Shape and distribution of FWP2 potholing on the Merensky Reef, Northam Platinum Mine:

Implications for pothole formation and growth

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1. LOCATION OF STUDY AREA

2. LOCAL GEOLOGY / STRATIGRAPHY

3. AIMS OF STUDY

4. POTHOLE SHAPE
   i. AXIAL RELATIONSHIPS
   ii. ECCENTRICITY/CIRCULARITY
   iii. LONG AXIS ORIENTATION
   iv. NORMALISED POTHOLE SHAPE
   v. DENDRICITY

5. POTHOLE CENTRE DISTRIBUTION
   i. FRACTAL ANALYSIS
   ii. FRY ANALYSIS

6. MODEL FOR POTHOLE GROWTH
DISTRIBUTION OF REEF TYPES
**AXIAL RELATIONSHIPS**

Pothole Long Axis (m) vs Short Axis (m)

\[ y = 0.6239x \quad R^2 = 0.9258 \]

N = 1385

Short vs Long Axis Ratio vs. Max Long Axis Length
(excl. Ratios of 1:1 and long axes < 6m)

Max Length of Long Axis Interval
(from correlation within ranges)

N = 1385
**Pothole Eccentricity**

**Eccentricity test**

*Circular Potholes*

\[ \varepsilon = 1 - \frac{SA^2}{LA^2} = 0 \]

*Non-Circular (Elliptical) Potholes*

\[ \varepsilon = 1 - \frac{SA^2}{LA^2} > 0 \]

(\(\varepsilon \to 1\) with increasing eccentricity)
POTHOLE SHAPE ANALYSIS
Pothole Circularity

Circularity test

*Circular potholes*

\[ \tilde{r} = \frac{\sum(r)}{nr} = 1 \]

*Non-circular (elliptical) potholes*

\[ \tilde{r} = \frac{\sum(r')}{nr} < 1 \]

\[ \tilde{r} \to 2 / nr \text{ (ie. 0.17) with increasing aspect ratio} \]
Pothole Circularity

N = 638

Circularity interval, $\bar{r}$

Circularity, $\bar{r}$

- 0-35
- 35-60
- 60-100
- 100+

Frequency

N = 638
Pothole long axis orientation
Average normalized pothole shapes

- Mean total - all data: $n=638$
- Mean total - LA<35m: $n=390$
- Mean total - 35<LA<60: $n=111$
- Mean total - 60<LA<100: $n=81$
- Mean total - 100<LA: $n=56$
Pothole Dendricity

Symmetrical potholes will have $\mathcal{D} = 0$

$\mathcal{D} \rightarrow \infty$ with increasing disruption/dendricity

$\mathcal{D} = |\mathcal{D}[x]| + |\mathcal{D}[y]|$

$\mathcal{D}[x] = |(r_{090} - r_{270})| + |(r_{030} - r_{330})|$

$+ |(r_{060} - r_{300})| - |(r_{120} - r_{240})| - |(r_{150} - r_{210})|$

$\mathcal{D}[y] = |(r_{000} - r_{180})| + |(r_{030} - r_{150})|$

$+ |(r_{060} - r_{120})| - |(r_{210} - r_{330})| - |(r_{240} - r_{300})|
Fractal Analysis

N = 1385 centre points
Fry Plots

Interpretation supported by trend diagrams

All data

60<100m

< 35m

> 100m

35<60m
### Summary of findings

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>RANGE OF LONG AXIS LENGTH</th>
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<tbody>
<tr>
<td></td>
<td>&lt; 35m</td>
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<tr>
<td><strong>MEAN SA:LA</strong></td>
<td>0.47 – 0.55</td>
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<tr>
<td><strong>DECREASING ECCENTRICITY</strong></td>
<td></td>
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<tr>
<td><strong>DENDRICITY</strong></td>
<td></td>
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<tr>
<td><strong>MEAN NORMALISED SHAPE</strong></td>
<td>SIMPLE ELLIPSE</td>
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<tr>
<td><strong>MEAN CIRCULARITY</strong></td>
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<td><strong>MEAN ECCENTRICITY</strong></td>
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<td><strong>DENDRICITY</strong></td>
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<td><strong>PREFERRED ALIGNMENT OF POTHOLE CENTRES</strong></td>
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Model for pothole growth
THANK YOU