Supplementary Information about
Kinetic deflection change due to target global curvature as revealed by NASA/DART

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ABSTRACT

This Supplemental Information material contains three supplementary tables. Supplementary Table S.1 provides the parameters for iSALE simulations and π-scaling relationship analysis. Supplementary Table S.2 shows the spacecraft and Dimorphos orientations at the time of impact. Supplementary Table S.3 compiles the parameters for the catastrophic disruption thresholds.

Supplementary Tables

Table S1. Parameters for comparison tests. π-scaling parameters K_1 and μ assume dry sands and rocks. The uncertainties provided are 1σ.

Quantity	Notations	Value		Units
	[-]	Impactor	Target	
Equivalent diameter	[-]	2.4	150	m
Impact speed	[-]	6	0	km/s^3
Total mass	[-]	580	3.4×10^9	kg
Bulk density	ρ	107	1,925	kg/s^3
Cohesive strength	Y	1	1	Pa
Maxwell-Z model[a]				
π-scaling parameter	K_1	[-]	0.22 ± 0.02	[-]
π-scaling parameter	μ	[-]	0.47 ± 0.07	[-]
iSALE-2D simulations				
Material	[-]	Aluminium	Basalt	[-]
Equation of state	[-]	Tillotson[b]	Tillotson[c]	[-]
Strength model	[-]	Johnson-Cook	LUNDD	[-]
Poisson ratio	[-]	0.33	0.25	[-]
LUND strength parameters[d]				
Strength at zero pressure	[-]	[-]	1	Pa
Strength at infinite pressure	[-]	[-]	3.5	GPa
Internal friction coefficient (damaged)	[-]	[-]	0.55	Pa
Johnson-Cook strength parameters[e]				
Strain coefficient A	[-]	244	[-]	MPa
Strain coefficient B	[-]	488	[-]	MPa
Strain exponent	[-]	0.50	[-]	MPa
Strain rate coefficient	[-]	0.02	[-]	MPa
Thermal softening	[-]	1.7	[-]	MPa
Porosity model parameters[f]				
Initial porosity	[-]	[-]	45%	[-]
Initial distension	[-]	[-]	1.80	[-]
Distension at transition to power-law	[-]	[-]	1.00	[-]
Elastic volumetric strain threshold	[-]	[-]	-1.88×10^{-9}	[-]
Exponential compaction rate	[-]	[-]	0.99	[-]

[a](24); [b](72); [c](73); [d](45); [e](74); [f](46)   .

Table S2. Unit vector quantities for orbital motions of Dimorphos and spacecraft at the DART impact. The along-track unit vector of Dimorphos is given on September 26, 2022, at 23:14:24.183 UTC. DART's incident unit vector and negative $(-)$ solar panel unit vector are given on September 26, 2022, at 23:14:24 UTC because of the unavailability of data samples at the actual impact time.

Quantity	Notation	Value	Units	Frame
Dimorphos along-track unit vector, x	x_{Dimo}	-1.0902×10^{-1}	[-]	Dimorphos
Dimorphos along-track unit vector, y	y_{Dimo}	9.9404×10^{-1}	[-]	Dimorphos
Dimorphos along-track unit vector, z	z_{Dimo}	2.1239×10^{-14}	[-]	Dimorphos
DART incident unit vector, x	x_{DART}	-1.7299×10^{-1}	[-]	Dimorphos
DART incident unit vector, y	y_{DART}	9.7050×10^{-1}	[-]	Dimorphos
DART incident unit vector, z	z_{DART}	1.6794×10^{-1}	[-]	Dimorphos
$-$ DART solar panel unit vector, x	x_{SPne}	2.5866×10^{-2}	[-]	Dimorphos
$-$ DART solar panel unit vector, y	y_{SPne}	-1.6145×10^{-1}	[-]	Dimorphos
$-$ DART solar panel unit vector, z	z_{SPne}	9.8654×10^{-1}	[-]	Dimorphos

Table S3. Empirical parameters to compute scaling functions of strength, σ_T, and disrupting target radius, $R_{Q_D^*}$. The provided values for Equations (20, 23, 24) are based on earlier work (49, 79). The results gives $R_{Q_D^*}$ and Y for the three bulk densities: 1000 kg/m^3, 2000 kg/m^3, and 4000 kg/m^3.

Parameters	Units	Pumice (strength)	Basalt (strength)	Strengthless
Equation (20)				
Q_0	J/kg	1.0×10^4	2.9×10^3	[-]
a_s	[-]	-0.45	-0.35	[-]
b_s	[-]	1.22	1.29	[-]
B	Jm^3/kg^2	5.70×10^{-7}	1.50×10^{-7}	[-]
Equation (23)				
m	[-]	9.5	9.5	[-]
$\sigma_T(1.5cm)$	MPa	3.2	32	[-]
Equation (24)				
a_g	J/(m^{3}s$^{-2+3\mu_g}$)	[-]	[-]	1.0×10^{-4}
μ_g	[-]	[-]	[-]	0.39
Results				
$R_{Q_D^*}$ (1000 kg/m^3)	m	16	16	53
$R_{Q_D^*}$ (2000 kg/m^3)	m	13	13	42
$R_{Q_D^*}$ (4000 kg/m^3)	m	10	10	33
Y (1000 kg/m^3)	MPa	0.37	4.4	0.01
Y (2000 kg/m^3)	MPa	0.39	4.7	0.01
Y (4000 kg/m^3)	MPa	0.42	5.1	0.01