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

Implications for pothole formation and growth

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OVERVIEW

1. LOCATION OF STUDY AREA

2. LOCAL GEOLOGY / STRATIGRAPHY

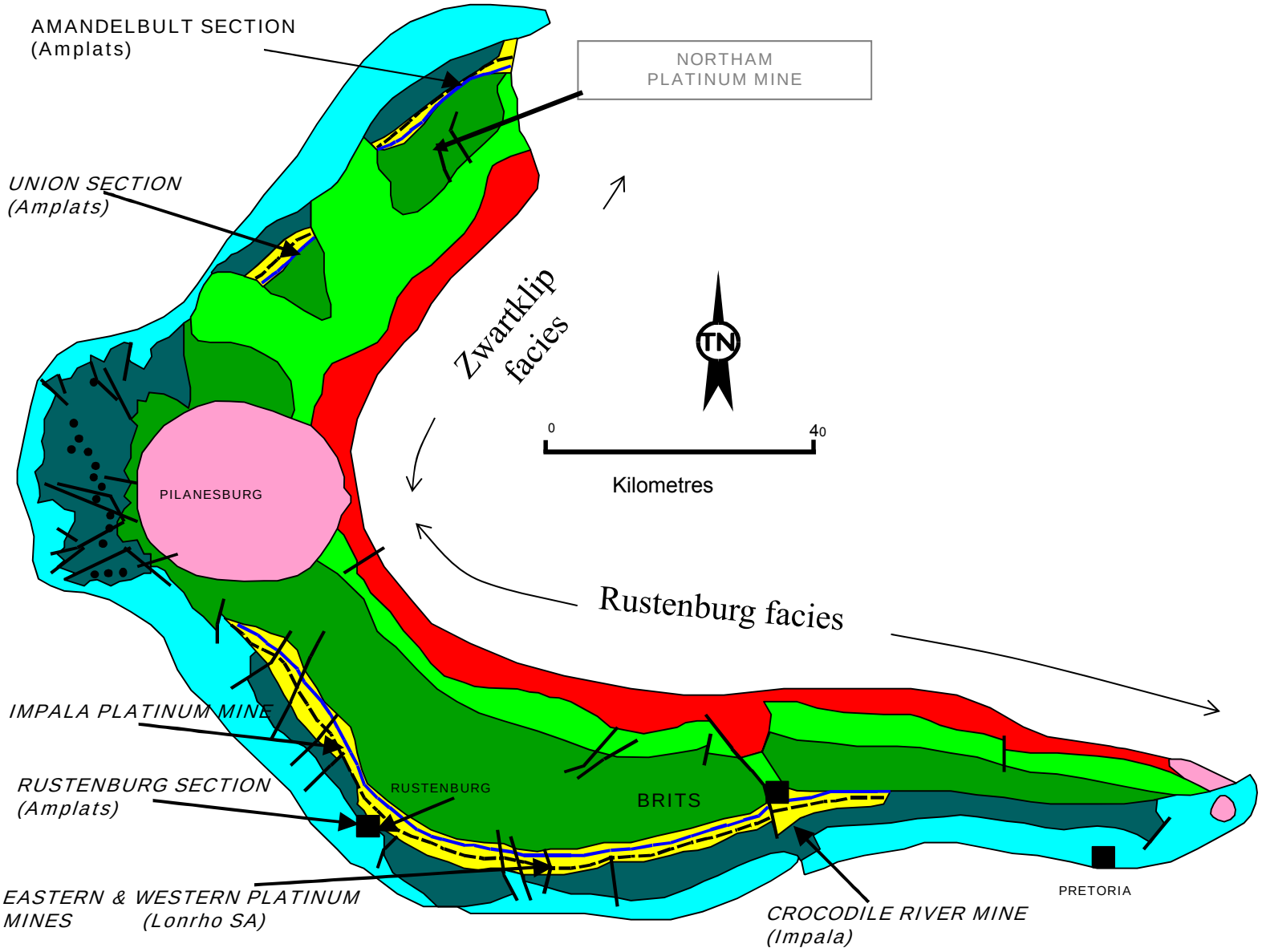
3. AIMS OF STUDY

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

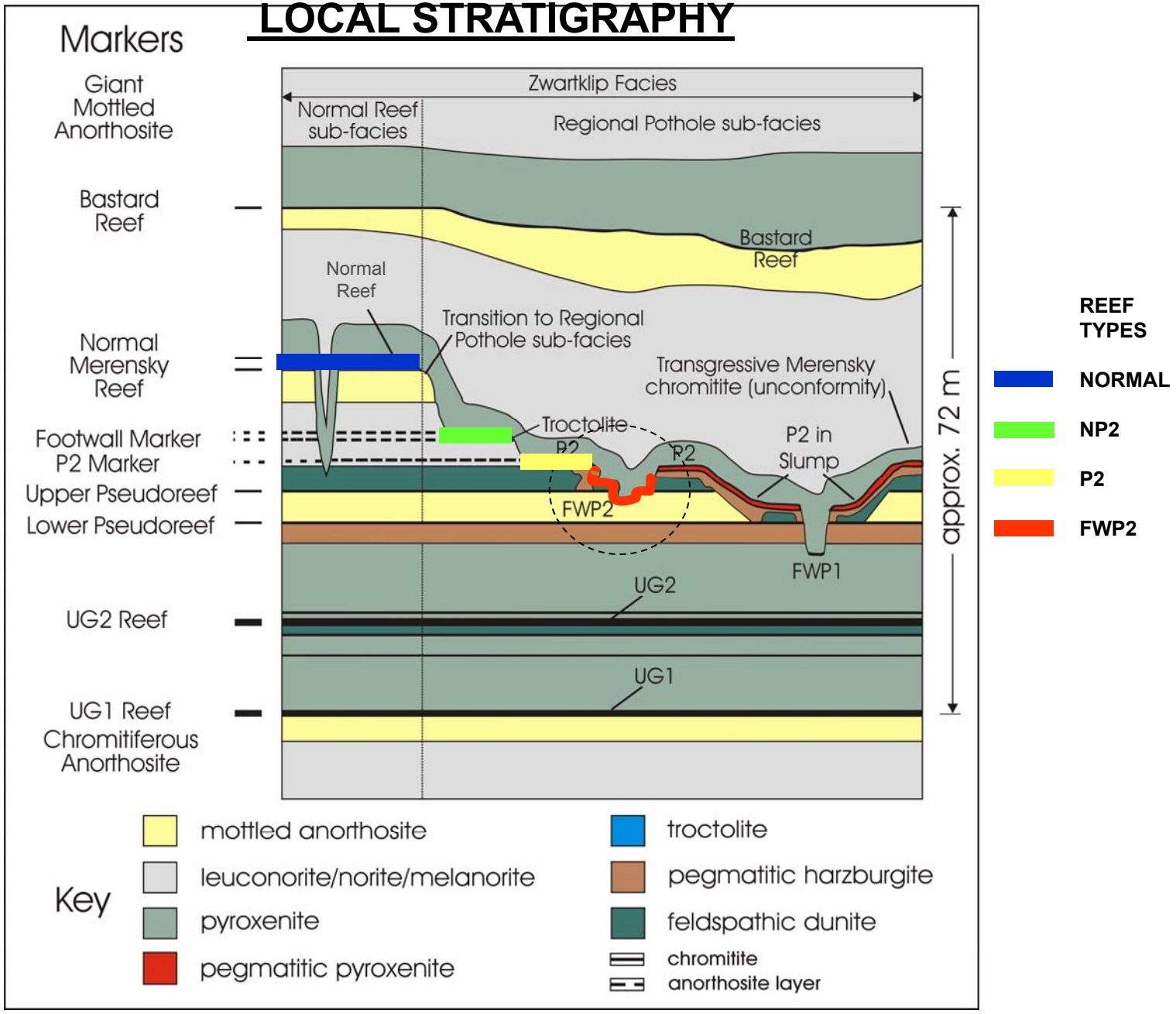
6. MODEL FOR POTHOLE GROWTH

REGIONAL SETTING

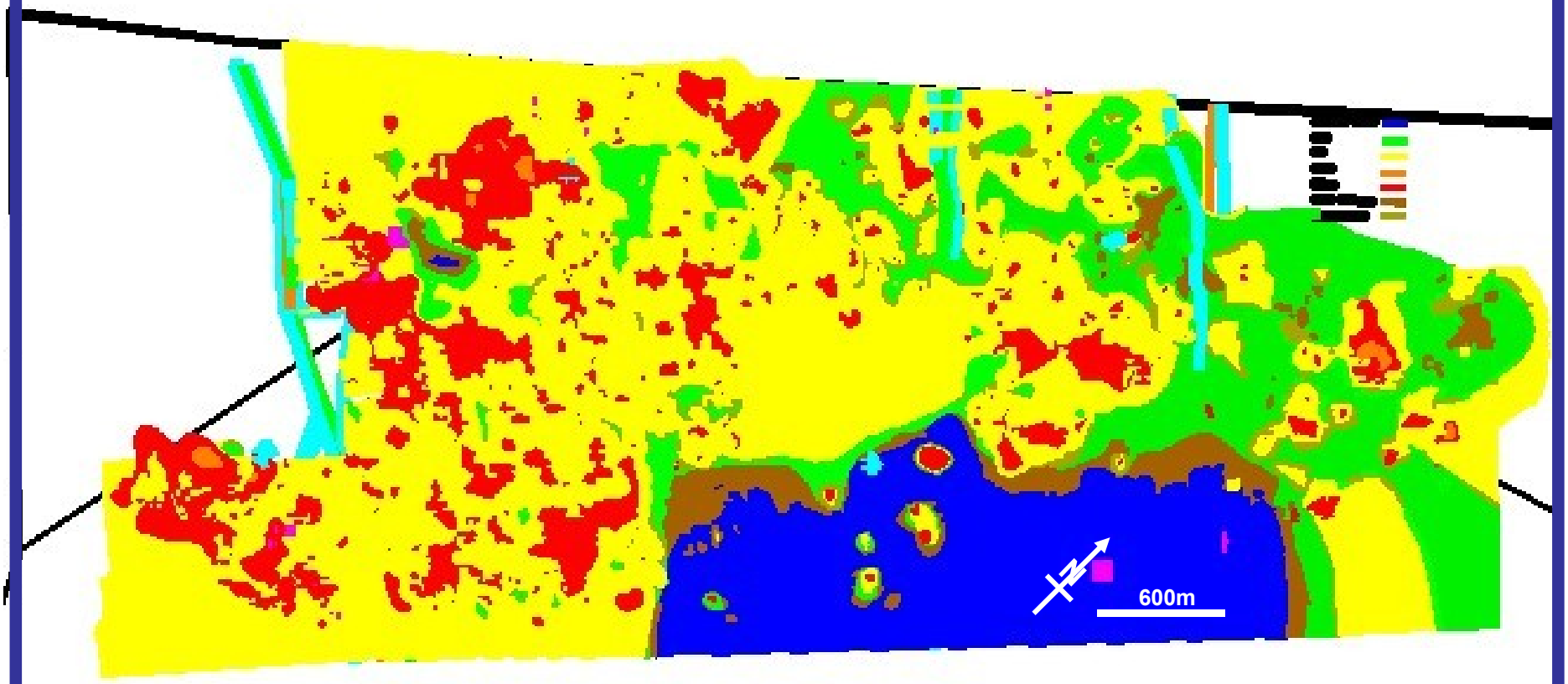


Modified from Viljoen, 1994

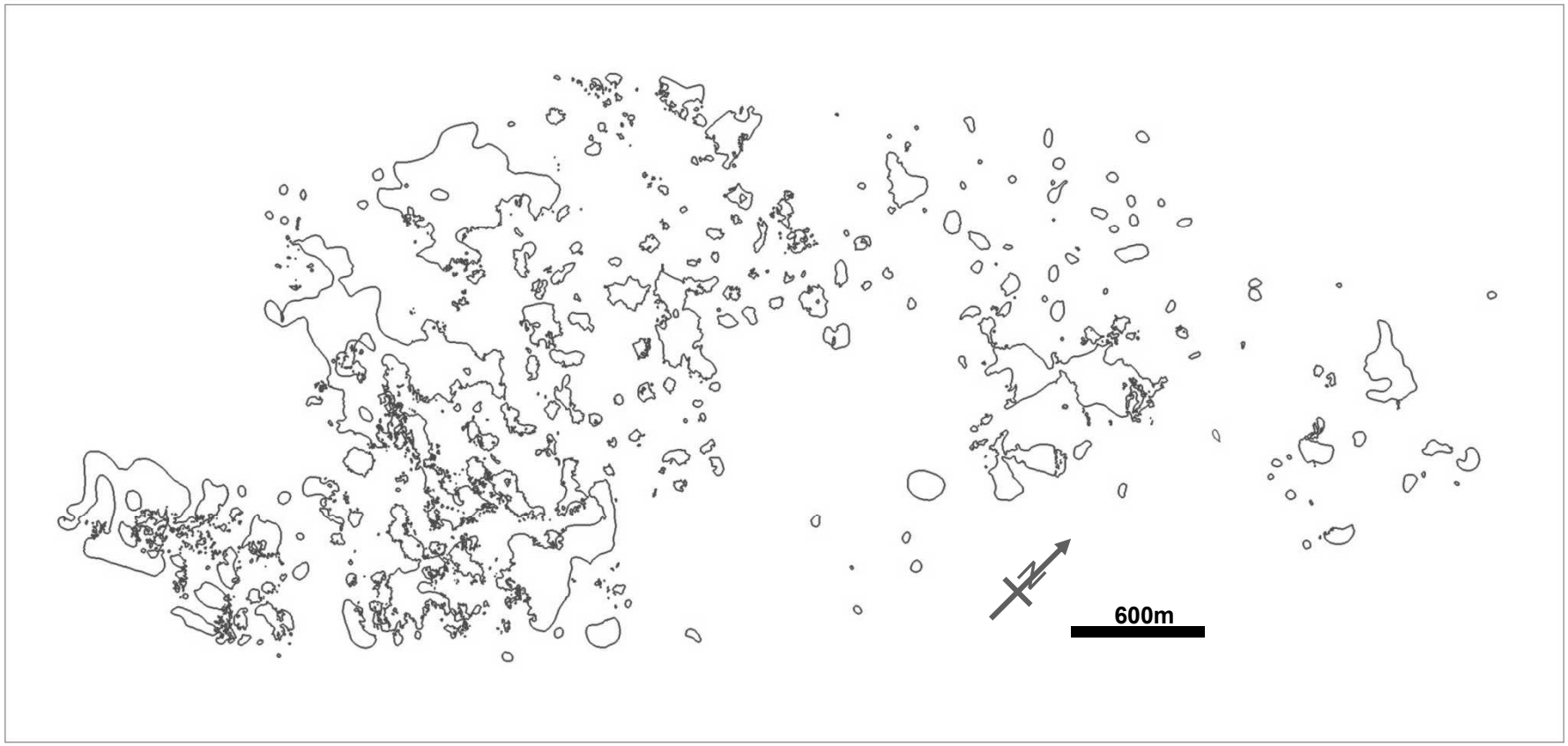
LOCAL STRATIGRAPHY



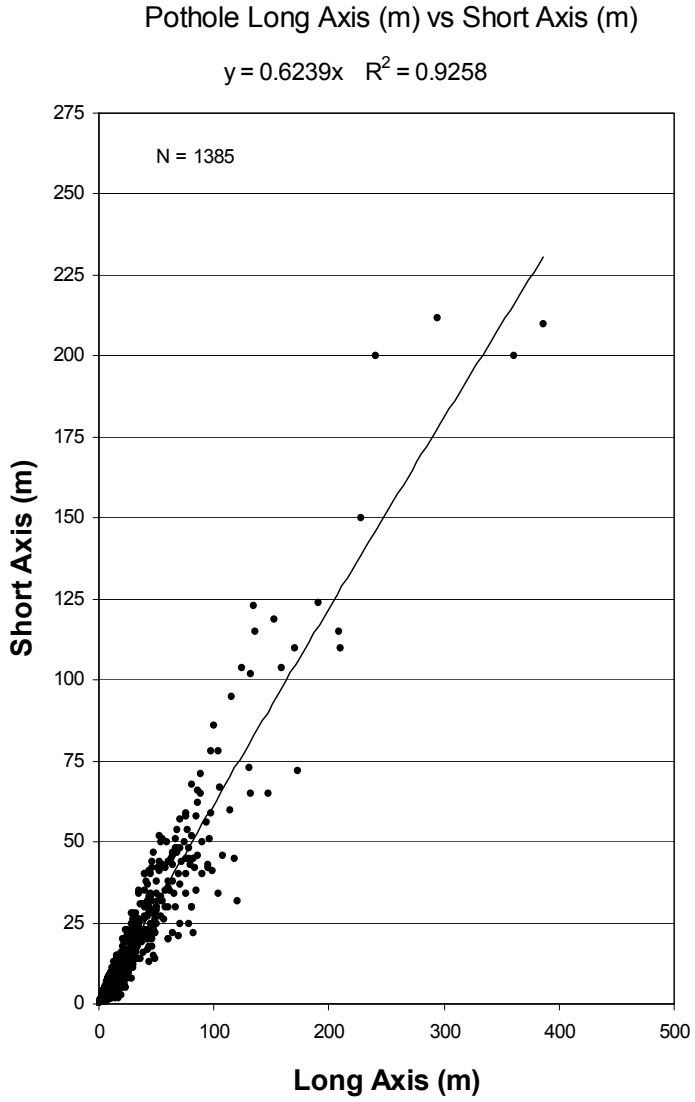
DISTRIBUTION OF REEF TYPES

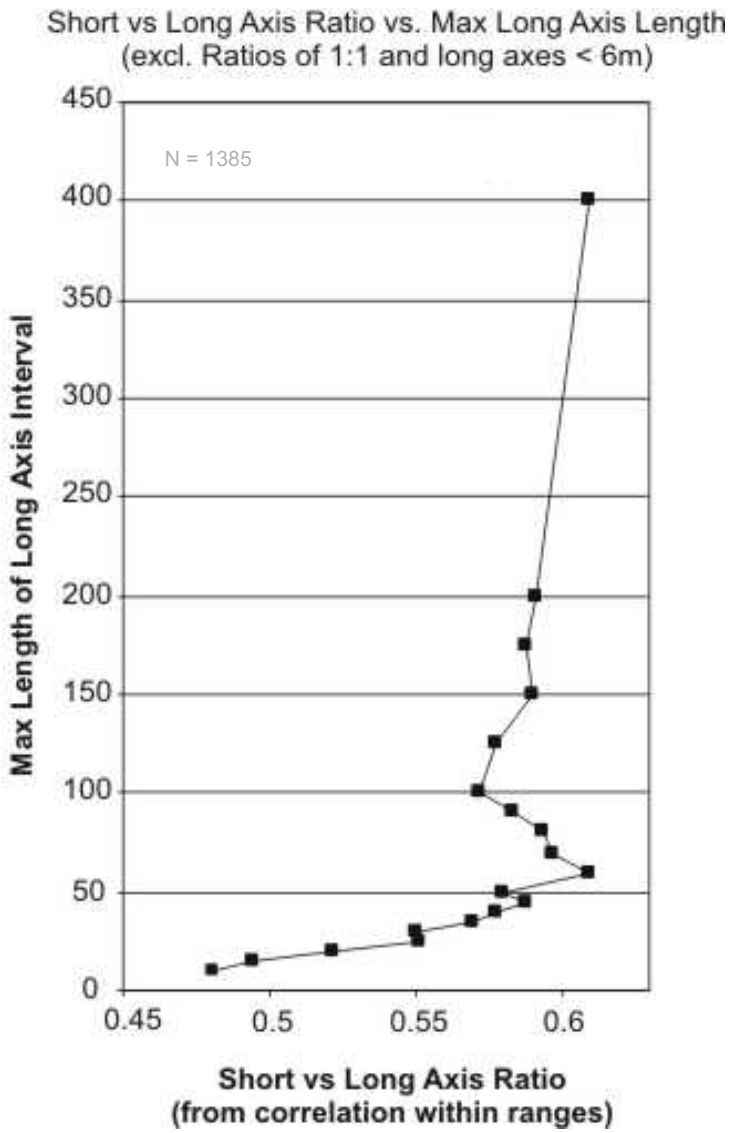


DISTRIBUTION OF FWP2 POTHOLING



AXIAL RELATIONSHIPS





Pothole Eccentricty

Eccentricity test

Circular Potholes

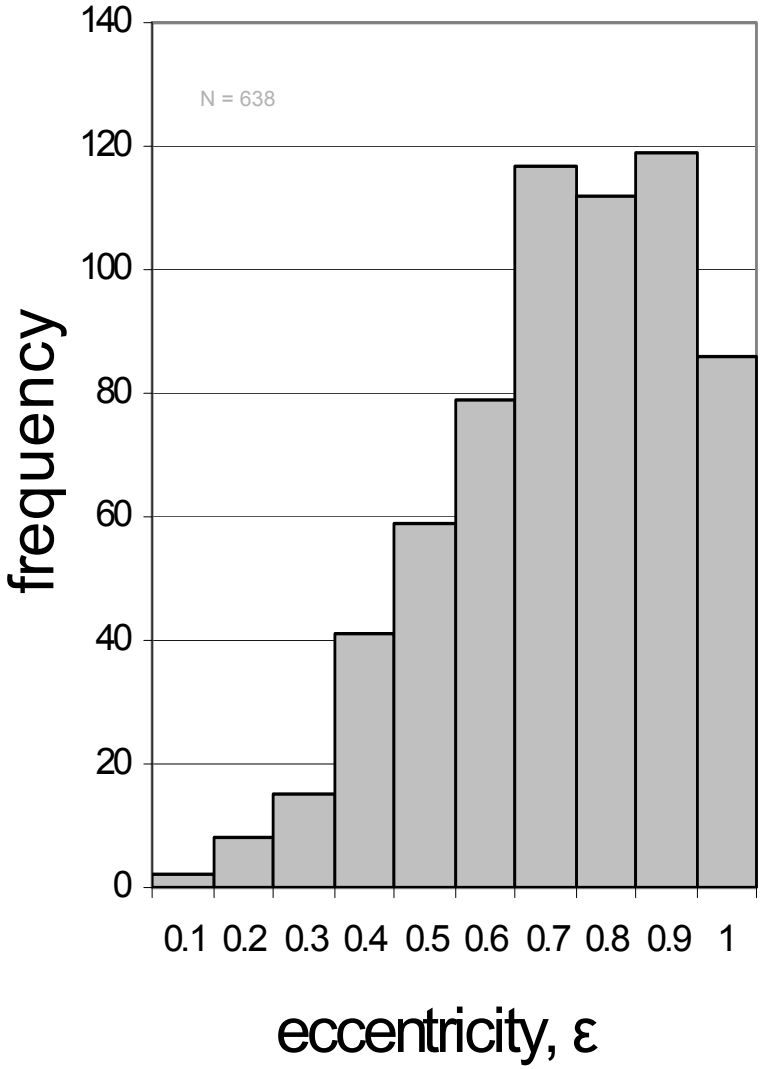
$\varepsilon = 1 - SA2 / LA2 = 0$

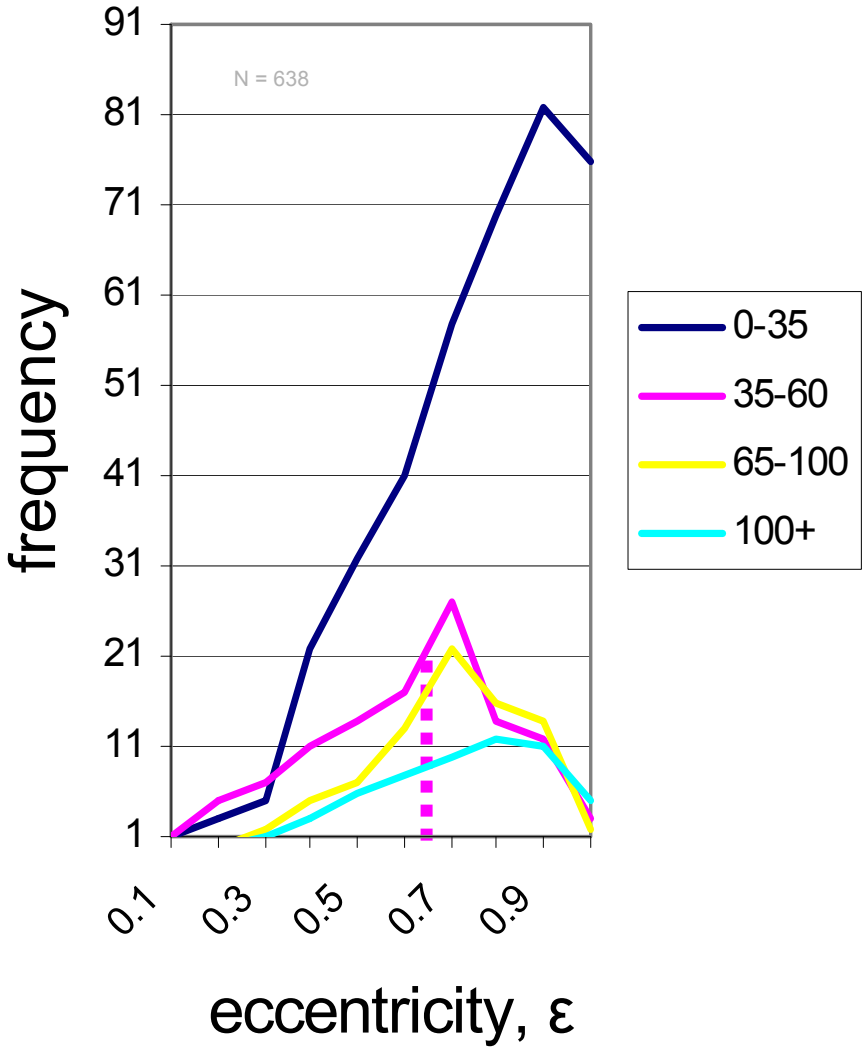
Non-Circular (Elliptical) Potholes

$\varepsilon = 1 - SA2 / LA2 > 0$

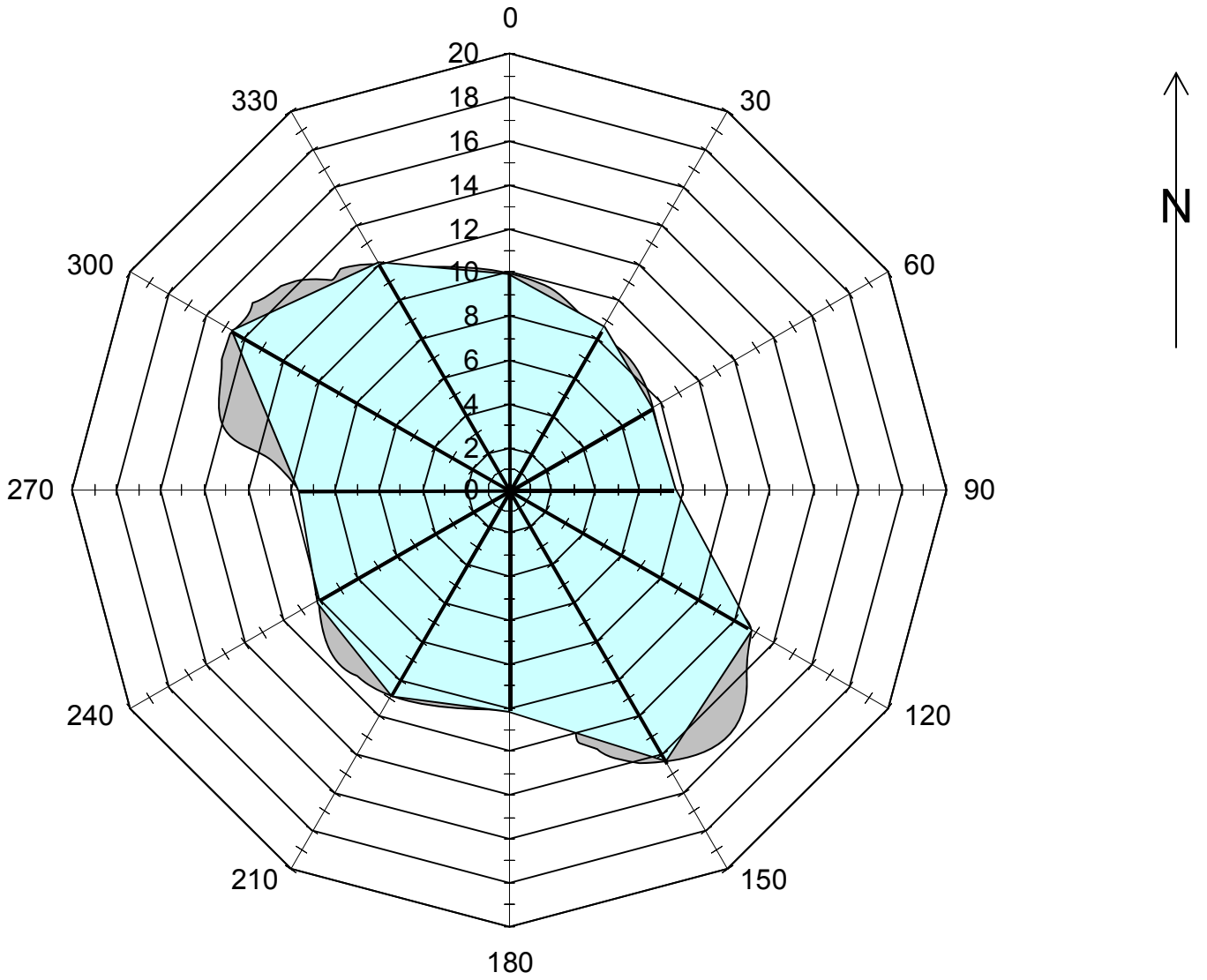
($\varepsilon \rightarrow 1$ with increasing eccentricity)

Pothole Eccentricity





POTHOLE SHAPE ANALYSIS



Pothole Circularity

Circularity test

Circular potholes

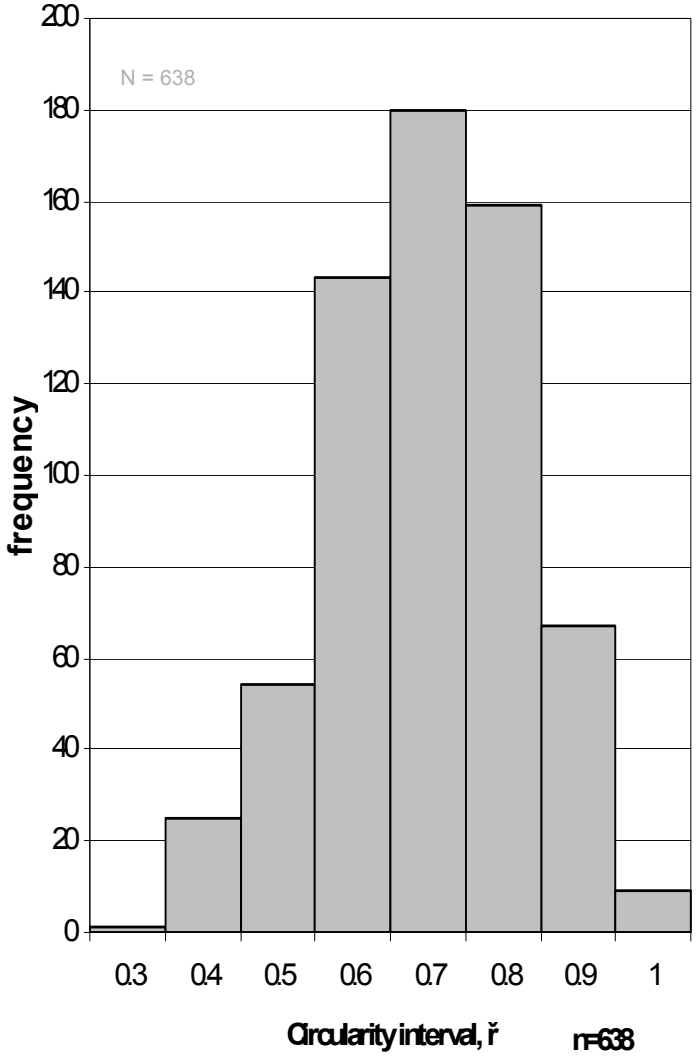
$\check{r} = \sum(r') / nr = 1$

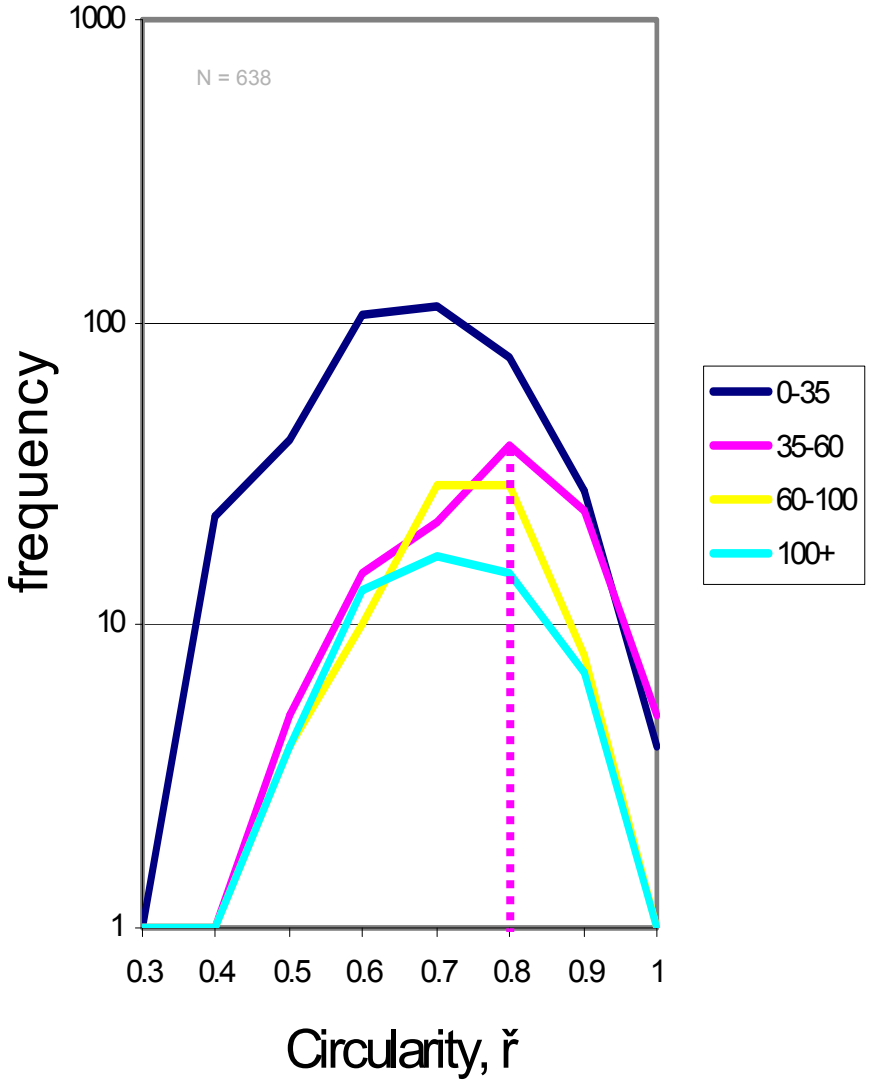
Non-circular (elliptical) potholes

$\check{r} = \sum(r') / nr < 1$

$\check{r} \rightarrow 2 / nr$ (ie. 0.17) with increasing aspect ratio

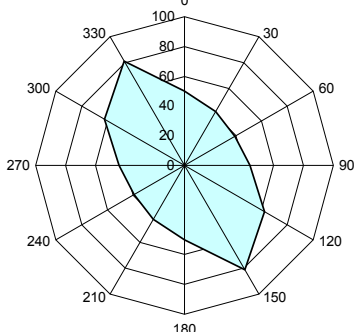
Pothole Circularity



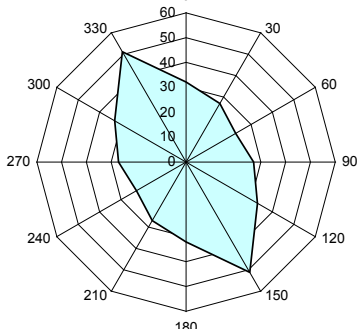


Pothole long axis orientation

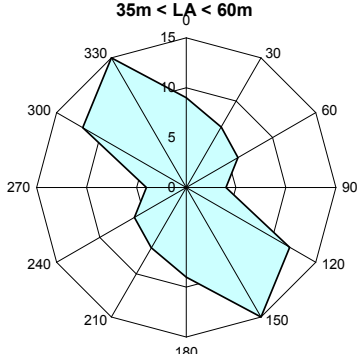
RADAR DIAG - LONG AXES
ALL DATA



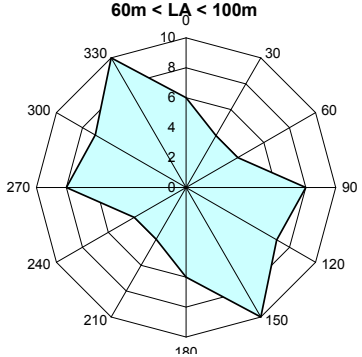
RADAR DIAG - LONG AXES
LA < 35m



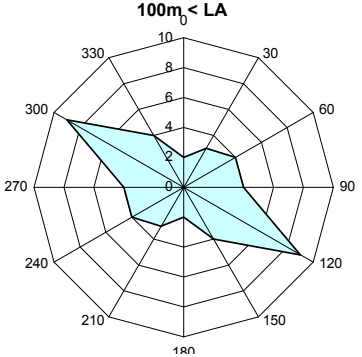
RADAR DIAG - LONG AXES
35m < LA < 60m



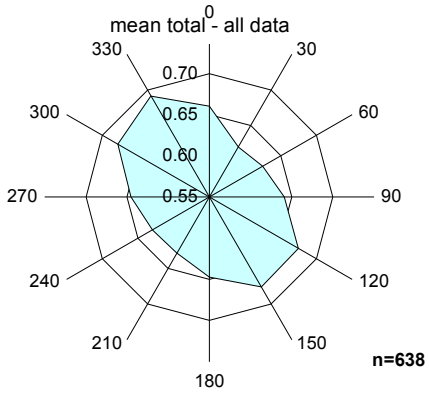
RADAR DIAG - LONG AXES
60m < LA < 100m

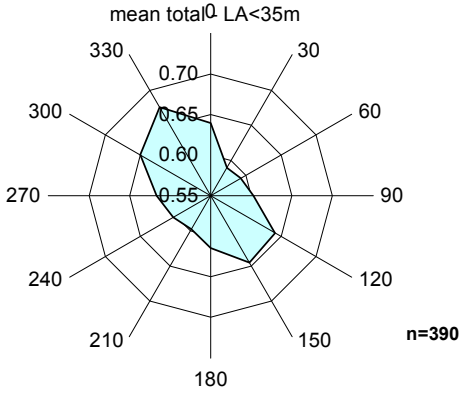


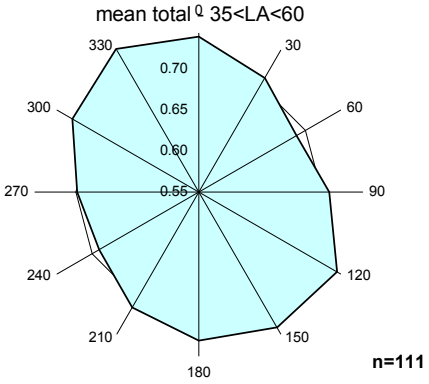
RADAR DIAG - LONG AXES
100m < LA

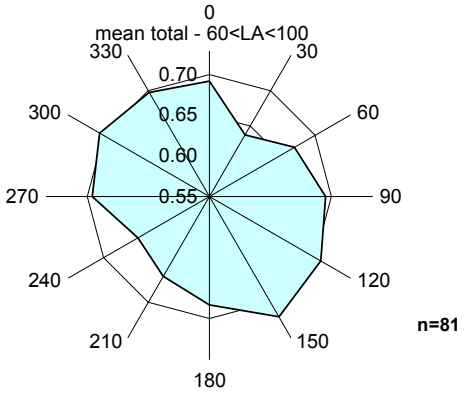


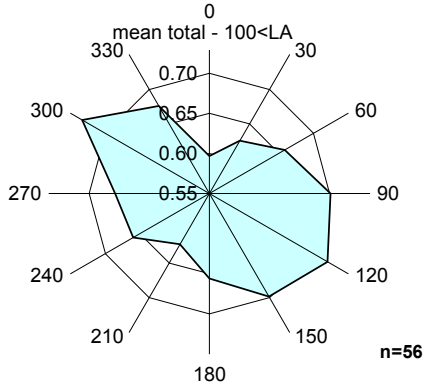
Average normalized pothole shapes



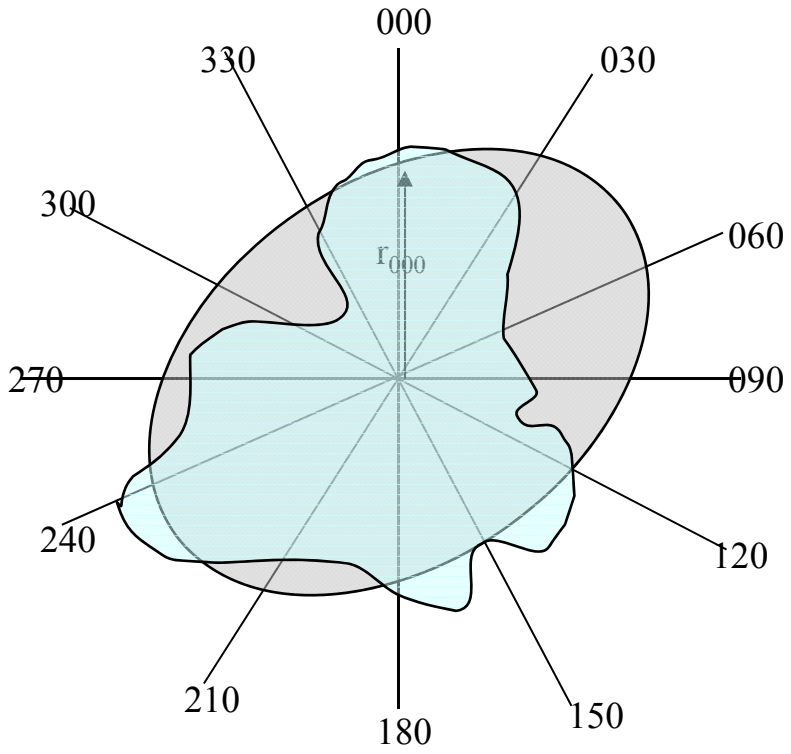








Pothole Dendricity



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

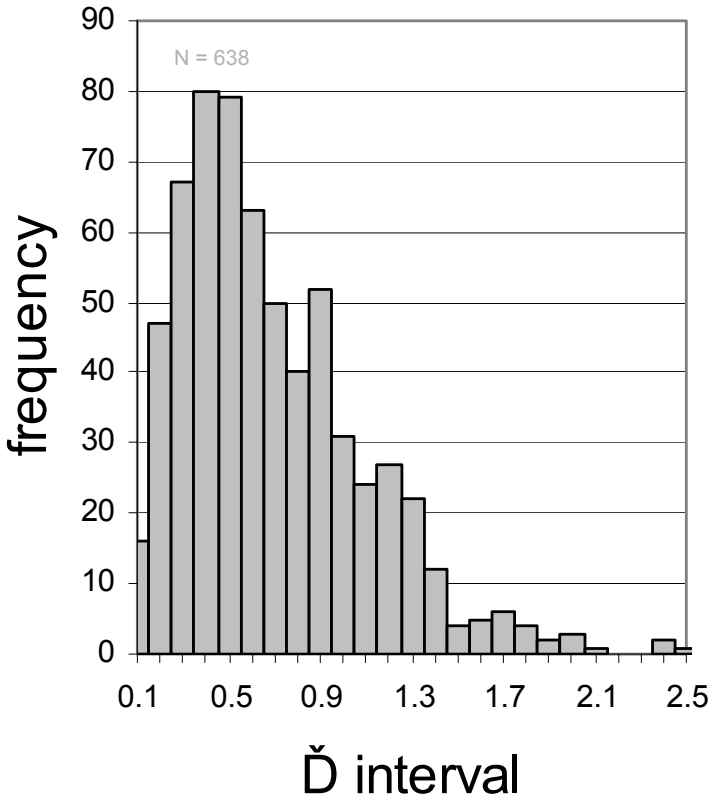
$$\check{D}[x] = |(r_{090} - r_{270})| + |(r_{030} - r_{330})| + |(r_{060} - r_{300})| - |(r_{120} - r_{240})| - |(r_{150} - r_{210})|$$

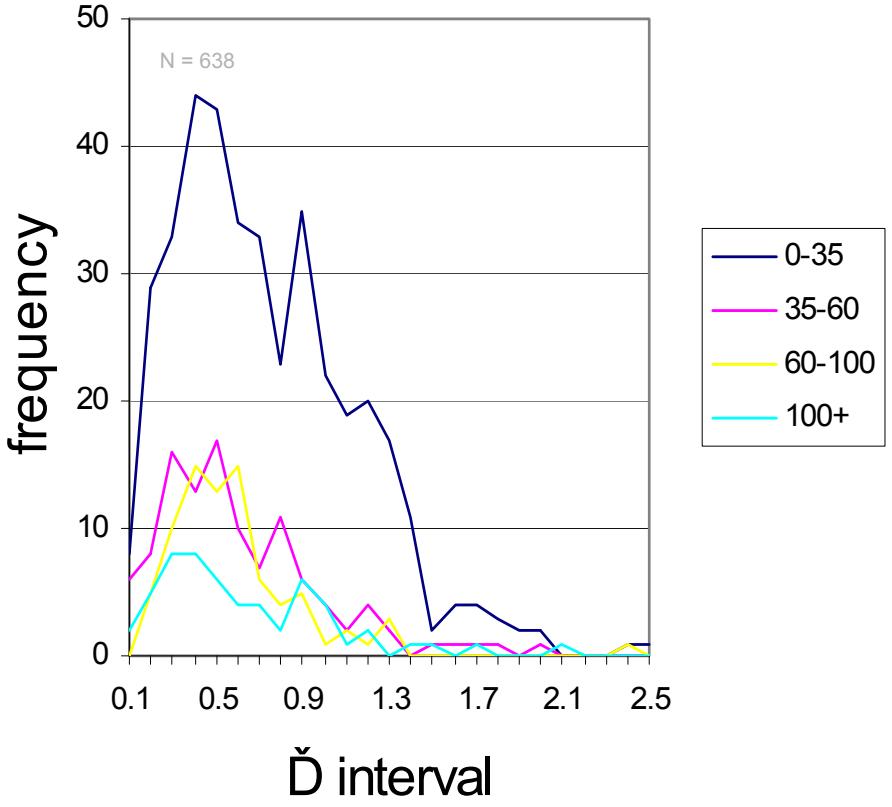
$$\check{D}[y] = |(r_{000} - r_{180})| + |(r_{030} - r_{150})| + |(r_{060} - r_{120})| - |(r_{210} - r_{330})| - |(r_{240} - r_{300})|$$

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

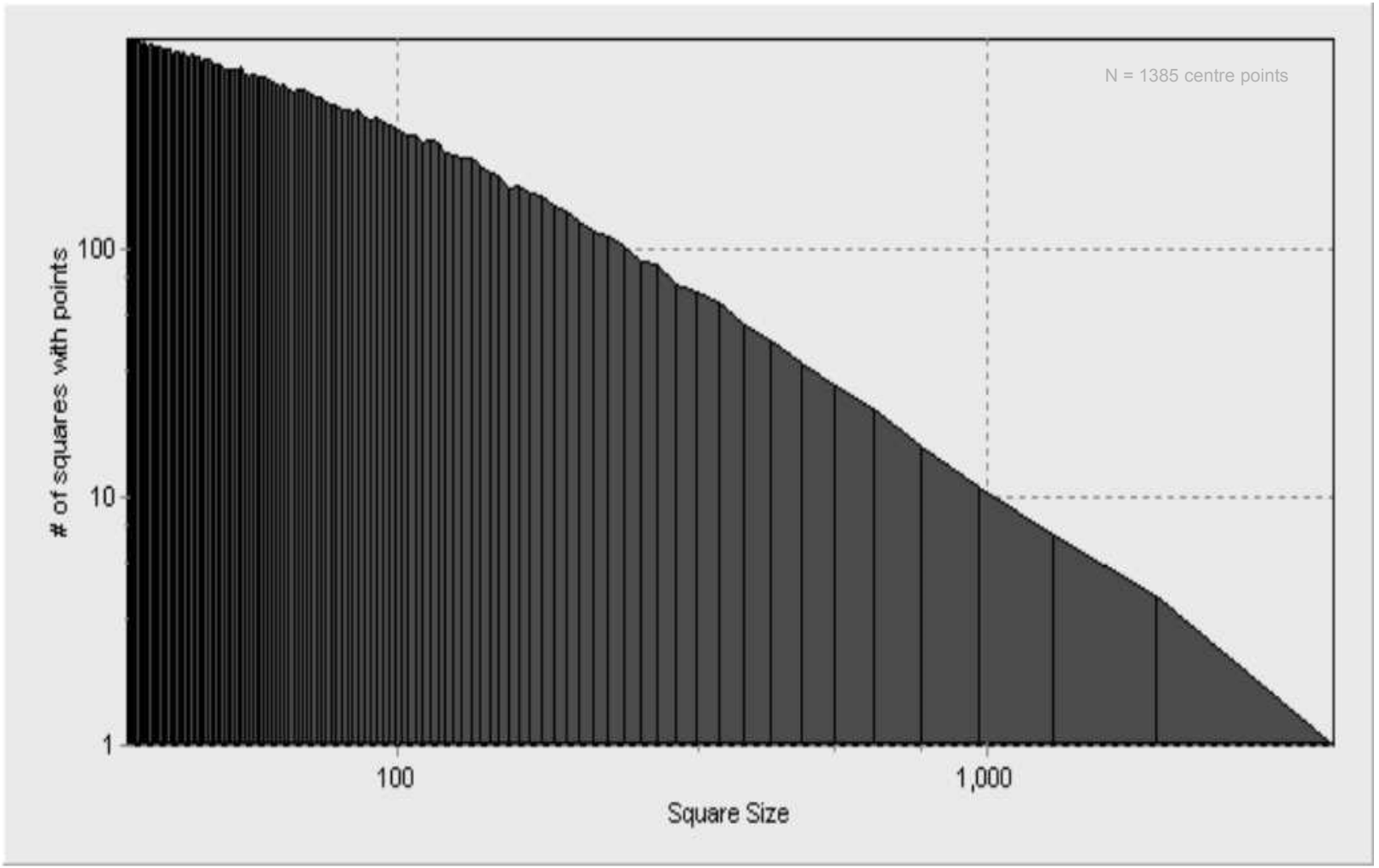
$\check{D} \rightarrow \infty$ with increasing disruption/dendricity

Dendricity

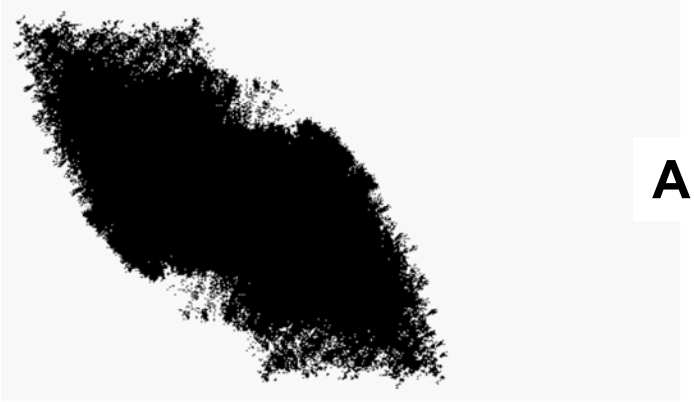

N = 638
frequency
90
80
70
60
50
40
30
20
10
0
0.1
0.5
0.9
1.3
1.7
2.1
2.5
Ď interval


N = 638
frequency
50
40
30
20
10
0
0.1
0.5
0.9
1.3
1.7
2.1
2.5
Ď interval
0-35
35-60
60-100
100+

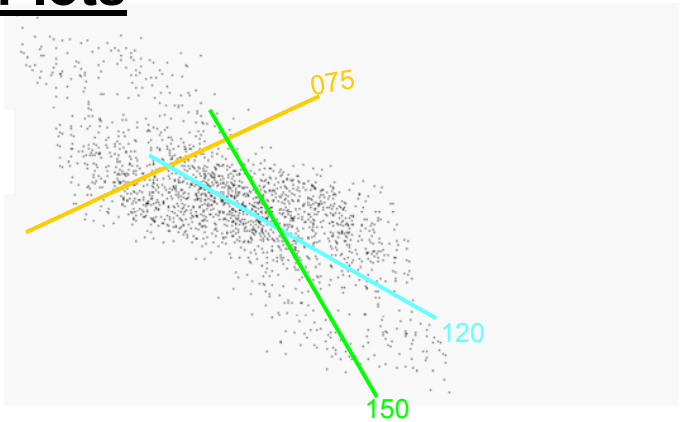
Fractal Analysis



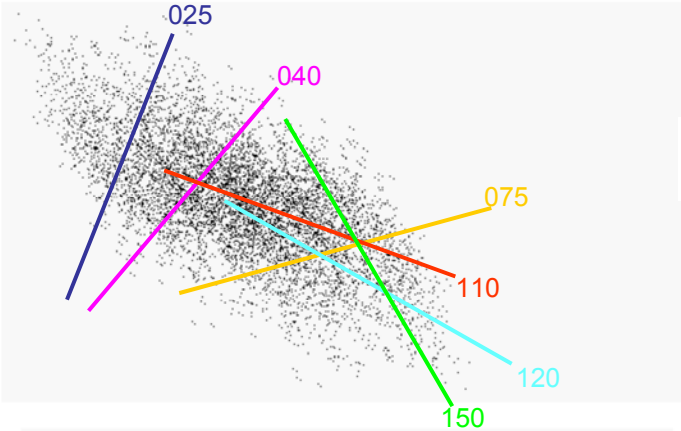
Fry Plots



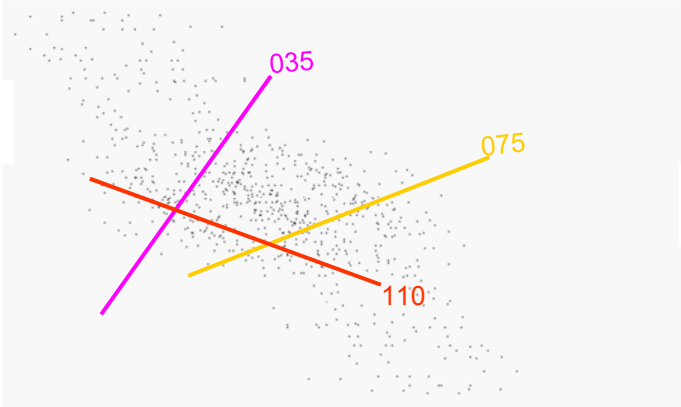
All data



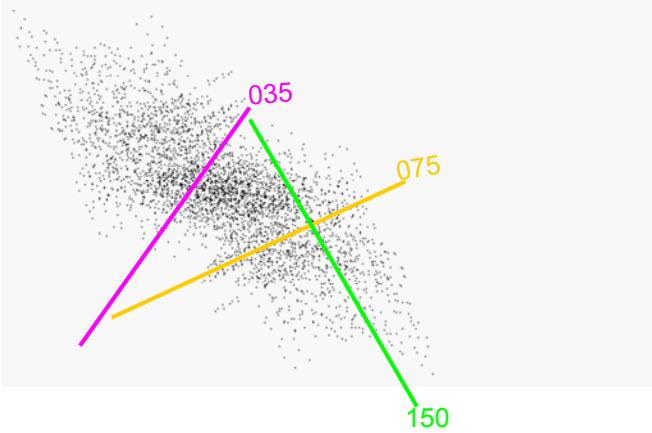
60<100m



< 35m



> 100m



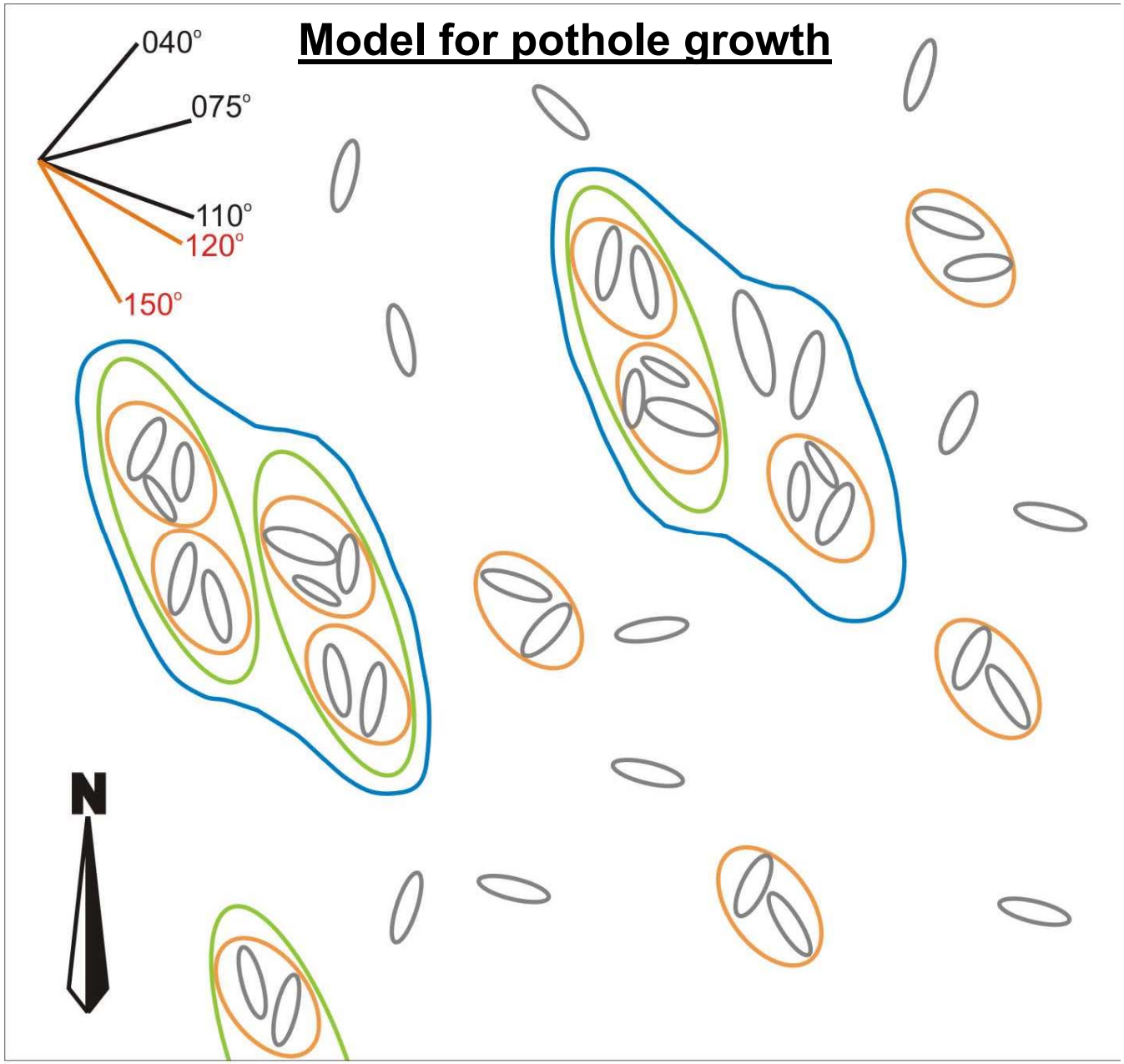
35<60m

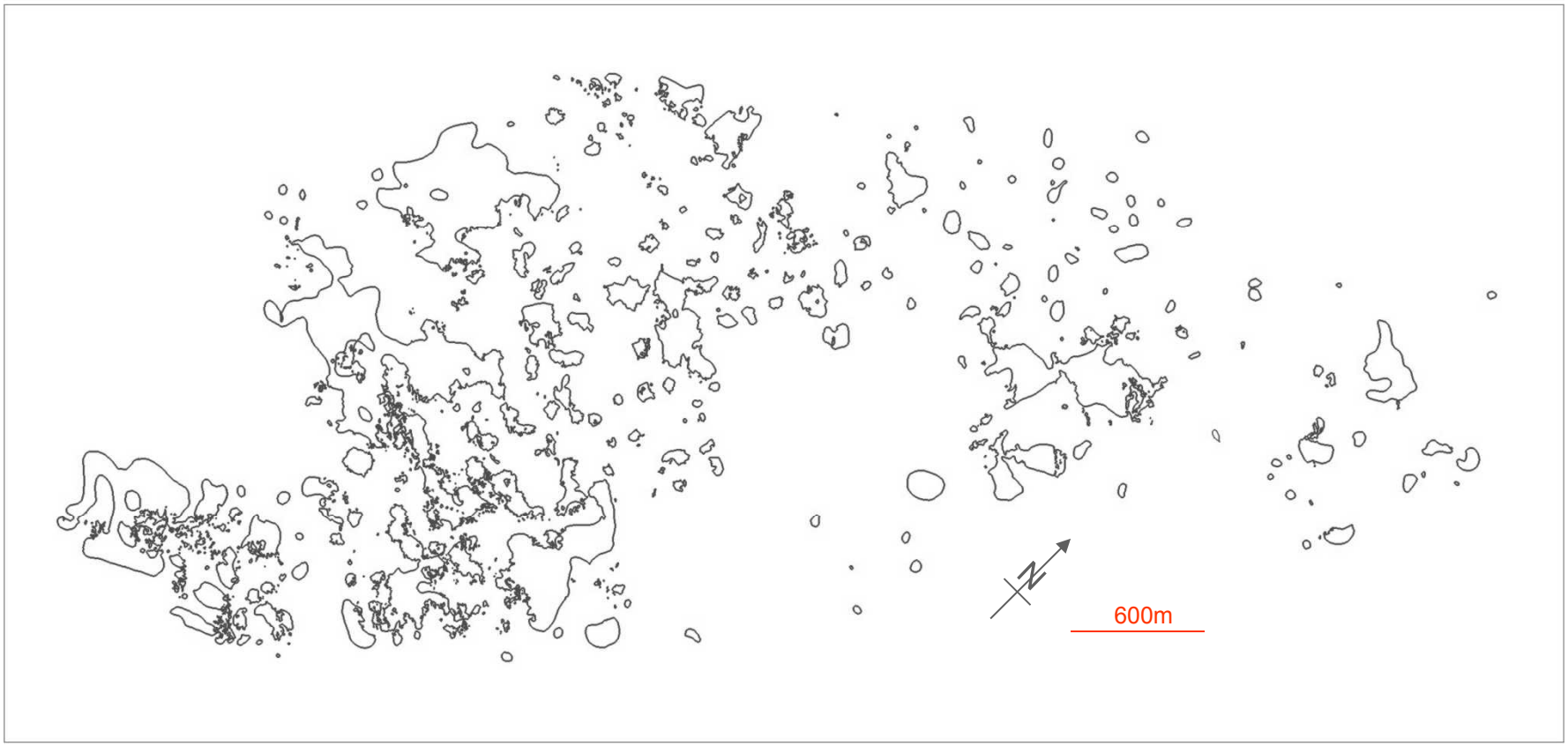
Interpretation supported by trend diagrams

Summary of findings

CRITERIA	RANGE OF LONG AXIS LENGTH			
	< 35m	35 – 60m	60 - 100m	> 100m
MEAN SA:LA	0.47 – 0.55 DECREASING ECCENTRICITY	0.55 – 0.62 DECREASING ECCENTRICITY	0.62 – 0.57 INCREASING ECCENTRICITY	0.57 – 0.61 DECREASING ECCENTRICITY
LA ORIENTATION	150°	120° - 180°	150°	120°
MEAN NORMALISED SHAPE	SIMPLE ELLIPSE	SIMPLE ELLIPSE	SIMPLE ELLIPSE	BI-LOBATE
MEAN CIRCULARITY	0.64	0.80	0.73	0.71
MEAN ECCENTRICITY	1.00	0.80	0.80	0.90
DENDRICITY	0.50	0.60	0.60	0.50
PREFERRED ALIGNMENT OF POTHOLE CENTRES	025°			
	040°	035°		035°
	075°	075°	075°	075°
	110°			110°
	120°		120°	
	150°	150°	150°	

Model for pothole growth





THANK YOU