

Structural Geology and Tectonics GEO3-1307 – “tussentoets”

Date: Wednesday March 13th 2012

Time: 15.15-16.45 hr.

Please read the complete exam before starting. Ask any language-related question. Always explain how you got to the answer. Be creative and good luck!

DON'T FORGET to hand-in Figs. 1 and 2 after you have finished the test.

Question 1: Quantification of strain

An outcrop close to Porto, Portugal, shows an oolitic limestone of Triassic age and a fossil-rich limestone of Jurassic age both dipping 35° E (Fig. 1). Shape and orientation of ooids in the Triassic sediment have been measured using the $R_f\text{-}\phi$ ' method (Fig. 1a). The limestone contains deformed fossils that originally had symmetrical shapes (Fig. 1b). Strain has been determined for the fossils using the Breddin graph (Fig. 1c) method. Tension gashes filled with new calcite crystals indicate 15% volume change during deformation. The layers form part of a fold, with the fold axis running exactly north-south. The fold was found to be stretched 10% parallel to the fold axis.

- Why did the geologist who carried out the study choose the $R_f\text{-}\phi$ ' method rather than the centre-to-centre (Fry) method to analyse the ooids?
- Determine what the strain ratio R_1 is of the ooids (Fig. 1a) and R_2 of the deformed fossils (Fig. 1b).
- What do the results of the strain analysis tell about the fold mechanism?
- What are tension gashes? Add a few tension gashes to Fig. 1, in the orientation that you expect.
- Quantify the strain of the fossil-rich limestone in 3 dimensions by giving values for the principal strains.
- The tensor that is believed to describe the deformation of the fossils in the limestone layer (in the plane of section) is given below. Analyze the tensor in order to check if your results of b) and e) are consistent with the predictions of the tensor.

$$F_{ij} = \begin{pmatrix} 0.8 & -0.8 \\ 0.1 & 1.3 \end{pmatrix}$$

Question 2: Structural styles

Fig. 2 shows an interpreted cross-section of the Atlantic passive margin at Gabon and Congo (after Rouby *et al.*, 2002). Your task is to analyse the section (forget the black box and arrow added on the NE side of the section).

- a) Make a clear list of *observations* for the section of Fig. 2. Use numbers, colors or other annotations to relate your observations to specific parts of the section. **HAND-IN** the figure after having finished the test.
- b) Give an *interpretation* of the geological history of this section, consistent with your observations. Present this interpretation in a framework of 'structural styles'.