



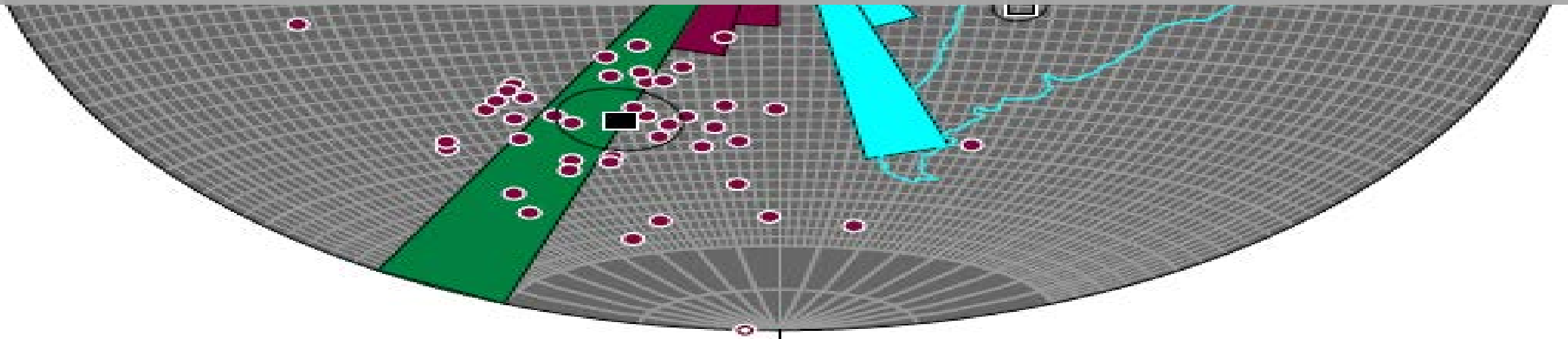
UNIVERSIDADE FEDERAL DE PERNAMBUCO
CENTRO DE TECNOLOGIA EM GEOCIÊNCIAS
DEPARTAMENTO DE GEOLOGIA

DISCIPLINA: GEOLOGIA ESTRUTURAL

Prof. Tiago Miranda
tiagogeoufpe@gmail.com
tiagomiranda.org



Projeções estereográficas



Sumário

Projeções estereográficas

Introdução

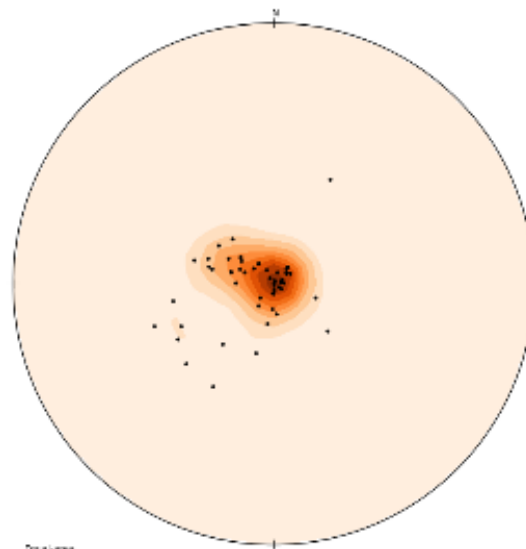
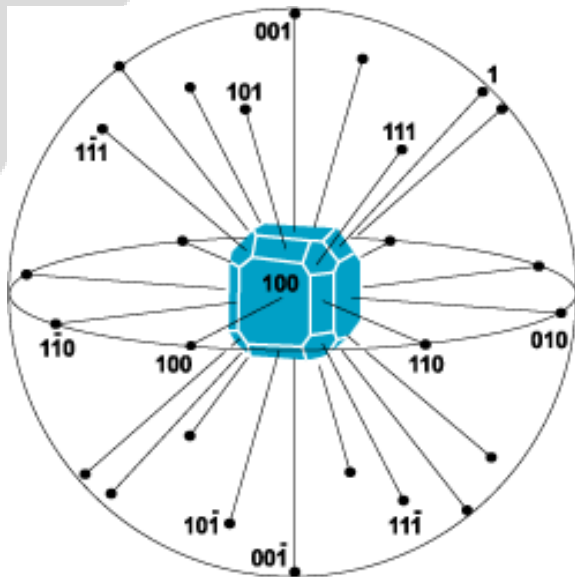
Estereograma

Planos

Linhas

Introdução

- Projeções estereográficas foi primeiramente estudado pelos astrônomos, no mapeamento de estrelas e na cartografia dos primeiros mapas do Planeta Terra.
- A projeção estereográfica é a representação da atitude de estruturas planares e lineares em um diagrama em 2D.

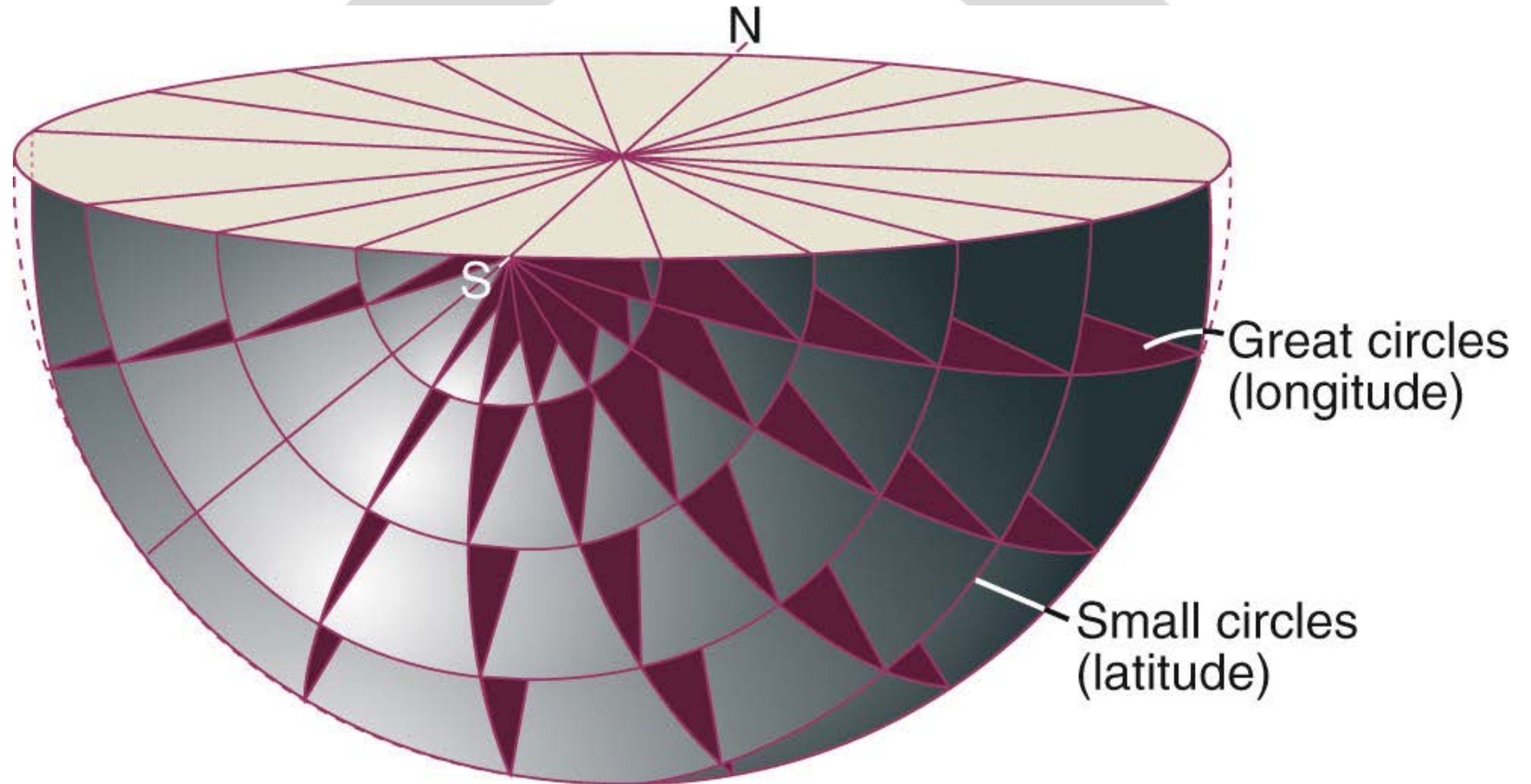


Estruturas geológicas

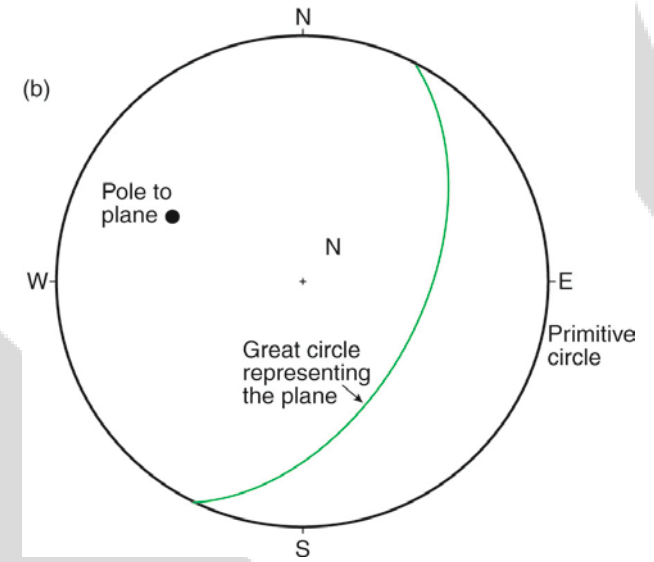
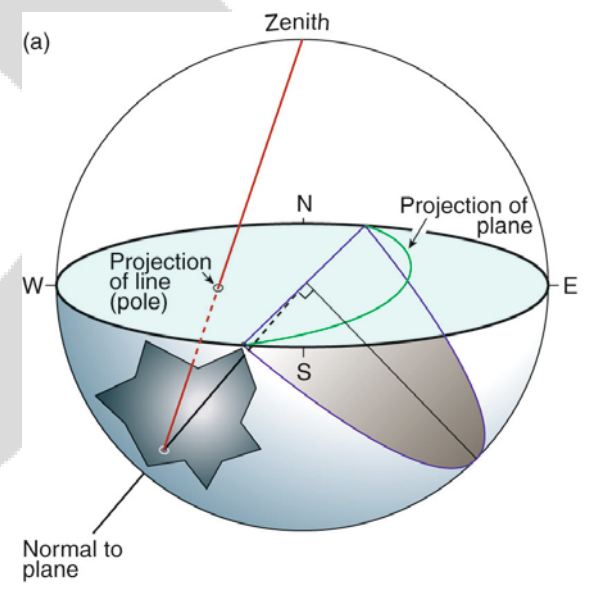
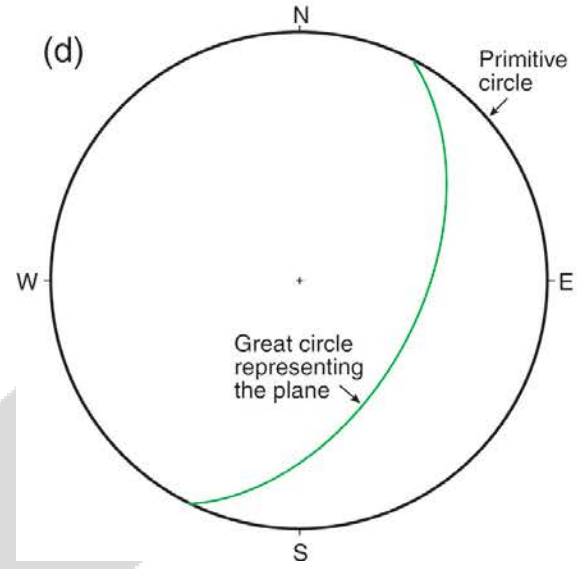
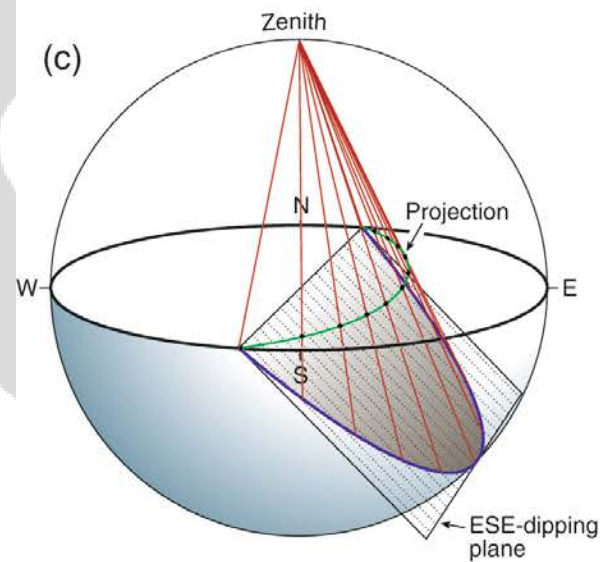
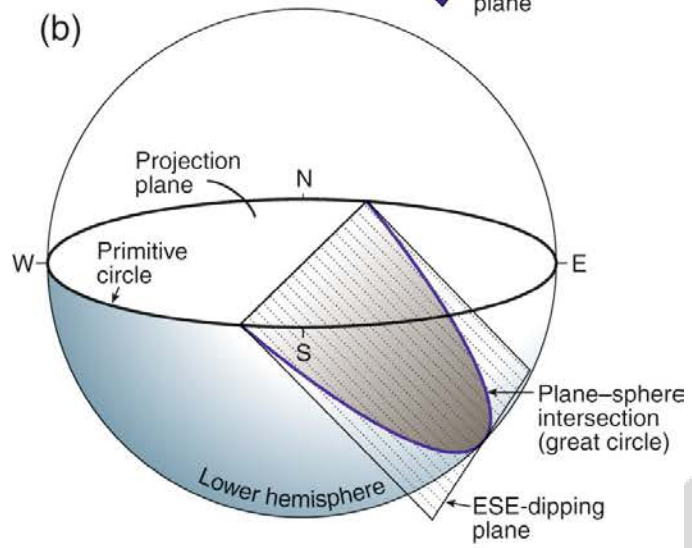
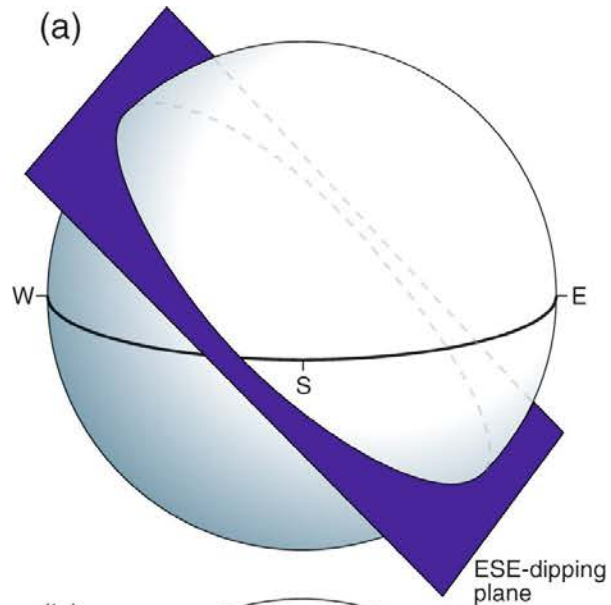
- Estruturas planares
 - Foliação, acamamento, falha, fratura e diques
- Estruturas lineares
 - Eixo de dobra (linha de charneira), intersecção entre planos, estria, lineação de estiramento mineral



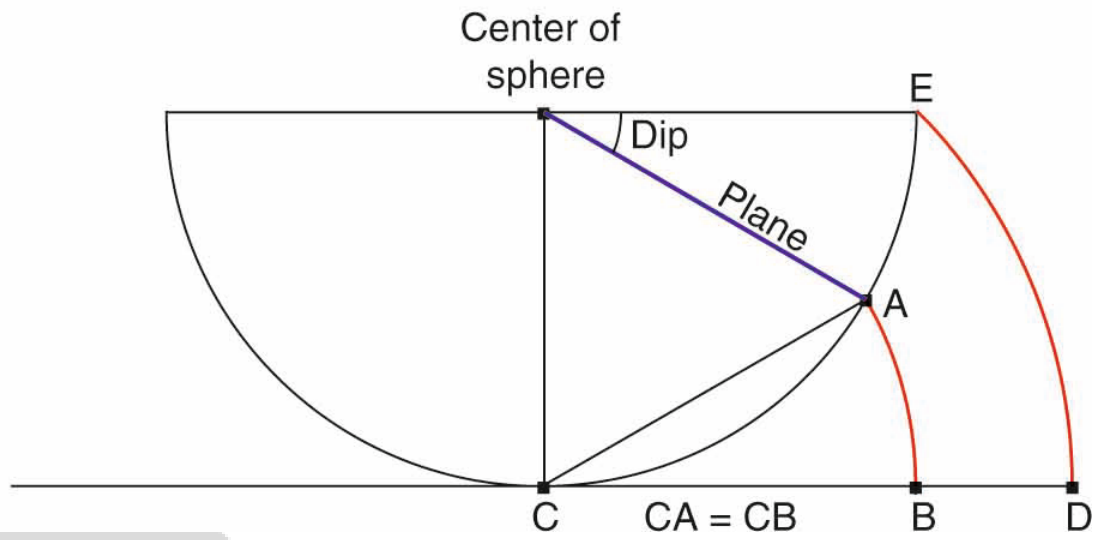
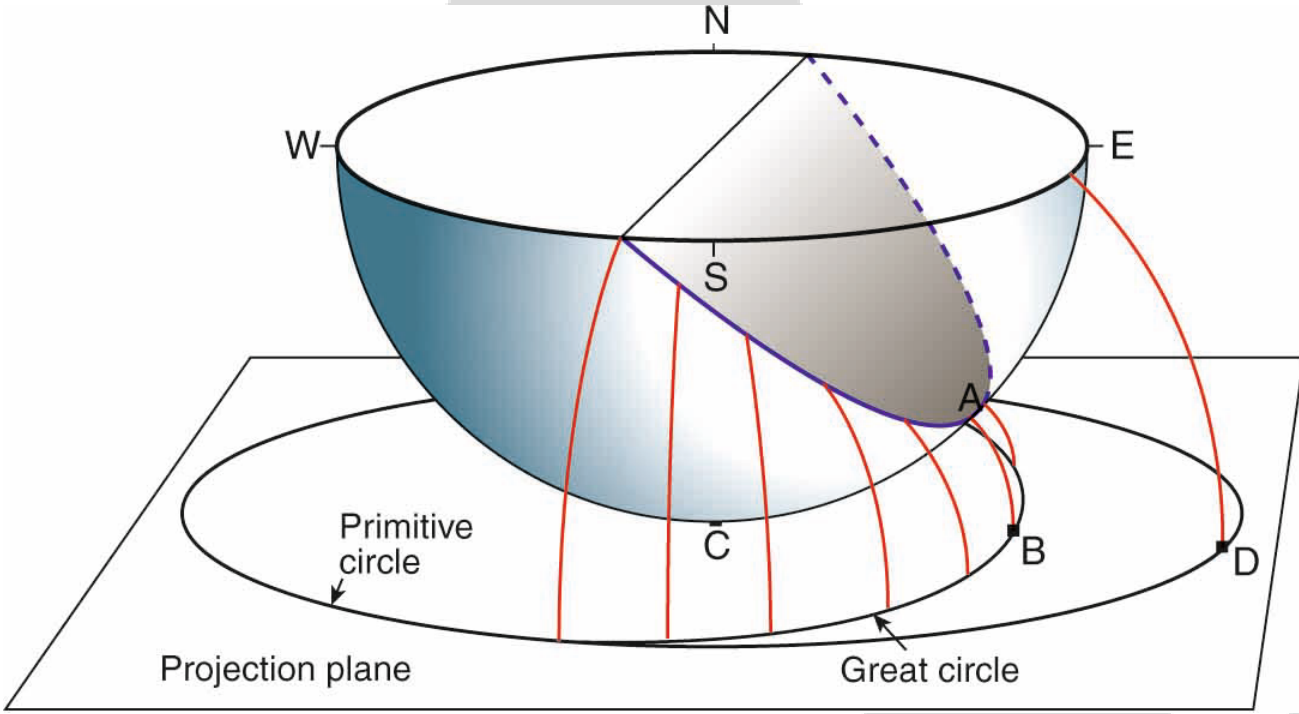
Estereograma



Estereograma

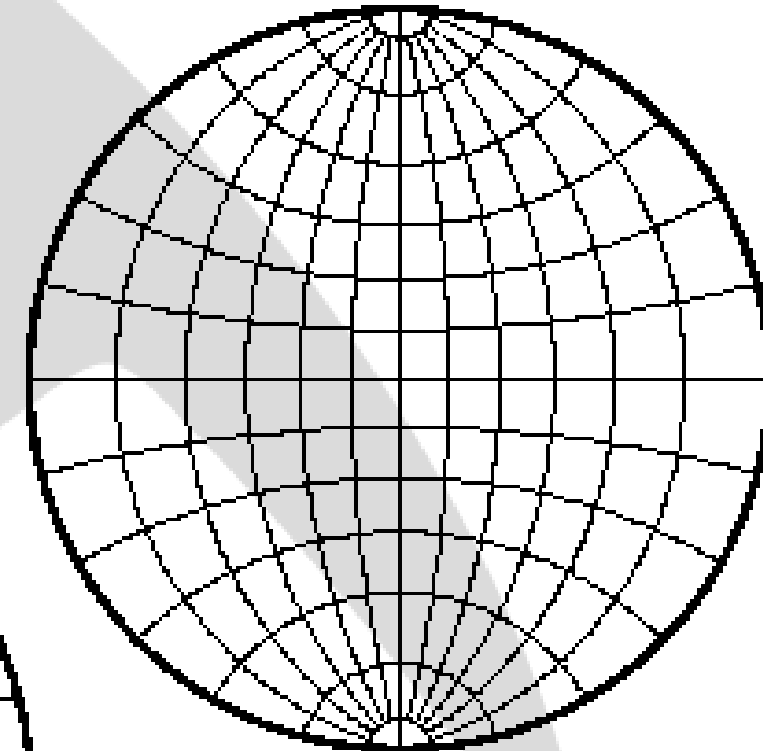
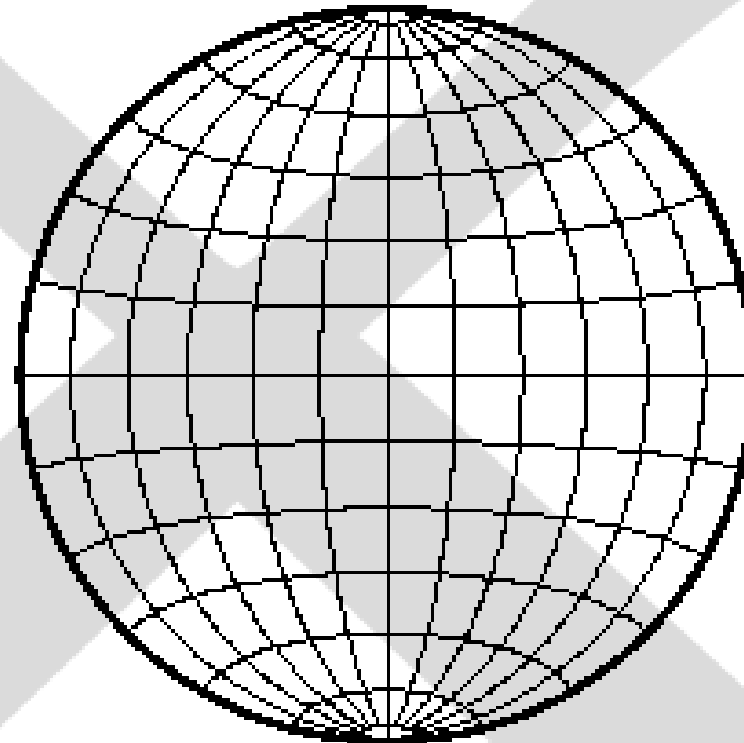


Projeções Estereográficas

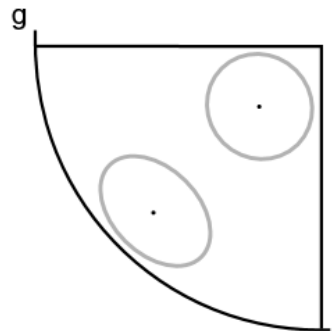
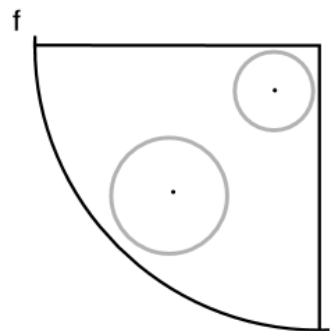
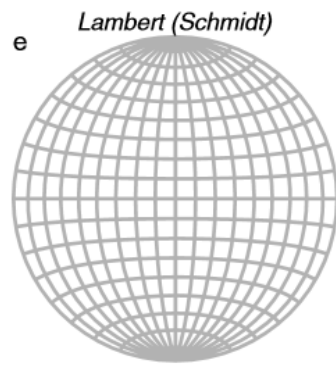
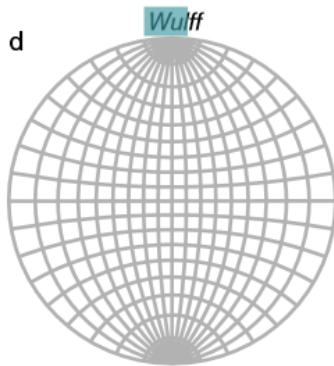
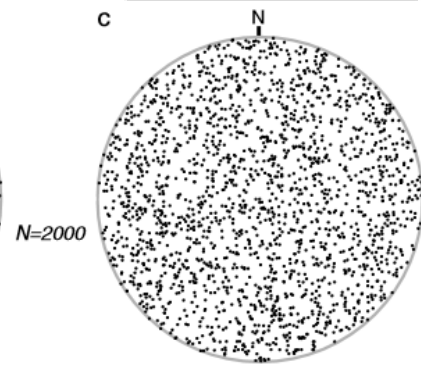
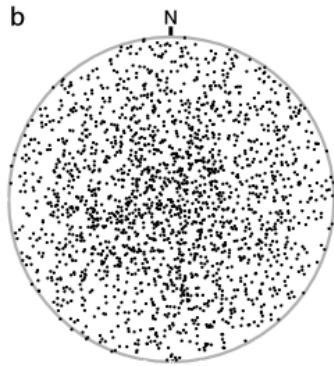


Estereograma – Tipos de Redes

- Wulff
 - Permite trabalhar com relações angulares
 - Projeções cristalográficas
- **Schmidt**
 - Rede de igual-área: permite a comparação entre as projeções em qualquer área do gráfico
 - Mais usado pela Geologia Estrutural



Estereograma – Tipos de Redes



- Principais diferenças entre a representação de planos nas redes estereográficas de Wulff e Schmidt.
- A rede estereográfica de Wulff gera distorções, e focaliza os dados em círculos.

Stereonet

Stereonet terminology

University of Leeds

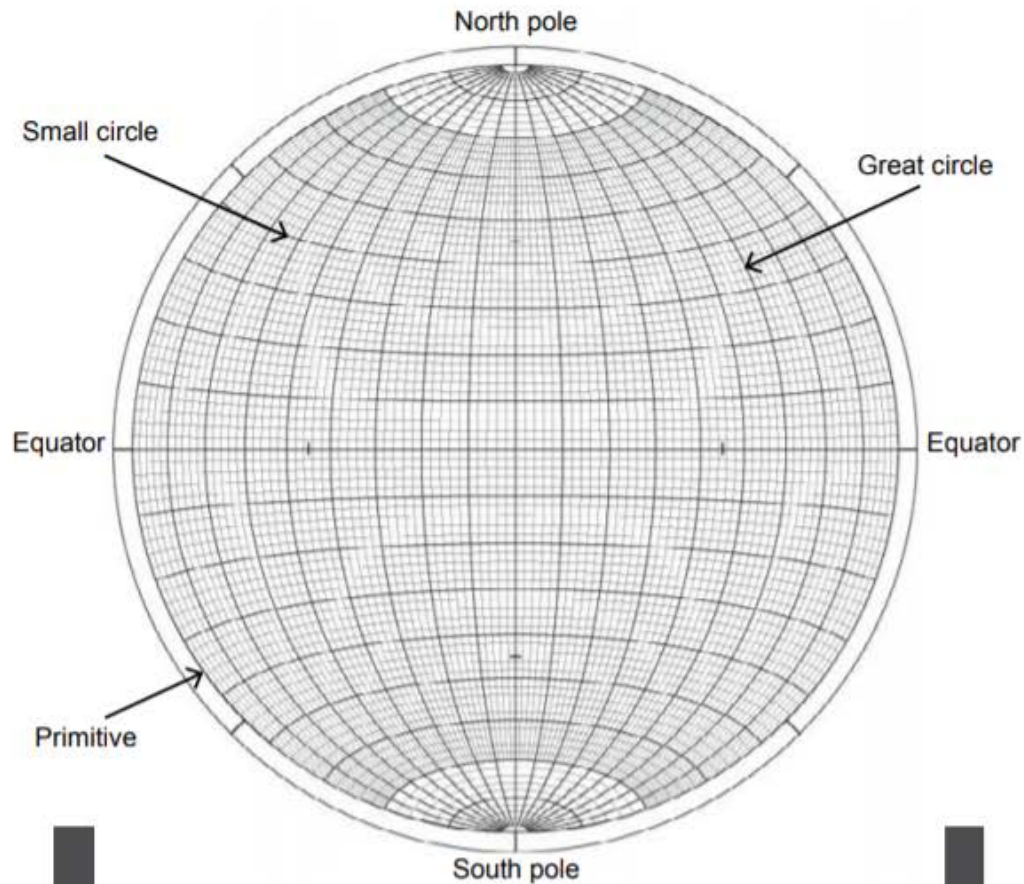


Figure 3: Equal Area Stereonet (Schmidt): each of the sectors has the same area.

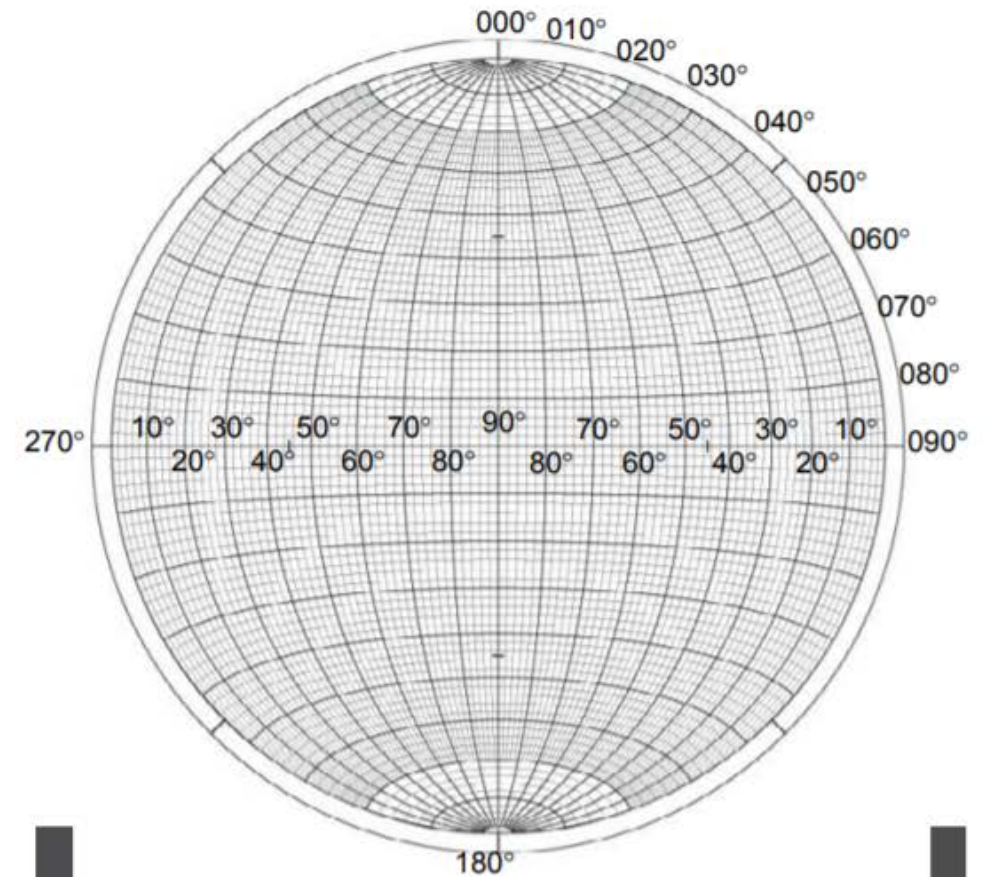
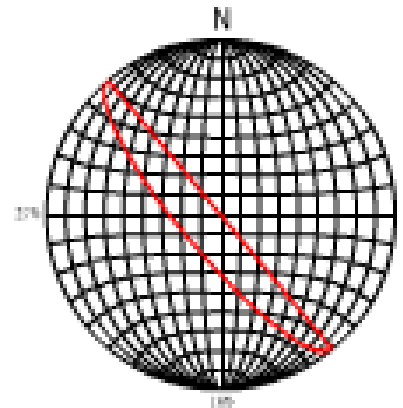
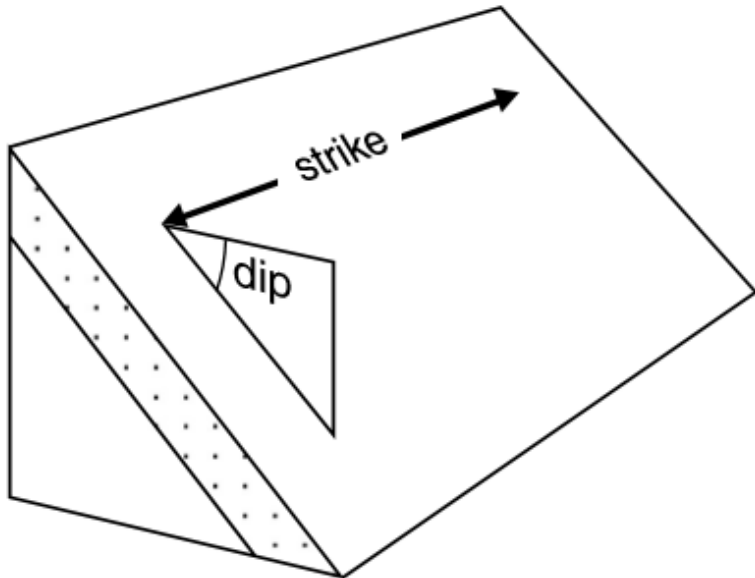


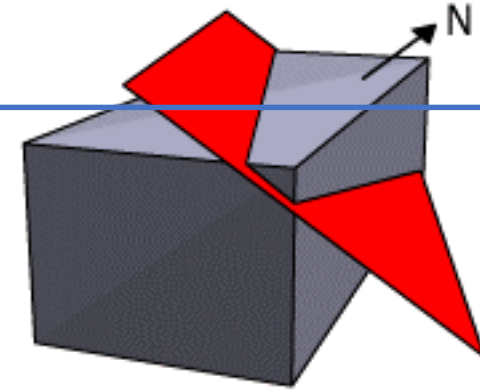
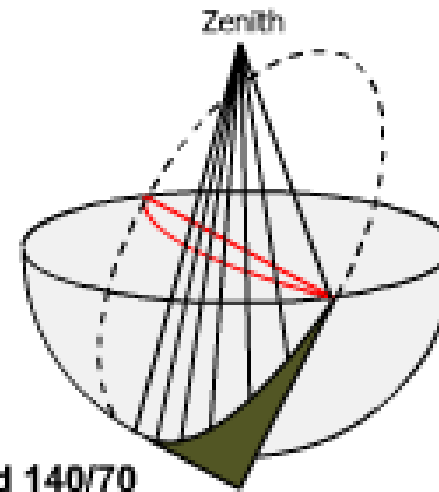
Figure 4: Equal Area Stereonet showing the degrees around the primitive and across the equator.

Representação de planos

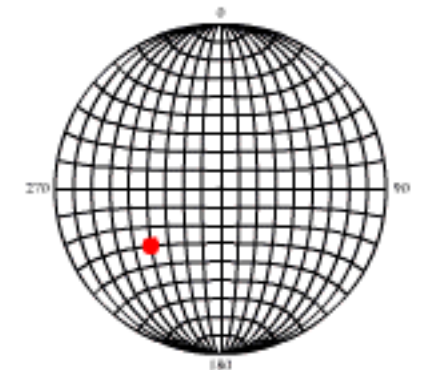
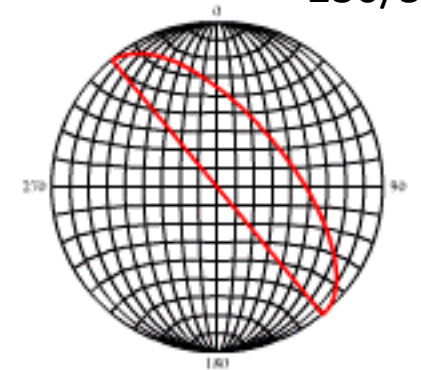
- Os planos podem ser representados em estereogramas de duas maneiras diferentes:
 - Grande círculos
 - Polos (linha perpendicular ao plano)



Plane oriented 140/70



230/50



Representação de planos

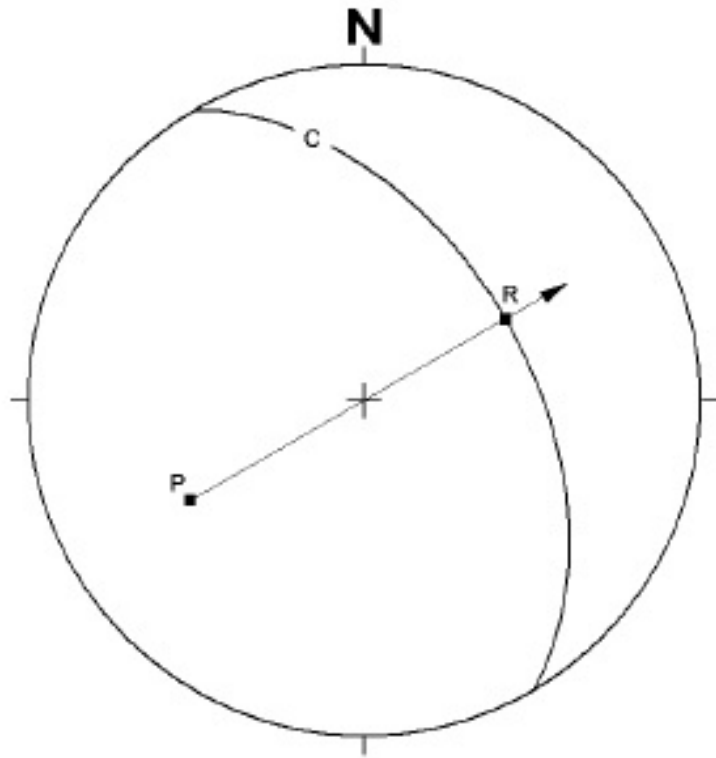
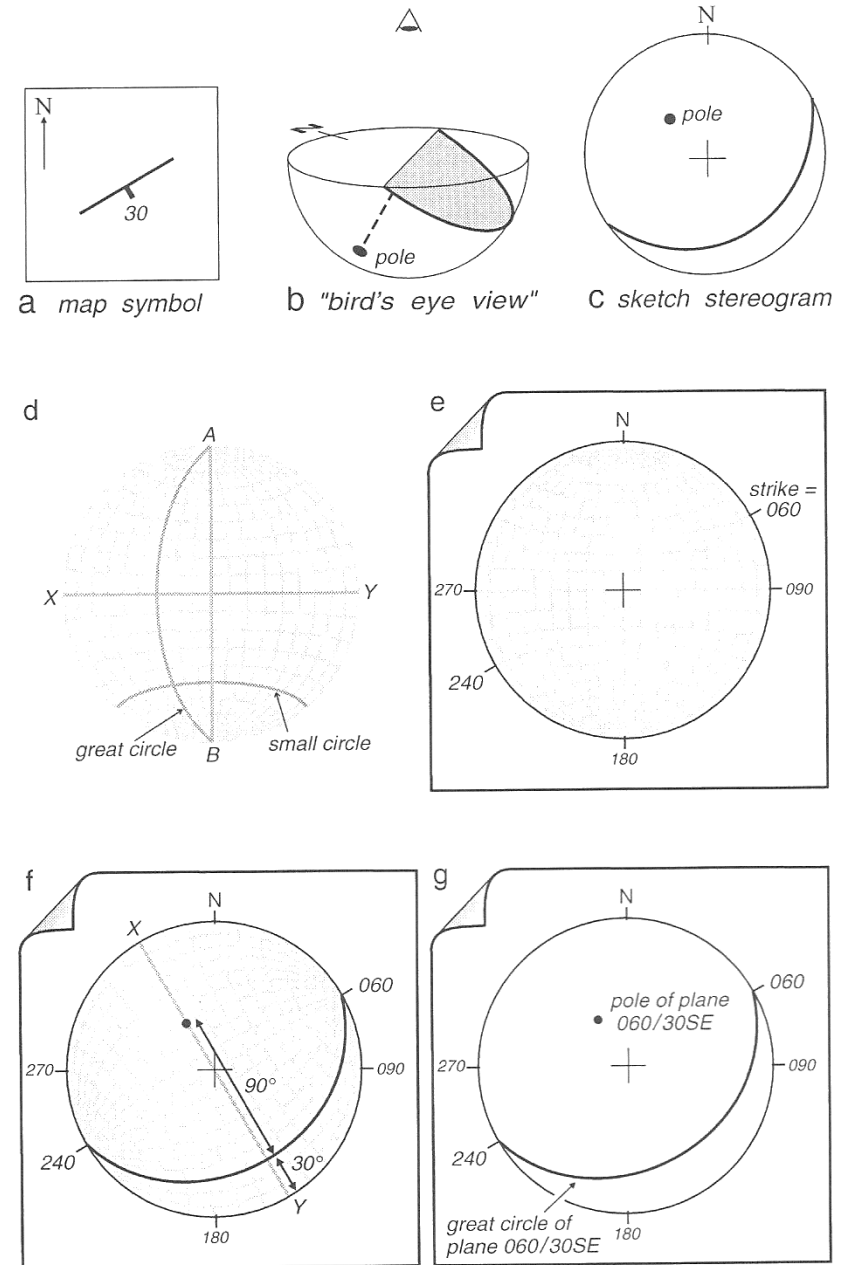


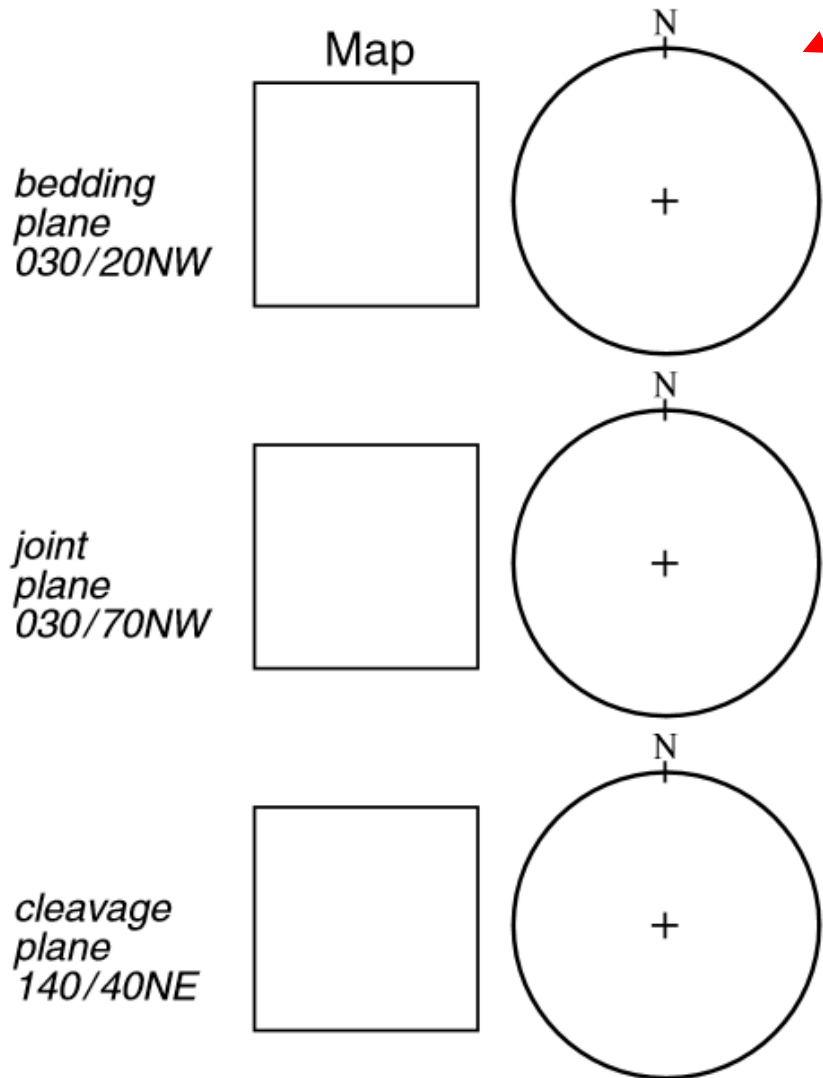
Figura 7. Formas de representação de um plano no Diagrama de Schmidt-Lambert. P é a projeção polar do plano, c é sua projeção ciclográfica (ciclograma) e R é a projeção da reta pendente do mergulho

To plot the plane 060/30SE

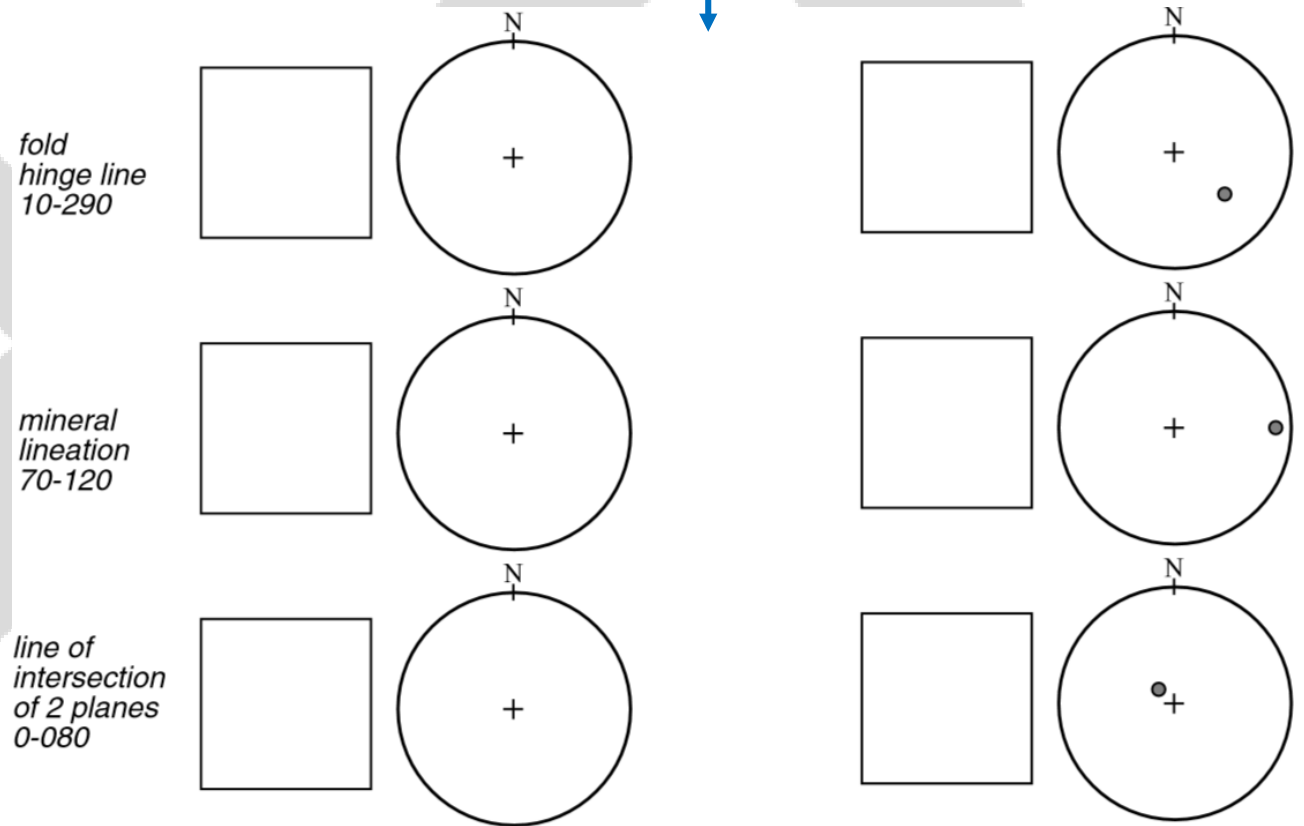


Representação de planos

Qual a representação aproximada de cada estrutura planar?

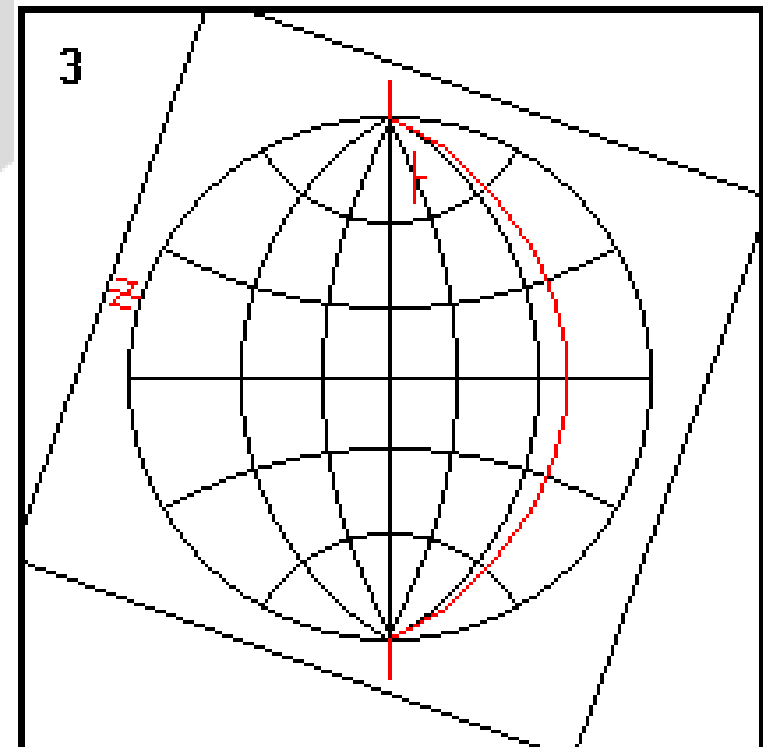
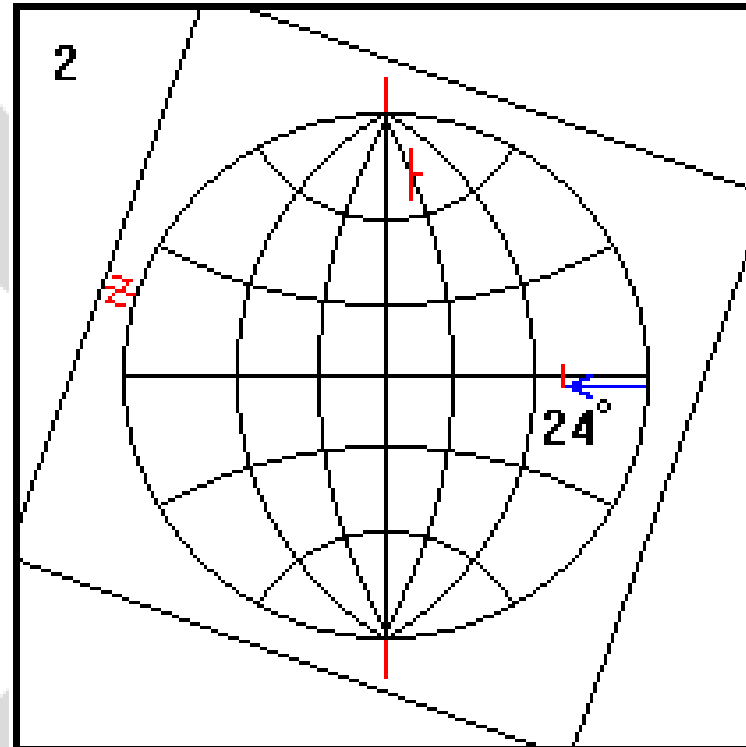
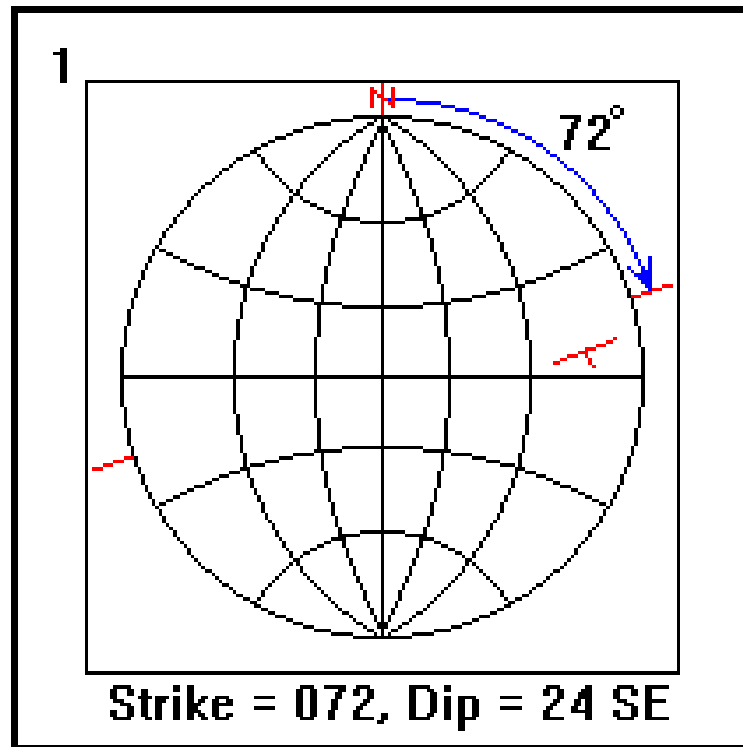


Qual a representação aproximada de cada estrutura linear?



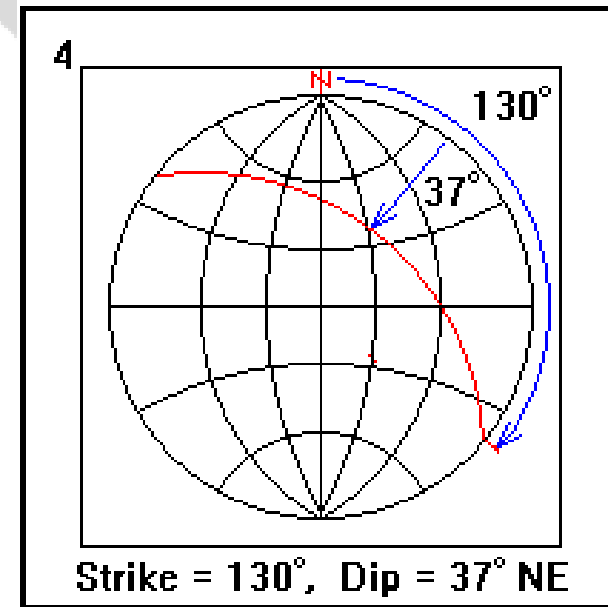
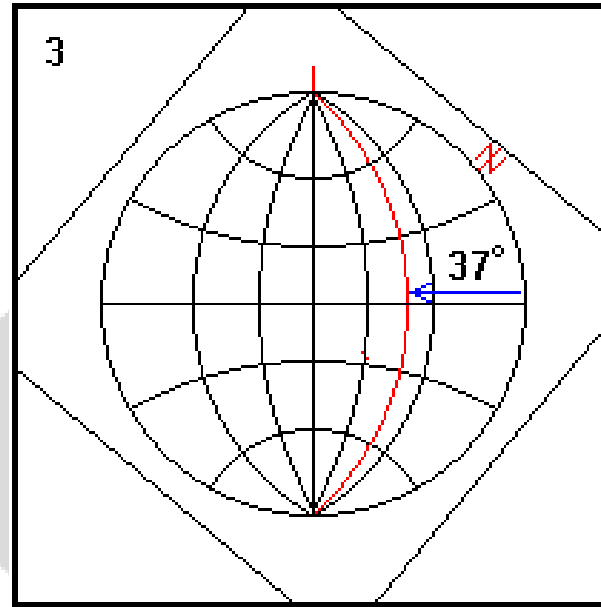
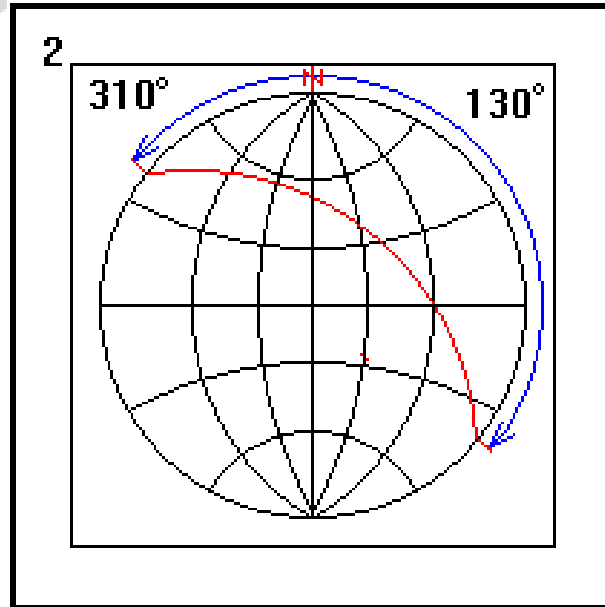
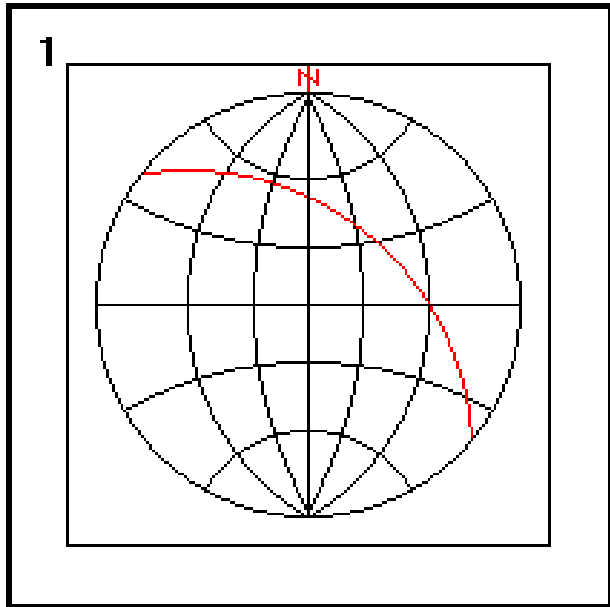
Representação de planos

- Como plotar o plano 72Az/24°SE?



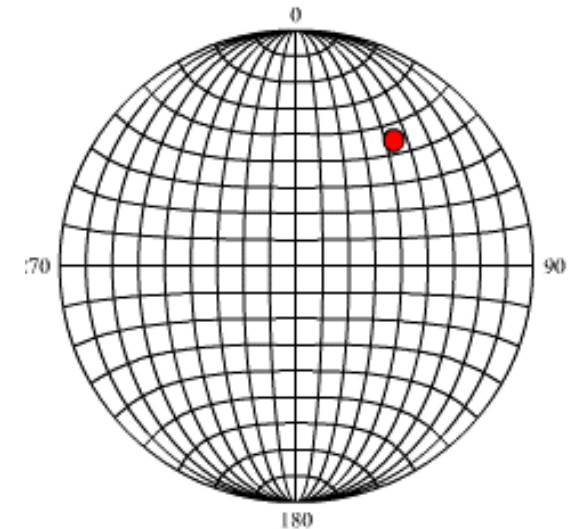
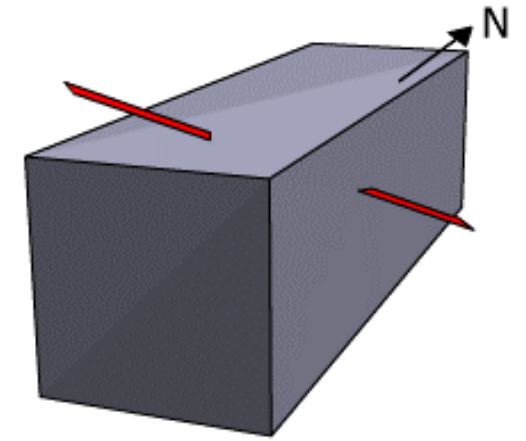
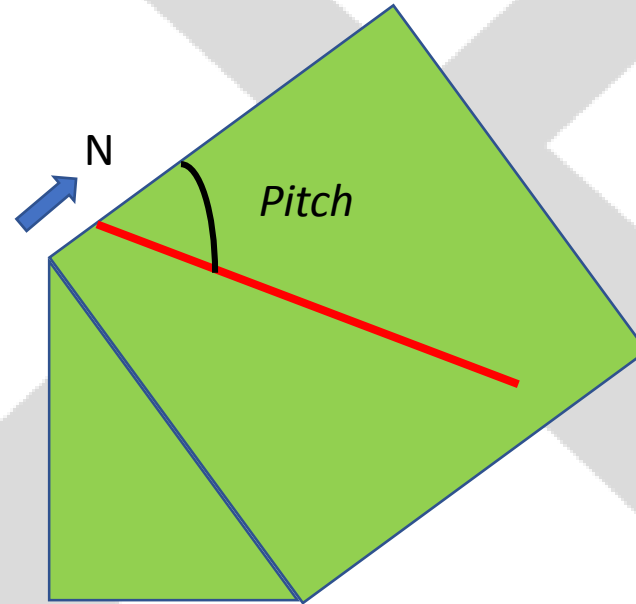
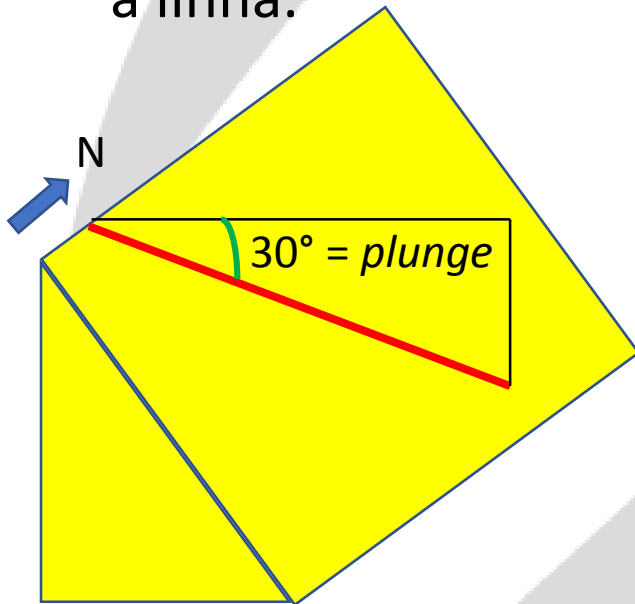
Representação de planos

- Como obter a atitude do plano a partir do grande círculo?
 - 040/37



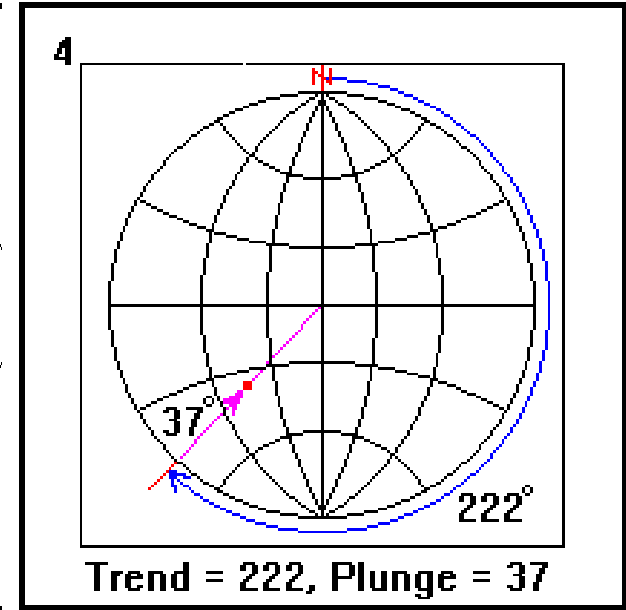
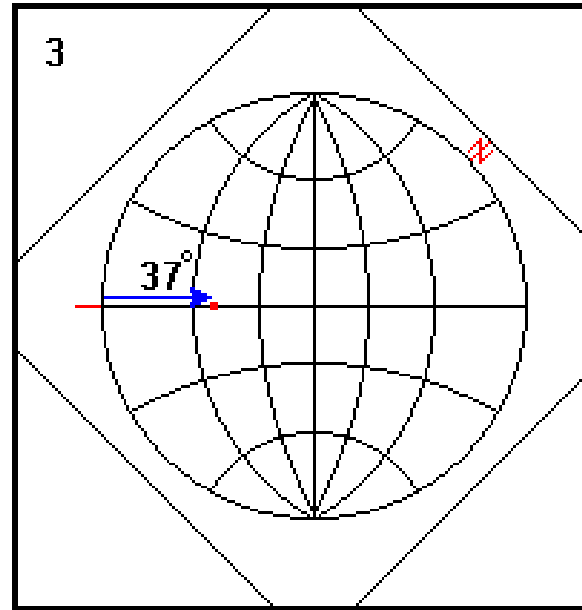
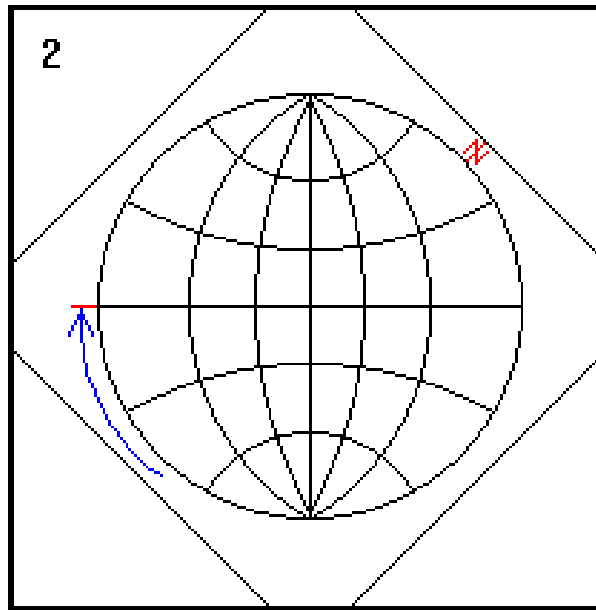
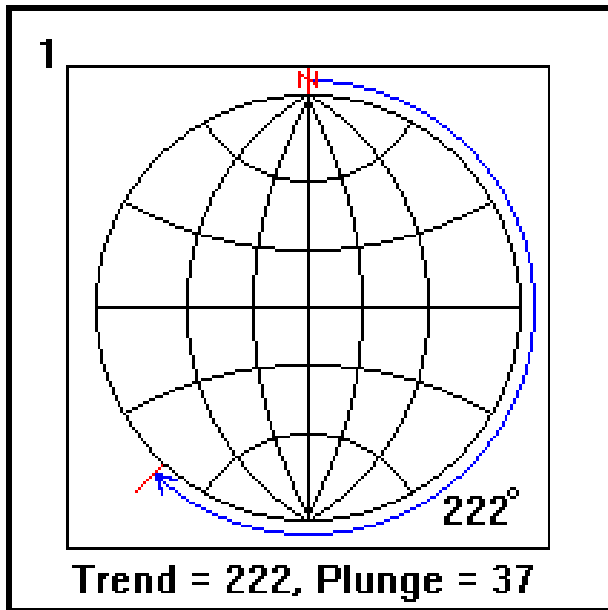
Representação de linhas

- A representação de uma linha em projeções estereográficas é dada por um ponto.
- Existem duas maneiras para plotar os dados de linhas:
 - Caimento (*plunge*) = ângulo entre a linha e um plano vertical.
 - *Obliquidade (Pitch, rake)* = é o ângulo entre a direção do plano e a linha.



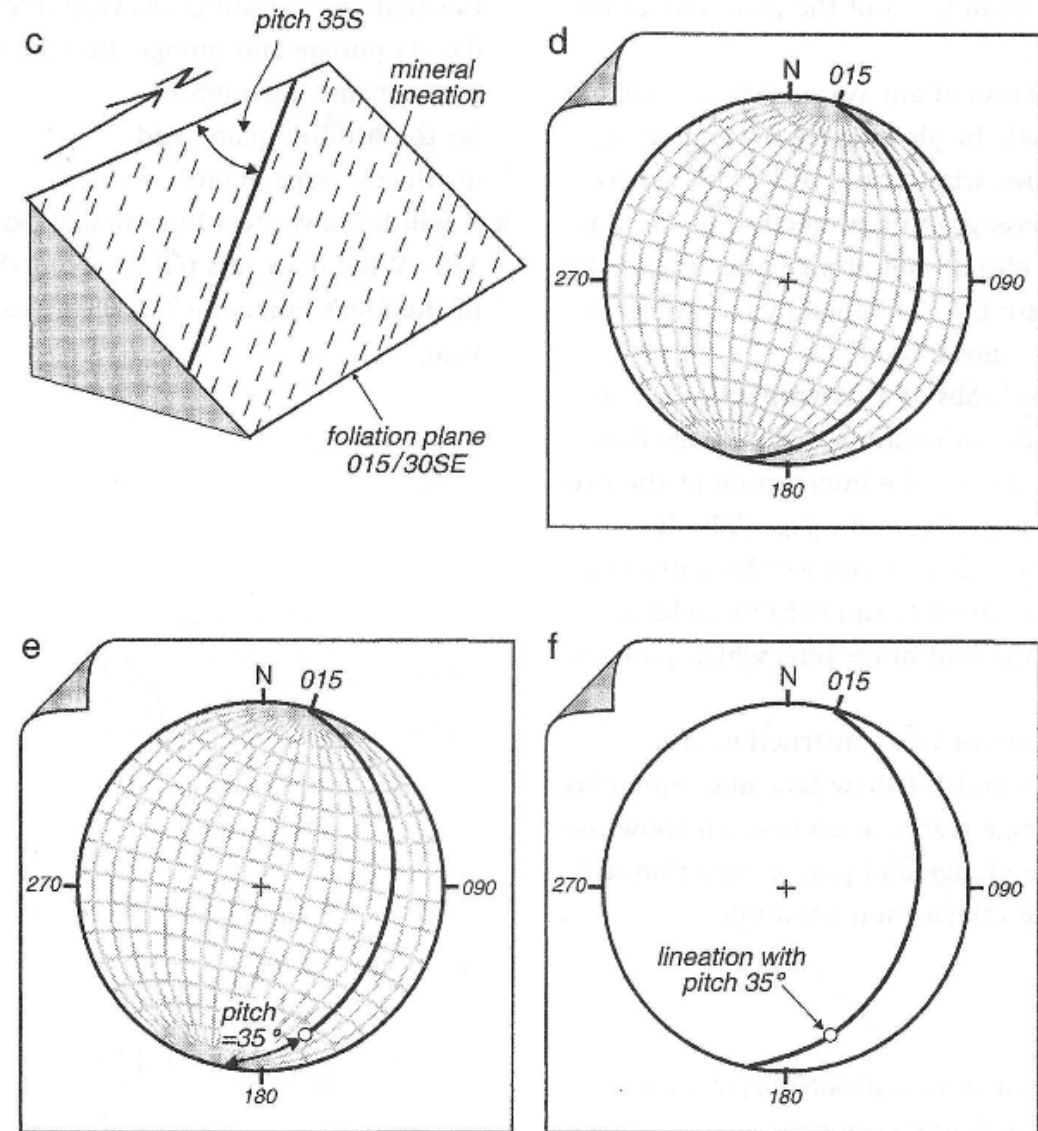
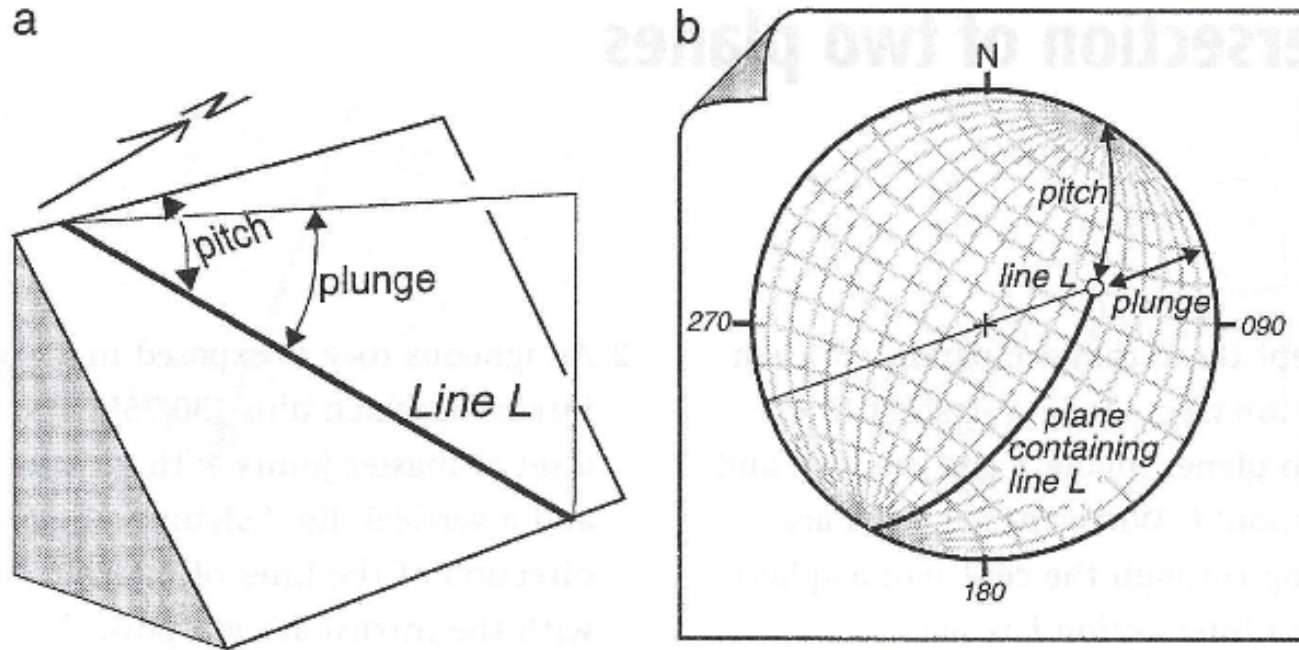
Representação de linhas - *Plunge*

- Como plotar a linha 222/37?



Representação de linhas

- *Pitch*



Exemplificando

1 - 40/030 (Plot Plunge)

2 - 258/56 20°/NW (Plot Pitch)

Fig. 12.

Intersecção entre dois planos

- A intersecção entre dois planos é representada por uma linha
 - **Grandes círculos** → a linha de intersecção será um ponto
 - **Polos** → a linha de intersecção será o polo do grande círculo que contém os polos dos dois planos

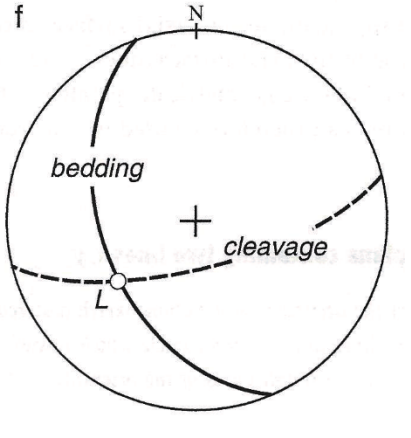
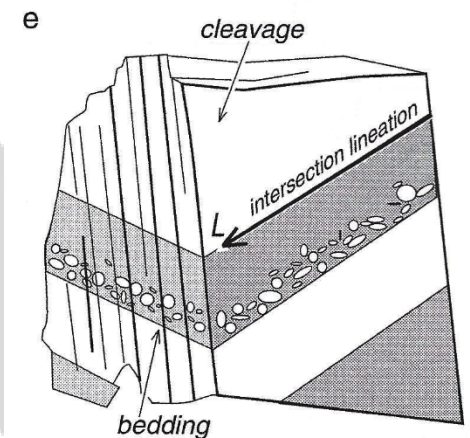
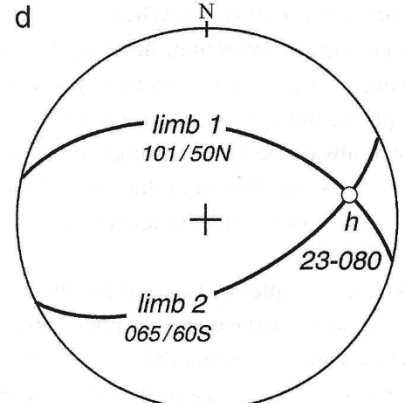
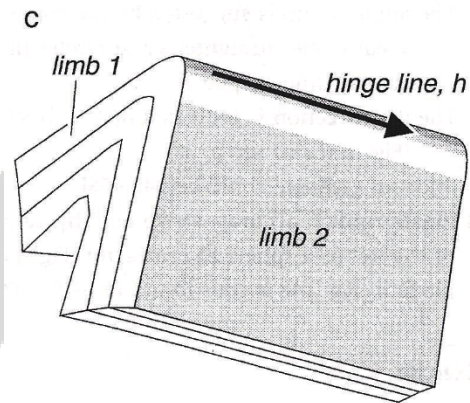
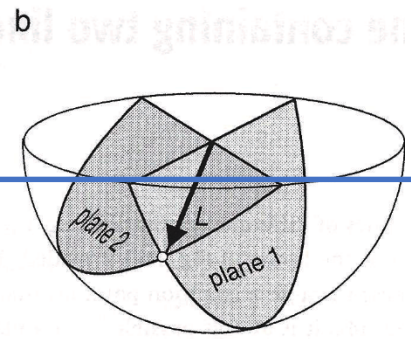
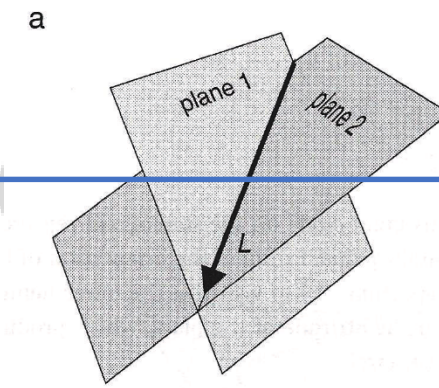
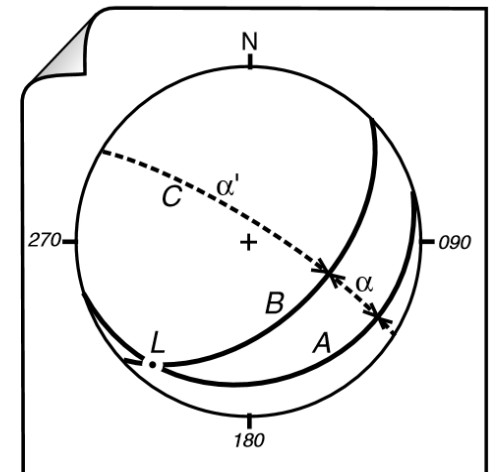
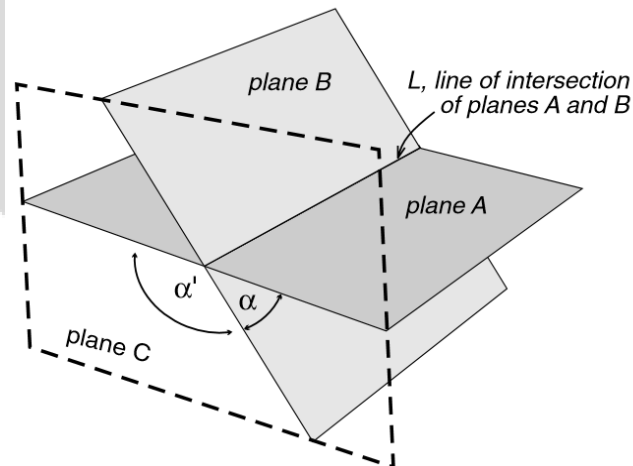
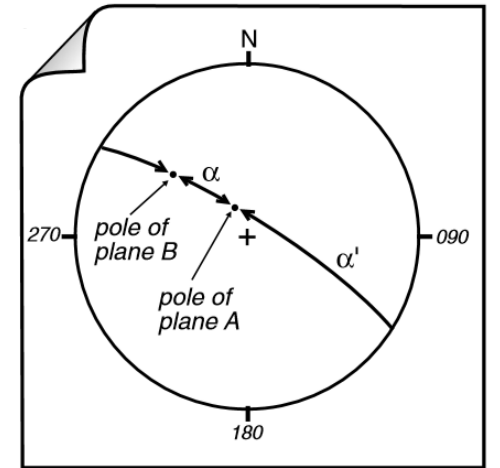
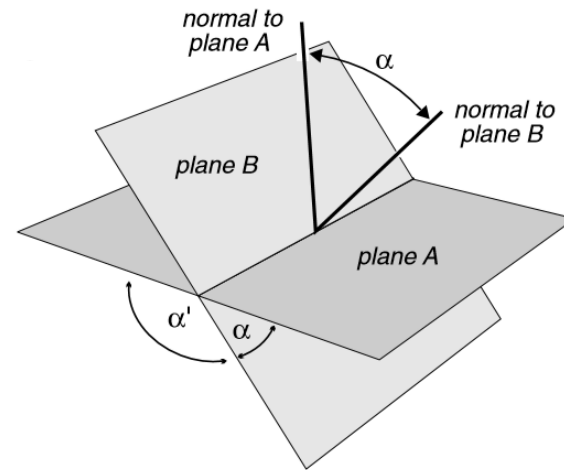
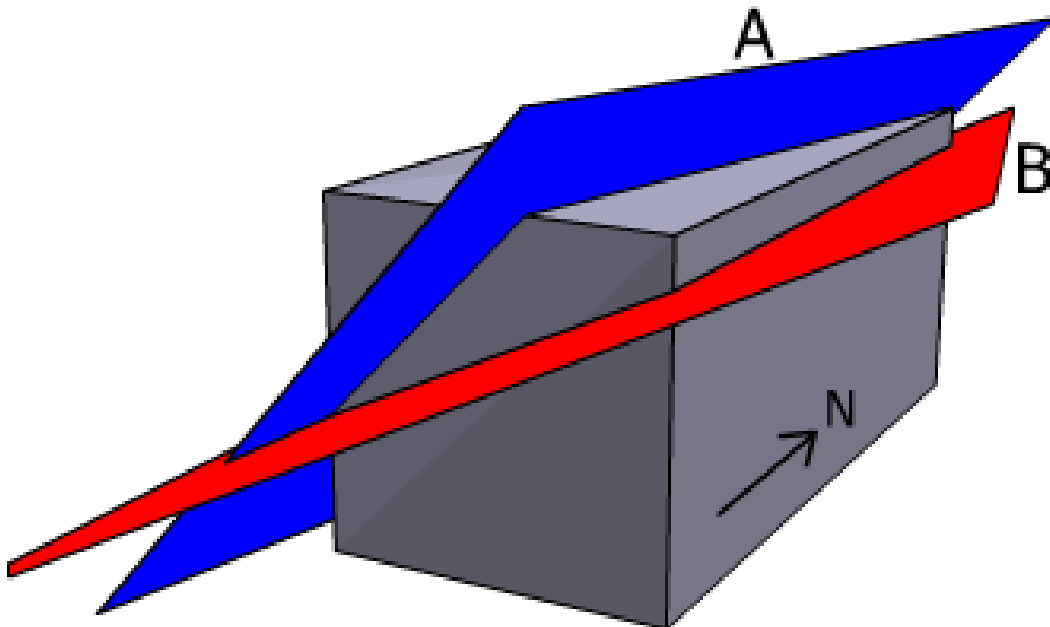


Fig. 13.

Ângulo entre dois planos

- O ângulo entre dois planos (fraturas, falhas) pode ser calculado
 - Através dos polos
 - Através dos planos

Qual o ângulo entre os planos **A = 205/20**
B = 280/40?



Ângulo entre duas linhas

- Duas linhas podem ser ajustadas a um mesmo plano (grande círculo) e a distância entre elas corresponde ao ângulo entre as duas linhas.

? Qual o ângulo entre as seguintes estruturas lineares 080/23 e 135/56?

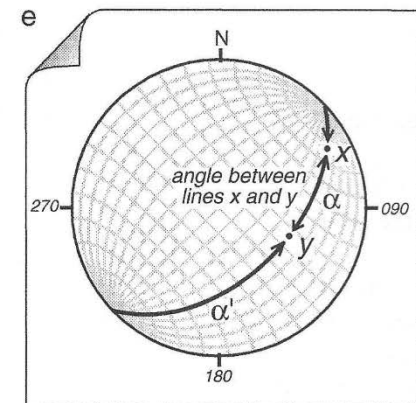
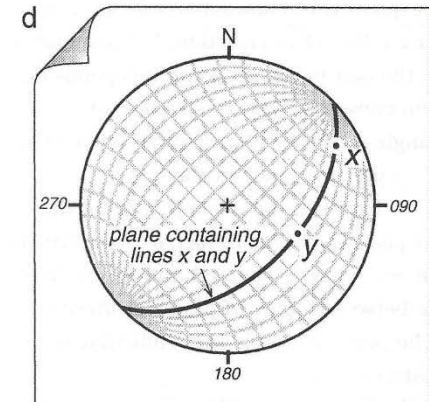
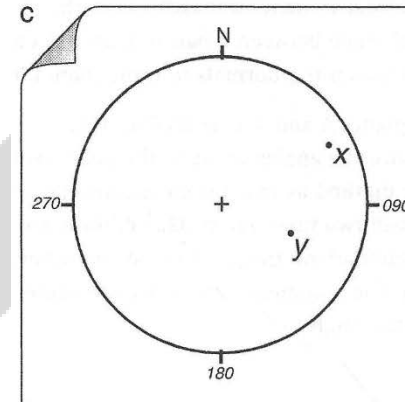
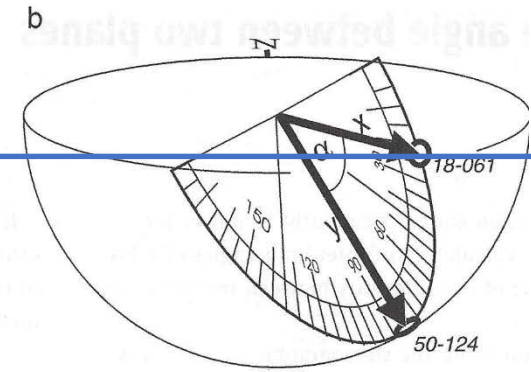
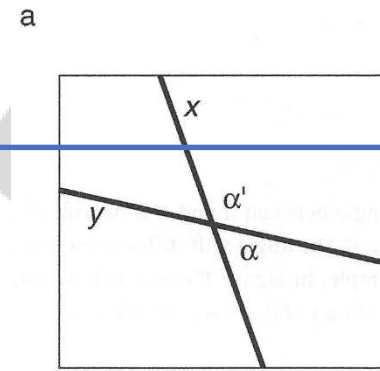
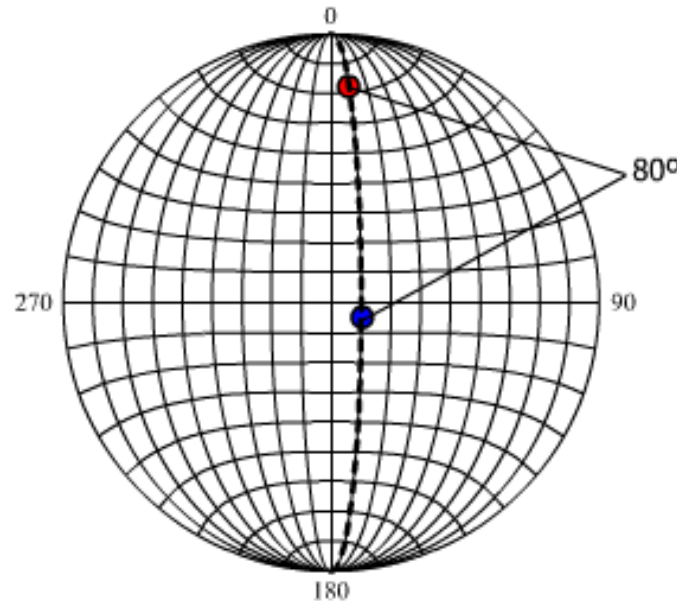
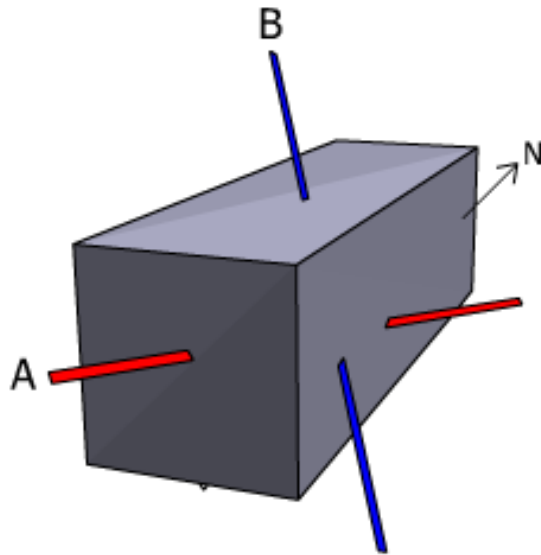
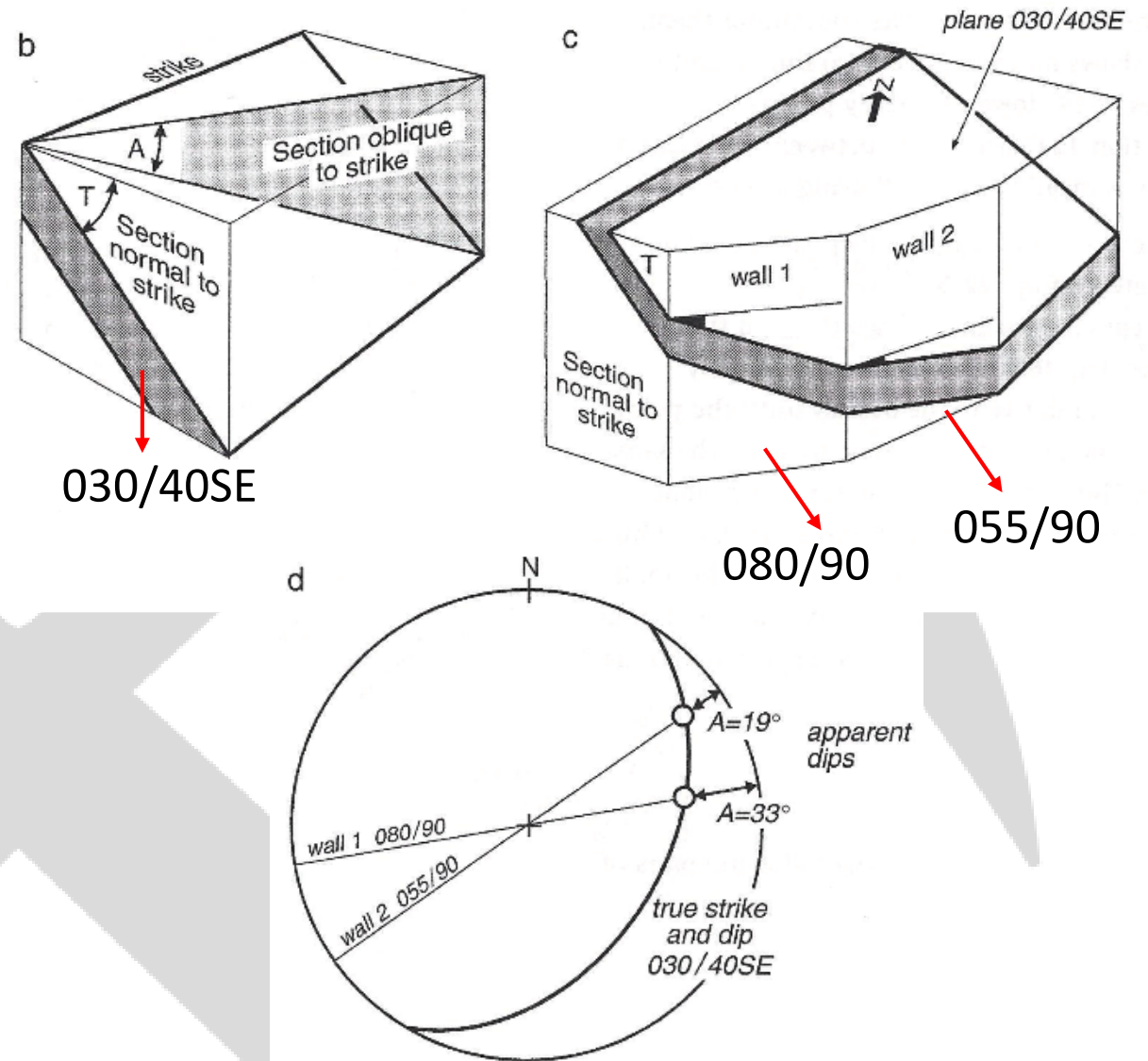


Fig. 16.

Mergulho aparente

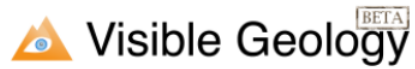
- O mergulho aparente depende de dois fatores:
 - O ângulo do mergulho verdadeiro;
 - O ângulo entre o plano da seção a direção do plano.
- Este cálculo é usado para definir o mergulho verdadeiro e a direção do plano a partir do mergulho aparente



? Considerando um corpo mineralizado tabular, com orientação 030/40SE, qual o mergulho aparente deste corpo nas seguintes orientações de bancada de uma mineração a céu aberto? Bancada 1 – 080Az/90, Bancada 2 – 055Az/vert.

Visualização on-line 3D

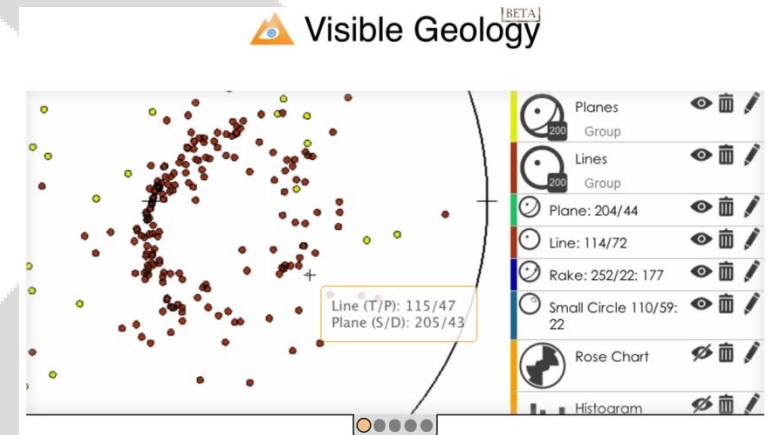
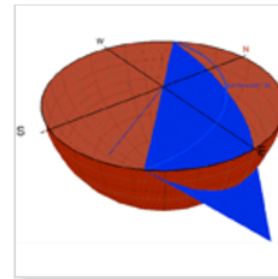
Extras



Log in

Online Stereonet

This online stereonet program is designed for students learning what a stereonet is, and how it can be helpful in visualizing orientation data. Pick planes and lines with a click of your mouse or drag to measure angles and bearings. To understand all of the data **quickly rotate into 3D** to understand what great-circles and points on a stereonet actually mean. If you have data already you can **copy and paste from Excel** and quickly see your data.

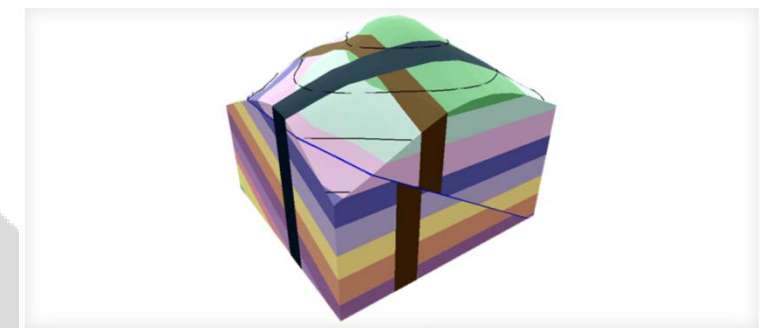
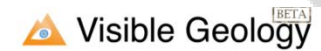


Stereonet



Visible Paleo-Earth

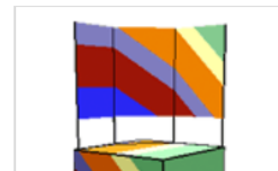
Scroll through 700Ma of earth's history to view the positions of the continents in true-color! The images for Visible Paleo Earth were produced by The Planetary Habitability Laboratory @ UPR Arcibo, NASA, Ron Blakey and Colorado Plateau Geosystems, Inc., and The PaleoMap Project. Visit their [website](#) to see more images and animations.



Visualize

Apparent Dip

Learn about apparent dip by seeing the strike and dip of geologic layers in a cross section. The mini-app calculates apparent dip in the cross-section, and shows you the results, which you can (of course) rotate and scale!



Programas

- Stereonet : <http://www.geo.cornell.edu/geology/faculty/RWA/programs/stereonet.html>
- Openstereo: <http://www.igc.usp.br/index.php?id=391>

Exercícios

- Fazer o download do PROJEÇÕES ESTEREOGRÁFICAS DEFORMAÇÃO RÚPTIL no site: www.tiagomiranda.org

- Referência

Lisle, R. J., 2004, Stereographic Projection Techniques for Geologists and Civil Engenineers. Cambridge: Cambridge University Press.