THE KAMIL CRATER (EGYPT): A TYPE STRUCTURE FOR SMALL IMPACT CRATERS ON EARTH

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The Kamil crater is a small (45 m in diameter) impact crater in southwestern Egypt (22°01'06"N, 26°05'16"E) that was discovered by Vincenzo de Michele (formerly Civico Museo di Storia Naturale, Milan, Italy) and subsequently investigated by our research group through the first Italian-Egyptian geophysical survey in 2010 and subsequent laboratory work [1–8].

The data set gathered so far provides a nearly full characterization of the impact structure and projectile (Table 1) and documents that Kamil crater is a nearly pristine structure generated by the hypervelocity impact of a small iron meteorite. As such, Kamil Crater can be considered as a type structure that could serve as ground-truth for experimental and numerical models for small impact craters on Earth. Note, for instance,,that most of our data about shock metamorphism and the physical-chemical interaction between target and projectile during impact melting at Kamil Crater [5, 8] are consistent with those obtained in analog hypervelocity impact cratering experiments by the MEMIN project [9, 10], thereby validating their experimental set up and results, at least for small-scale impacts generated by iron meteorite bodies. The aim of our paper is thus to stimulate interest in the Kamil Crater and seek for cooperative efforts to merge our field and laboratory data with experiments and numerical models.

Table 1. Summary table listing the main features of Kamil Crater.

Attribute	*Description*	*Attribute*	*Description*
Target [4]		**Projectile** [3, 4, 6, 8]	
Surface type	Rocky desert	Meteorite name	Gebel Kamil
Surface topography	Flat, ~ 600 m a.s.l.	Projectile class	iron meteorite (ungrouped ataxite)
Rock type	Sandstones (quartzarenite, minor wacke)	Shrapnel mass on the surface (recovered/identified/inferred)	~700/~1700/~3400 kg
Bedding	Subhorizontal	Total impactor mass estimate	8283 kg
Formation	Gilf Kebir Formation (Cretaceous)	Shrapnel maximum concentration and distance	SSE, ~1.6 km E of crater
		Microscopic impactor debris (concentration and extension)	up to ~400 m SSE-SSW of crater, ~300,000 m^2
Crater morphology and morphometric parameters[1] [4]		Preatmospheric mass (CN-Noble Gases)	>20 t (most likely 50-60 t)
Type	Simple crater		
Shape	Bowl-shaped, circular	**Shock metamorphism** [5, 8]	
Final diameter, D_{fr}	45 ± 2 m	Whole rock impact melt	scattered cm-µm-sized masses/particles
Crater rim height, h_{fr},	3 ± 0.7 m	Mineral melt	lechatelierite
Crater floor depth, d_{fr}	~10 m	Diaplectic glass	silica phase
d_{fr}/D_{fr}	~0.22	Melt veins	Si-Al rich glass
Excavated depth	~7 m	HP phases	coesite, stishovite (?)
Excavated volume	~3800 m^3	Other shock features	(ill-developed) shatter cones
Breccia lens thickness, t_{br}	6 m	Peak Pressure	30 - 60 GPa
Transient crater diameter, D_{tc},	≤35 ± 2 m	Peak post shock temperature	>1600 °C
Transient crater depth, d_{tc},	~13 m, bottom off-center to the SE	Impact velocity (vertical component)	3.5 to 5.5 km sec^{-1}
Transient crater volume	≤5300 m^3		
d_{tc}/D_{tc}	~0.37	**Impactor trajectory [4]**	
Ejecta distribution	Rayed, asymmetric (mainly due SE of crater)	Incident direction and angle	from the northwest (305–340° N), 30-45°
Age [2,11]			
Geomorphological evidence	Holocene		
Archeological evidence	<5000 yrs		
TL dating	2000 BCE - 500 CE		

[1] Crater morphometric parameters following definitions by [12].

References

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