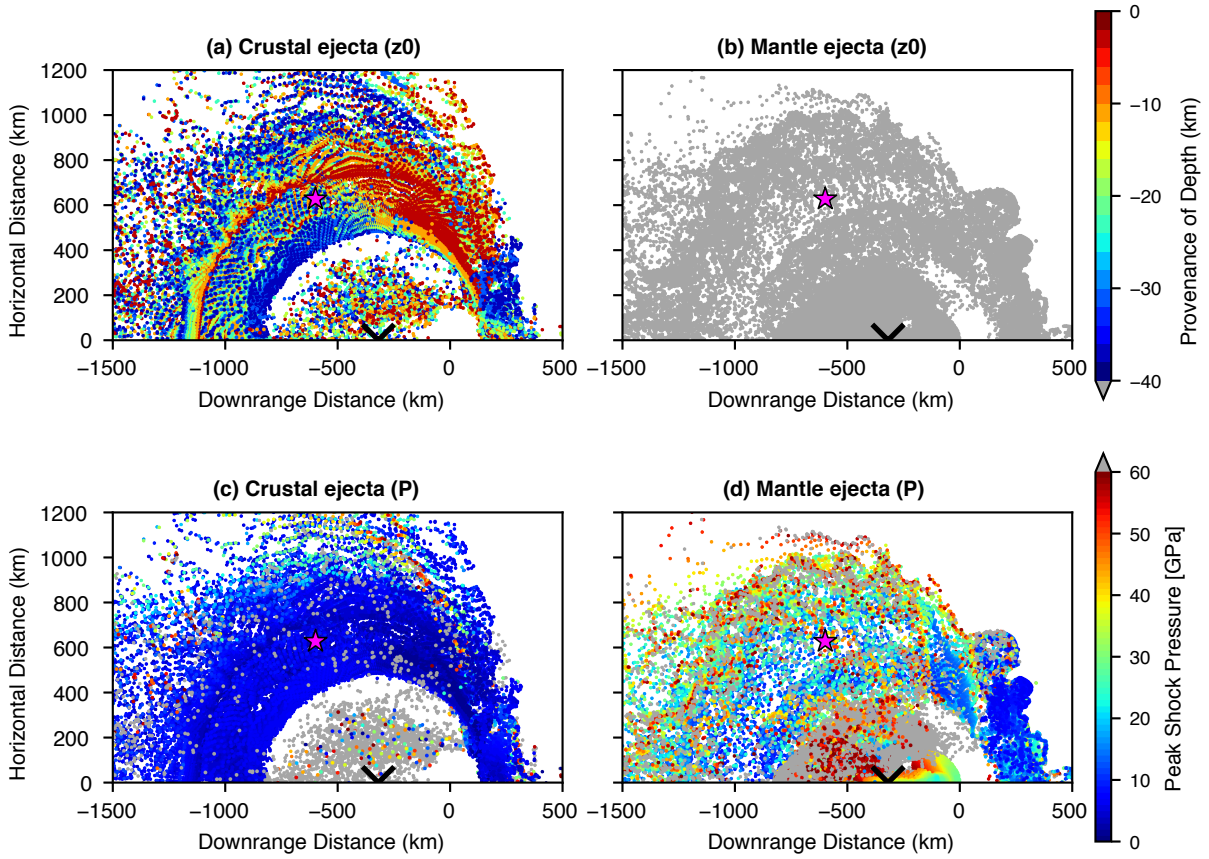


Figure S4. Top-down view of Lagrangian tracer particle for our best-fit 3D iSALE run. Subfigures are excavated a) crust colored by provenance of depth; b) mantle material colored by provenance of depth; c) crust colored by peak shock pressure; and d) mantle material colored by peak shock pressure. Magenta star marks Jezero crater. Center of simulated center marked by black X. Tracers are organized so material corresponding to highest peak shock pressure is plotted on top.

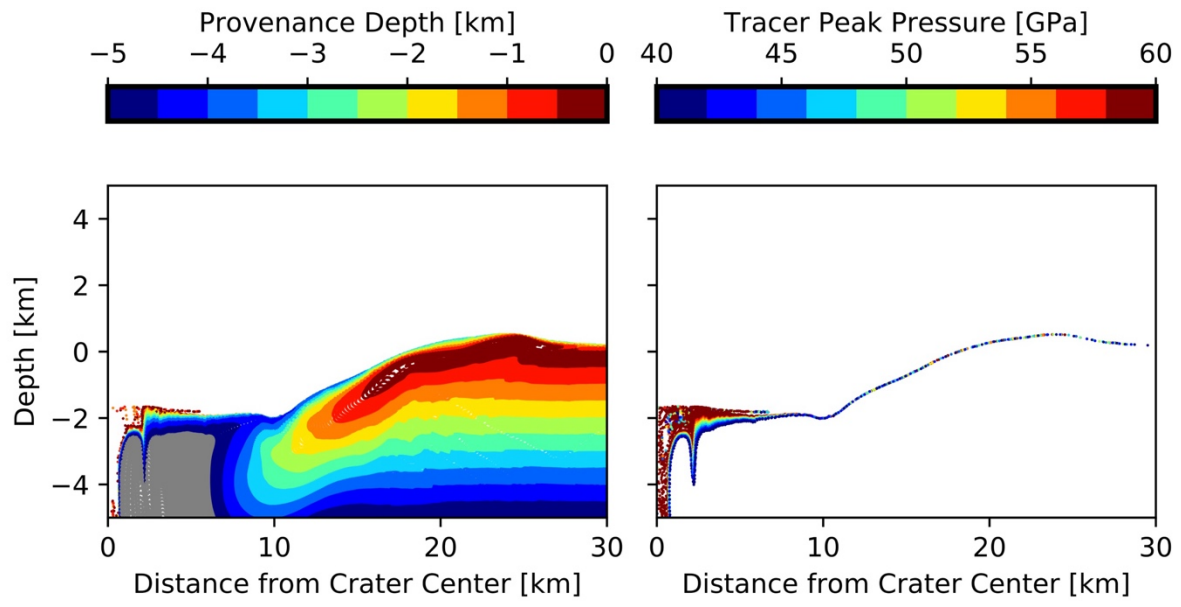


Figure S5. Cross section of 2D iSALE Lagrangian tracer particle for a Jezero crater sized simulation: 4 km diameter dunite impactor with an impact velocity of 9 km s^{-1} .

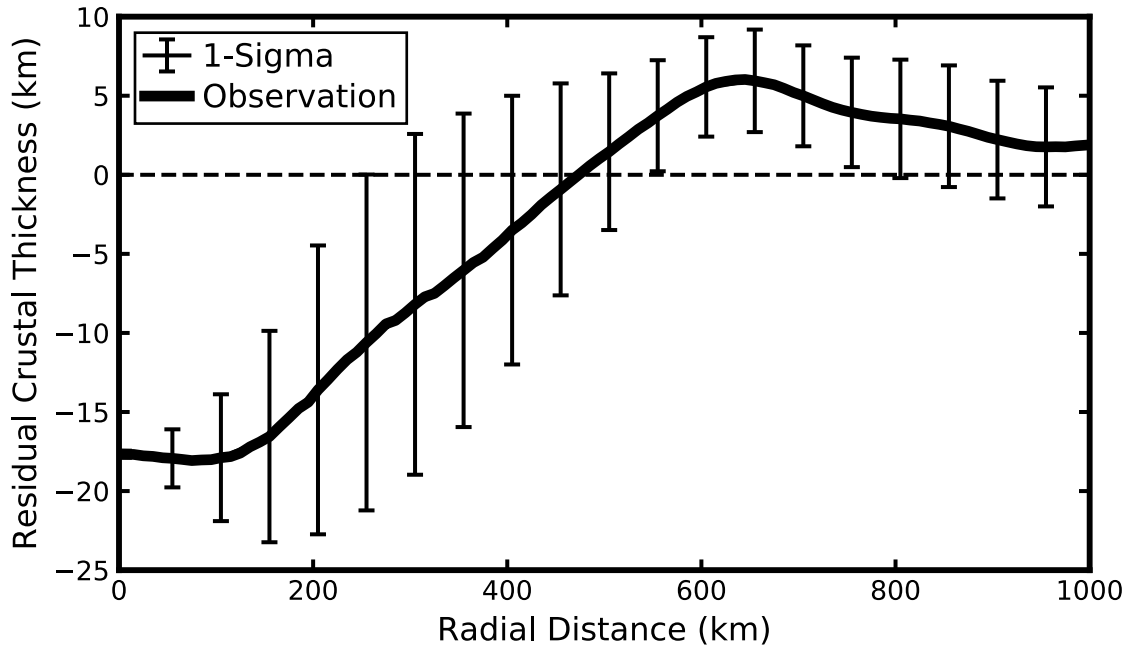


Figure S6. Azimuthally averaged residual crustal thickness as a function of radial distance from the Isidis basin center after removal of long-wavelength spherical harmonic components ($\ell < 12$). Positive residual values indicate crust thicker than the regional background, whereas negative values indicate thinner-than-background crust. Error bars show ± 1 standard deviation (1σ) of crustal thickness values within each radial bin, representing the azimuthal variability at each radius. The crustal thickness model is derived from the NASA GMM-3 gravity field and MOLA topography.