EPSC240: GEOLOGY IN THE FIELD

LANDFORMS

WEDNESDAY

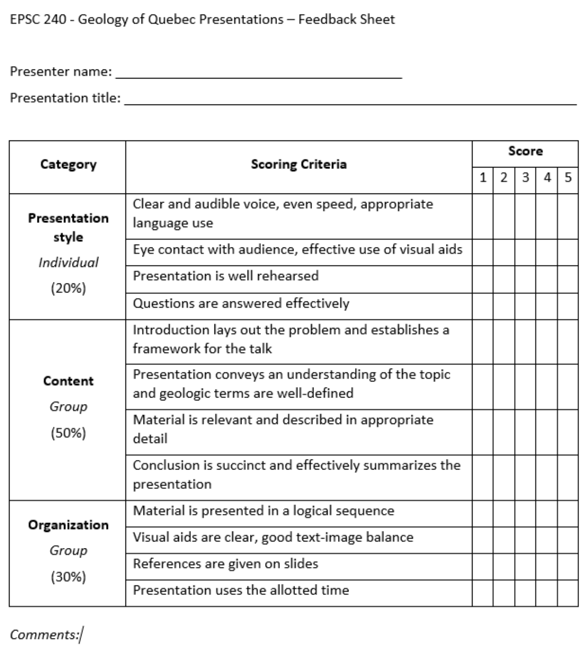
- Google Earth/Mars lab
  - Laptops
  - Install Google Earth Pro
- Île Sainte Hélène report due
- Return mineral ID kits (for non-Mineralogy students)

GEOLOGY OF QUEBEC PRESENTATIONS

- 10 minutes per group + 5 for questions
- Peer review feedback
- Individually marked

- Include references on slides
- Mix of images and text
- About 1 slide per minute

- Practice timing!



EPSC 240 - Geology of Quebec Presentations – Feedback Sheet

Presenter name: ____________________________________

Presentation title: ____

Category	Scoring Criteria	Score				
		1	2	3	4	5
Presentation style *Individual* (20%)	Clear and audible voice, even speed, appropriate language use					
	Eye contact with audience, effective use of visual aids					
	Presentation is well rehearsed					
	Questions are answered effectively					
Content *Group* (50%)	Introduction lays out the problem and establishes a framework for the talk					
	Presentation conveys an understanding of the topic and geologic terms are well-defined					
	Material is relevant and described in appropriate detail					
	Conclusion is succinct and effectively summarizes the presentation					
Organization *Group* (30%)	Material is presented in a logical sequence					
	Visual aids are clear, good text-image balance					
	References are given on slides					
	Presentation uses the allotted time					

Comments:

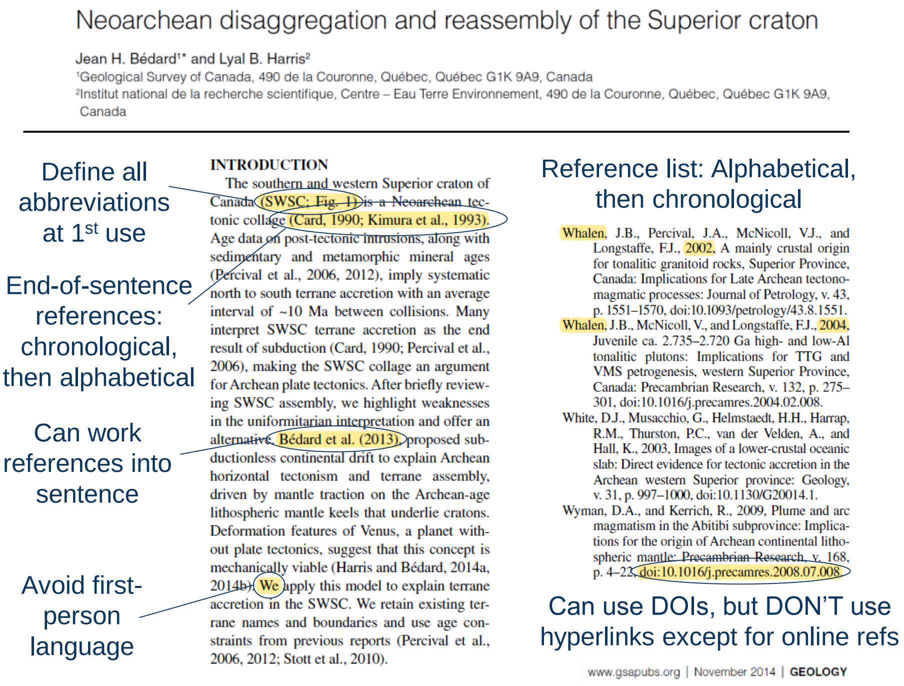
GEOLOGY OF QUEBEC REPORTS

- 2000 words (~8 pages double-spaced)
- Not including title page, figures, tables, reference list
- Individually written

- Sub-headings
  - Intro: Location, age, tectonic setting, purpose of report (why is topic of interest?)
  - Body headings depending on topic –
    - Geology, structures/deformation, formation processes, debates or particular features of interest to you
  - Conclusions/summary
  - Reference list
  - Figures can be embedded in text or in separate section at the end

GEOLOGY OF QUEBEC REPORTS

- Literature
  - At least 5 journal articles
  - Review articles / original research papers
  - General geology is probably in older papers!
  - Use a consistent referencing style (of your choice)



Neoarchean disaggregation and reassembly of the Superior craton

Jean H. Bédard[1]* and Lyal B. Harris[2]
[1]Geological Survey of Canada, 490 de la Couronne, Québec, Québec G1K 9A9, Canada
[2]Institut national de la recherche scientifique, Centre – Eau Terre Environnement, 490 de la Couronne, Québec, Québec G1K 9A9, Canada

Define all abbreviations at 1st use

End-of-sentence references: chronological, then alphabetical

Can work references into sentence

Avoid first-person language

INTRODUCTION

The southern and western Superior craton of Canada (SWSC; Fig. 1) is a Neoarchean tectonic collage (Card, 1990; Kimura et al., 1993). Age data on post-tectonic intrusions, along with sedimentary and metamorphic mineral ages (Percival et al., 2006, 2012), imply systematic north to south terrane accretion with an average interval of ~10 Ma between collisions. Many interpret SWSC terrane accretion as the end result of subduction (Card, 1990; Percival et al., 2006), making the SWSC collage an argument for Archean plate tectonics. After briefly reviewing SWSC assembly, we highlight weaknesses in the uniformitarian interpretation and offer an alternative. Bédard et al. (2013) proposed subductionless continental drift to explain Archean horizontal tectonism and terrane assembly, driven by mantle traction on the Archean-age lithospheric mantle keels that underlie cratons. Deformation features of Venus, a planet without plate tectonics, suggest that this concept is mechanically viable (Harris and Bédard, 2014a, 2014b). We apply this model to explain terrane accretion in the SWSC. We retain existing terrane names and boundaries and use age constraints from previous reports (Percival et al., 2006, 2012; Stott et al., 2010).

Reference list: Alphabetical, then chronological

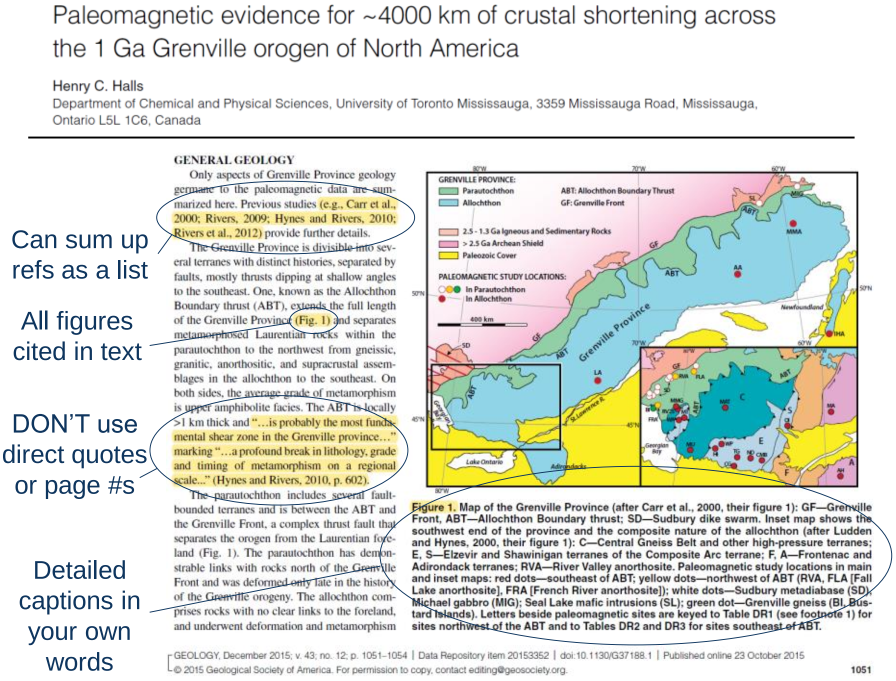
Whalen, J.B., Percival, J.A., McNicoll, V.J., and Longstaffe, F.J., 2002, A mainly crustal origin for tonalitic granitoid rocks, Superior Province, Canada: Implications for Late Archean tectonomagmatic processes: Journal of Petrology, v. 43, p. 1551–1570, doi:10.1093/petrology/43.8.1551.

Whalen, J.B., McNicoll, V., and Longstaffe, F.J., 2004, Juvenile ca. 2.735–2.720 Ga high- and low-Al tonalitic plutons: Implications for TTG and VMS petrogenesis, western Superior Province, Canada: Precambrian Research, v. 132, p. 275–301, doi:10.1016/j.precamres.2004.02.008.

White, D.J., Musacchio, G., Helmstaedt, H.H., Harrap, R.M., Thurston, P.C., van der Velden, A., and Hall, K., 2003, Images of a lower-crustal oceanic slab: Direct evidence for tectonic accretion in the Archean western Superior province: Geology, v. 31, p. 997–1000, doi:10.1130/G20014.1.

Wyman, D.A., and Kerrich, R., 2009, Plume and arc magmatism in the Abitibi subprovince: Implications for the origin of Archean continental lithospheric mantle: Precambrian Research, v. 168, p. 4–22, doi:10.1016/j.precamres.2008.07.008.

Can use DOIs, but DON'T use hyperlinks except for online refs



Paleomagnetic evidence for ~4000 km of crustal shortening across the 1 Ga Grenville orogen of North America

Henry C. Halls
Department of Chemical and Physical Sciences, University of Toronto Mississauga, 3359 Mississauga Road, Mississauga, Ontario L5L 1C6, Canada

Can sum up refs as a list

All figures cited in text

DON'T use direct quotes or page #s

Detailed captions in your own words

GENERAL GEOLOGY

Only aspects of Grenville Province geology germane to the paleomagnetic data are summarized here. Previous studies (e.g., Carr et al., 2000; Rivers, 2009; Hynes and Rivers, 2010; Rivers et al., 2012) provide further details.

The Grenville Province is divisible into several terranes with distinct histories, separated by faults, mostly thrusts dipping at shallow angles to the southeast. One, known as the Allochthon Boundary thrust (ABT), extends the full length of the Grenville Province (Fig. 1) and separates metamorphosed Laurentian rocks within the parautochthon to the northwest from gneissic, granitic, anorthositic, and supracrustal assemblages in the allochthon to the southeast. On both sides, the average grade of metamorphism is upper amphibolite facies. The ABT is locally >1 km thick and "…is probably the most fundamental shear zone in the Grenville province…" marking "…a profound break in lithology, grade and timing of metamorphism on a regional scale..." (Hynes and Rivers, 2010, p. 602).

The parautochthon includes several fault-bounded terranes and is between the ABT and the Grenville Front, a complex thrust fault that separates the orogen from the Laurentian foreland (Fig. 1). The parautochthon has demonstrable links with rocks north of the Grenville Front and was deformed only late in the history of the Grenville orogeny. The allochthon comprises rocks with no clear links to the foreland, and underwent deformation and metamorphism

Figure 1. Map of the Grenville Province (after Carr et al., 2000, their figure 1): GF—Grenville Front, ABT—Allochthon Boundary thrust; SD—Sudbury dike swarm. Inset map shows the southwest end of the province and the composite nature of the allochthon (after Ludden and Hynes, 2000, their figure 1): C—Central Gneiss Belt and other high-pressure terranes; E, S—Elzevir and Shawinigan terranes of the Composite Arc terrane; F, A—Frontenac and Adirondack terranes; RVA—River Valley anorthosite. Paleomagnetic study locations in main and inset maps: red dots—southeast of ABT; yellow dots—northwest of ABT (RVA, FLA [Fall Lake anorthosite], FRA [French River anorthosite]); white dots—Sudbury metadiabase (SD), Michael gabbro (MIG); Seal Lake mafic intrusions (SL); green dot—Grenville gneiss (BI, Bustard Islands). Letters beside paleomagnetic sites are keyed to Table DR1 (see footnote 1) for sites northwest of the ABT and to Tables DR2 and DR3 for sites southeast of ABT.

GEOLOGY, December 2015; v. 43; no. 12; p. 1051–1054 | Data Repository item 20153352 | doi:10.1130/G37188.1 | Published online 23 October 2015

GEOLOGY OF QUEBEC REPORTS

- **Report (50%):** Thorough and high-level, presented for audience of your peers, demonstrates understanding of the topic
- **Literature (20%):** Appropriate high-quality references, evidence of wide reading, correctly formatted in-text referencing & reference list
- **Figures/tables (15%):** Clear, relevant, with descriptive captions, sources, cited in text
- **Language & organization (10%):** Professional format, logical layout and headings, clearly-structured text, correct spelling of geological terms
- **Summary (5%):** Succinct, consistent with report, appropriate content

COURSE EVALUATIONS

- Open until Dec 22 in Mercury
- Anonymous
- Help us make this course better!

MERCURY
COURSE EVALUATIONS

- https://www.mcgill.ca/mercury/students

GEOMORPHOLOGY

- Study of the origin of topographic features at the earth's surface

➔ Faults, folds, orogens

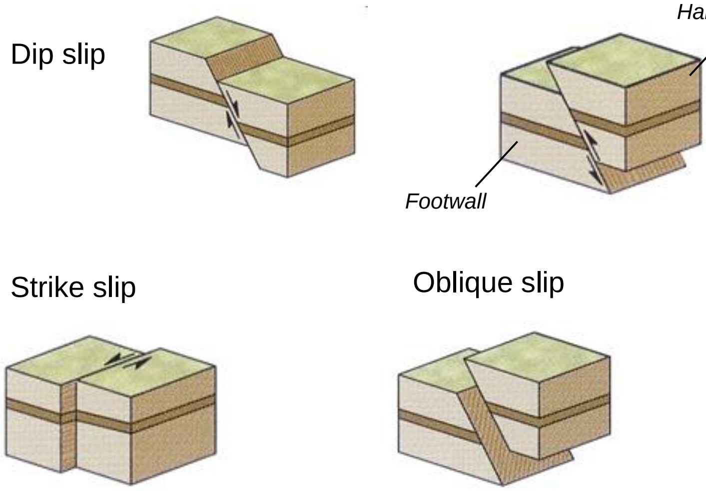
➔ Weathering, glaciation

➔ Volcanic processes

➔ Meteor impacts

Utah Badlands, Wikipedia

FAULTS



Normal

Reverse

Hanging wall

Dip slip

Footwall

Strike slip

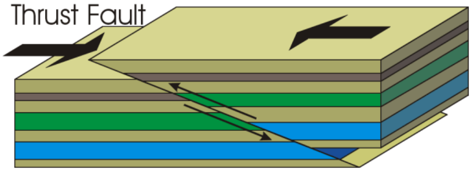
Oblique slip

Left-lateral vs right-lateral

Dip slip + strike slip

THRUST FAULTS

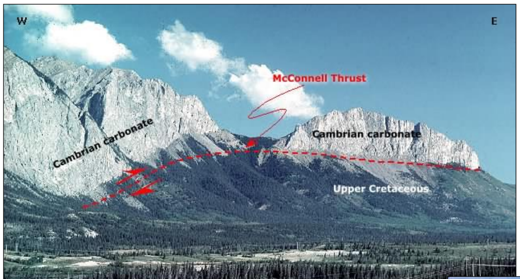
- Special class of reverse faults
  - Fault plane dips at <30°



Black Hawk College, Richard Harwood

St Mary's University, J. Waldron

THRUST FAULTS



McConnell Thrust, Rocky Mountains

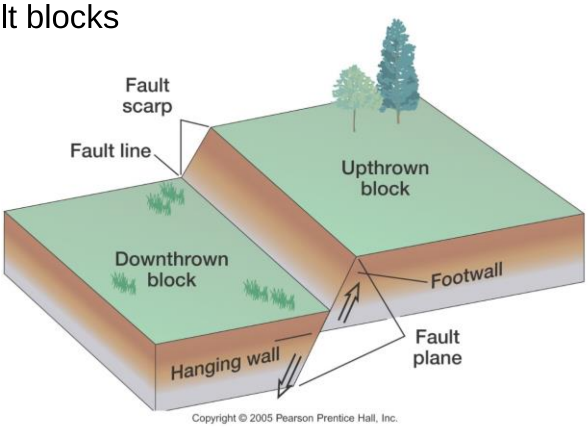
Image: Cornell University

Thrust fault in Chilean Andes

Image: Cornell University, Constantino Mpodozis

FAULT SCARPS

- Topographic difference between downthrown and upthrown fault blocks



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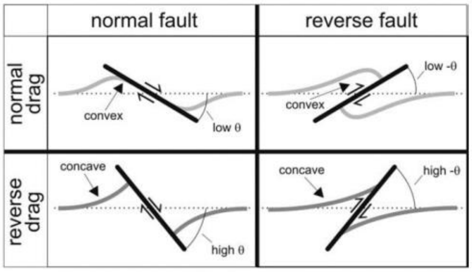
FAULT SCARPS

Wikipedia

geology.utah.gov

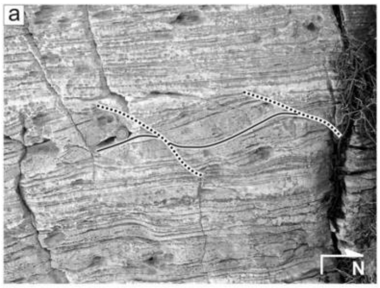
FAULT DRAG

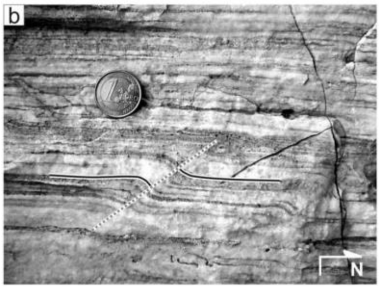
- Evidence for direction of slip



Images: Grasemann et al. 2005

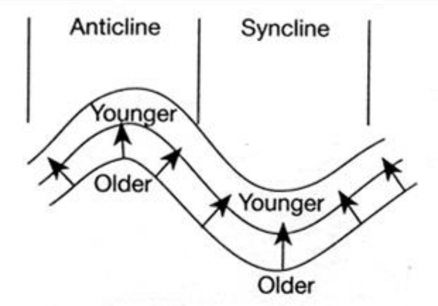
Normal faults showing normal drag

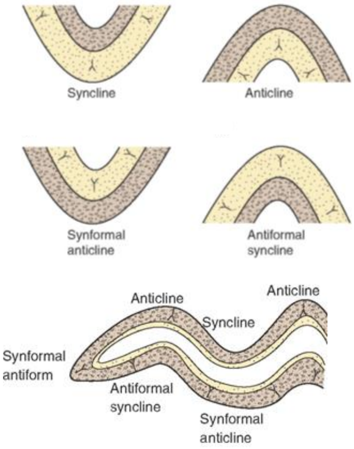




Normal fault with reverse drag, same outcrop!

FOLDS

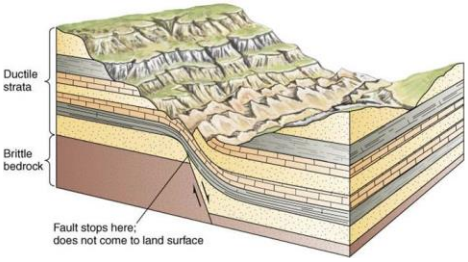


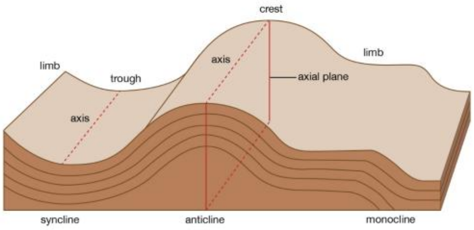


'Y' symbol = younging upward

MONOCLINES

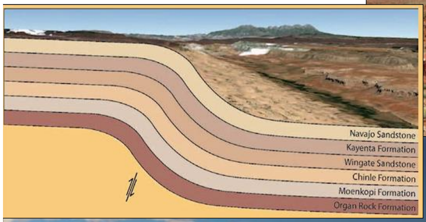
- Folds with one long, shallow limb, and one short, steep limb
- Develop as a ductile response of rocks above a deep-seated fault
- Usually regional scale (big)





MONOCLINES

Theoretical view of the monocline in the absence of erosion *(after Robinson 2012)*



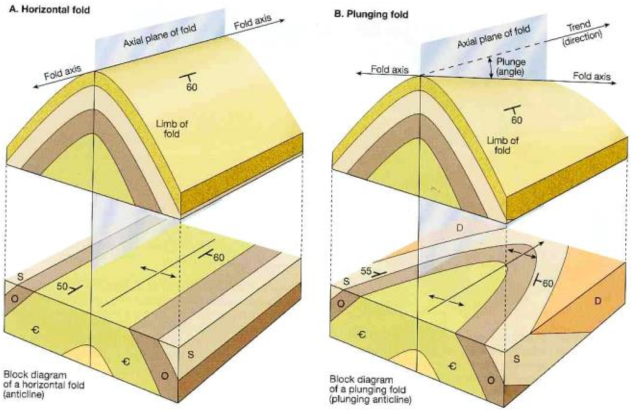
Top: ***Exposure of the monocline at the San Juan River***

Left: ***Comb Ridge monocline, Monument Upwarp, Utah***

Images & interpretation: plantsandrocks.blogspot.com.au

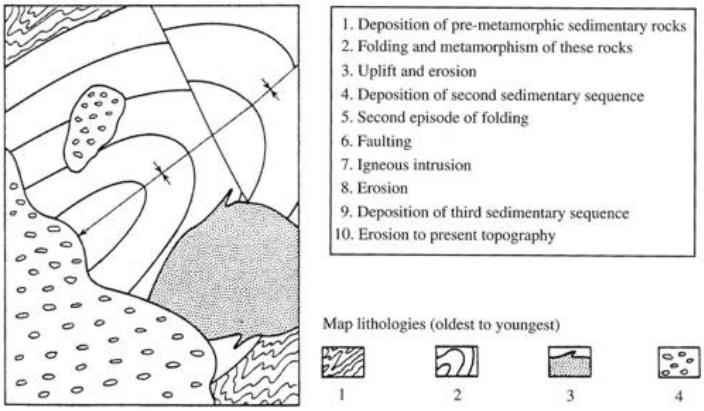
PLUNGING FOLDS

- If a plunging fold intersects a horizontal surface (e.g., the surface of the earth), the fold hinge can be seen on that surface



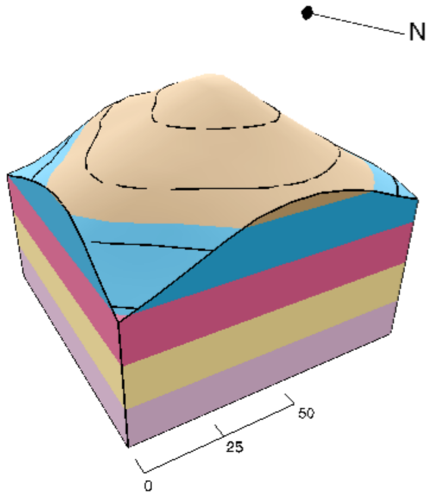
MAP PATTERNS

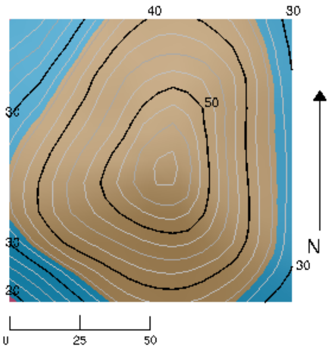
- Depict type of contact: depositional, intrusive, tectonic and relative timing



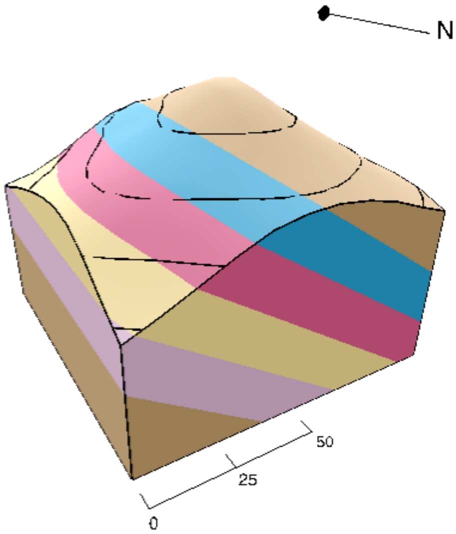
1. Deposition of pre-metamorphic sedimentary rocks
2. Folding and metamorphism of these rocks
3. Uplift and erosion
4. Deposition of second sedimentary sequence
5. Second episode of folding
6. Faulting
7. Igneous intrusion
8. Erosion
9. Deposition of third sedimentary sequence
10. Erosion to present topography

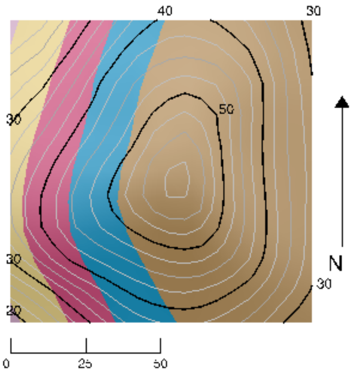
MAP PATTERNS



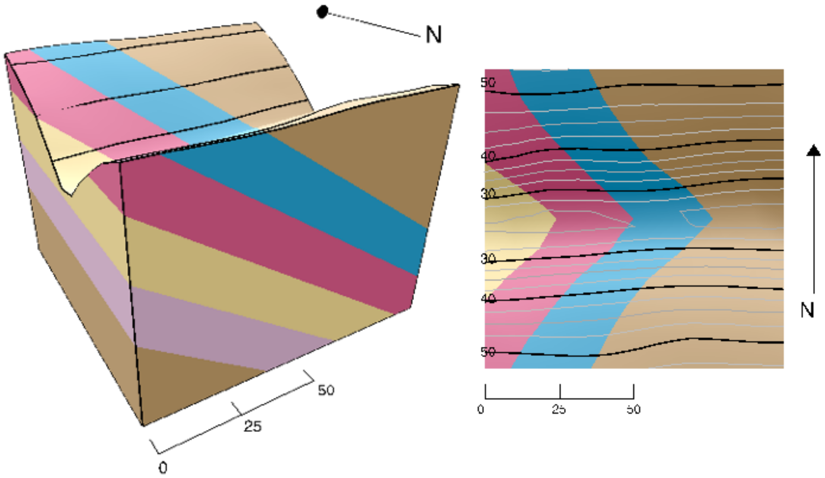


MAP PATTERNS





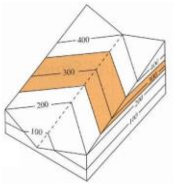
MAP PATTERNS



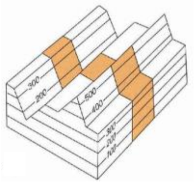
From Rowland et al. (2007), Structural Analysis and Synthesis, 3rd Ed.

RULE OF Vs: CONTACTS

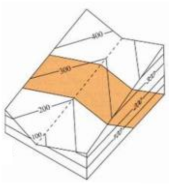
- Planar rock units are eroded in predictable patterns through valleys, depending on their dip angle
- Can use map patterns to estimate dip of a plane



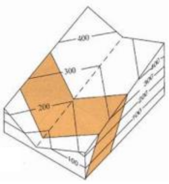
1. Horizontal plane



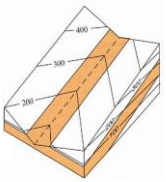
2. Vertical plane



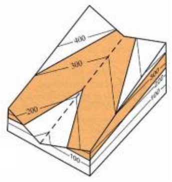
3. Dips upstream



4. Dips downstream



5. Dip = valley gradient



6. Dip downstream < valley