A new method for quantifying flake scar organisation on cores using orientation statistics

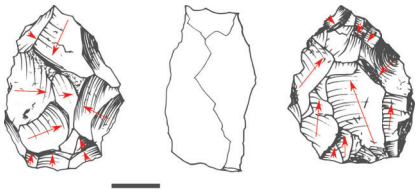
Sam Lin[1,2], Chris Clarkson[3,2], I Made Agus Julianto[4], Anton Ferdianto[1,2,5], Jatmiko[5], Thomas Sutikna[5,2]

[1]University of Wollongong; [2]ARC Centre of Excellence for Australian Biodiversity and Heritage; [3]University of Queensland; [4]Udayana University; [5]Badan Riset dan Inovasi Nasional (BRIN)

Introduction

Core scar patterning is key to understand past flaking technologies.

- Typically described by **qualitative units**. e.g., unidirectional, bifacial, radial, etc.
- Issues of subjectivity and replicability (Pargeter et al. 2023).

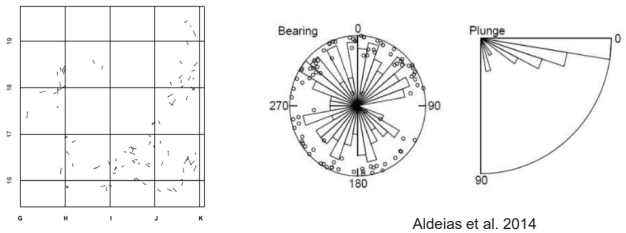


Clarkson et al. (2006) developed the Scar Pattern Index (SPI).

- Quantify scar 'parallelness' among similar core technologies (Bretzke & Conard 2012; Lombao et al. 2022).
- But distinct core types can produce similar SPI values. Difficult to compare different core technologies.

Orientation analysis

Commonly used to summarise the orientation of archaeological remains during excavation.



Aldeias et al. 2014

Can we apply orientation analysis to measure core scar orientation, with each core treated as an 'assemblage' of scars?

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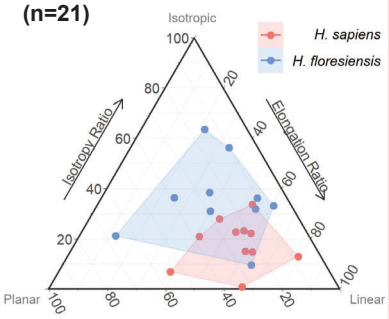
Type locality of *Homo floresiensis* on Flores, Indonesia

- Stone artefacts made by *Homo floresiensis* (190–50 ka) & *Homo sapiens* (46 ka–present) (Sutikna et al. 2016)
- Continuity of simple core reduction techniques (Moore et al. 2009).

Analysis of multiplatform cores (n=21)



H. sapiens: lower isotropy values

- Scars more parallel.
- Flaking along similar axes.

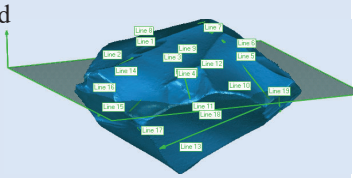
H. floresiensis: higher and more variable isotropy values

- Scars more 'jumbled'.
- Flaking along variable angles and axes.
- Corresponds to more core rotations (Lin et al. 2024).

Measuring core scar orientation

Extract 3D scar vectors relative to best-fit plane

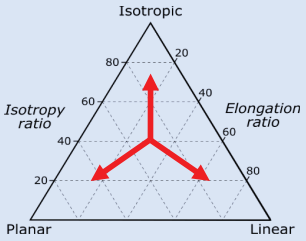
- Define scar vectors using start & end points of observable scars ≥0.5 cm (Geomagic Wrap).
- Fit a best-fit plane to core volume (Geomagic Wrap).



- Rotate such that the best-fit plane aligns with the X-Y plane and the longest scar vector aligns to the X-axis (Rhino 7).

Compute scar orientation statistics in R

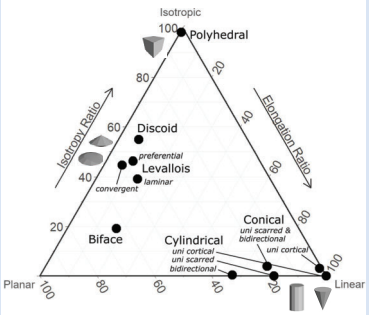
- **Isotropy:** scar inclination relative to best-fit plane (plunge).
- **Elongation:** scar arrangement along best-fit plane (bearing).
- Summarise in a ternary diagram.



Experimental results

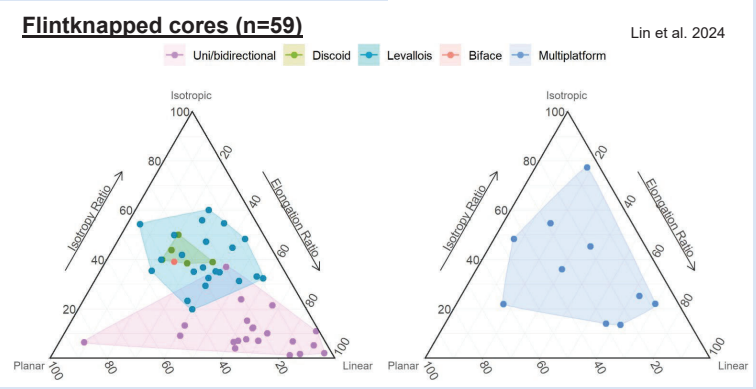
- **Uni/bidirectional:** high elongation, low isotropy
- **Discoid/Levallois/biface:** low elongation, variable isotropy
- **Polyhedral:** low elongation, high isotropy
- **Multiplatform:** variable as the type is not defined by specific scar patterns.

Digital standardised core models



Flintknapped cores (n=59)

Lin et al. 2024



Summary & Conclusion

Orientation analysis useful for quantifying core scar arrangement.

- Detect new patterns about reduction, esp. among informal cores.

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- Hominin difference in core reduction pattern, with *H. floresiensis* detaching flakes from more variable angles via frequent rotations.

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- Sutikna et al.(2016). *Nature*, 532(7599), 366-369.