STRUCTURAL GEOLOGY

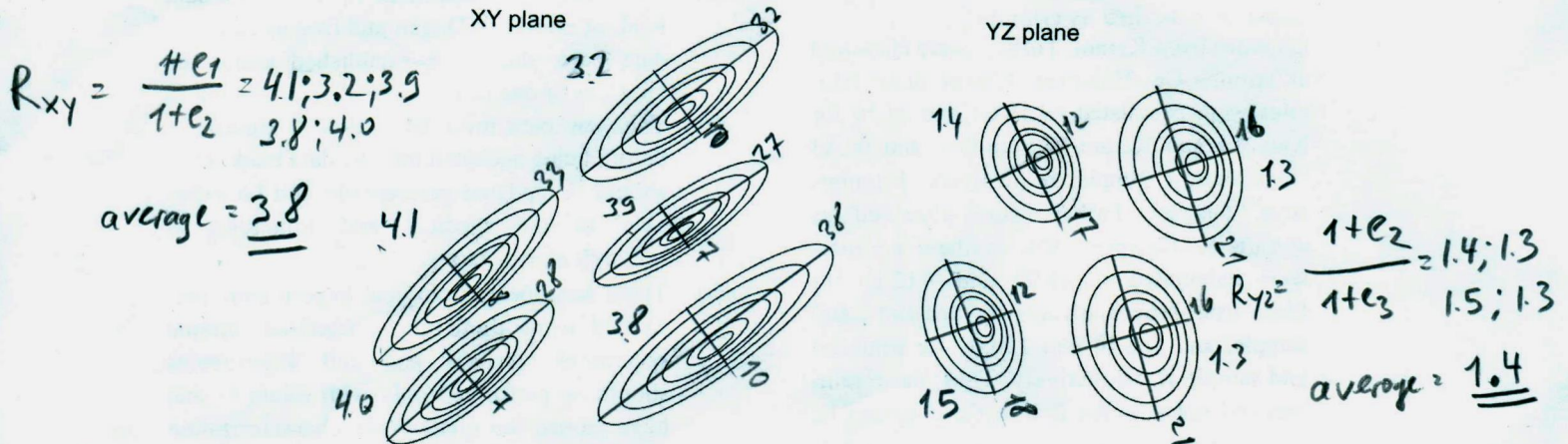## Mid-Term Exam Questions

10th April 2013

1. Using stereographic projections
a) Find the trend and plunge of the line of intersection of the planes 12/64NW and 156/23NE.
b) Pass a plane through the lines 04/46NE and 88/12W. Find out the strike and dip of the plane.

2. Provide short answers to the following questions:
a) What is the relation between cleavage plane, mineral streching lineation and the axes of the finite strian ellipsoid. Explain your answer with the help of a diagram.
b) Draw a block diagram of a fold and show: fold plane, fold (hinge) axis, fold limbs and hinge zone.
c) What are the factors that control the ductile versus brittle behaviour of the rocks?
d) What is strain rate, how is it described? Because of spreading along the mid-Atlantic ridge, London moves away from New York by 2.5 cm a year. Calculate the strain rate considering that the distance between London and New York is 5500 km.
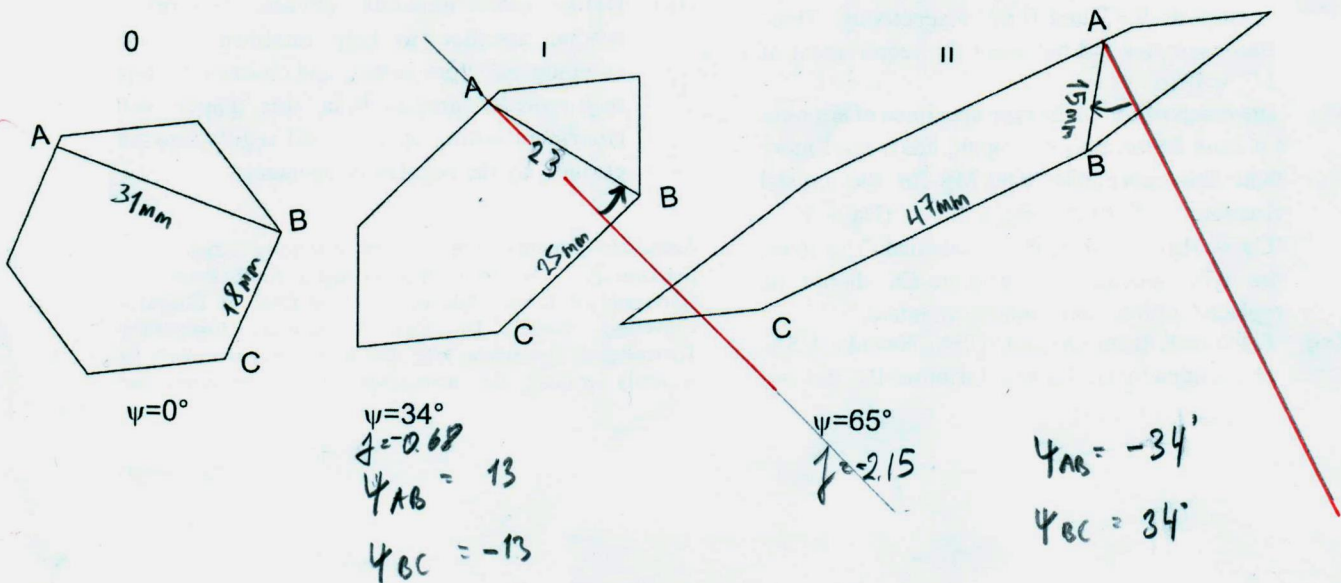
3. The diagrams below show the XY and YZ sections of deformed ooids from a single rock sample. Find out the principal axial ratios and show them on a Flinn diagram. How would you describe the shape of the finite strain ellipsoid?
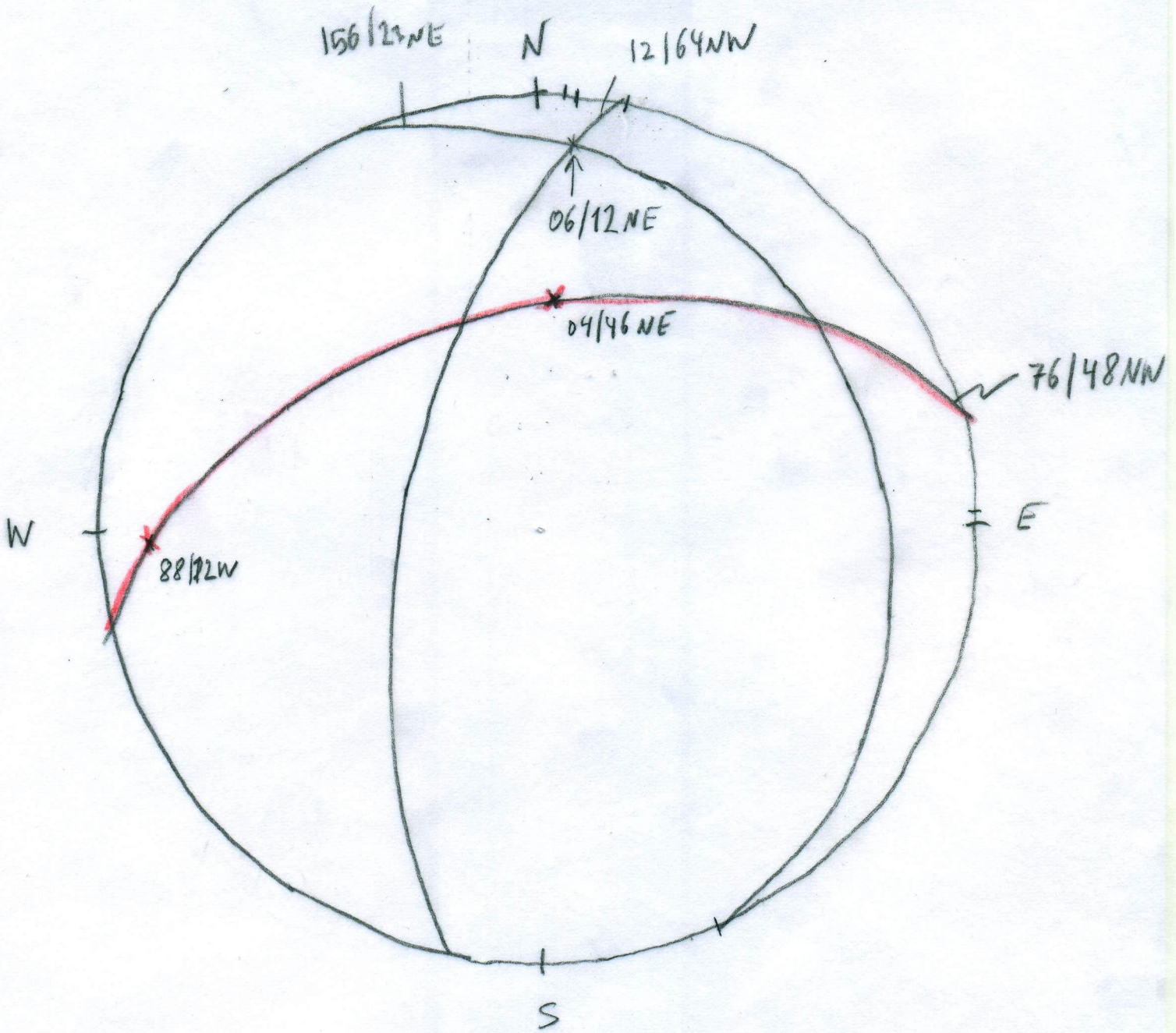
XY plane

YZ plane

$$R_{xy} = \frac{1+e_1}{1+e_2} = 4.1; 3.2; 3.9 \\ 3.8; 4.0$$

average = 3.8

3.2

33   27

39

28   3.8

4.1

3.8

4.0   70

1.4   12   16

1.3

12   16 $R_{yz} = \frac{1+e_2}{1+e_3} = 1.4; 1.3 \\ 1.5; 1.3$

1.3

1.5   average = 1.4

4. The diagram below shows undeformed and deformed hexagons.
a) Calculate the longitudinal changes along the lines AB and BC. Show them on a γ versus e diagram.   3 + 3 + 8 = 14
b) Calculate the angular changes along AB and BC and show them on a γ versus γ diagram.
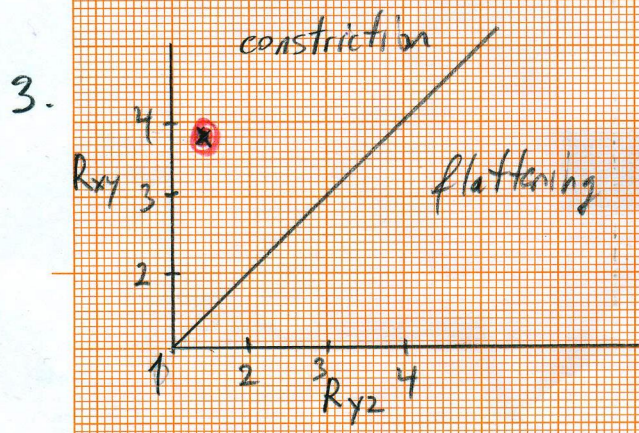c) Calculate the incremental extension along AB between stages I and II.

0

A

31mm

B

18mm

C

ψ=0°

I

A

23

25mm

B

C

ψ=34°
ʃ=0.68
ψ_AB = 13

ψ_BC = -13

II

A

15mm

B

47mm

C

ψ=65°
ʃ=2.15

γ_AB = -34'

γ_BC = 34'

answer 1

156/23NE   N   12/64NW

06/12NE

04/46NE

76/48NW

W   E

88/32W

S

2d. $e = \dfrac{l - l_0}{l_0} = \dfrac{2.5\,cm}{5500\,km} = \dfrac{2.5\,cm}{5.5 \times 10^8\,cm} = 4.6 \times 10^{-9}$ $\dot{e} = \dfrac{e}{t} = \dfrac{4.6 \times 10^{-9}}{365 \times 24 \times 60 \times 60}$

$$= \dfrac{4.6 \times 10^{-9}}{3.15 \times 10^{7}}$$

$$= 1.4 \times 10^{-16}\ s^{-1}$$

3.

constriction

flattening

R_{xy} (vertical axis), R_{yz} (horizontal axis)

4.

a)

	e_{AB}	e_{BC}
0	0	0
I	−0.26	0.39
II	−0.52	1.61

$e_{AB}^{I} = \dfrac{23 \cdot 31}{31} = -0.26$

$e_{AB}^{II} = \dfrac{15 \cdot 31}{31} = -0.52$

$e_{BC}^{I} = \dfrac{25 \cdot 18}{18} = 0.39$

$e_{BC}^{II} = \dfrac{47 \cdot 18}{18} = 1.61$

b)

	ψ_{AB}	γ_{AB}	ψ_{BC}	γ_{BC}
0	0	0	0	0
I	13	0.23	−13	−0.23
II	−34	−0.68	34	0.68
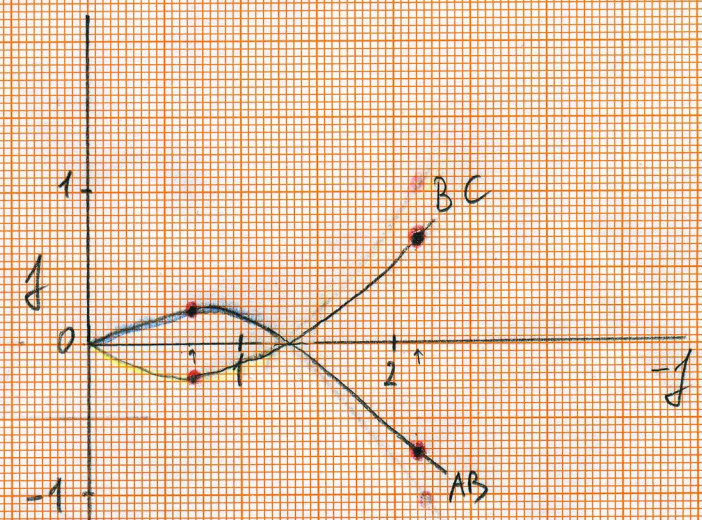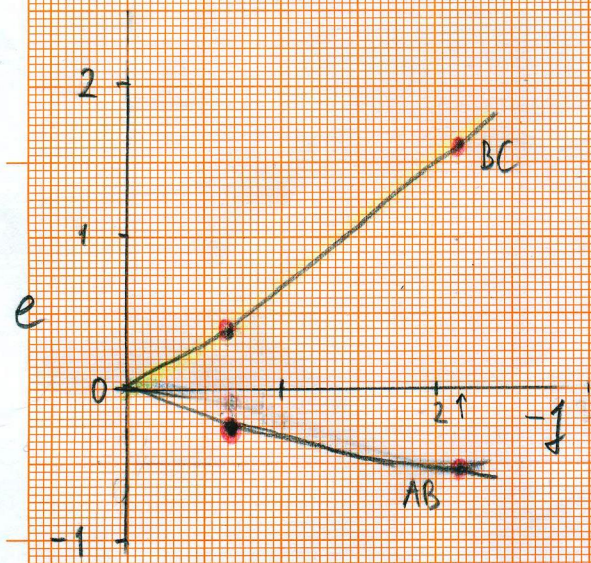
c) incremental extension $e_i = \dfrac{15 - 23}{23} = -0.35$