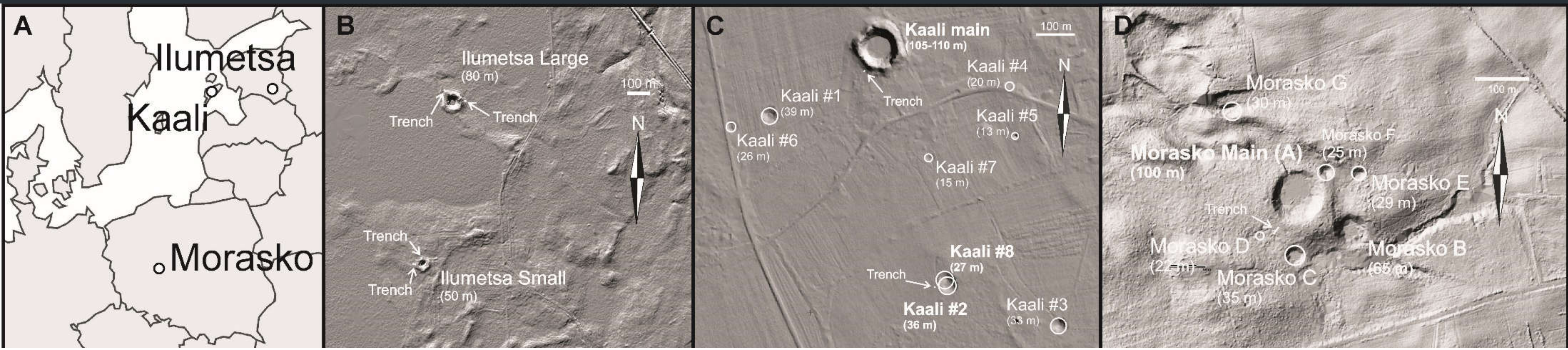
ENVIRONMENTAL EFFECTS OF VERY SMALL CRATER FORMATION

wildFIRE Lab

A. Losiak[1,2], C. Belcher[1],

J. Plado[3], A. Jõeleht[3], C. D. K. Herd[4], R. S. Kofman[4], M. Szokaluk[5], W. Szczuciński[5], A. Muszyński[5], M. Szyszko, E. M. Wild[6]

[1]wildFIRE Lab, Hatherly Laboratories, University of Exeter, UK; [2]Institute of Geological Sciences, PAS, Poland; [3]Department of Geology, University of Tartu, Estonia, [4]Institute of Geology, Adam Mickiewicz University in Poznan; [6]VERA Laboratory, Faculty of Physics, University of Vienna;

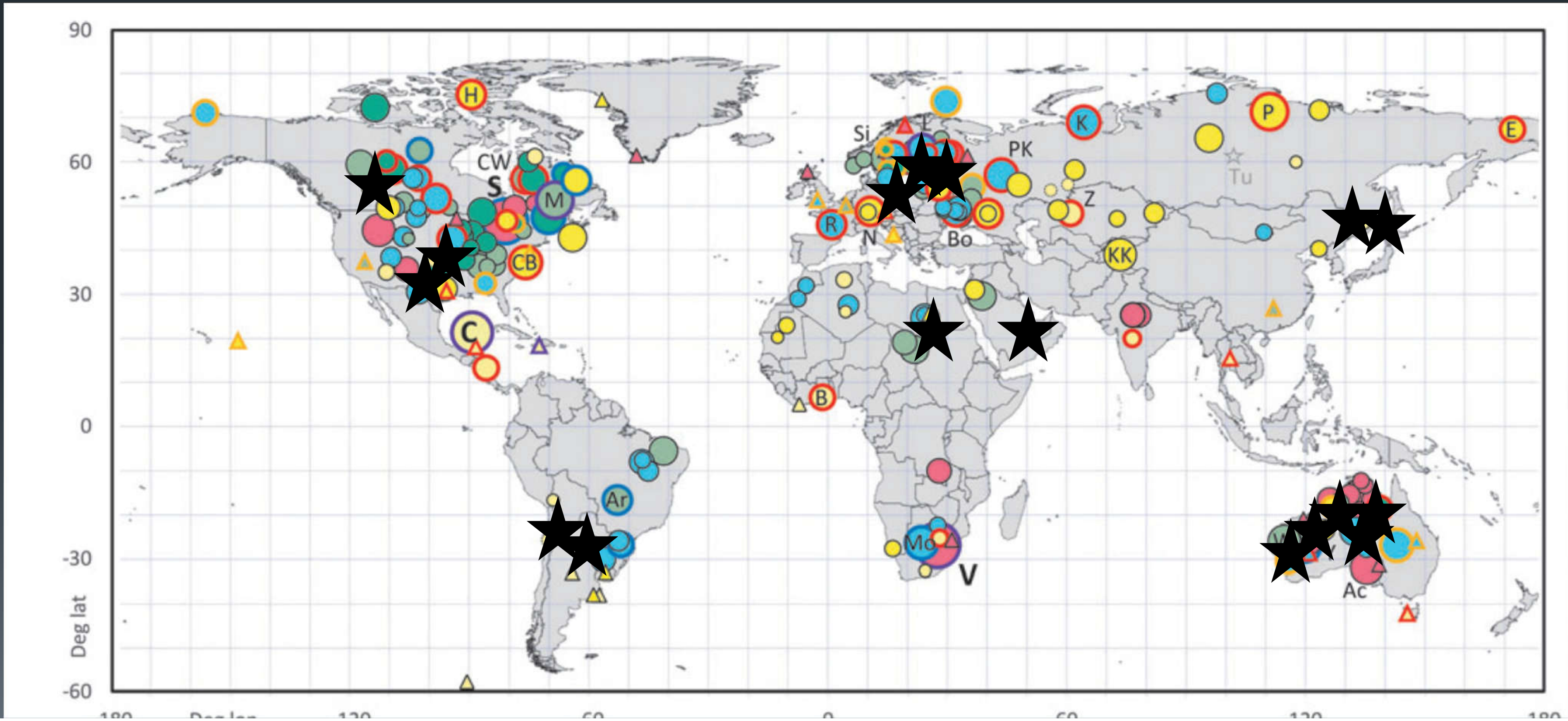



Chixulub
10 km asteroid
180 km crater

What about very small craters?

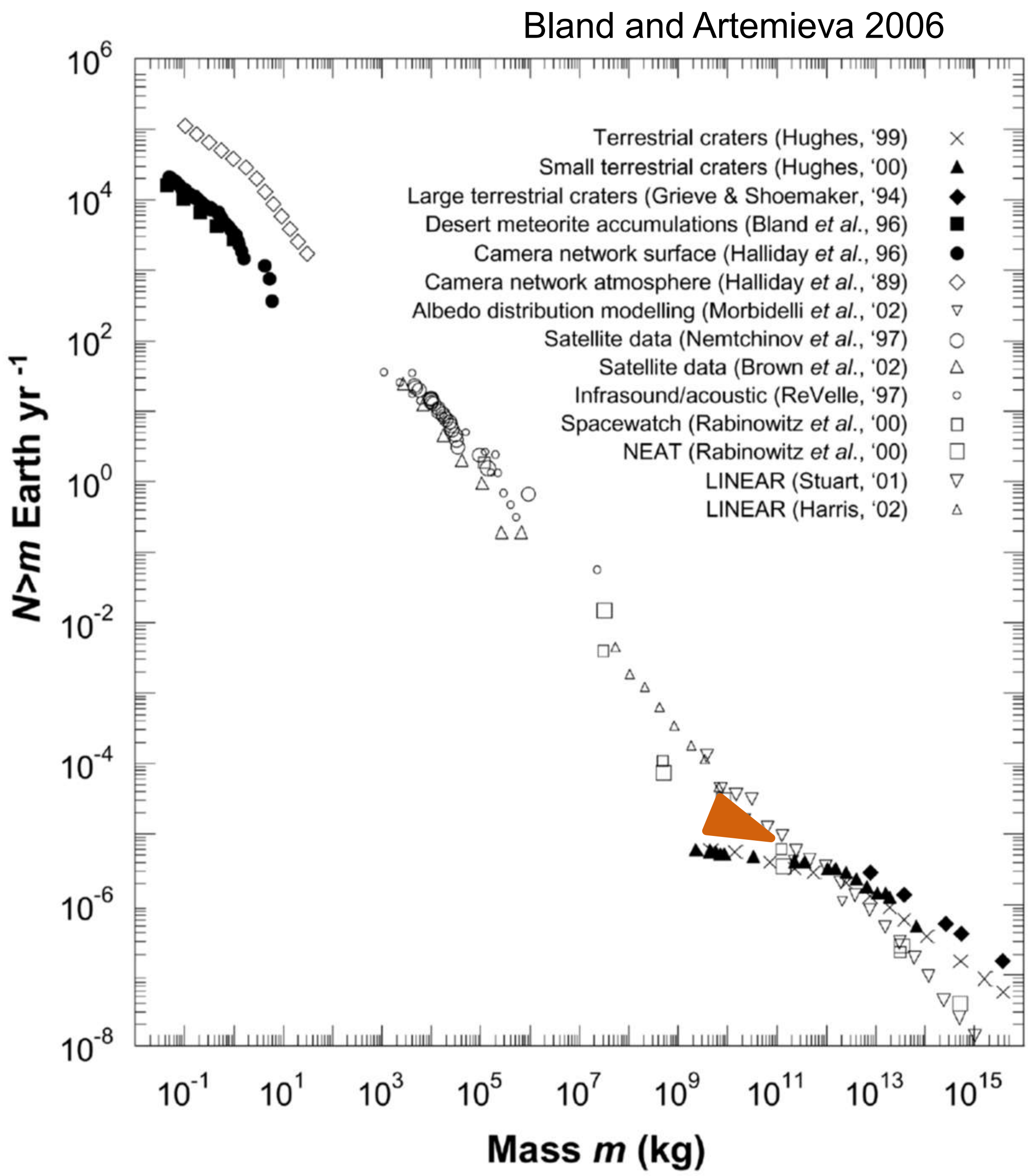
- 17 known craters <200 m

Schmieder and Kring 2020



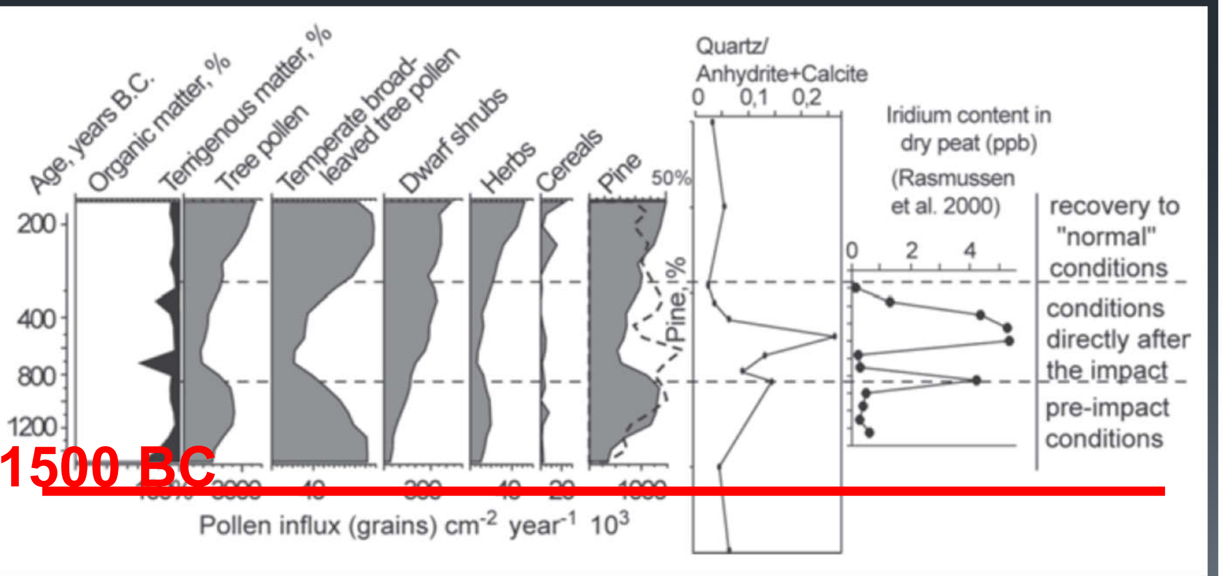
What about very small craters?

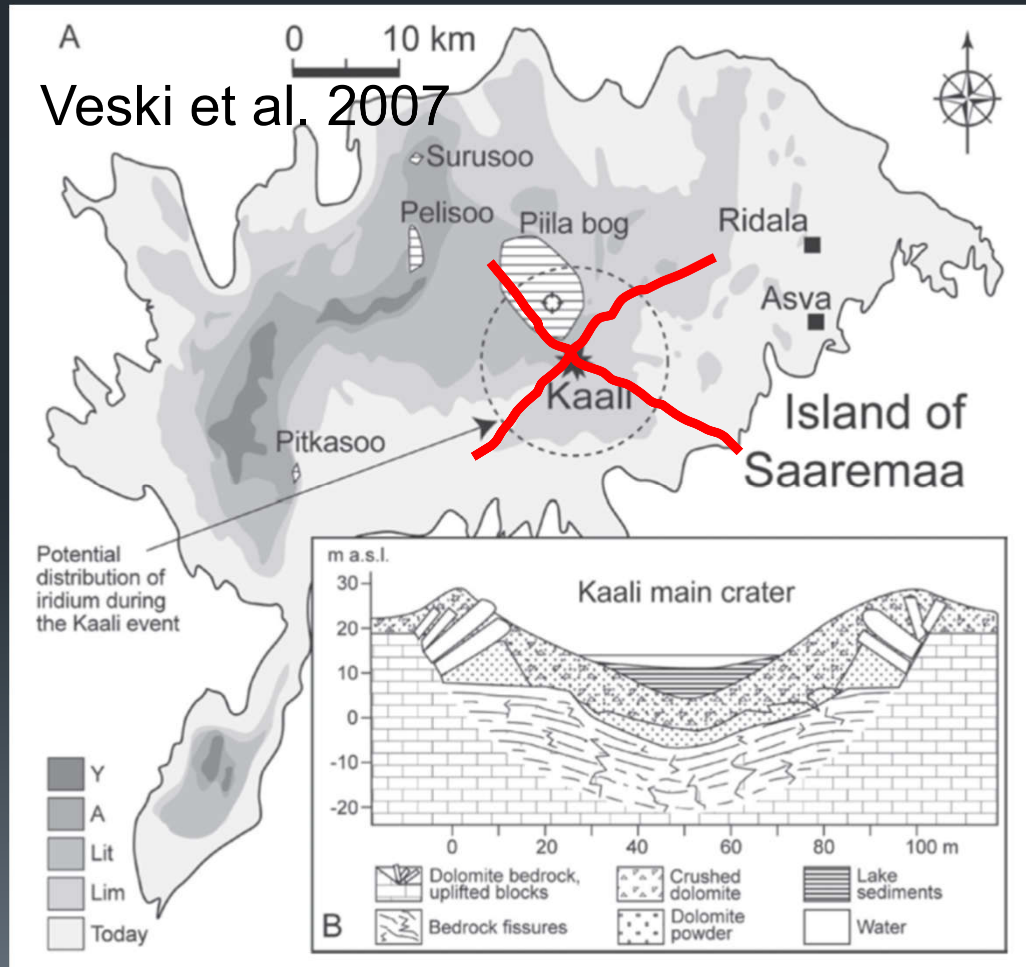
- 17 known craters <200 m
- Should be >20 Holocene ~100m craters
  - There are 5 (80-120m)



Environmental effects: Kaali

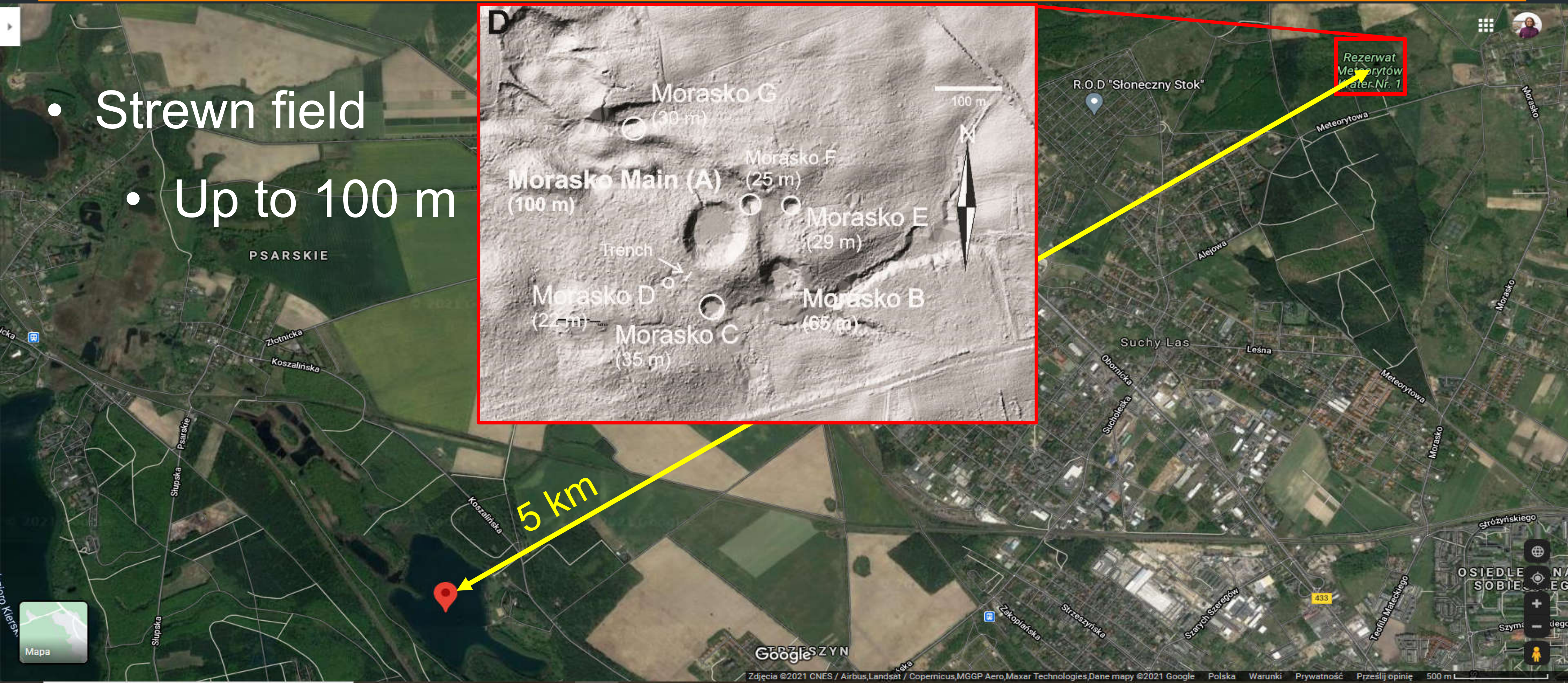
- Strewn field
  - Up to 100 m





Environmental effects: Morasko

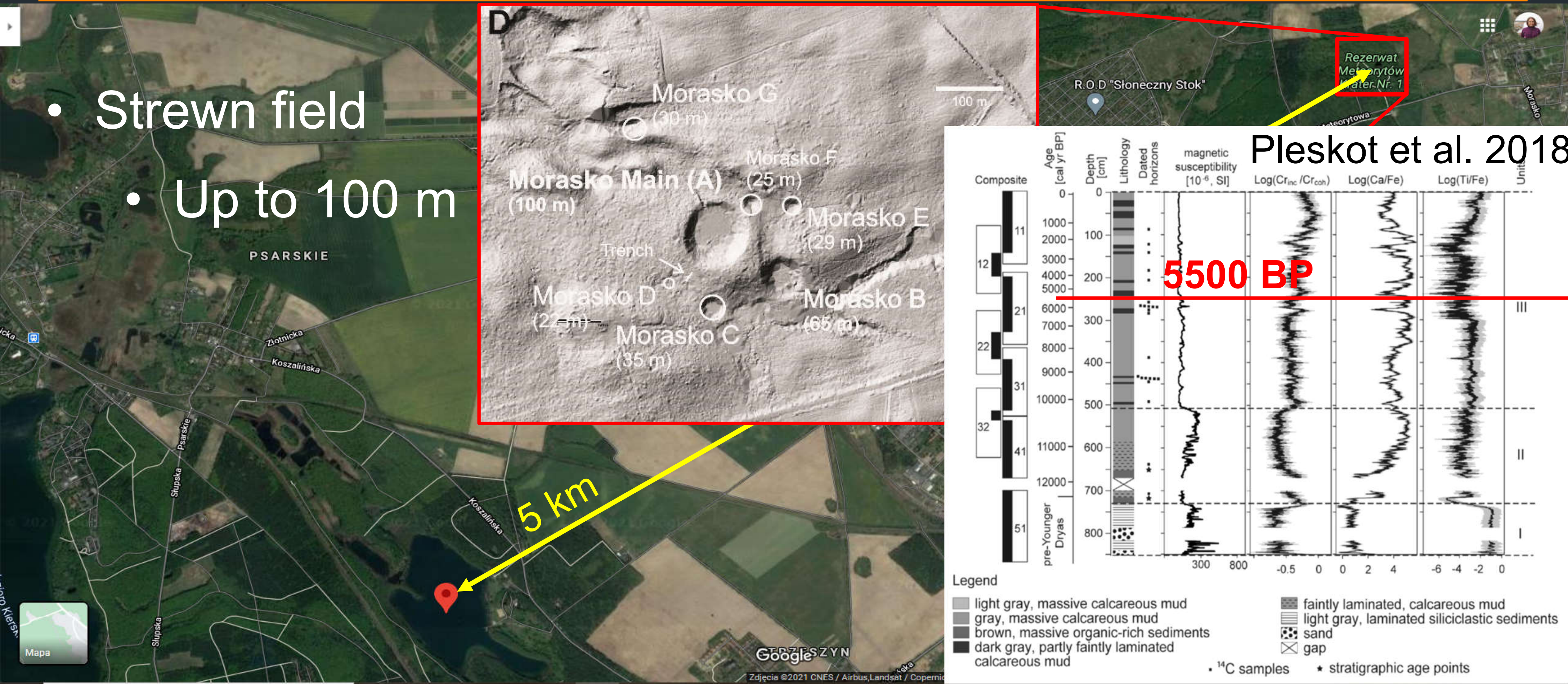
- Strewn field
  - Up to 100 m



Environmental effects: Morasko

wildFIRE lab

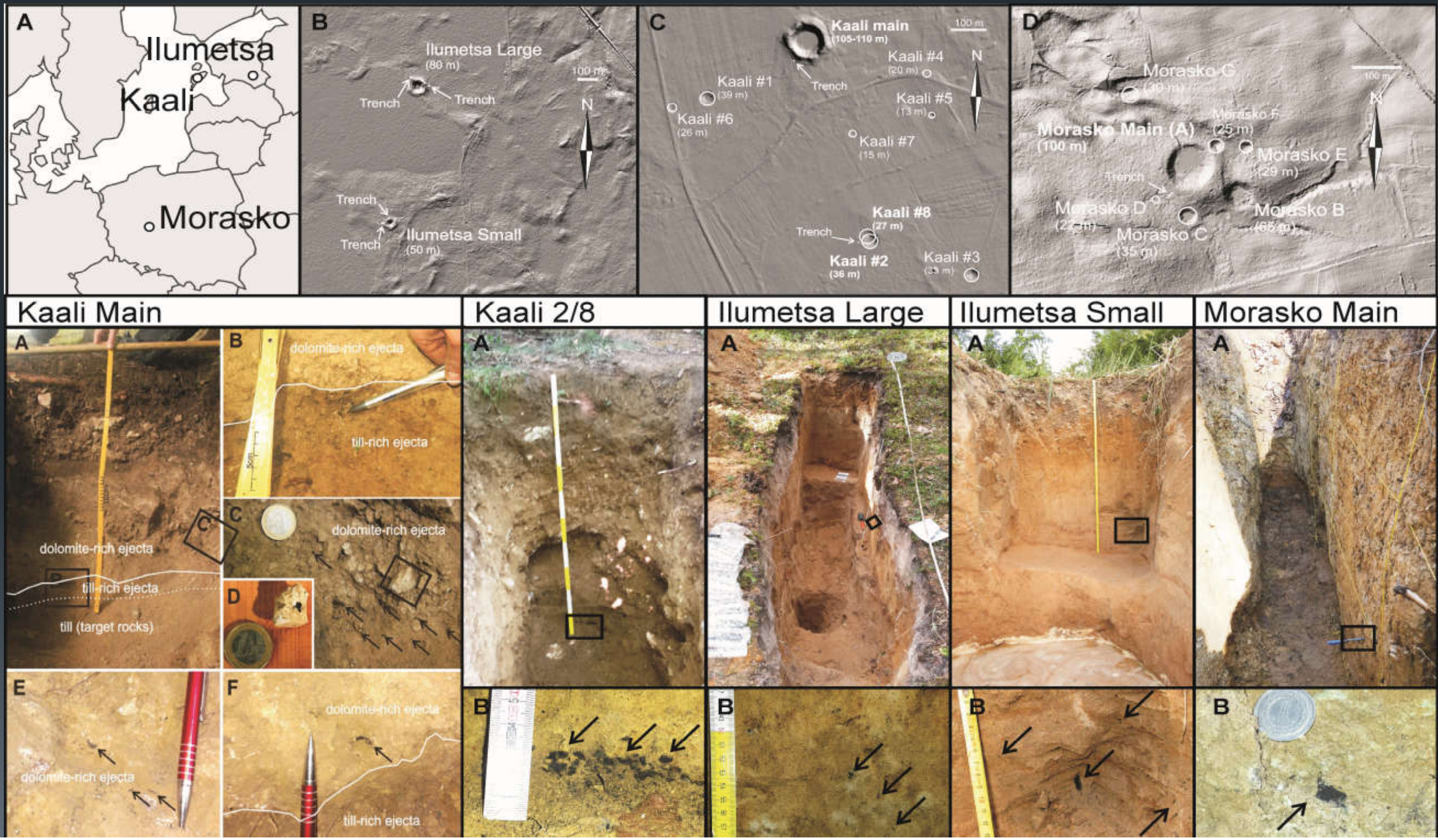
- Strewn field
  - Up to 100 m



Charcoal in proximal ejecta of small impact craters

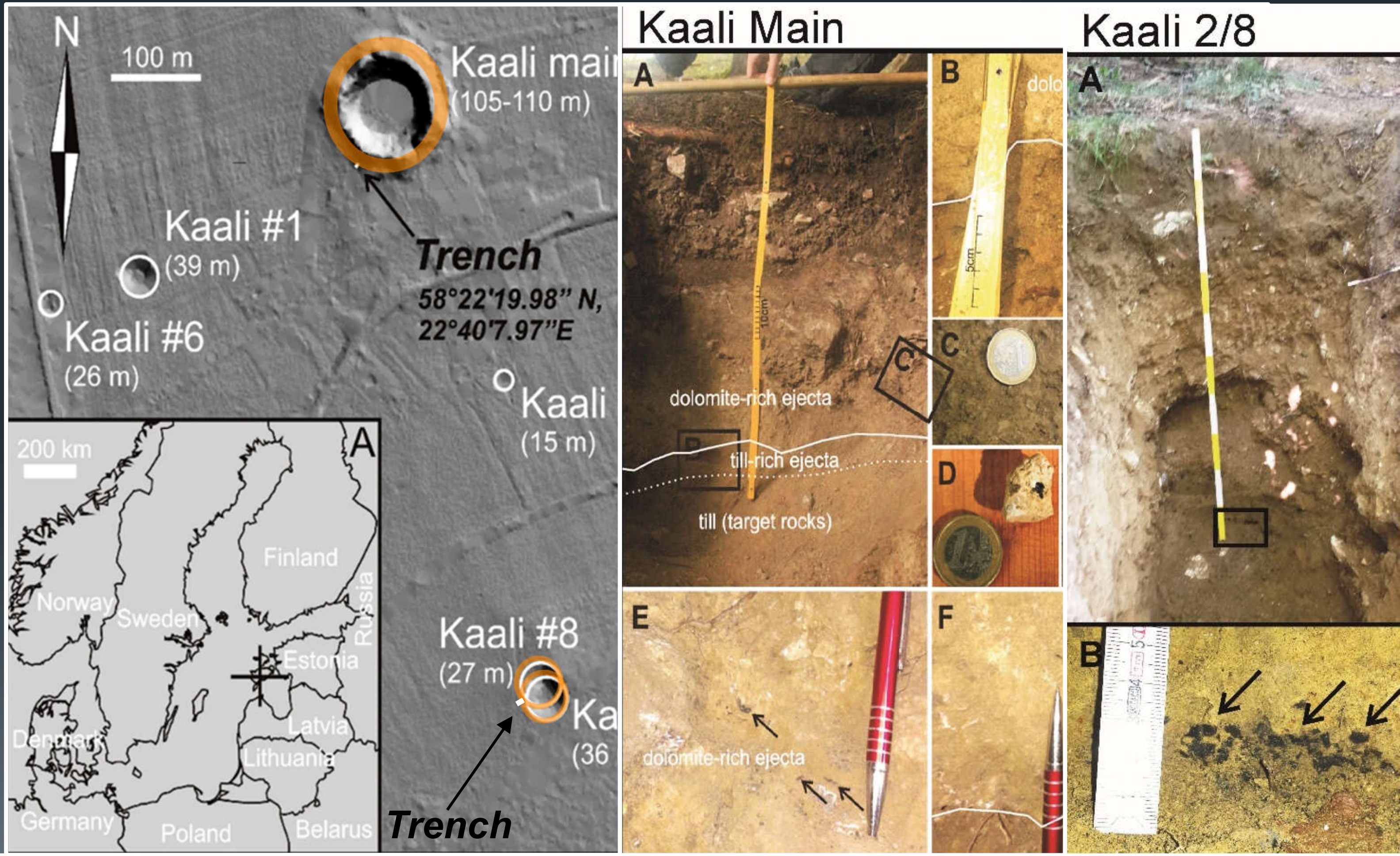
wildFIRE lab

Charcoal in proximal ejecta of small impact craters



Small impacts charcoal: distribution

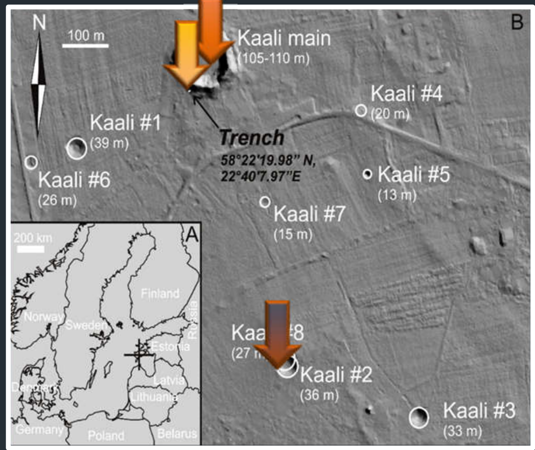
- Horizontal distribution:
  - Ring <rim to < ~0.1 R
- Vertical distribution:
  - Depth > 50 cm
  - Most close to ejecta base
- Double charcoal layer at overlapping craters

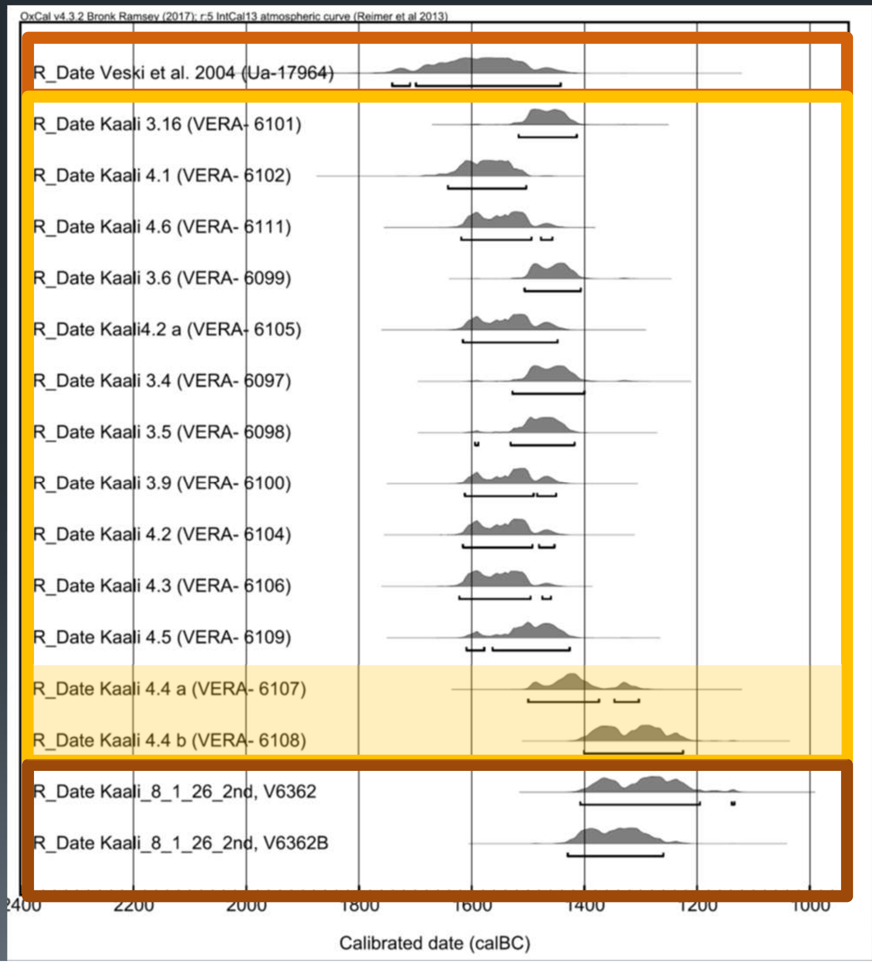


Small impacts charcoal: ages

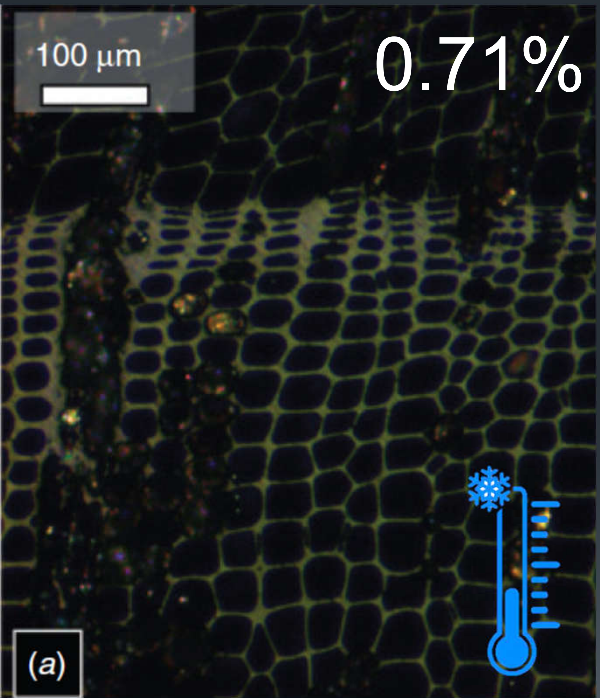
wildFIRE lab

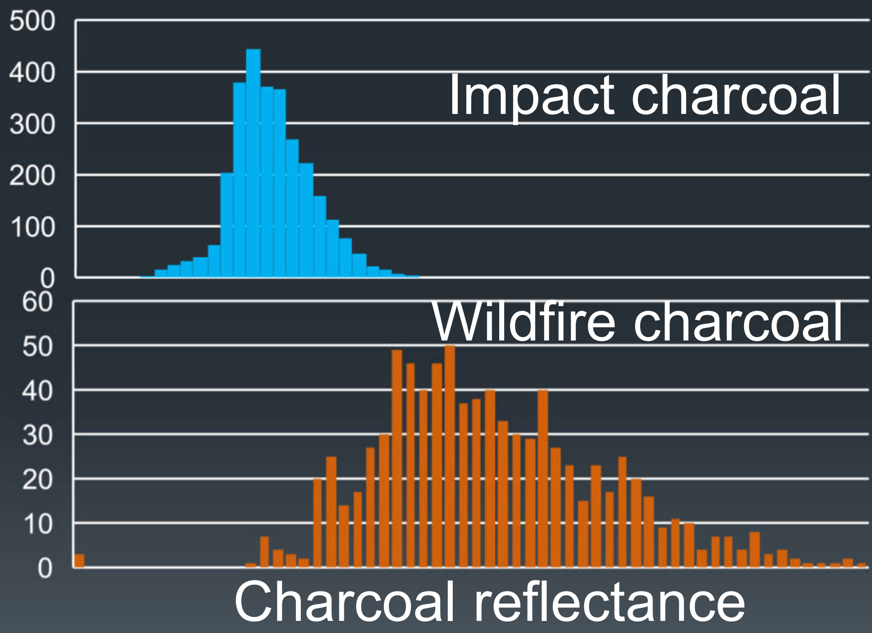
- ± same age
  - Oldest sediments inside craters and proximal ejecta charcoals
  - Proximal ejecta charcoals from different craters of the same strewn field

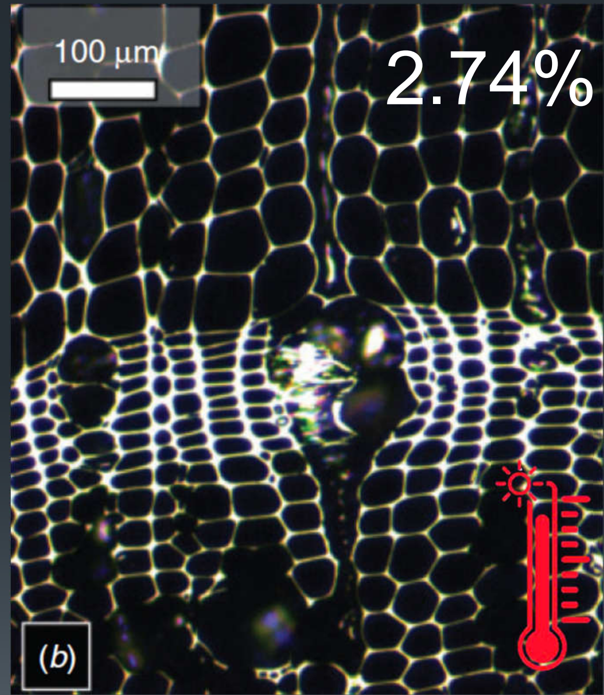




Small impacts charcoal: REFLECTANCE

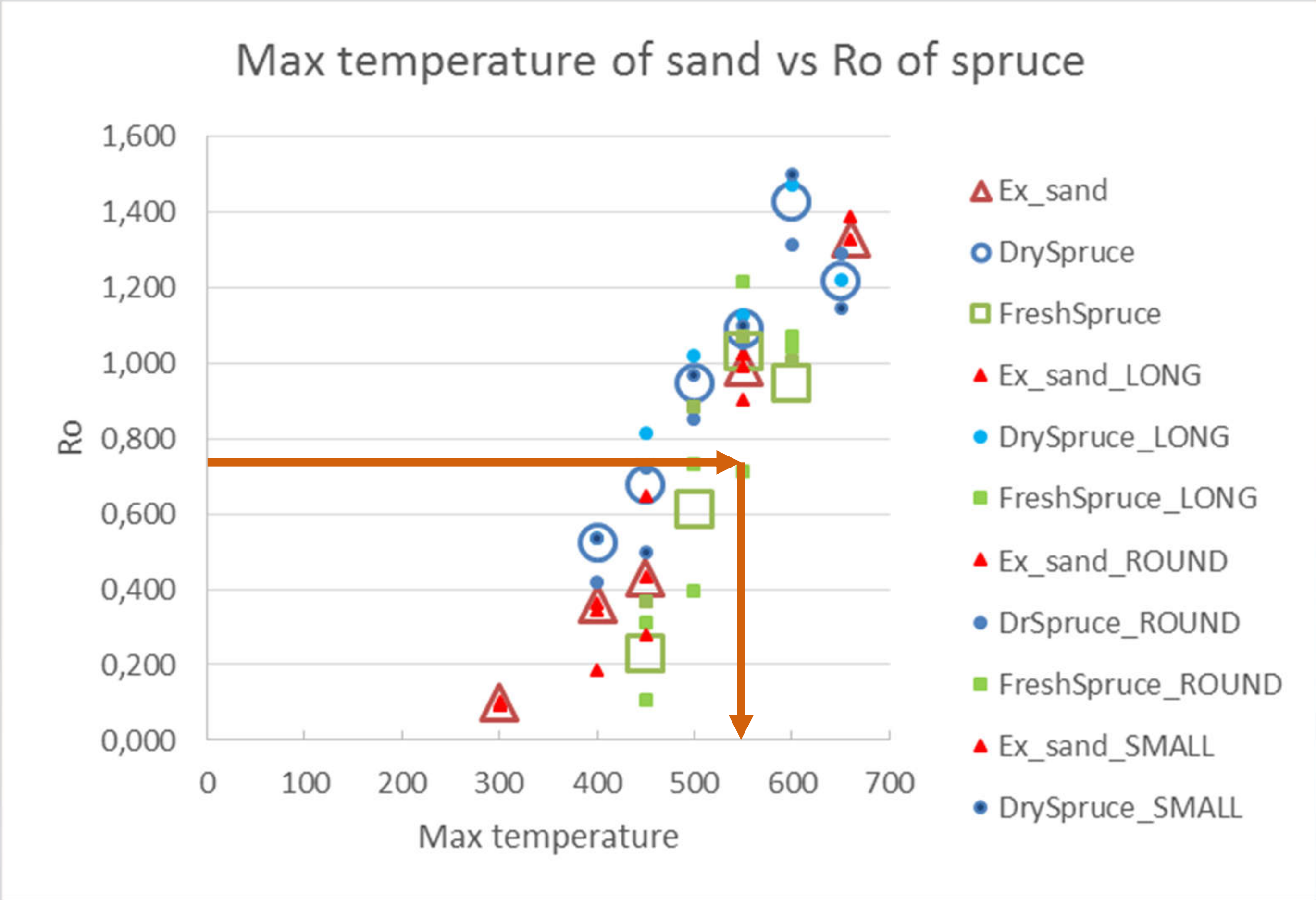


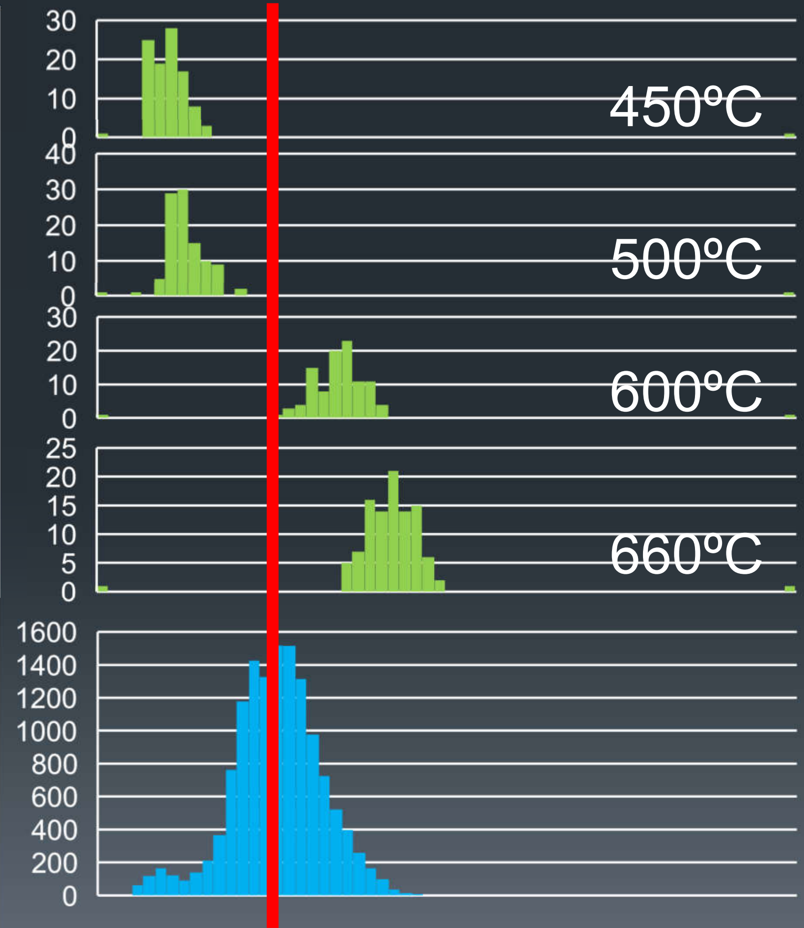




Belcher and Hudspith 2016

Heated sand experiments





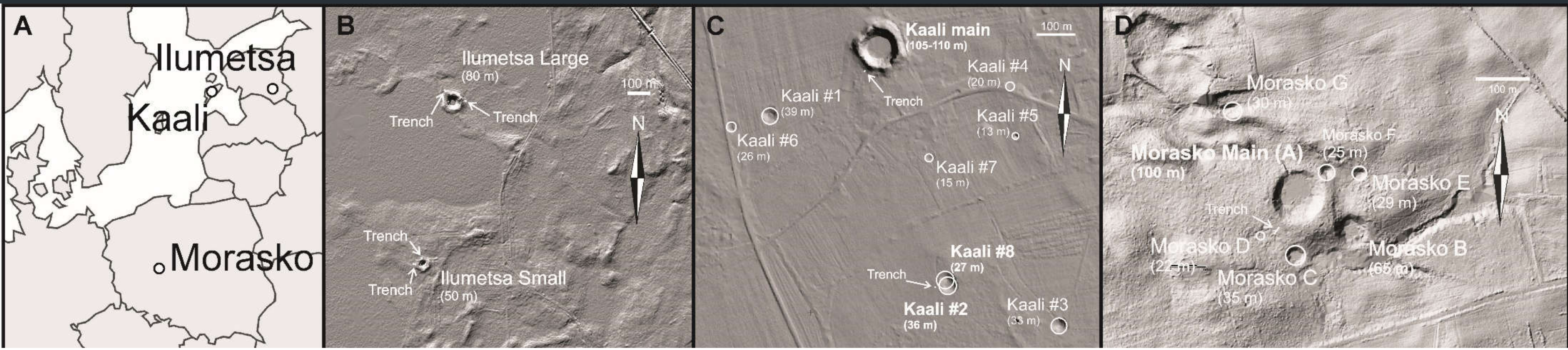
ENVIRONMENTAL EFFECTS OF VERY SMALL CRATER FORMATION

wildFIRE lab

A. Losiak[1,2], C. Belcher[1],

J. Plado[3], A. Jõeleht[3], C. D. K. Herd[4], R. S. Kofman[4], M. Szokaluk[5], W. Szczuciński[5], A. Muszyński[5], M. Szyszko, E. M. Wild[6]

[1]wildFIRE Lab, Hatherly Laboratories, University of Exeter, UK; [2]Institute of Geological Sciences, PAS, Poland; [3]Department of Geology, University of Tartu, Estonia, [4]Institute of Geology, Adam Mickiewicz University in Poznan; [6]VERA Laboratory, Faculty of Physics, University of Vienna;



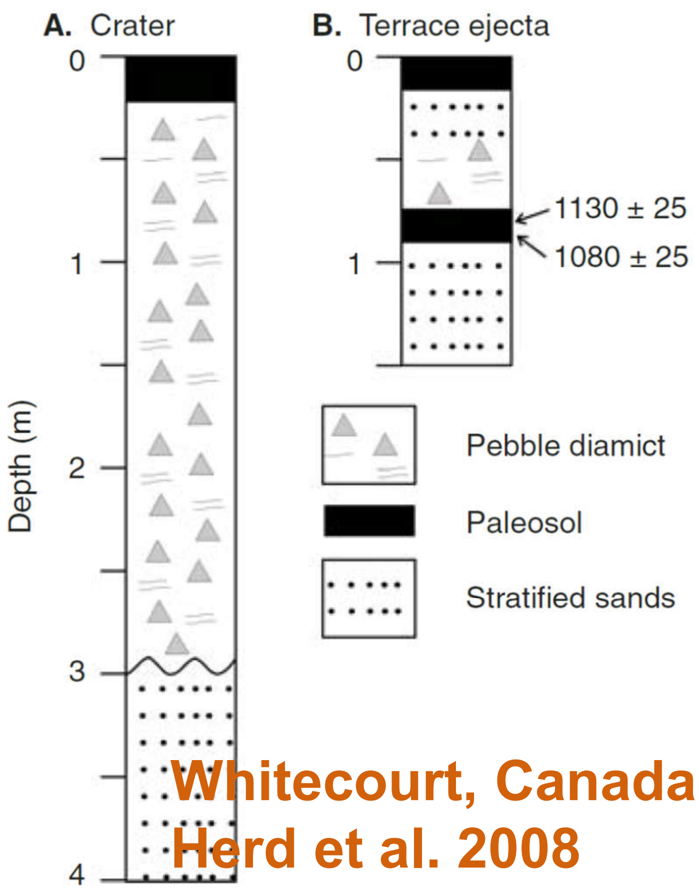
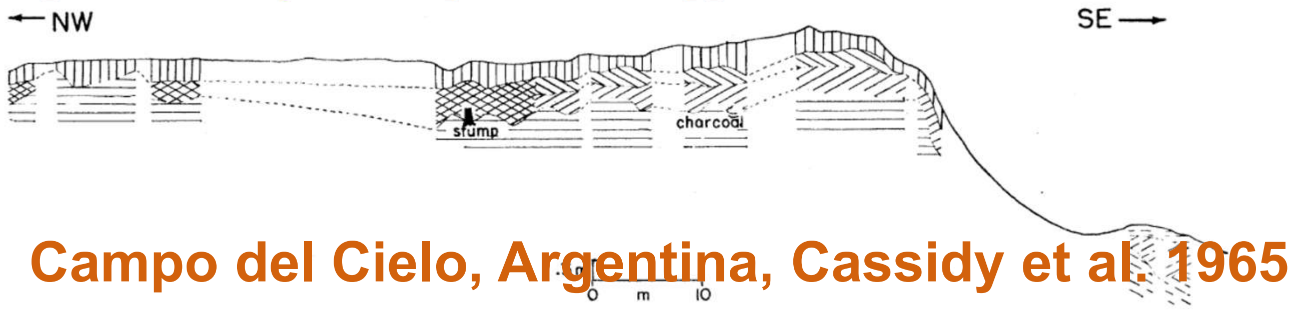


Figure 2. Stratigraphy of sediments at the Whitecourt meteorite impact crater. A: Stratigraphy beneath crater floor at its approximate center. B: Stratigraphy of interpreted ejecta and buried paleosol from adjacent terrace ~11.5 m east of crater rim. Radiocarbon ages in ^{14}C yr B.P. are shown for the buried paleosol.



Campo del Cielo, Argentina, Cassidy et al. 1965

Fig. 9. Sectional diagram of trench along northwest radius, crater 2.

Symbol	Zone	Description	Interpretation
	a	Soft dark-colored soil with much vegetable matter Lumpy texture Gradational boundary	Modern soil developed in throwout material
	b	Light-tan, clayey material, in part cemented by caliche Lumpy texture Sharply defined boundary	Modern subsoil developed in throwout material
	c	Compact, dark-colored, organic-rich zone Gradational boundary	Pre-impact soil
	d	Compact, tan-colored, clayey material	Pre-impact subsoil
	b′	Darker, less clayey material than b, with material suggesting zone c occasionally near its base.	Transitional zone between b and c found at distances greater than 25 m from the crest, where the sharply defined boundary between b and c disappears
	e	Light-tan, clayey material Gradational boundary	Recent wash from crater walls
	f	Dark, organic-rich zone, becoming redder and containing decreasing amounts of organic material with greater depth Gradational boundary	Older wash from crater walls that accumulated relatively slowly and allowed some degree of soil formation
	g	Apparent "clay conglomerate" or "clay breccia" or both, consisting of dark brown or red clay containing apparent clasts of darker and harder clay fragments and variable amounts of caliche and veinlike and patchy green clay. Small meteorite fragments, oxide flakes, and rust spots also noted within a lenslike zone at depth (Fig. 8)	Older wash from crater walls that accumulated fast enough that soil formation did not occur. May grade downward into fallback material and autochthonous breccia

Ries
1 km asteroid
24 km crater

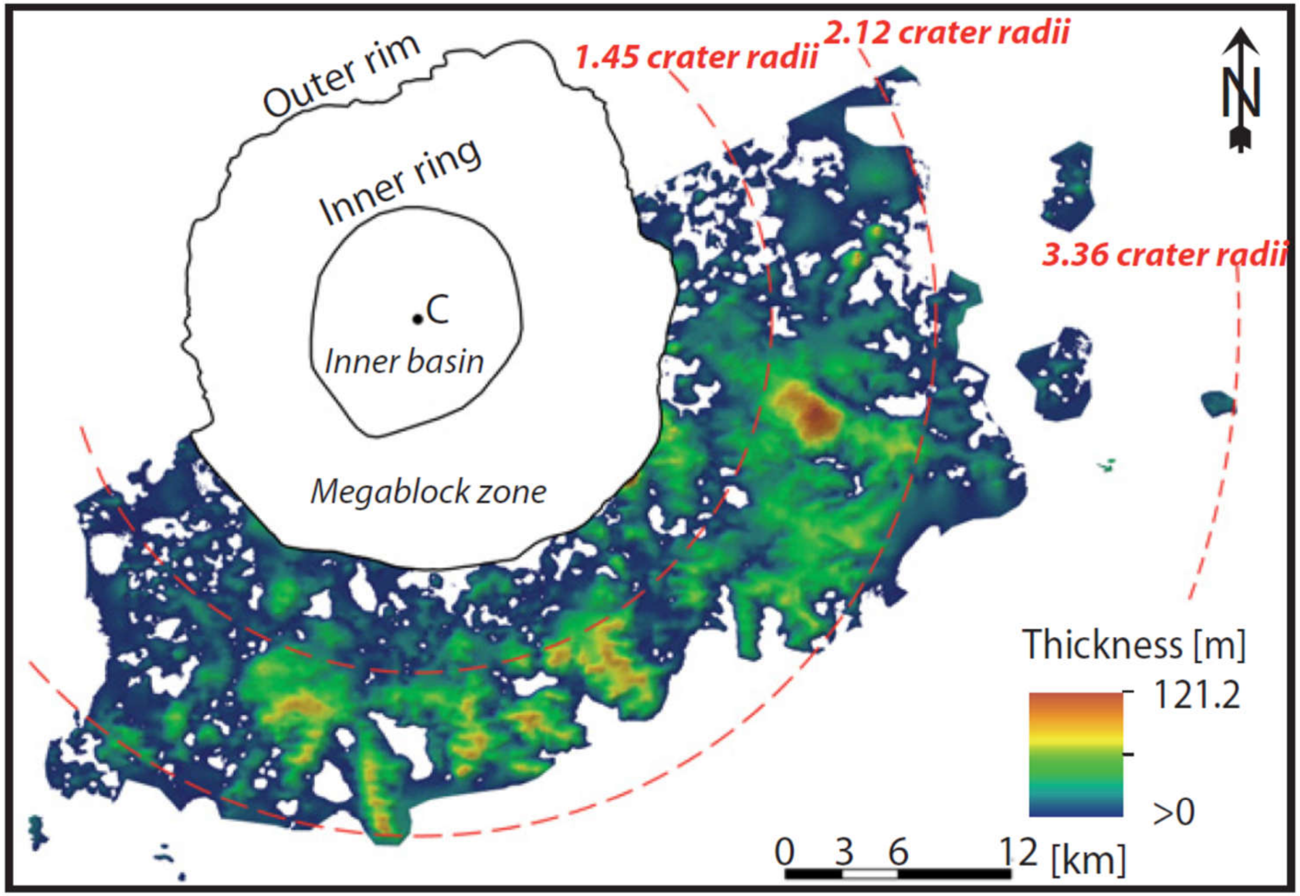
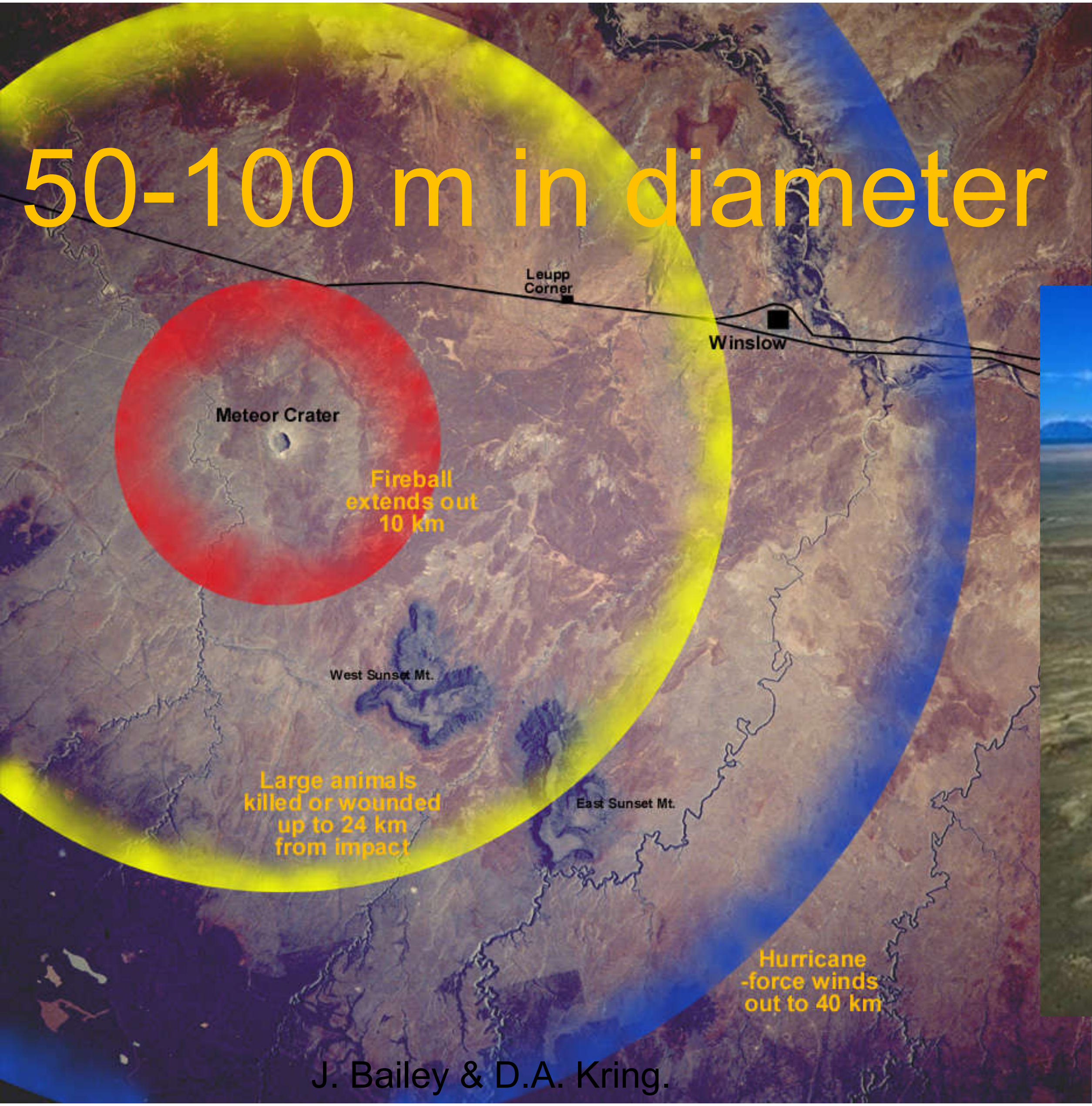


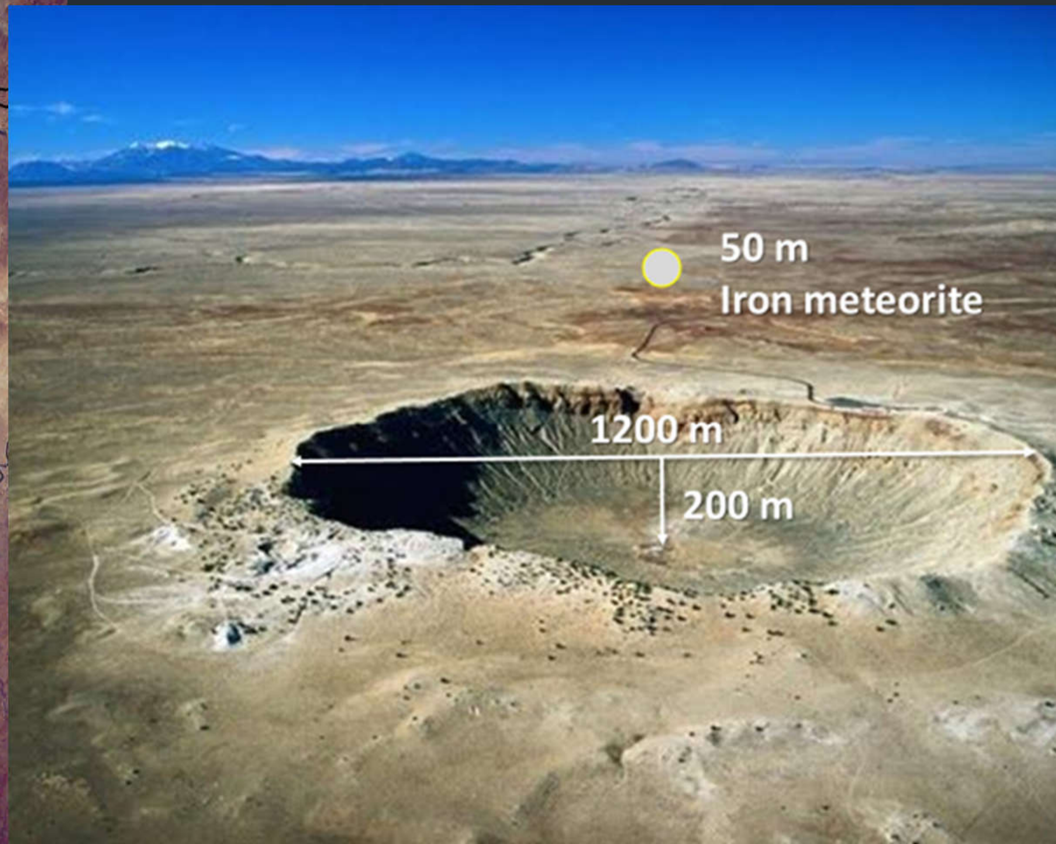
Figure 2. Results of the interpolated morphology of the Bunte Breccia thickness. White areas represent outcropping weathered autochthonous units (e.g., Malmian limestone) or post-impact sediments (e.g., loess) (C—crater center).

Sturm et al. 2013

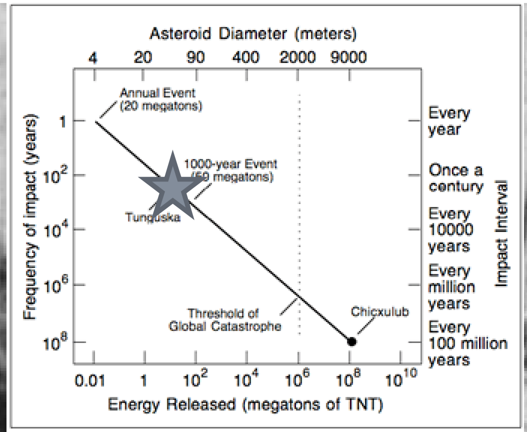
50-100 m in diameter

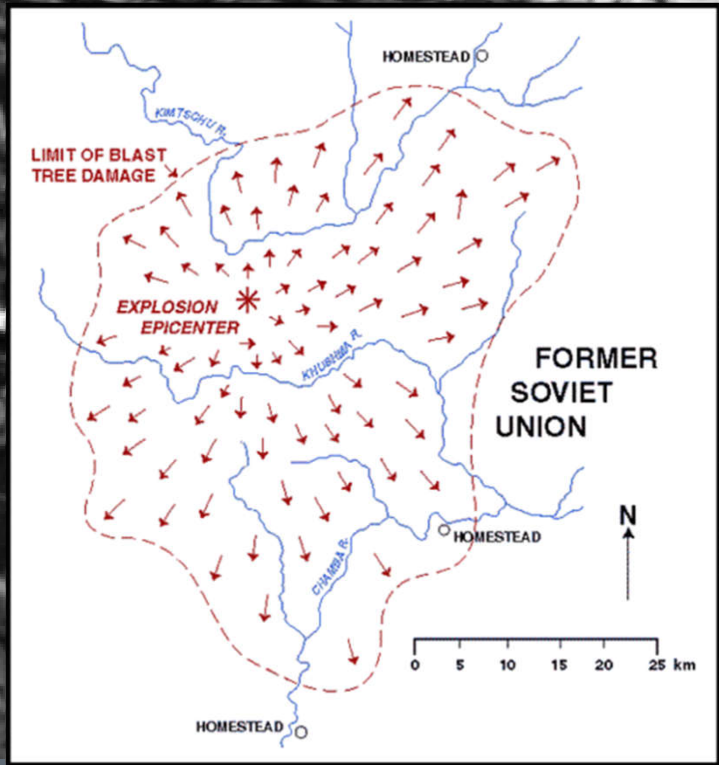


J. Bailey & D.A. Kring.



~50 m diameter





Tunguska

Russia

30.06.1908

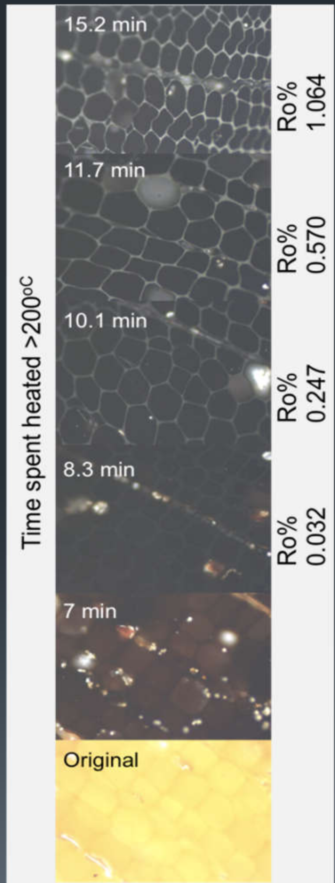
No crater, Forest damaged

X injured

Chelyabinsk meteor
15 February 2013
> 1000 injured people
~ 20 m in diameter

Methods: Charcoal reflectance

- Temperature of formation
- Time of heating
- Ignition
- Fuel moisture
  - Fuel type



Belcher et al. 2018