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Multivariable Regression 3D Failure Criteria for In-Situ Rock

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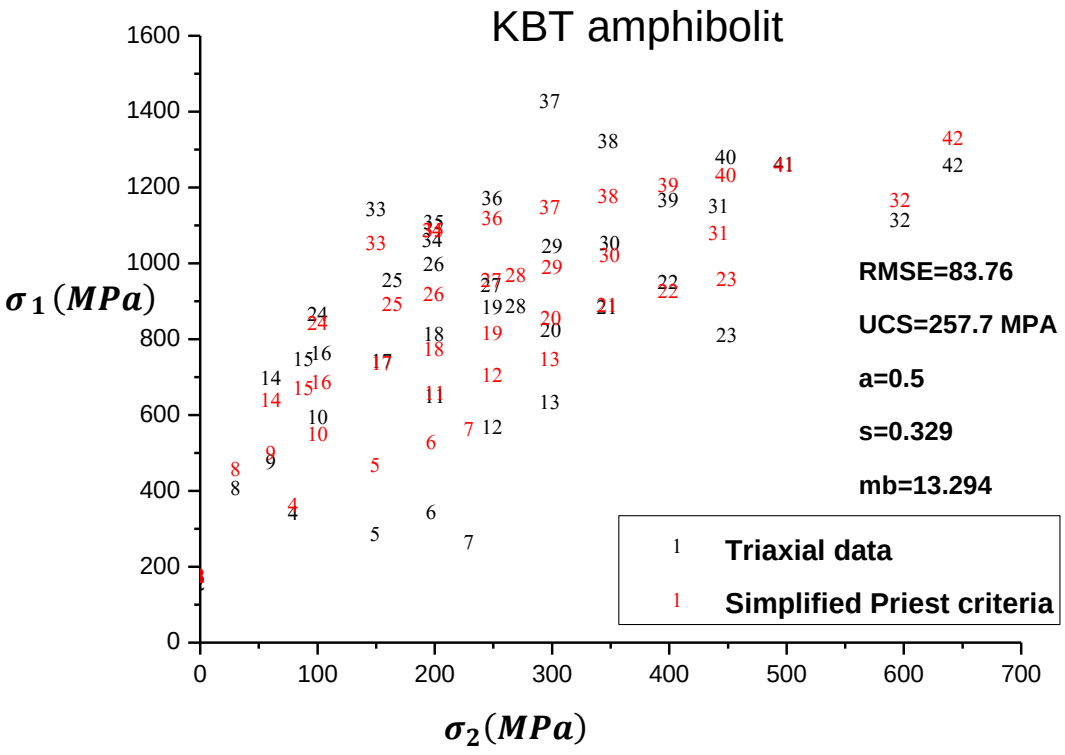
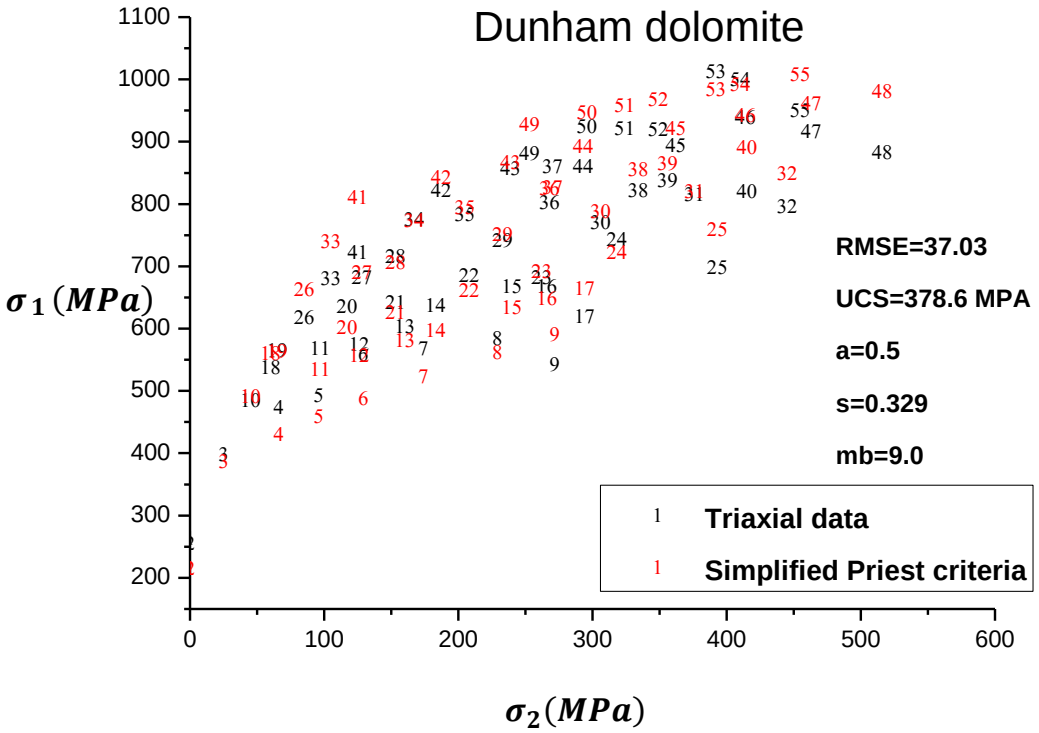
APPENDIX I: -

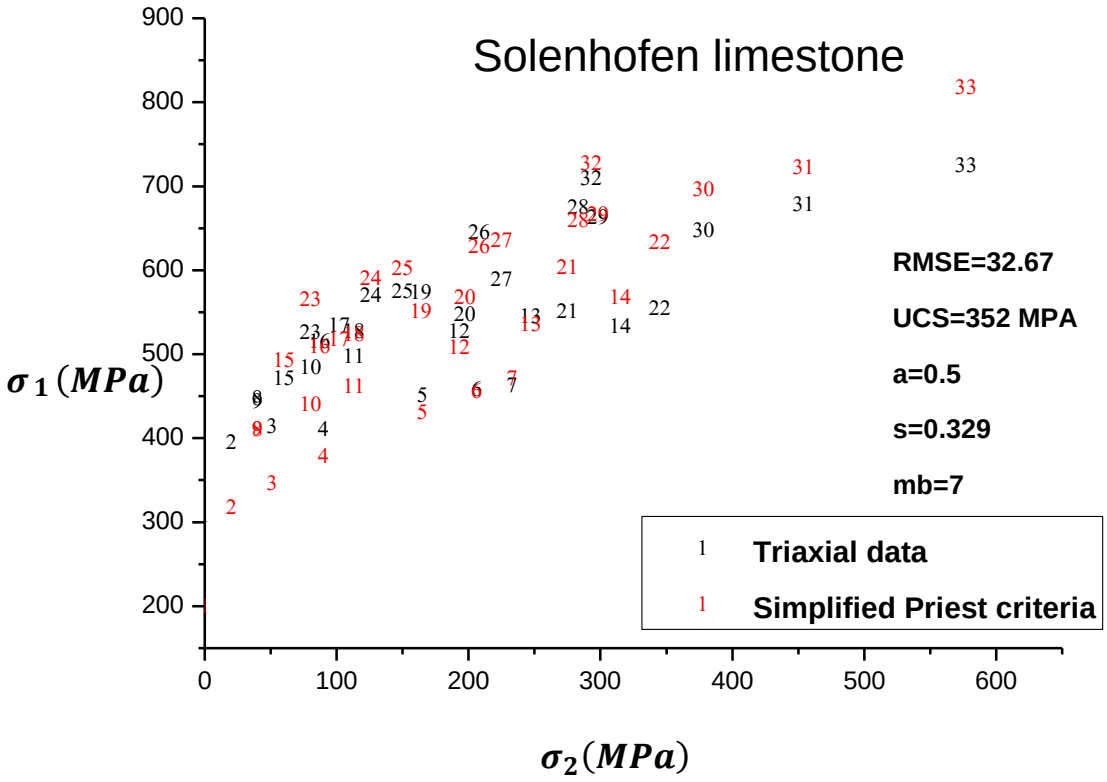
Failure prediction for eleven rock type by simplified Priest Criterion



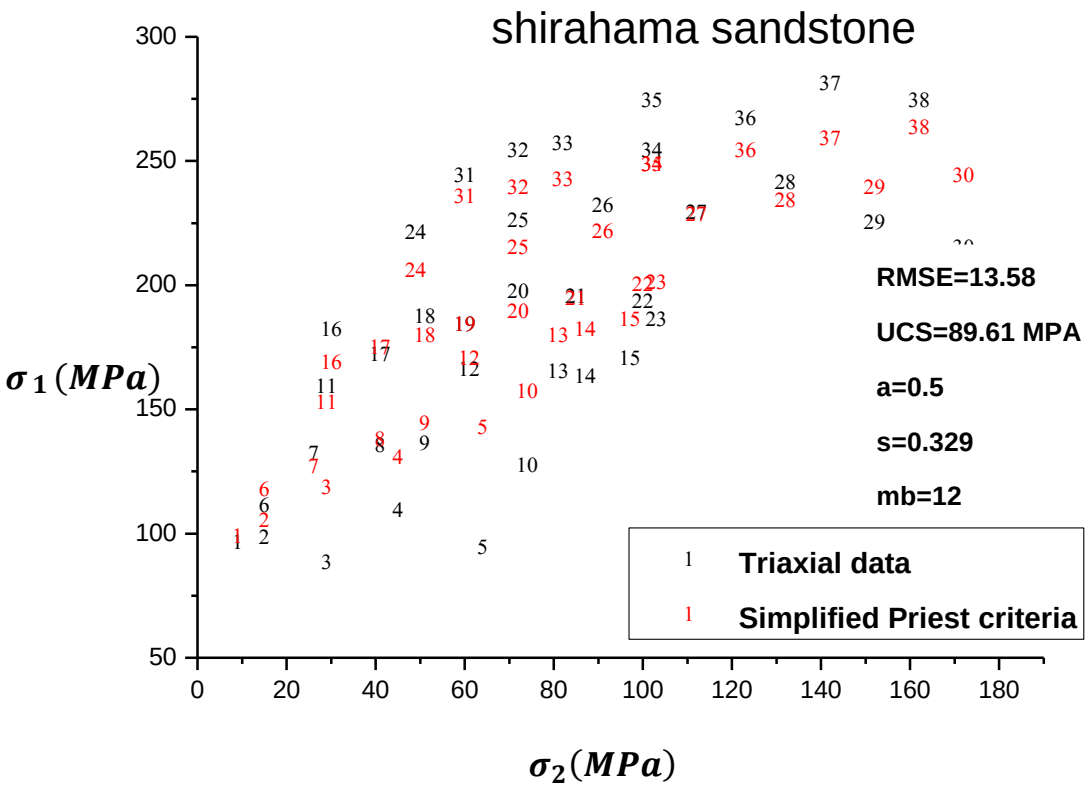
(A)


Dunham dolomite
RMSE=37.03
UCS=378.6 MPA
a=0.5
s=0.329
mb=9.0
Triaxial data
Simplified Priest criteria
$\sigma_1(MPa)$
$\sigma_2(MPa)$

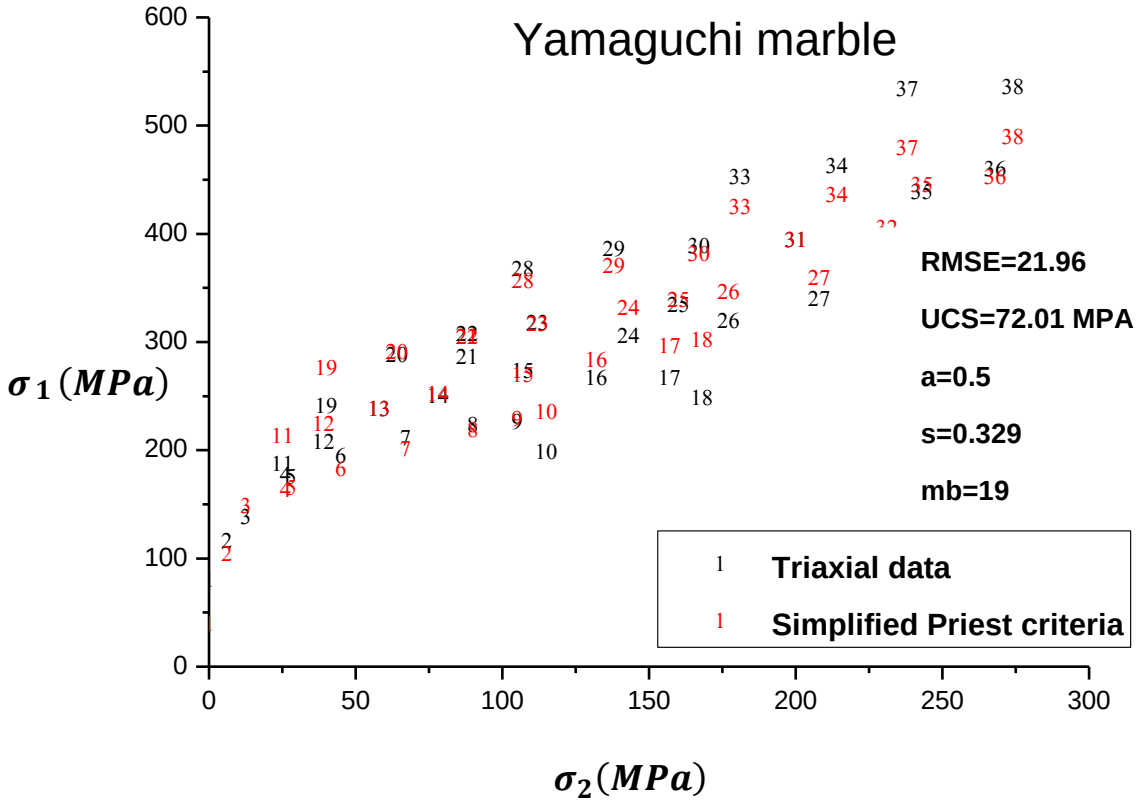
(B)


Solenhofen limestone
RMSE=32.67
UCS=352 MPA
a=0.5
s=0.329
mb=7
Triaxial data
Simplified Priest criteria
$\sigma_1(MPa)$
$\sigma_2(MPa)$
900
800
700
600
500
400
300
200
0
100
200
300
400
500
600

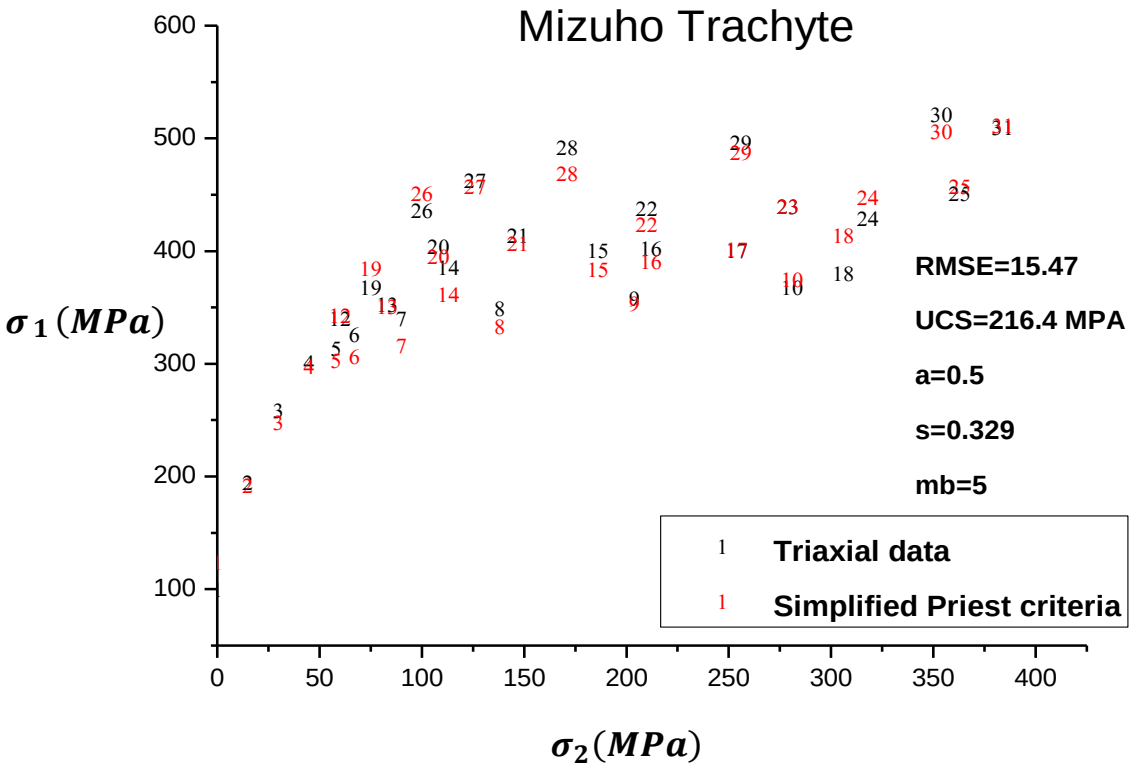
(C)


shirahama sandstone
RMSE=13.58
UCS=89.61 MPA
a=0.5
s=0.329
mb=12
Triaxial data
Simplified Priest criteria
$\sigma_1(MPa)$
$\sigma_2(MPa)$

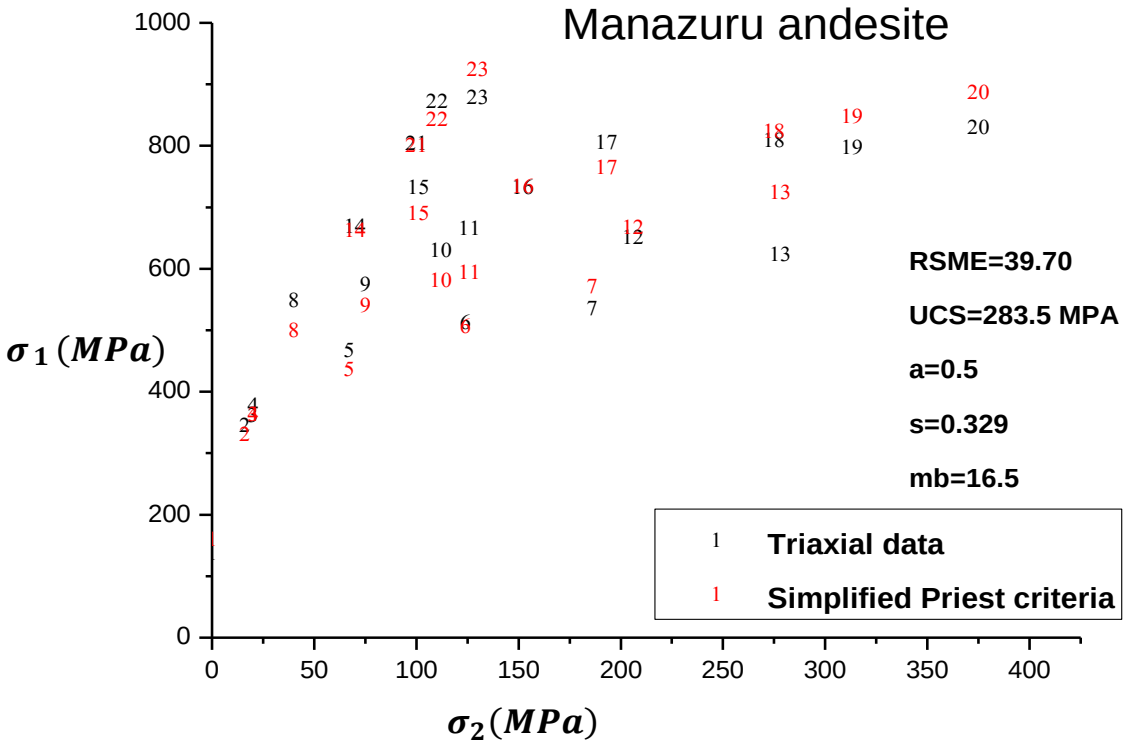
(D)


Yamaguchi marble
RMSE=21.96
UCS=72.01 MPA
a=0.5
s=0.329
mb=19
Triaxial data
Simplified Priest criteria
$\sigma_1 (MPa)$
$\sigma_2 (MPa)$
0
100
200
300
400
500
600
0
50
100
150
200
250
300

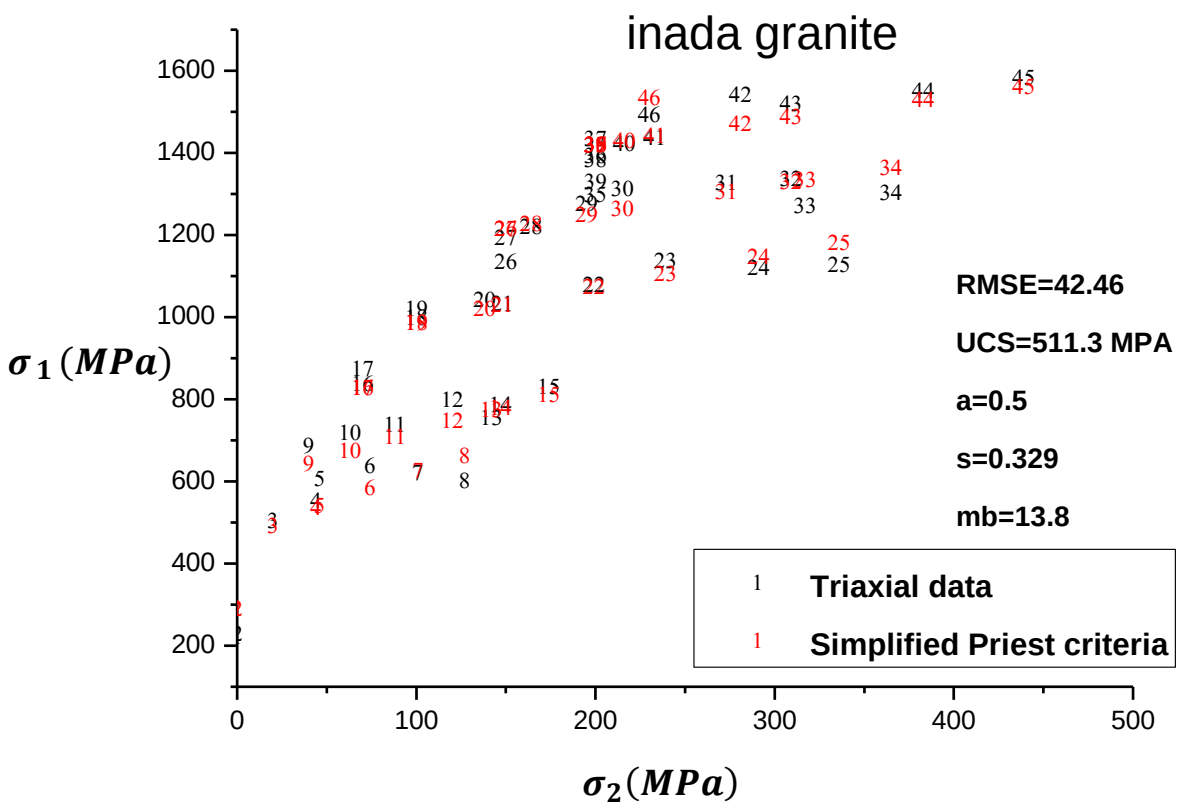
(E)


Mizuho Trachyte
$\sigma_1(MPa)$
$\sigma_2(MPa)$
RMSE=15.47
UCS=216.4 MPA
a=0.5
s=0.329
mb=5
Triaxial data
Simplified Priest criteria

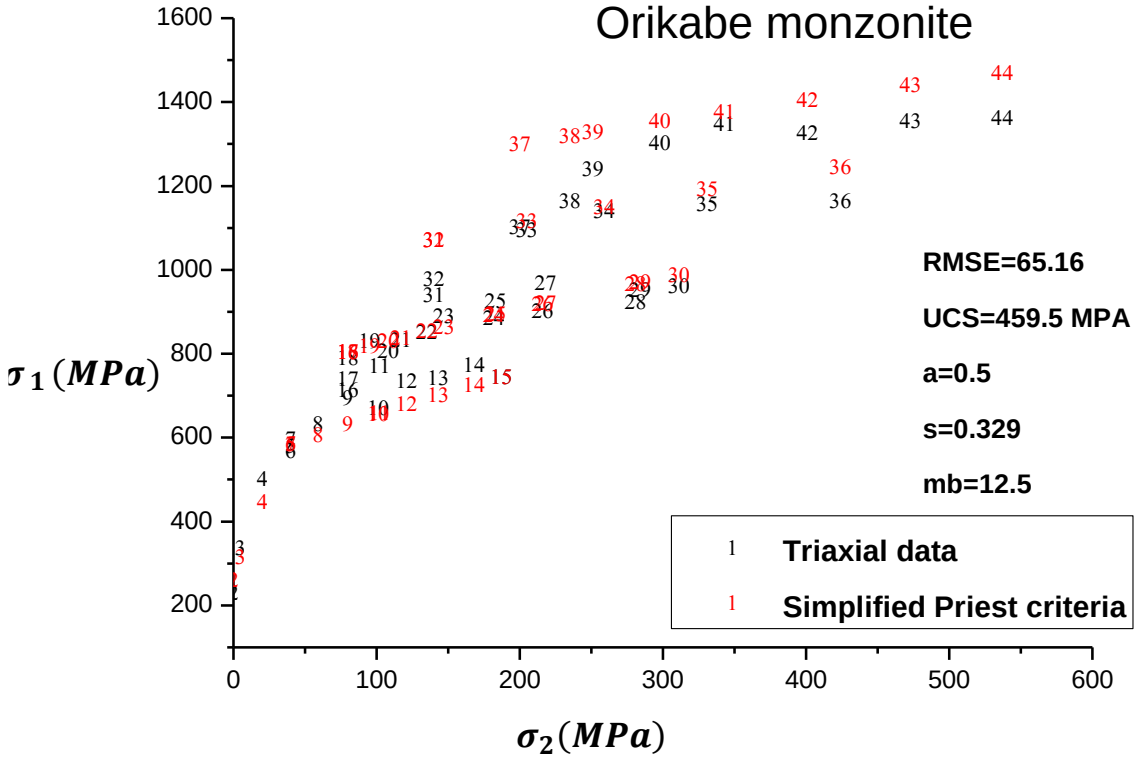
(F)


Manazuru andesite
$\sigma_1(MPa)$
$\sigma_2(MPa)$
0
200
400
600
800
1000
0
50
100
150
200
250
300
350
400
RSME=39.70
UCS=283.5 MPA
a=0.5
s=0.329
mb=16.5
Triaxial data
Simplified Priest criteria

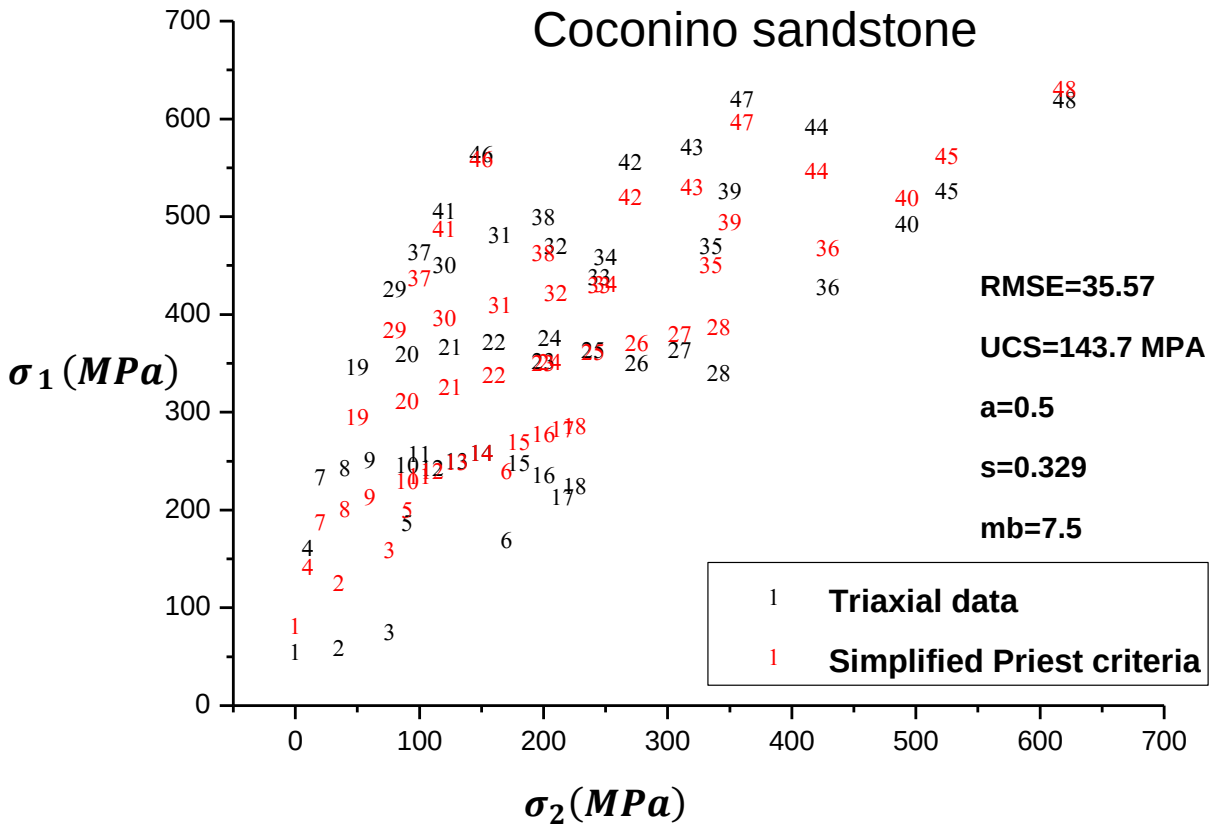
(G)


inada granite
$\sigma_1(MPa)$
$\sigma_2(MPa)$
RMSE=42.46
UCS=511.3 MPA
a=0.5
s=0.329
mb=13.8
Triaxial data
Simplified Priest criteria

(H)


Orikabe monzonite
RMSE=65.16
UCS=459.5 MPA
a=0.5
s=0.329
mb=12.5
Triaxial data
Simplified Priest criteria
$\sigma_1(MPa)$
$\sigma_2(MPa)$
1600
1400
1200
1000
800
600
400
200
0
100
200
300
400
500
600

(I)



(J)

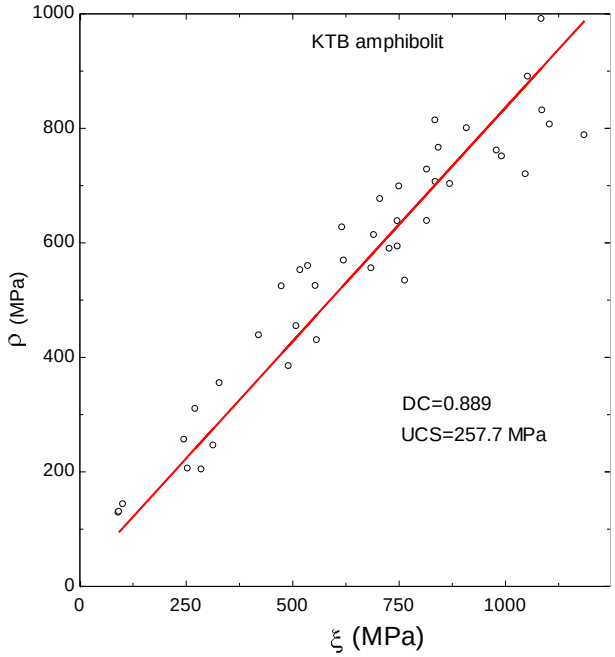
Figure - Failure prediction for ten rock type by Simplified Priest criterion.

APPENDIX II: -

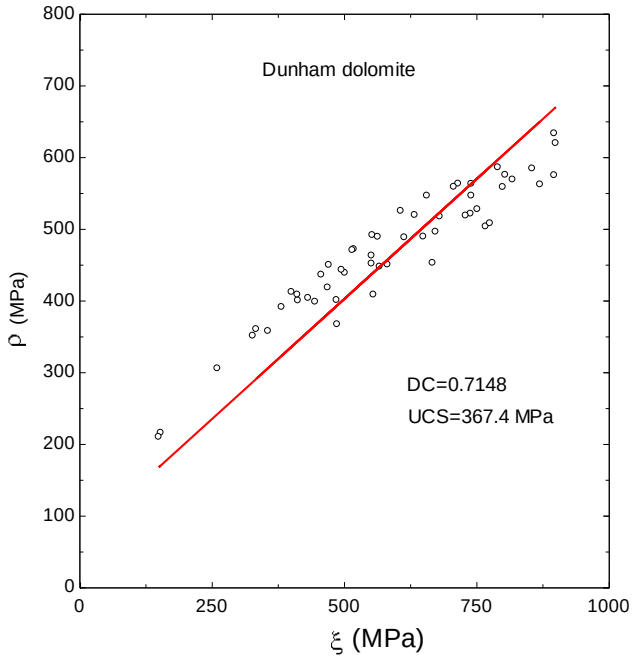
Failure prediction for eleven rock type by Drucker-Prager Criterion

Rad solid line = Drucker-Prager Criterion

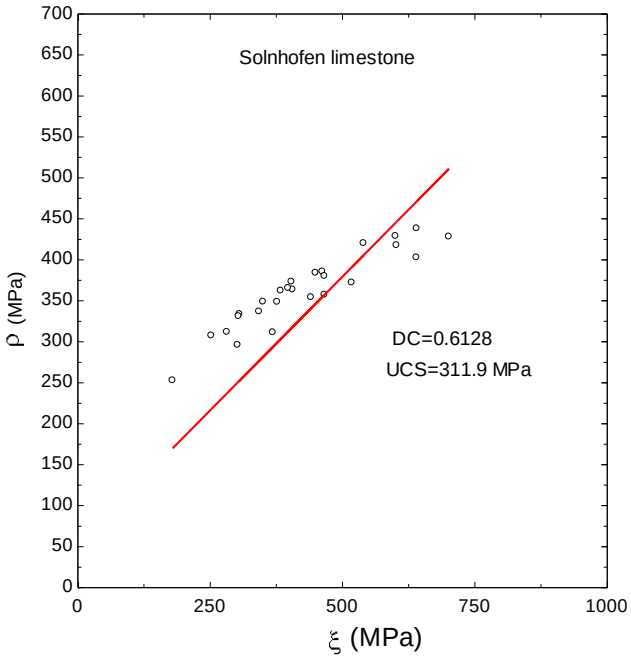
Black scatter data = Triaxial Compression test data



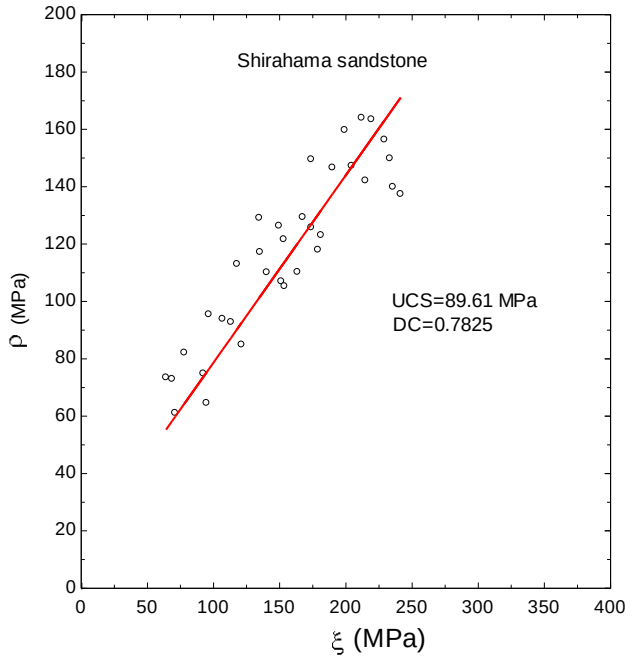
(A)



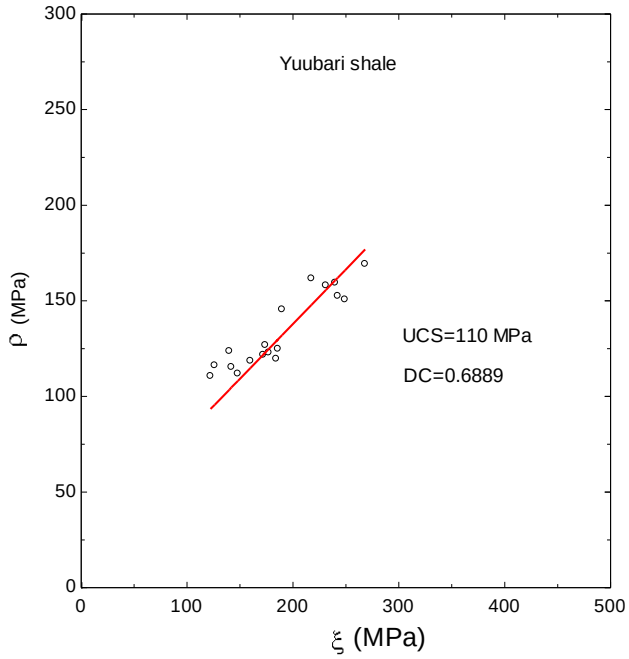
(B)


Solnhofen limestone
DC=0.6128
UCS=311.9 MPa
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
0
250
500
750
1000

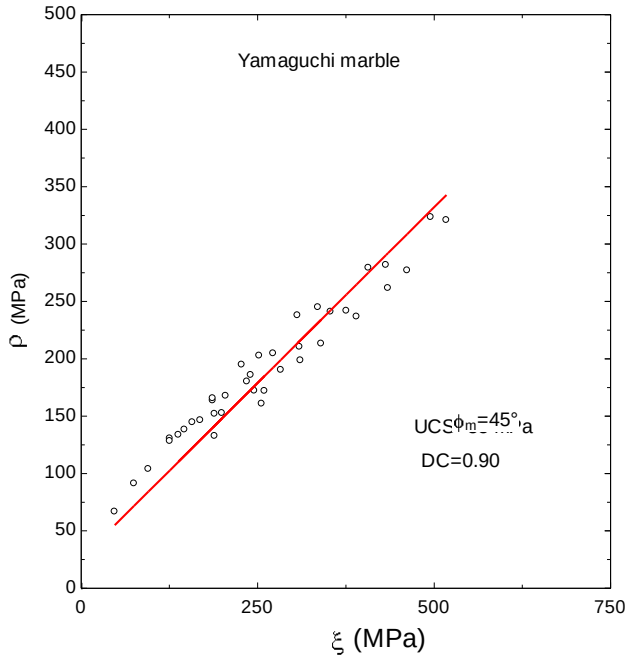
(C)


Shirahama sandstone
UCS=89.61 MPa
DC=0.7825
ρ (MPa)
ξ (MPa)
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
300
350
400

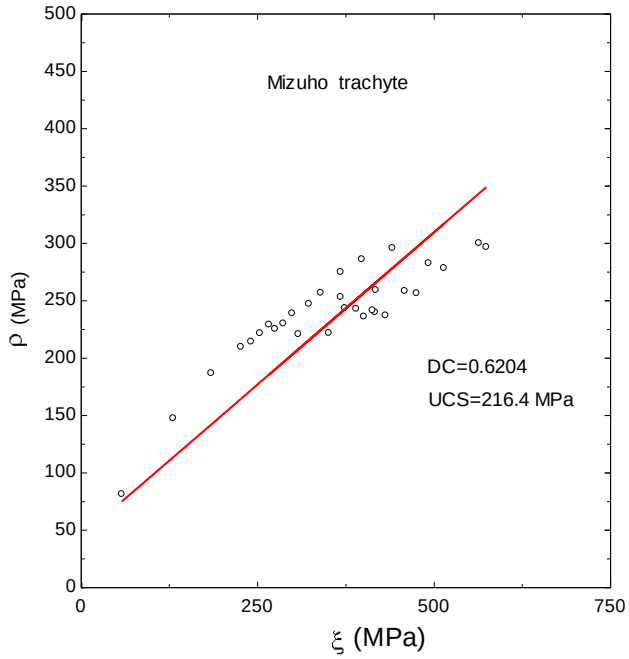
(D)


Yuubari shale
UCS=110 MPa
DC=0.6889
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
0
100
200
300
400
500

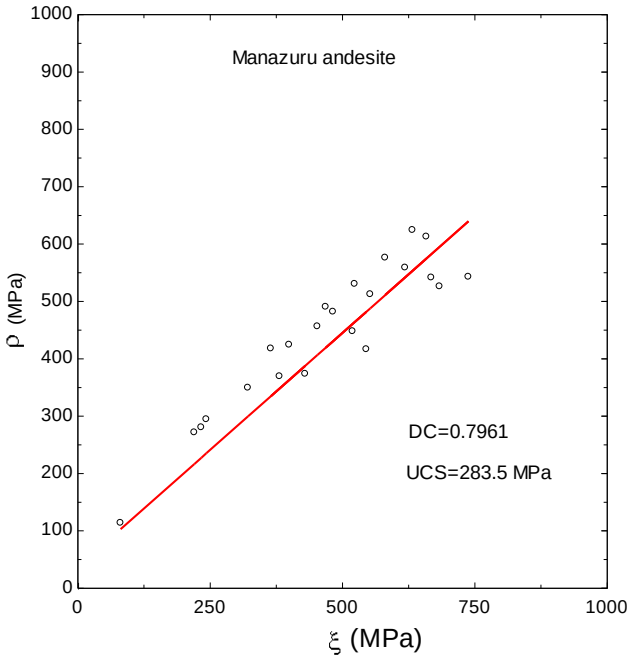
(E)


Yamaguchi marble
DC=0.90
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
0
250
500
750

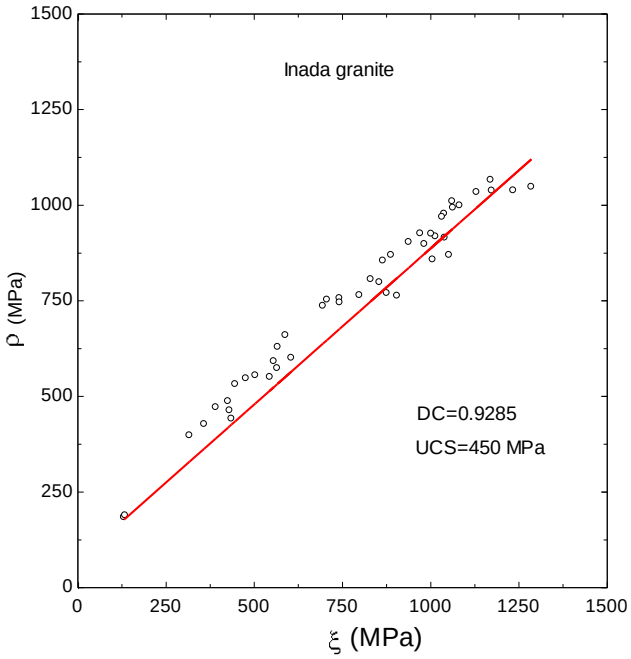
(F)


Mizuho trachyte
DC=0.6204
UCS=216.4 MPa
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
0
250
500
750

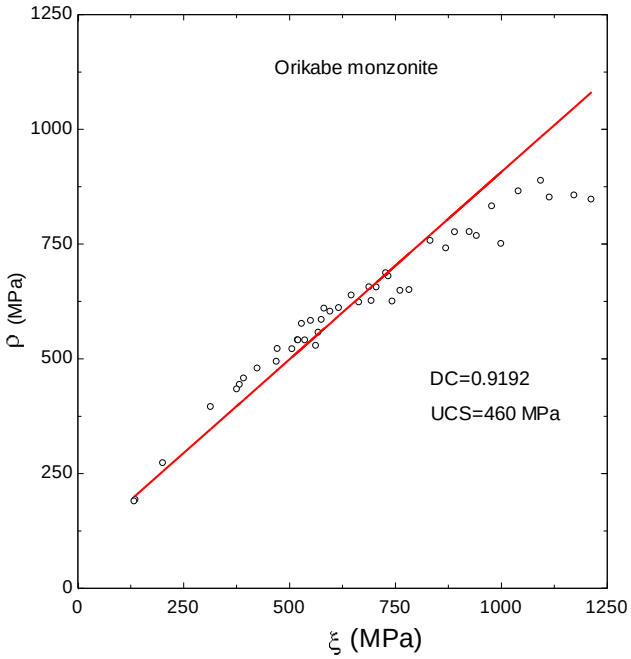
(G)


Manazuru andesite
DC=0.7961
UCS=283.5 MPa
ρ (MPa)
ξ (MPa)
0
100
200
300
400
500
600
700
800
900
1000
0
250
500
750
1000

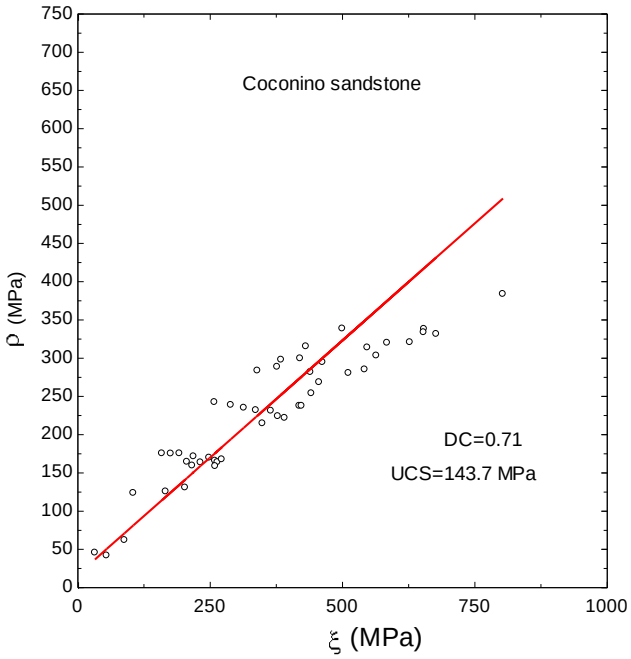
(H)


Inada granite
DC=0.9285
UCS=450 MPa
ρ (MPa)
ξ (MPa)
0
250
500
750
1000
1250
1500

(I)


Orikabe monzonite
DC=0.9192
UCS=460 MPa
ρ (MPa)
ξ (MPa)
0
250
500
750
1000
1250

(J)

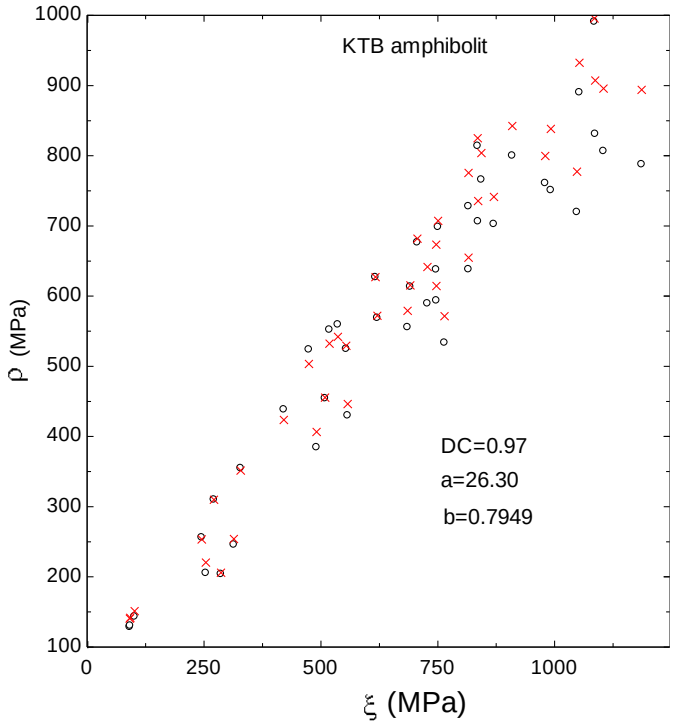

Coconino sandstone
DC=0.71
UCS=143.7 MPa
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
0
250
500
750
1000

(K)

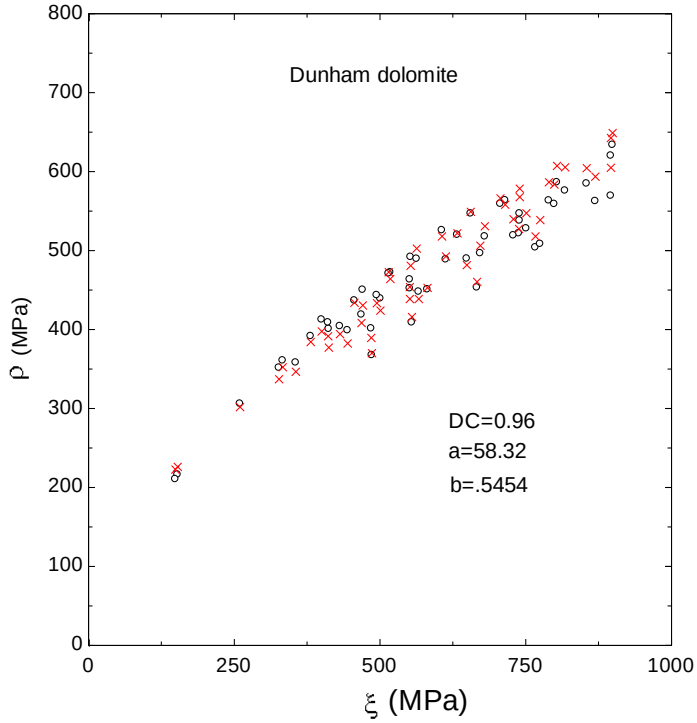
APPENDIX III: -
Failure prediction for ten rock types by Mogi-Coulomb criterion.

Rad scatter data = Mogi-coulomb Criterion

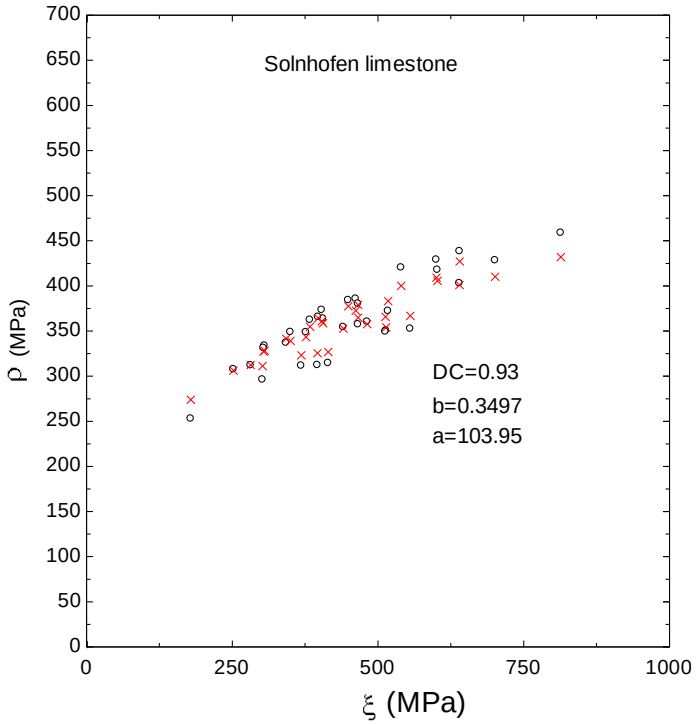
Black scatter data = Triaxial Compression test data



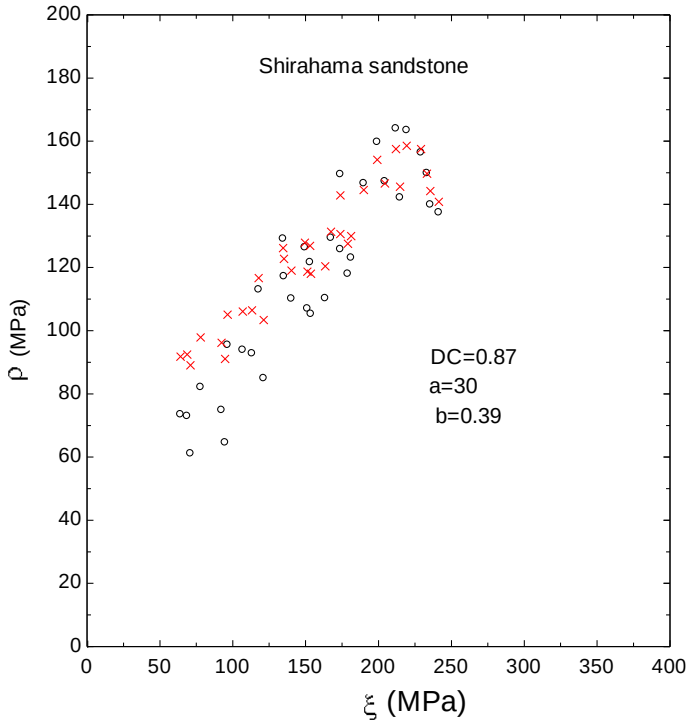
(A)



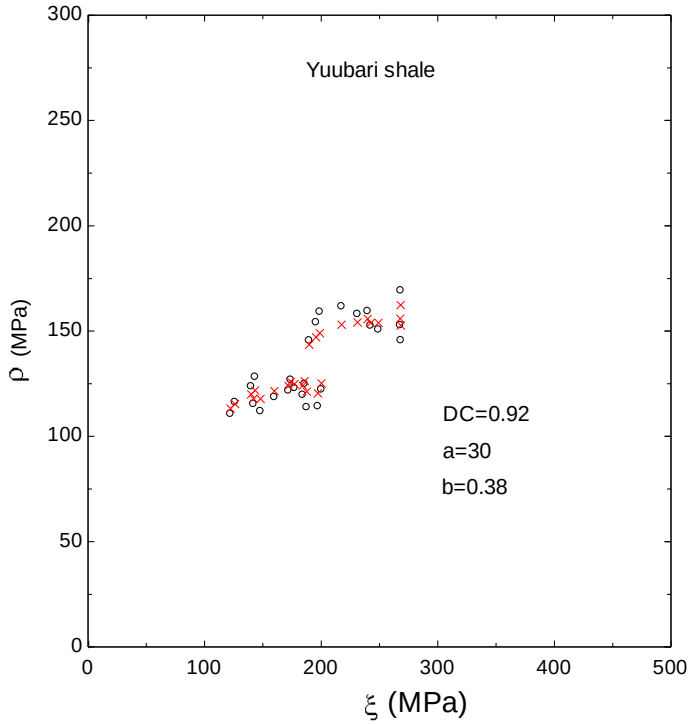
(B)


Solnhofen limestone
DC=0.93
b=0.3497
a=103.95
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
0
250
500
750
1000

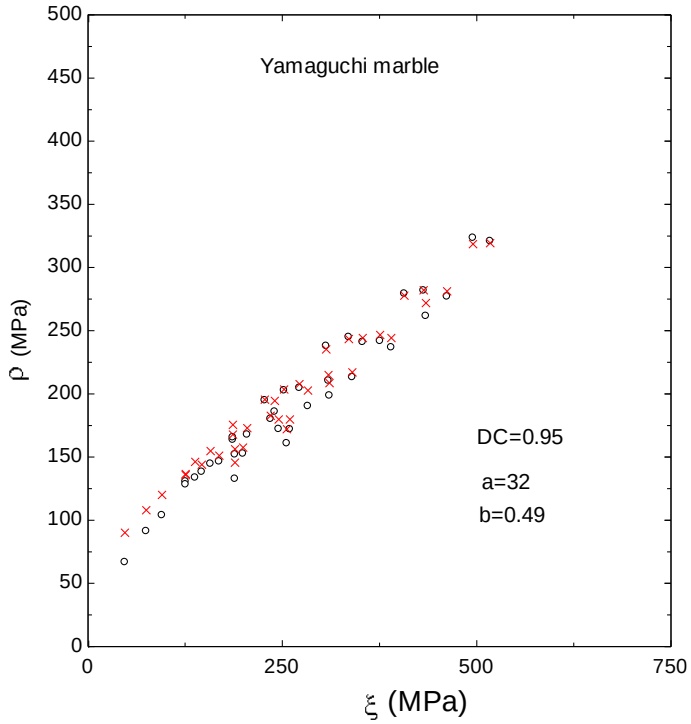
(C)


Shirahama sandstone
DC=0.87
a=30
b=0.39
ρ (MPa)
ξ (MPa)
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
300
350
400

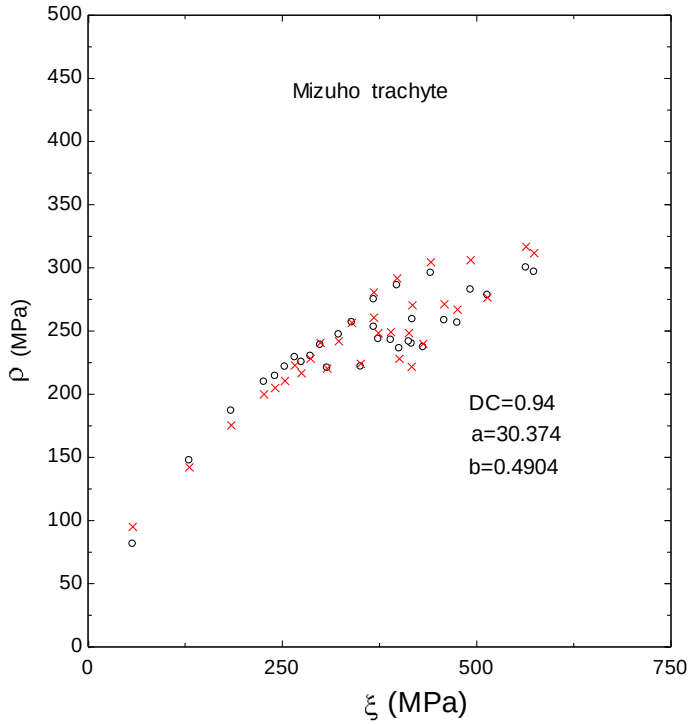
(D)


Yuubari shale
DC=0.92
a=30
b=0.38
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
0
100
200
300
400
500

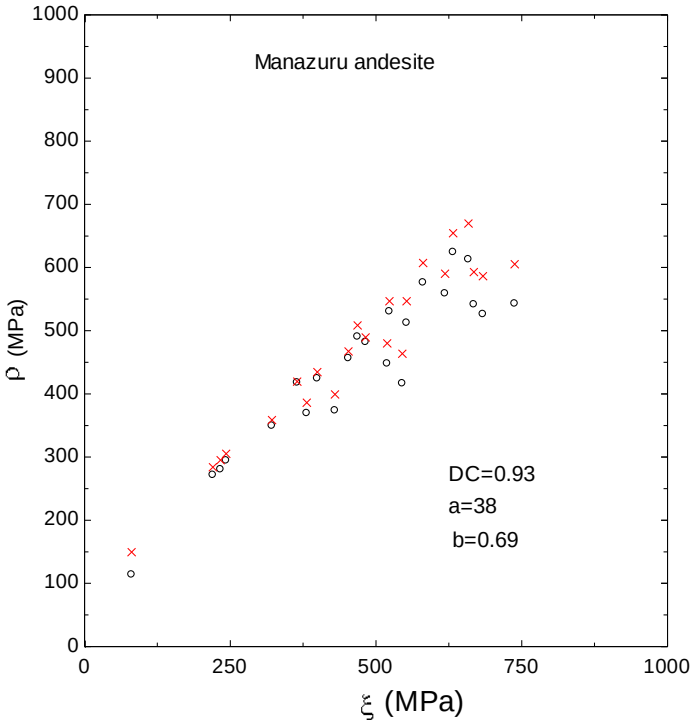
(E)


Yamaguchi marble
DC=0.95
a=32
b=0.49
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
0
250
500
750

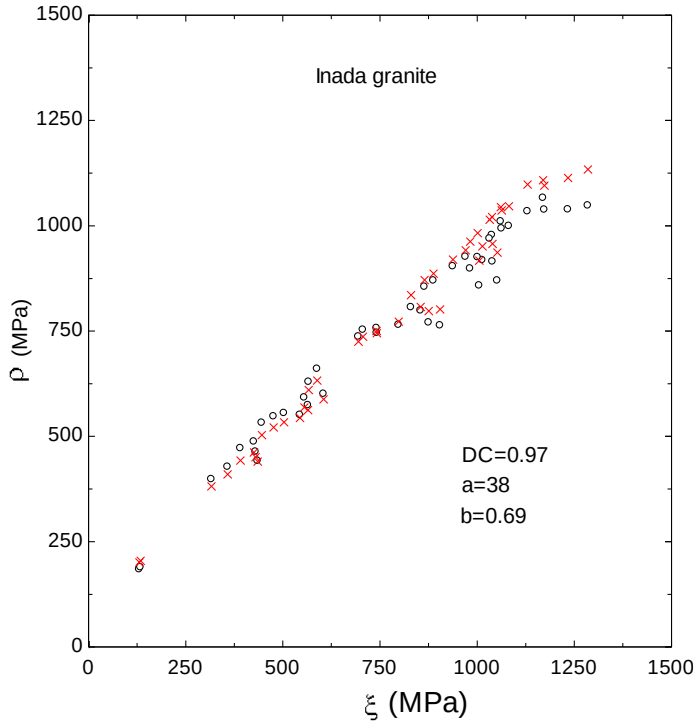
(F)


Mizuho trachyte
DC=0.94
a=30.374
b=0.4904
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
0
250
500
750

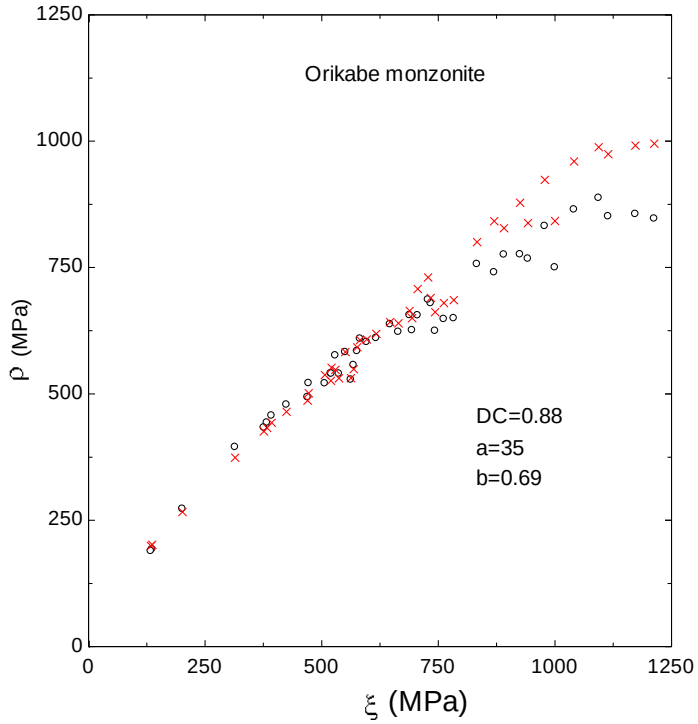
(G)


Manazuru andesite
DC=0.93
a=38
b=0.69
ρ (MPa)
ξ (MPa)
0
100
200
300
400
500
600
700
800
900
1000
0
250
500
750
1000

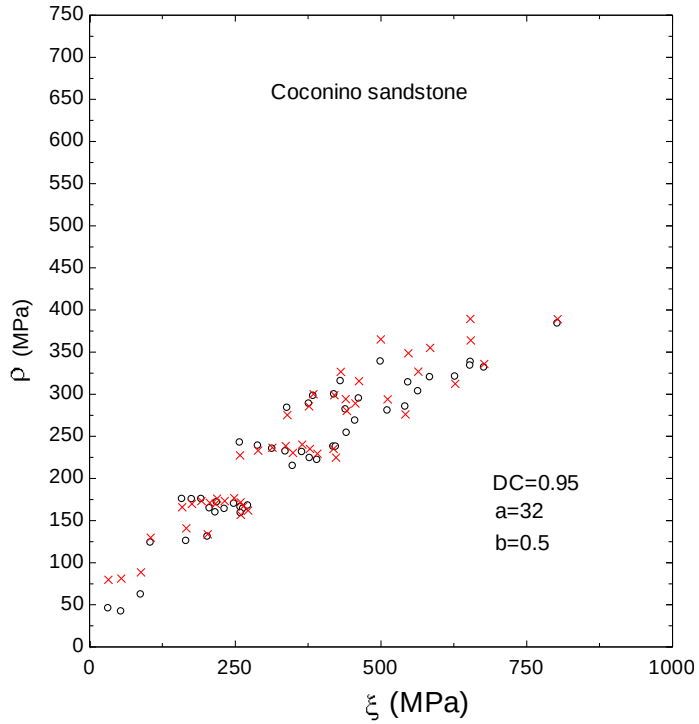
(H)


Inada granite
DC=0.97
a=38
b=0.69
ρ (MPa)
ξ (MPa)
0
250
500
750
1000
1250
1500

(I)


Orikabe monzonite
DC=0.88
a=35
b=0.69
ρ (MPa)
ξ (MPa)
0
250
500
750
1000
1250

(J)


Coconino sandstone
DC=0.95
a=32
b=0.5
ρ (MPa)
ξ (MPa)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
0
250
500
750
1000