SAMPLE DELIVERABLE

TECHNICAL REPORT · TERRAIN & VOLUME ANALYSIS

Lava Flow Volume Assessment

SP Crater lava flow, San Francisco Volcanic Field, Arizona

PREPARED BY
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REPORT VERSION
1.0

COORDINATE SYSTEM
WGS 84 / UTM 12N (EPSG:32612)

DATA SOURCE
Drone SfM survey

1. Summary

The SP Crater lava flow covers **12.1 km²** and has an estimated volume of **0.29 km³**, with a mean thickness of 24 m. Volume was calculated by differencing a 3.77 m drone-derived elevation model against an interpolated pre-eruption surface. The result is 11% below the published estimate of 0.33 km³ (Harburger et al.). The largest uncertainty is the buried base surface: each 1 m of systematic error in it changes the volume by 0.012 km³ (about 4%).

0.29 km³	12.1 km²	24 m	±4% / m
Flow volume	Flow area with thickness data	Mean thickness	Sensitivity to base bias

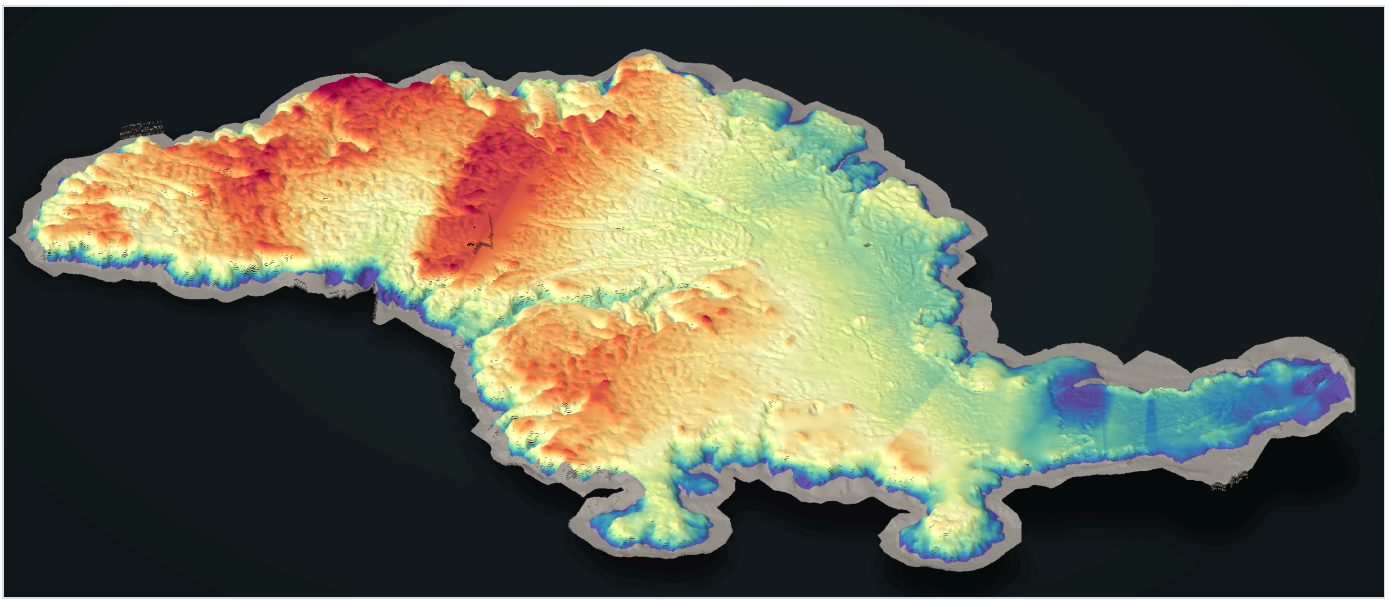

Figure 1. Drone-derived elevation model of the SP Crater flow, coloured by calculated thickness (0–50 m, Spectral ramp). 3× vertical exaggeration.

2. Data and methods

Input	Details
Drone imagery	2,622 images; 8.43 cm ground resolution; 22.2 km² coverage
Photogrammetry	Agisoft Metashape; reprojection error 0.61 px; dense point cloud and DEM
Elevation model	3.77 m grid, resampled to UTM zone 12N
Positioning	Onboard GNSS, no ground control; average camera-position error 4.97 m
Flow outline	Digitized margin, 12.4 km²

1. **Processing.** Images aligned and processed into a dense point cloud and DEM in Agisoft Metashape, then reprojected to UTM zone 12N.
2. **Flow outline.** Flow margin digitized from the DEM and hillshade in QGIS.
3. **Base surface.** Pre-eruption topography reconstructed by interpolating terrain just outside the margin across the flow (triangulated irregular network, TIN).
4. **Thickness and volume.** Thickness = DEM − base surface for each cell; volume = sum of thickness × cell area (14.19 m² per cell).
5. **Check.** Result compared with a published volume estimate and tested for sensitivity to base-surface error.

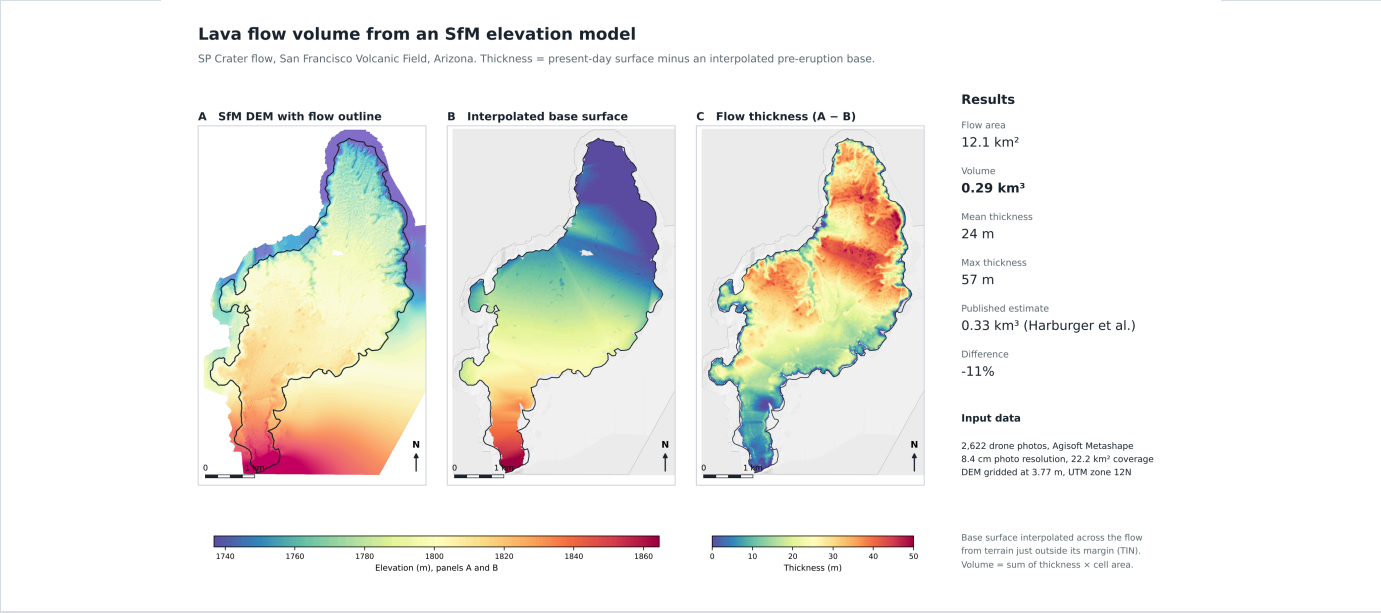

Figure 2. (A) Drone DEM with flow outline, (B) interpolated base surface, (C) thickness map.

3. Results

Measure	Value	Notes
Area with thickness data	12.05 km²	97% of the digitized outline
Volume	0.293 km³	293 million m³
Thickness, mean / median	24.3 m / 25.1 m	
Thickness, 5th–95th percentile	4.3–41.7 m	Maximum 57.7 m in the central lobe
Published estimate	0.33 km³	Harburger et al.; this study −11%

4. Quality assurance and limitations

Check	Result
Base-surface sensitivity	±1 m systematic bias in the base changes volume by ±0.012 km³ (±4%). This is the main source of uncertainty.
Coverage gaps	3% of the outlined area has no thickness value (data voids). Filling it at the mean thickness would add about 0.008 km³.
Negative thickness	1% of cells are below the interpolated base, mostly at the flow margin where the base meets the surface. Retained in the total.
Absolute position	No ground control; ~5 m average camera-position error. This shifts the model as a whole and has little effect on thickness, which is a relative measurement.
Independent comparison	Within 11% of the published estimate, consistent with the expected base-surface uncertainty.

Recommendations. Add surveyed ground control in any repeat survey; test alternative base-surface interpolations (TIN, spline, kriging) and report the spread as a volume range; use the 0.29 km³ value with its ±4%-per-metre sensitivity as input to flow simulations.

5. Delivered files

Folder	What it contains	Format
Elevation	Digital elevation model (3.77 m)	GeoTIFF
	Hillshade	GeoTIFF
	Dense point cloud	LAZ
Analysis	Pre-eruption base surface	GeoTIFF
	Lava flow thickness (metres)	GeoTIFF
	Flow outline with area	GeoPackage
Maps	3D thickness figure	PNG
	Volume method map sheet	PDF, print-ready
Report	Volume assessment report (this document)	PDF
	Photogrammetry processing report	PDF
Guide	File list, coordinate system, units and contact	Text

All rasters in WGS 84 / UTM zone 12N (EPSG:32612), elevations in metres. Formats can be matched to the client's software (Esri, QGIS, AutoCAD Civil 3D).