

Structural Geology and Tectonics GEO3-1307 – “tussentoets”

Date: Thursday March 20th 2008

Time: 15.00-16.30 hr.

extra

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!

Question 1: Quantification of strain

During mapping in the northern Dolomites, an outcrop has been studied showing folded Carboniferous microconglomerate and limestone (Fig. 1). Shape and orientation of small pebbles in the microconglomerate have been measured using the R_1 - ϕ ' method (Fig. 1a). The limestone contains deformed fossils (Fig. 1b) that originally had symmetrical shapes. Strain of the fossils can be determined using the Breddin graph (Fig. 1c) method.

Stylolites in the rocks suggest a 15% volume decrease during deformation. There is no evidence for any strain in parallel to the fold axis. The axis of maximum strain at the highest point of the fold appears to be oriented horizontally.

Plane-strain

- What are the main problems that can be encountered when applying the R_1 - ϕ ' method?
- Determine the strain ratio R_1 of the small pebbles (Fig. 1a) and R_2 of the deformed fossils in the limestone (Fig. 1b). If R_1 and R_2 turn out to be different, what can be the reason for this?
- What fold mechanism is in agreement with the strain observations?
- Quantify the strain of the limestone in 3 dimensions by giving values for the principal strains. Visualize the result in a suitable Flinn diagram.
- Previous investigation of the eastern fold limb has resulted in a forward position gradient tensor that is believed to describe the deformation of the fossils in the limestone layer. Analyze the tensor in order to check if your results of b) and c) are consistent with the predictions of the tensor.

$$F_{ij} = \begin{pmatrix} 0.6 & -0.5 \\ 0.2 & 1.3 \end{pmatrix}$$

Fig. 1

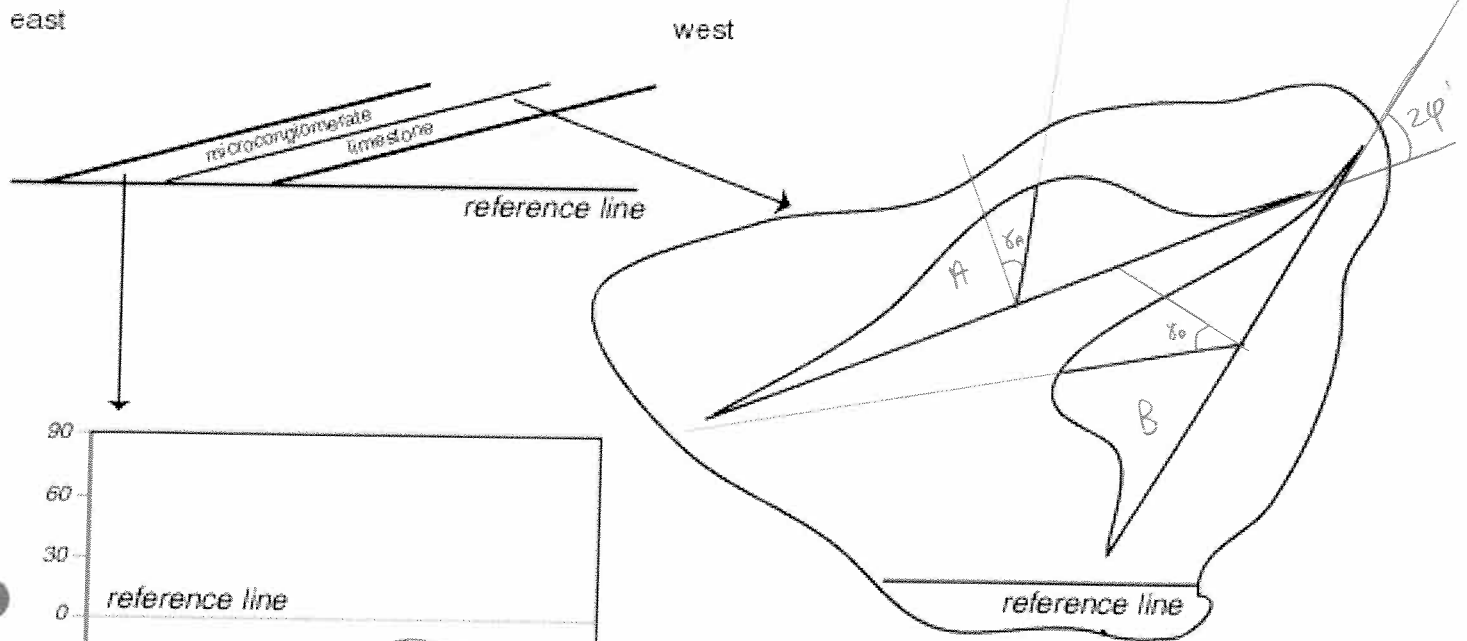


Fig 1b - deformed fossils in limestone layer

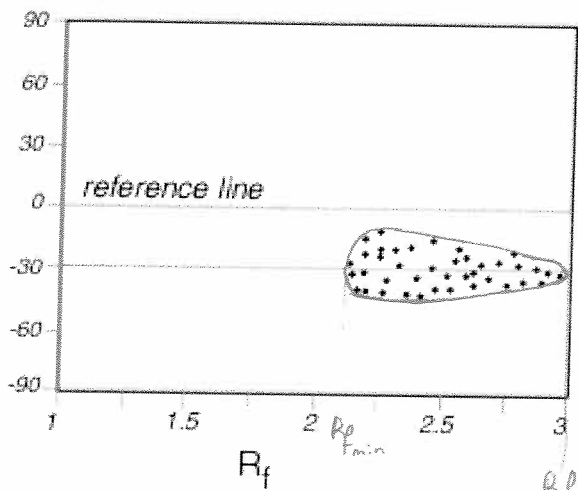


Fig 1a - positive angles ϕ' measured clockwise from reference line

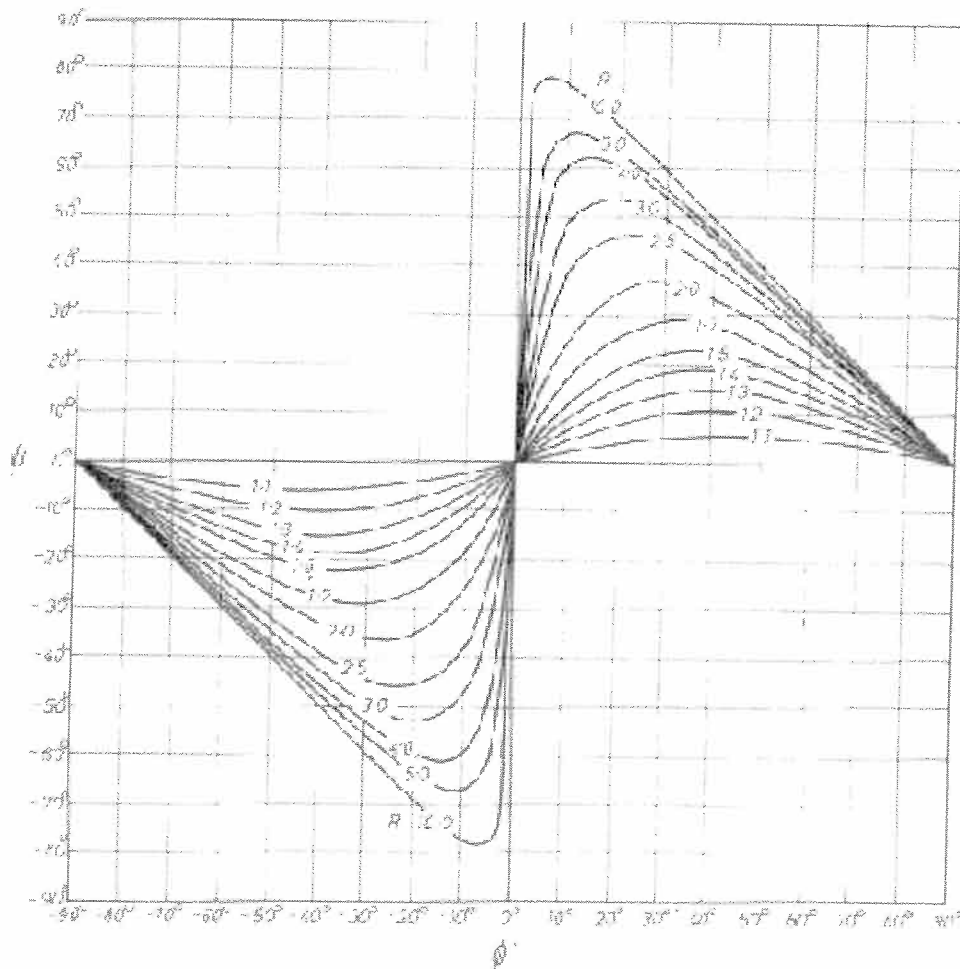


Fig 1c - Breddin Graph

Question 2: Structural styles

Fig. 2 shows sections through the Rühle-Annaveen and Adorf structures in the Saxony basin, Germany. The top figure shows the present-day geometry, the bottom one is a reconstruction for late-Cretaceous time. The letter-coding in the sections refers to the different stratigraphic units, their exact meaning is irrelevant for this exam question, except for z = Zechstein.

- a) What is meant with a “structural style” and why is it useful to think using this concept?
- b) Analyse the two individual sections and describe the structures in a framework of ‘structural styles’. Make sure you distinguish observations from interpretations

Fig. 2

