CZECH REPUBLIC
DEVELOPMENT COOPERATION

Česká geologická služba

Czech Geological Survey

95 LET | ANNIVERSARY

Compilation of geological map

„We mapped two, me and that fool before me“
My teacher of geology at University

Geological map must be:

As close to the reality as possible

Logic

Nice

Organisation of all factual documentation and data

Field map and field documentation
Remote sensing data
Laboratory results
Archive documents
...

Compilation a „fair-copy“ map interpreted from the factual data

Fair copy of geological map is subjective.

Much of the information gathered during the mapping is not transferred to the manuscript.

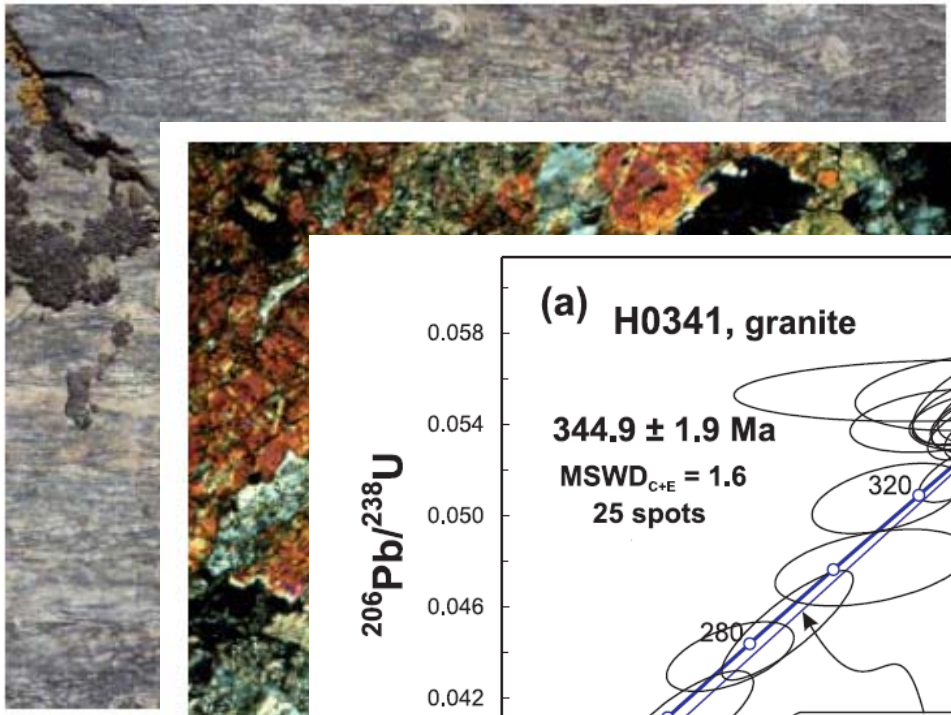
The general rule is to show any features which add to the understanding of the geology and geological history, and to omit those that do not. The criterion of what to show is mainly a matter of common sense and experience.

Map data

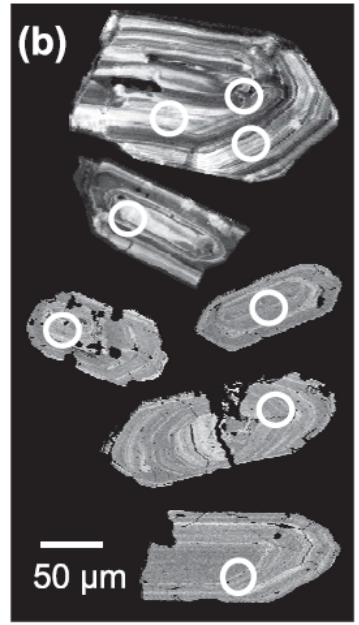

0 0,5 1 2 3 4
Kilometers

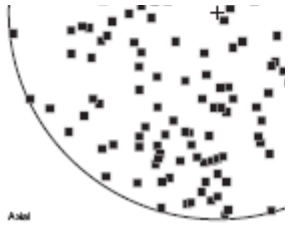
Light table
+ tracing paper

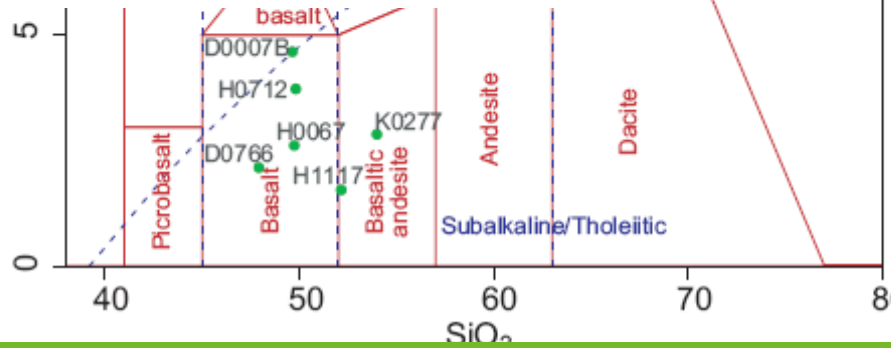
Field documetation
Laboratory data

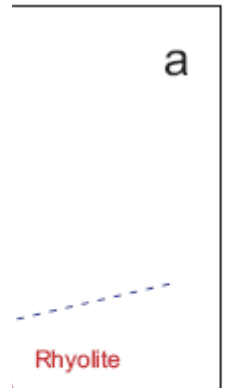


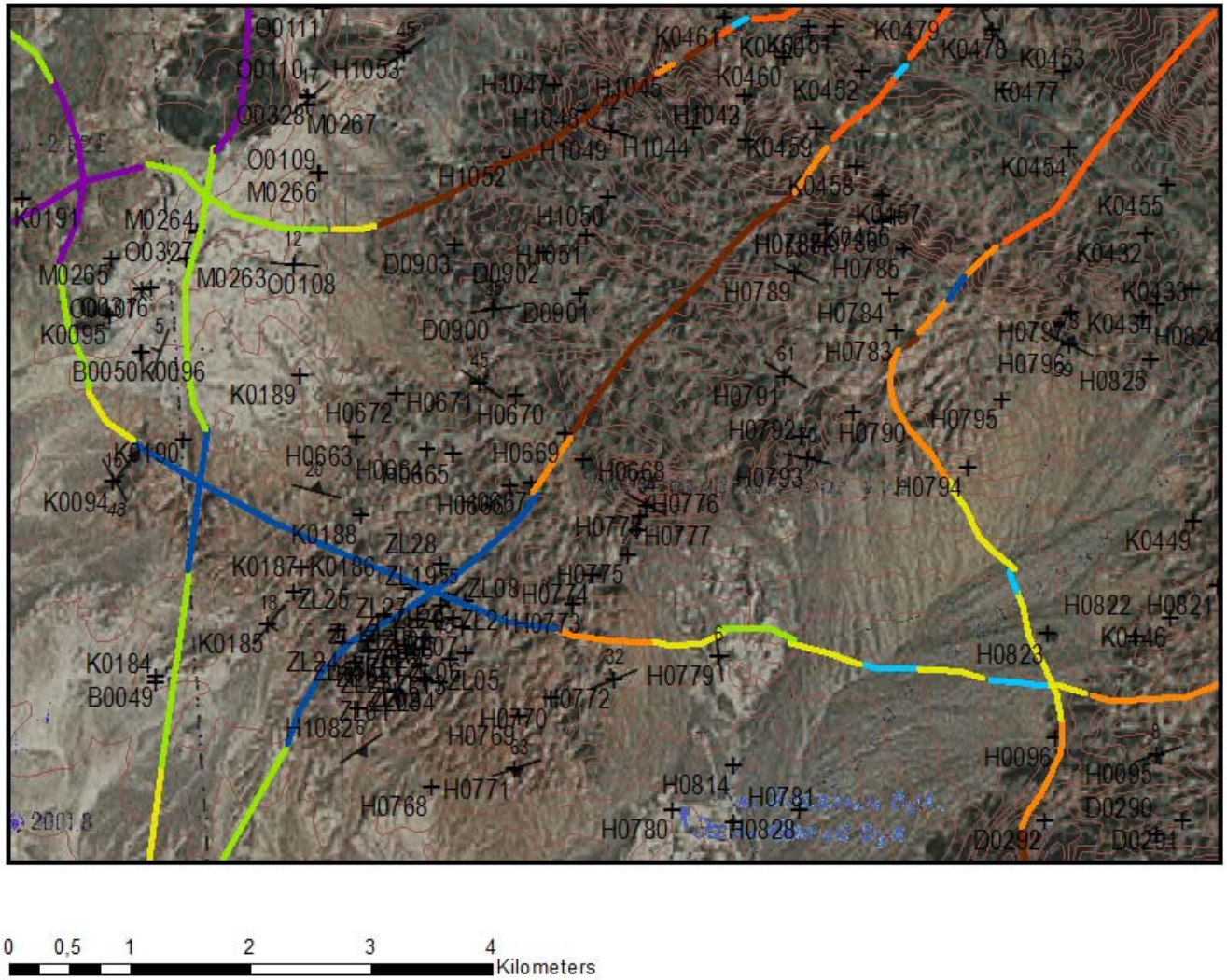
data-point error ellipses are 2σ
(a)
H0341, granite
344.9 ± 1.9 Ma
MSWD$_{C+E}$ = 1.6
25 spots
Intercepts at
154 ±160 & 354 ± 26 Ma
MSWD = 0.95, 32 spots
$^{206}Pb/^{238}U$
$^{207}Pb/^{235}U$
0.058
0.054
0.050
0.046
0.042
0.038
0.24
0.28
0.32
0.36
0.40
0.44
240
280
320
360

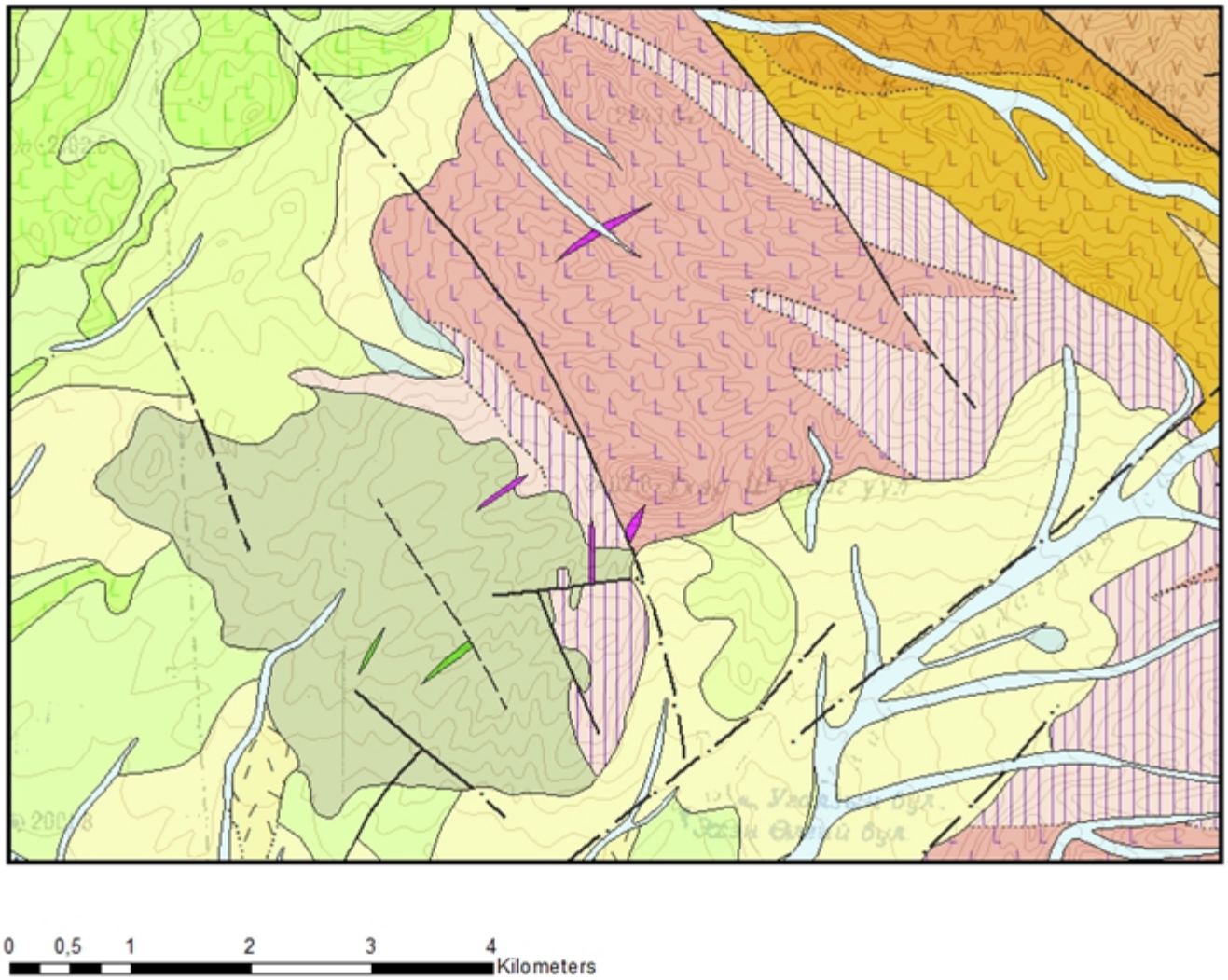

(b)
50 µm




basalt
D0007B
H0712
H0067
K0277
D0766
H1117
Picrobasalt
Basalt
Basaltic andesite
Andesite
Dacite
Subalkaline/Tholeiitic
0
5
40
50
60
70
80

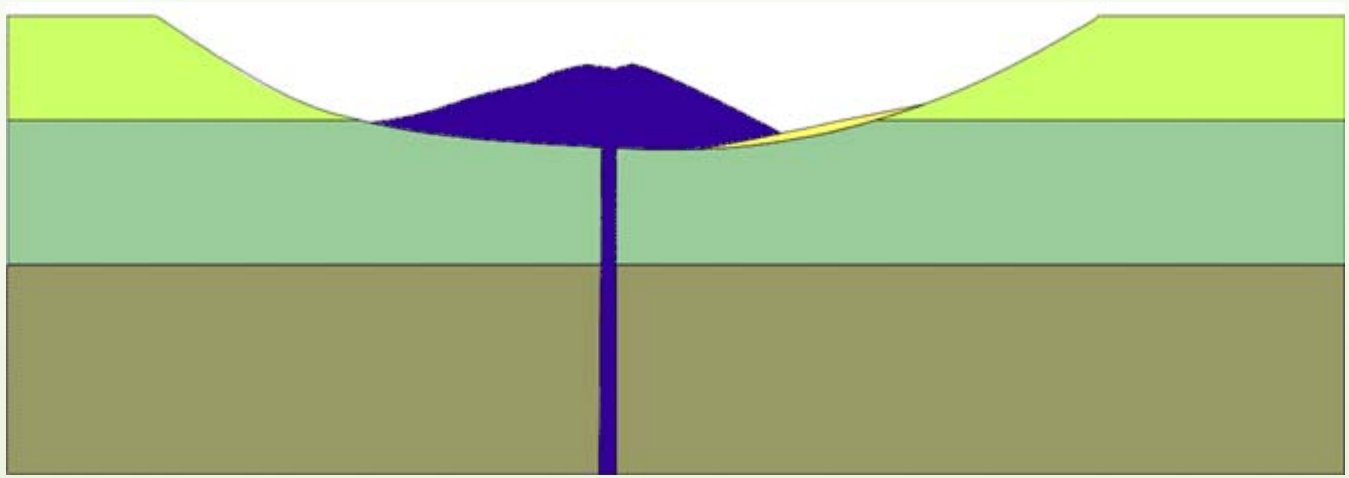

a
Rhyolite


O0111
O0110
H1053
O0328
M0267
O0109
M0266
K0191
M0264
O0327
M0265
M0263
O0108
K0095
B0050
K0096
K0189
H0672
H0671
H0670
K0190
H0663
H0669
K0094
K0188
ZL28
K0187
K0186
H0775
H0774
ZL26
H0773
K0185
K0184
B0049
H0779
H0772
H0770
H0769
H0771
H0768
H0814
H0781
H0780
H0828
D0292
D0290
K0461
K0460
K0452
K0479
K0478
K0453
K0477
H1047
H1045
H1048
H1042
H1049
H1044
K0459
K0454
H1052
K0458
K0455
H1050
H1051
D0903
D0902
D0901
D0900
H0788
H0786
H0789
H0784
H0783
K0432
K0433
K0434
H0824
H0825
H0796
H0791
H0792
H0790
H0795
H0793
H0794
H0776
H0777
K0449
H0822
H0821
K0446
H0823
H0779
H0096
H0095
D0290
D0291
0 0,5 1 2 3 4
Kilometers

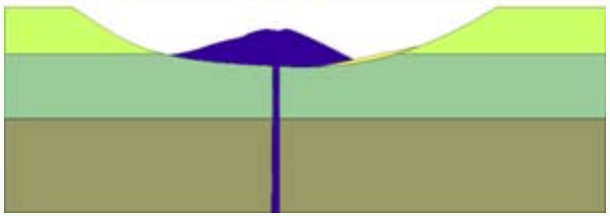

0 0,5 1 2 3 4
Kilometers

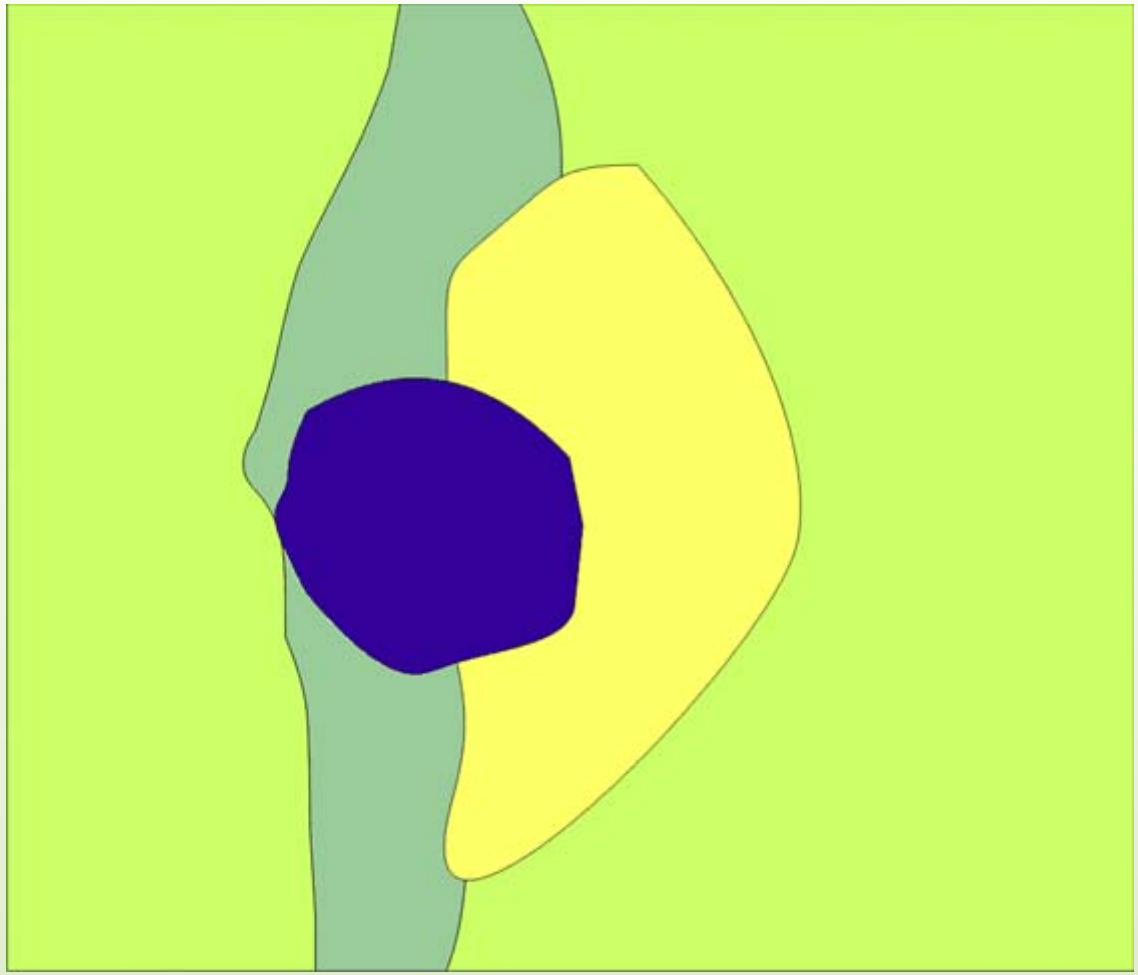
Basic principles of map compilation

Law of superposition - basic law of geochronology, stating that in any undisturbed sequence of rocks deposited in layers, the youngest layer is on top and the oldest on bottom, each layer being younger than the one beneath it and older than the one above it.



During the map compilation we start to draw a map from youngest (uppermost) units





Geological map is made from strata and is drawn from younger to older layers

- Quaternary (Cenozoic) cover
- Faults
- Platform cover
- pre-Platform units

On geological maps all contacts are shown. However, rocks are not everywhere exposed. Geologist need to interpret map from visible contacts.

The V-rule – a dipping surface that crops out in a valley or on a ridge will give rise to a V-shaped outcrop. The way of the outcrop patterns depends on the dip of the geological surface relative to topography.

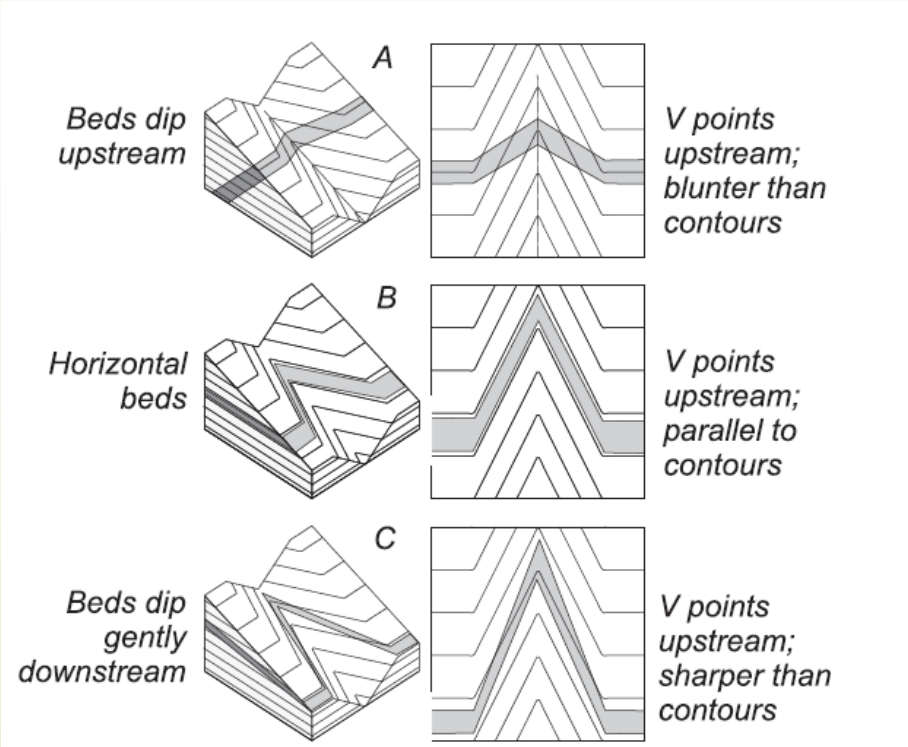


Fig. 2.17 To illustrate the V-rule.

[Link to exercise]

Geological map is an intersection of structural contour and topographic contour

Structure contour – line connecting points of equal elevation on a specific geologic surface.

The trend of the structure contour at any point is parallel to the strike of the layer at that point.

Interpolation of geological contact from outcrop and known orientation of strike and dip

To draw structure contours of known height

Interpret other structure contours - lines paralel with strike of bed and plotted in spacing between two known structure contours, spacing could be computed using equitation „spacing = contour int./tangent(angle of dip)“

Interpret course of layer at crossing of topographic and structural contours of the same heigth

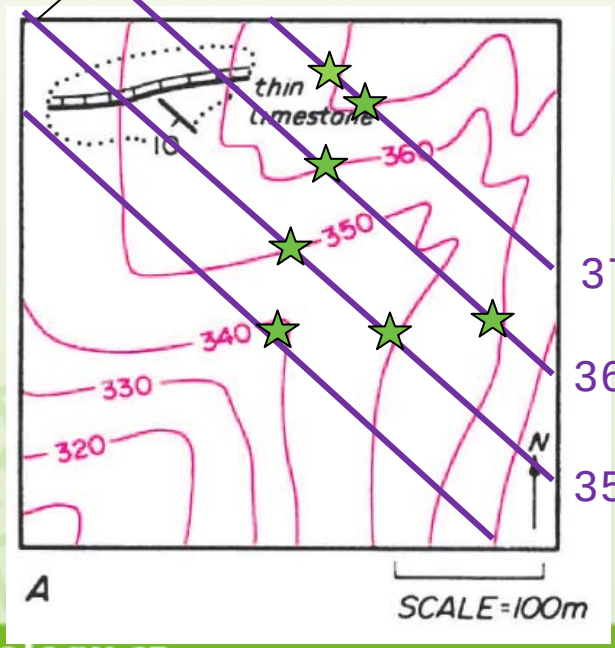
spacing

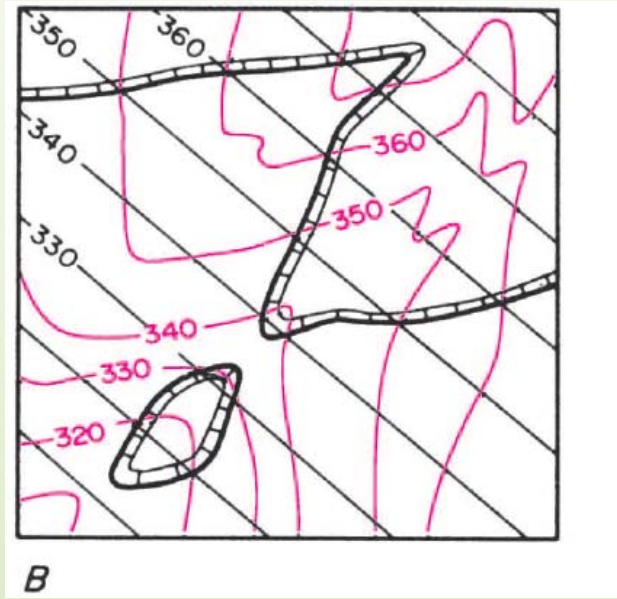
340

370

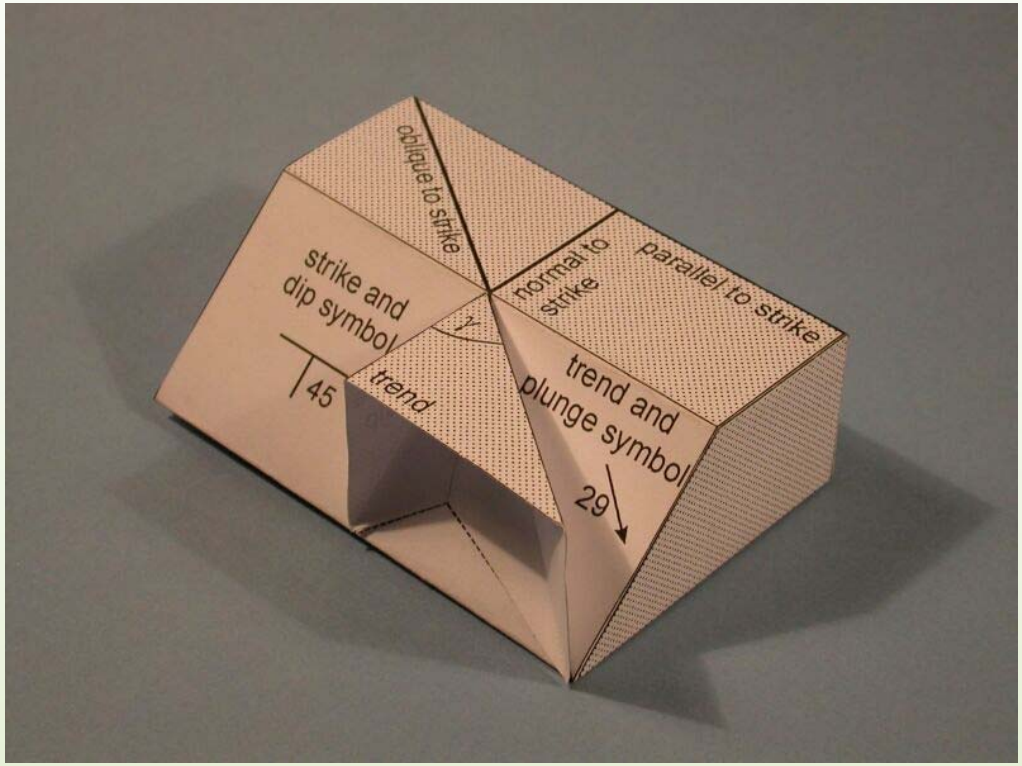
360

350

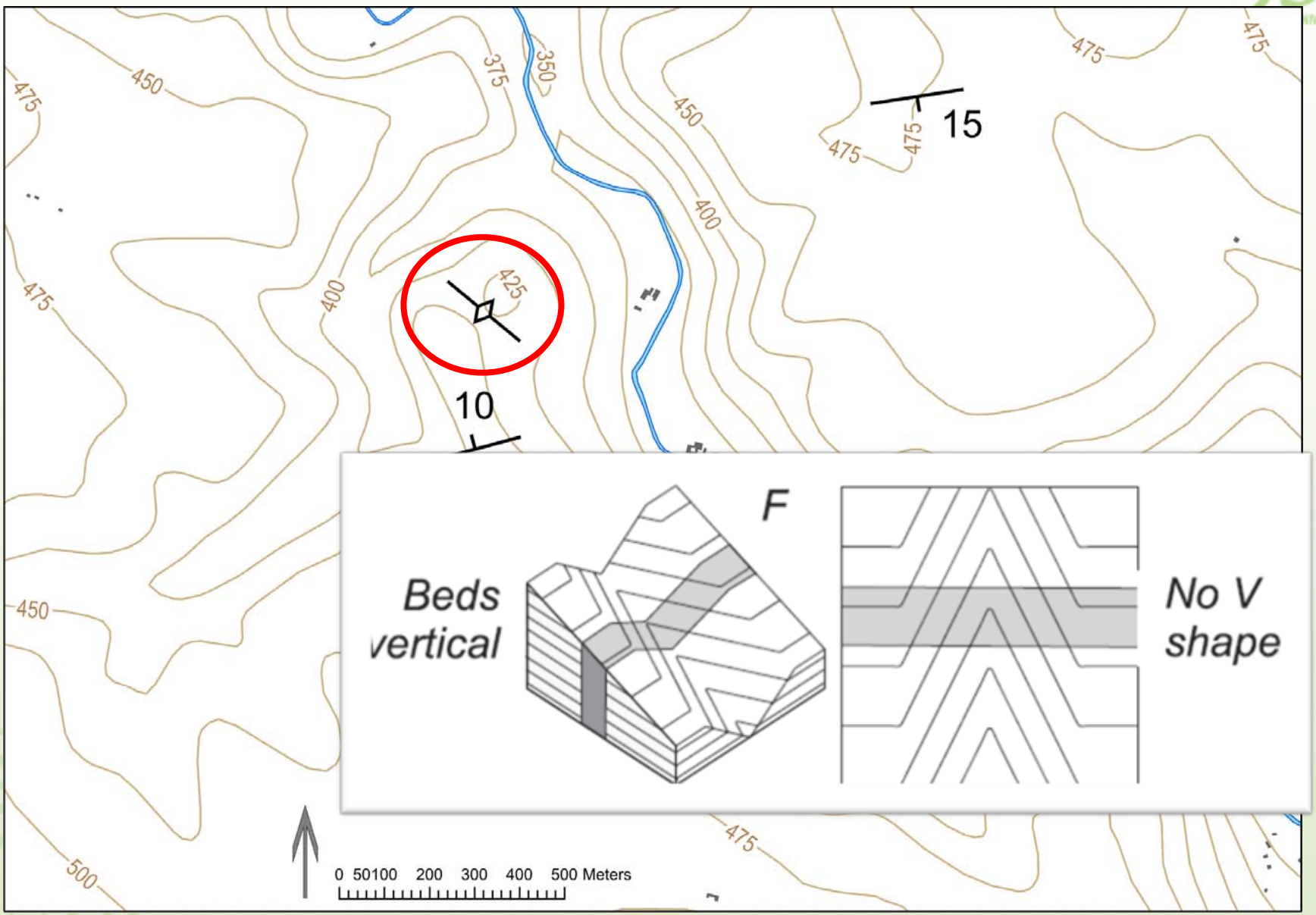


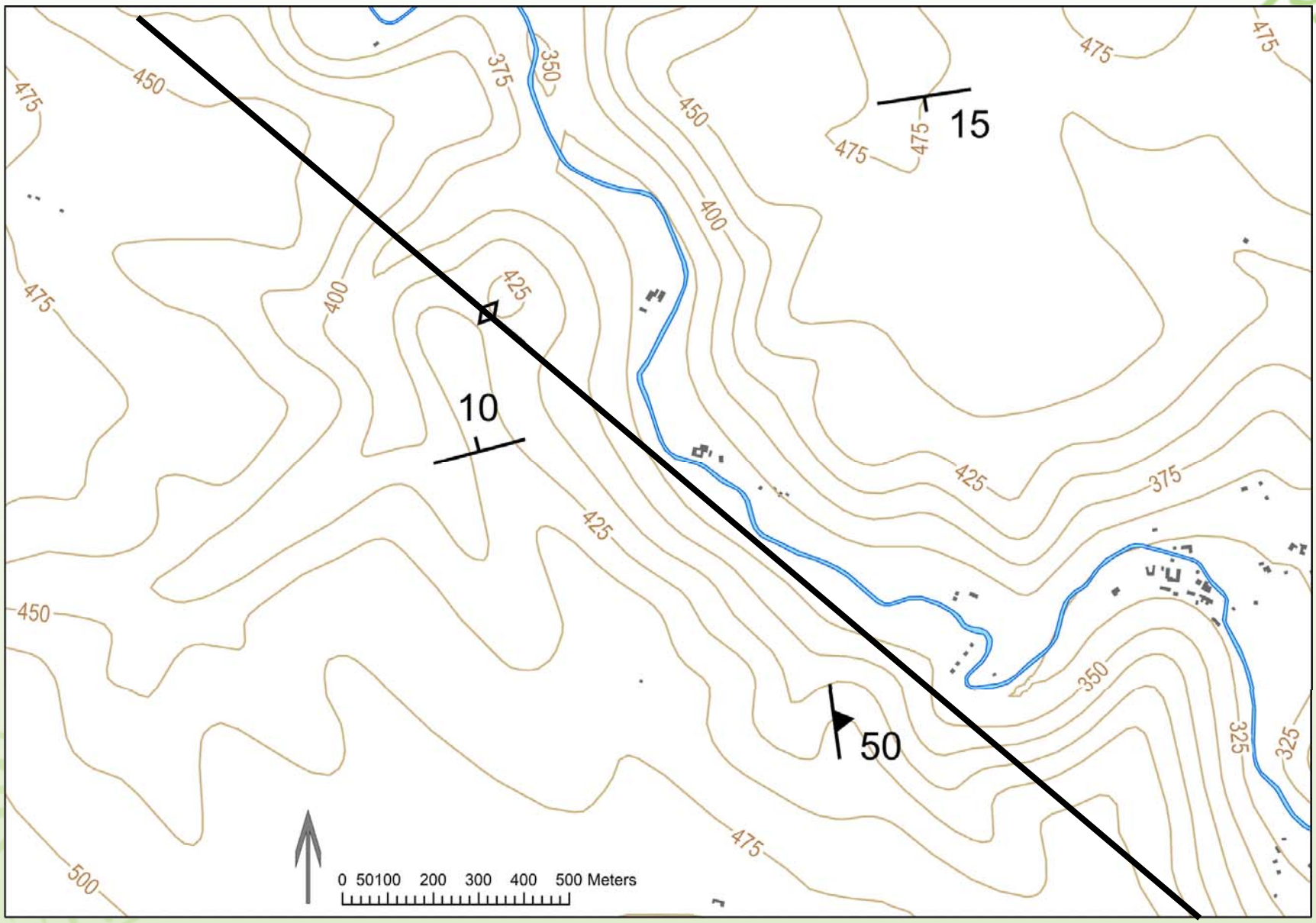


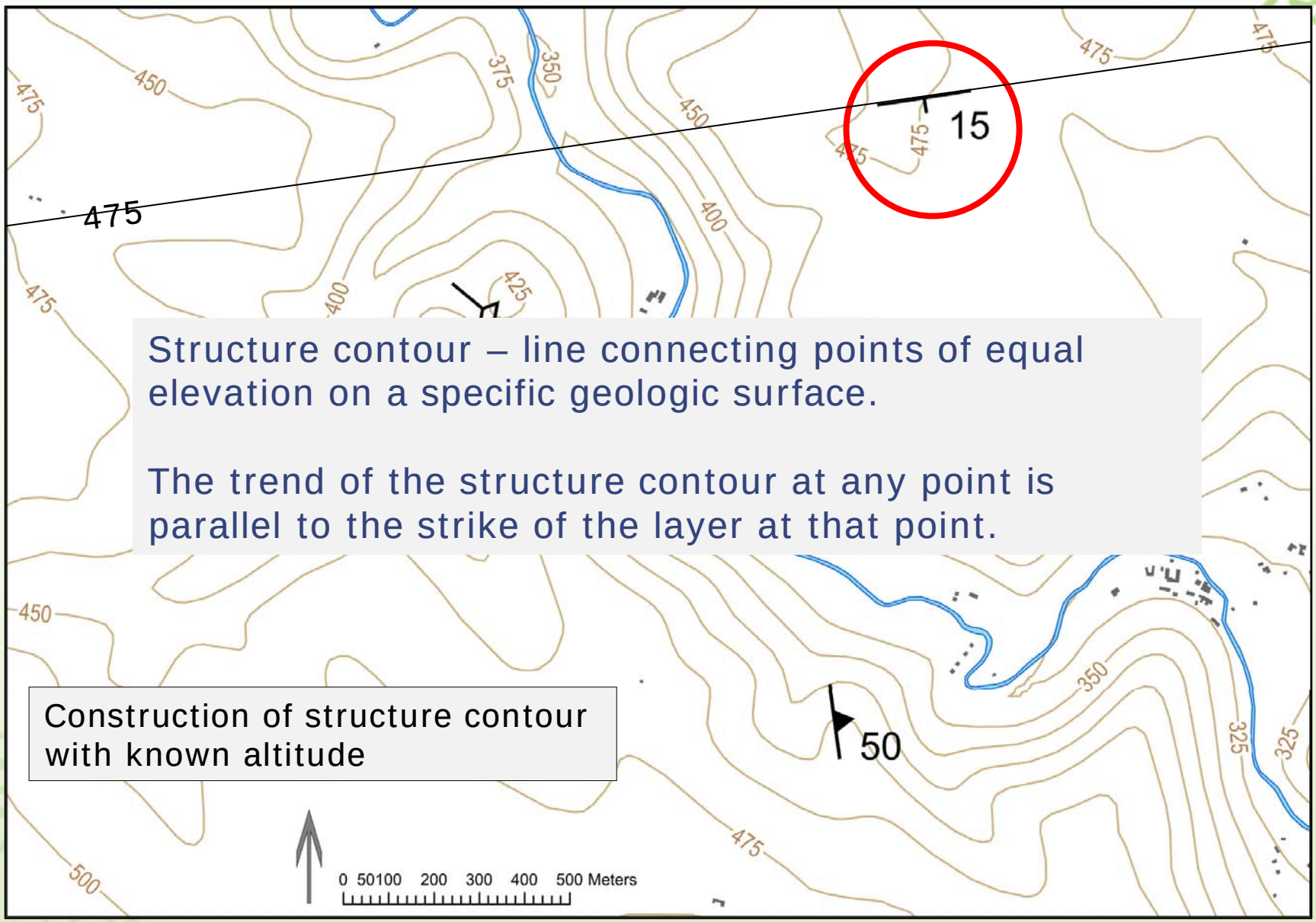
http://www.fault-analysis-group.ucd.ie/papermodels/papermodels.htm



Exercise


475
450
375
350
450
475
475
475
15
475
400
425
400
475
10
450
F
Beds
vertical
No V
shape
500
475
0 50100 200 300 400 500 Meters

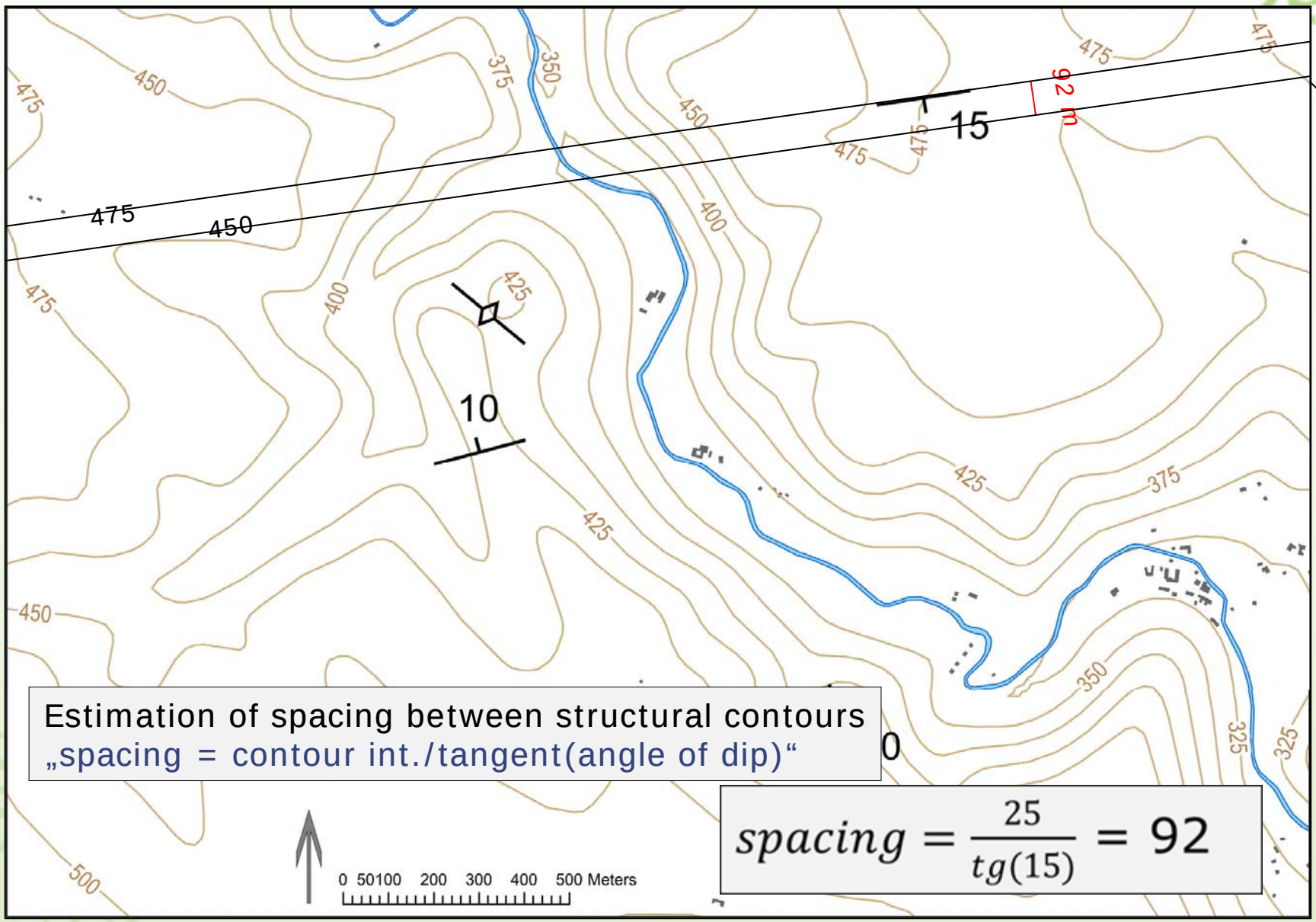

15
10
50
0 50100 200 300 400 500 Meters



Structure contour – line connecting points of equal elevation on a specific geologic surface.

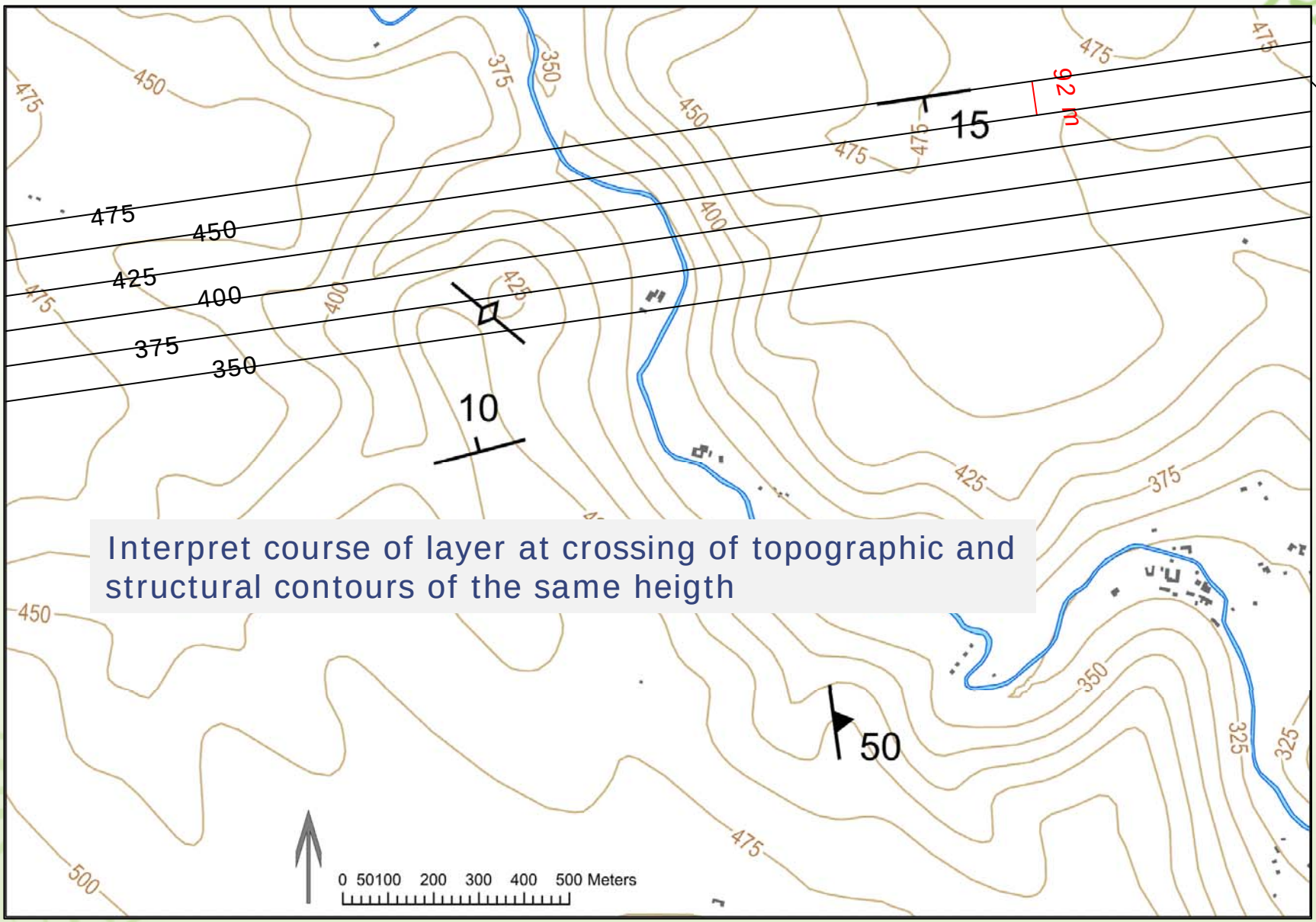
The trend of the structure contour at any point is parallel to the strike of the layer at that point.

Construction of structure contour with known altitude

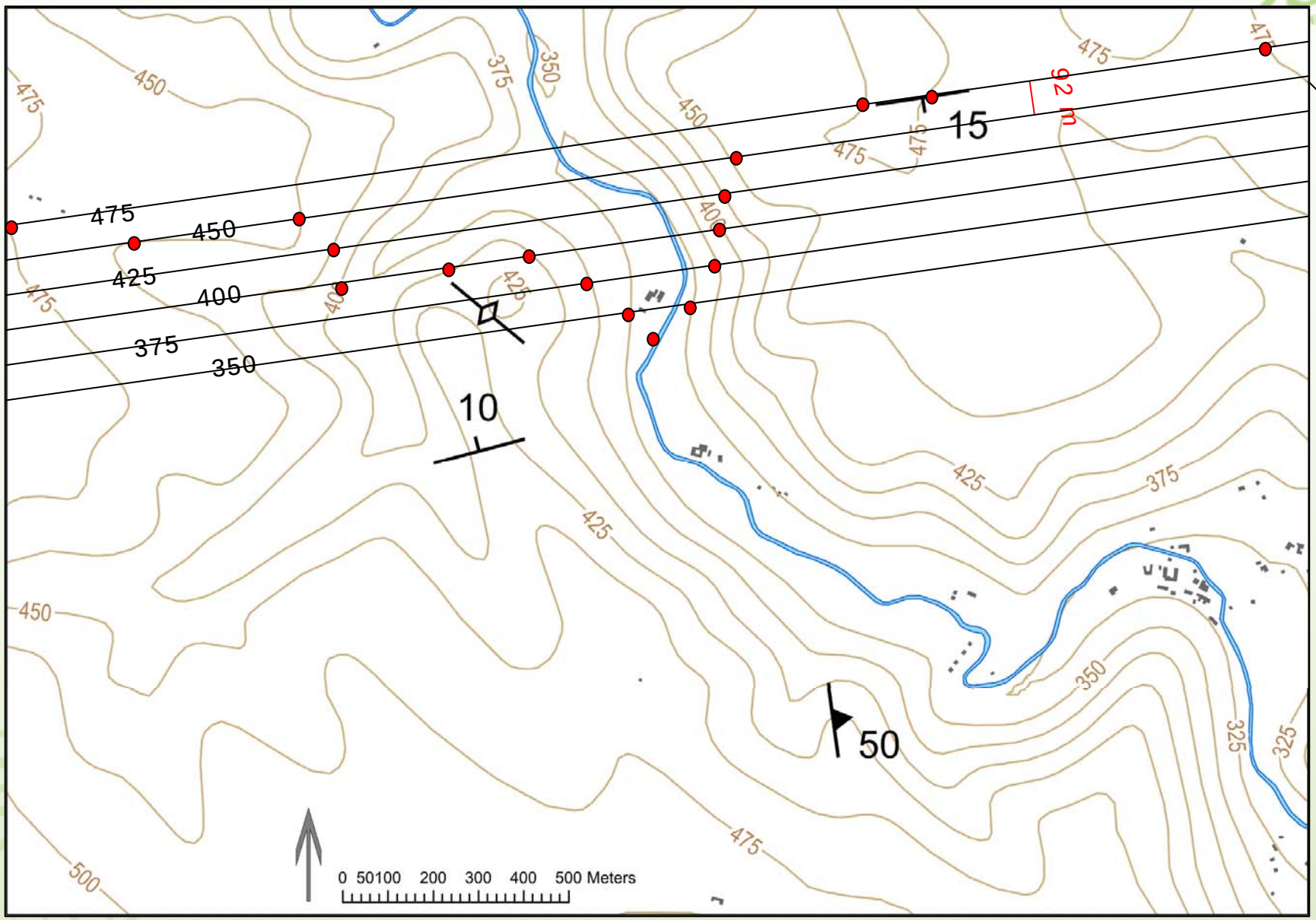


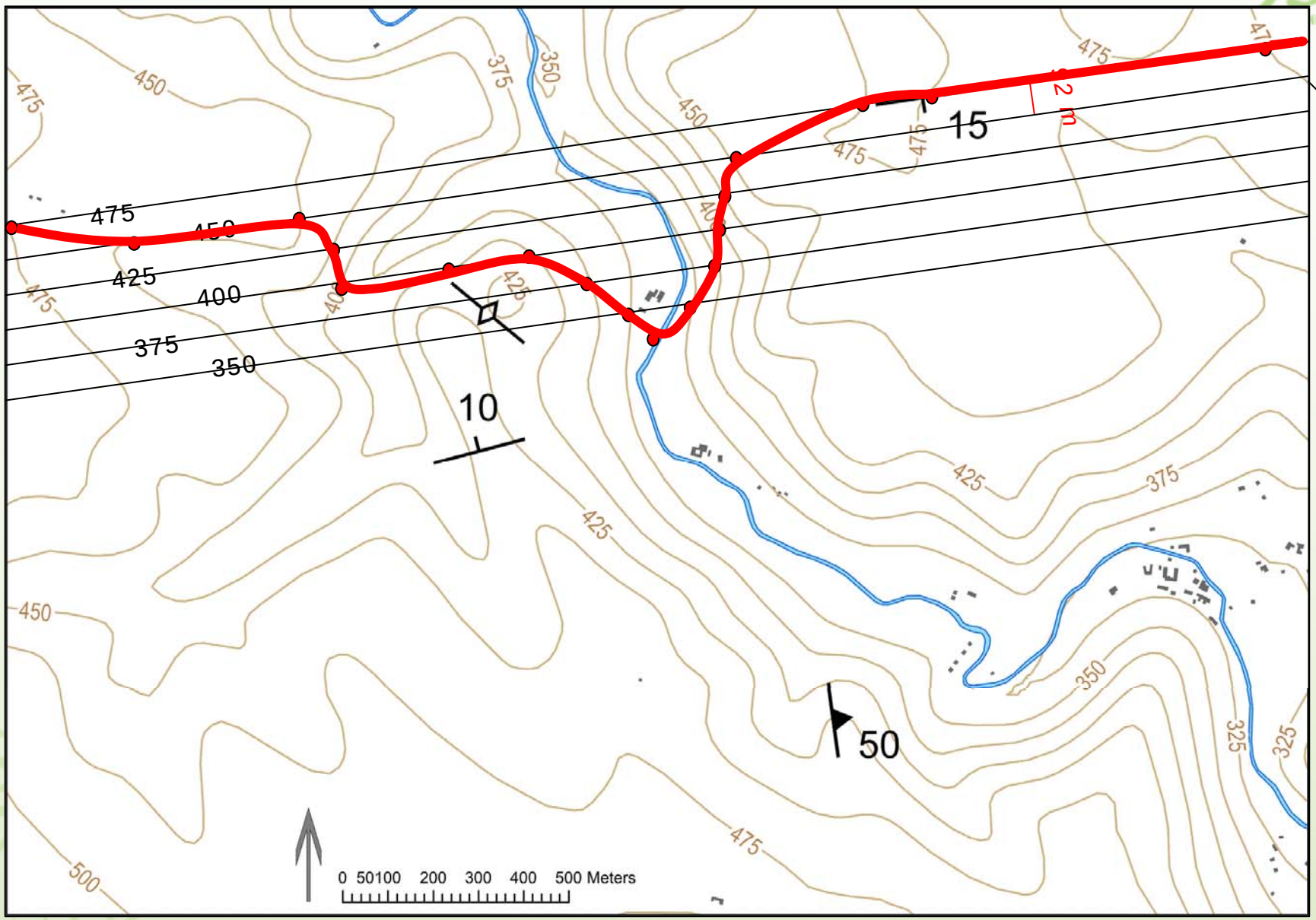
Estimation of spacing between structural contours
„spacing = contour int./tangent(angle of dip)“

$$spacing = \frac{25}{tg(15)} = 92$$

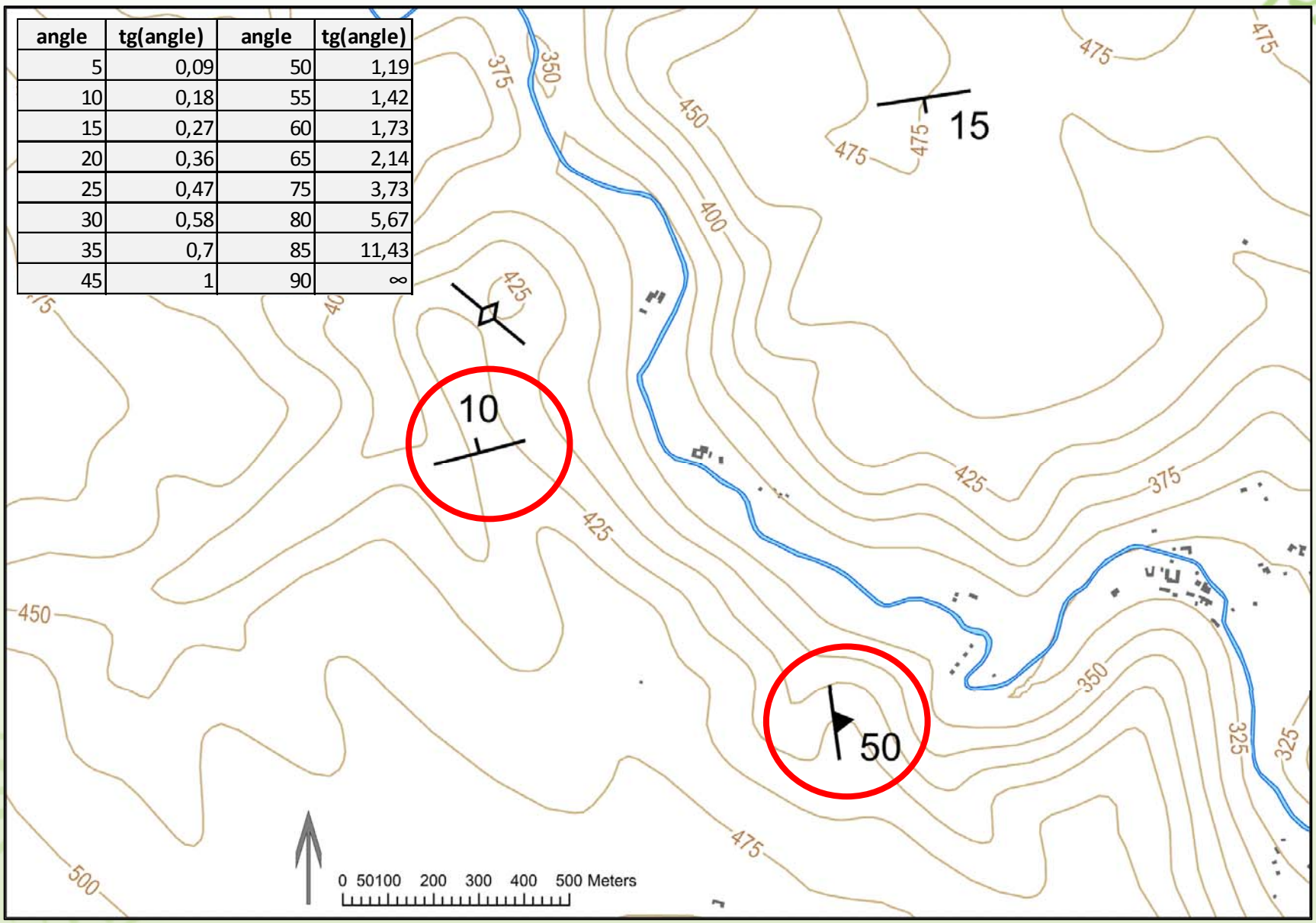


Interpret course of layer at crossing of topographic and structural contours of the same heigth

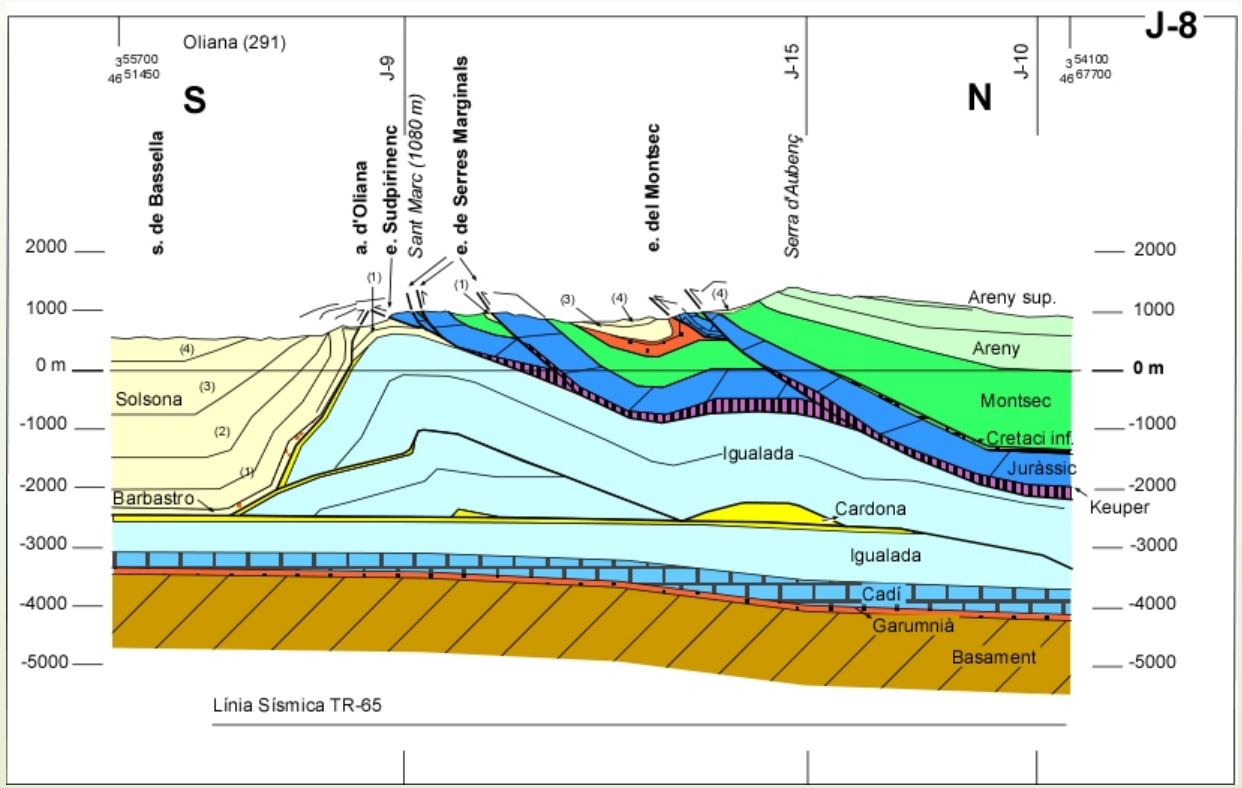

475
450
425
400
375
350
10
15
92 m
50
0 50100 200 300 400 500 Meters


475
450
425
400
375
350
10
15
2 m
50
0 50100 200 300 400 500 Meters

angle	tg(angle)	angle	tg(angle)
5	0,09	50	1,19
10	0,18	55	1,42
15	0,27	60	1,73
20	0,36	65	2,14
25	0,47	75	3,73
30	0,58	80	5,67
35	0,7	85	11,43
45	1	90	∞



Geological cross section



A geological cross-section is a graphic representation of the intersection of the geological bodies in the subsurface with a vertical plane of a certain orientation.

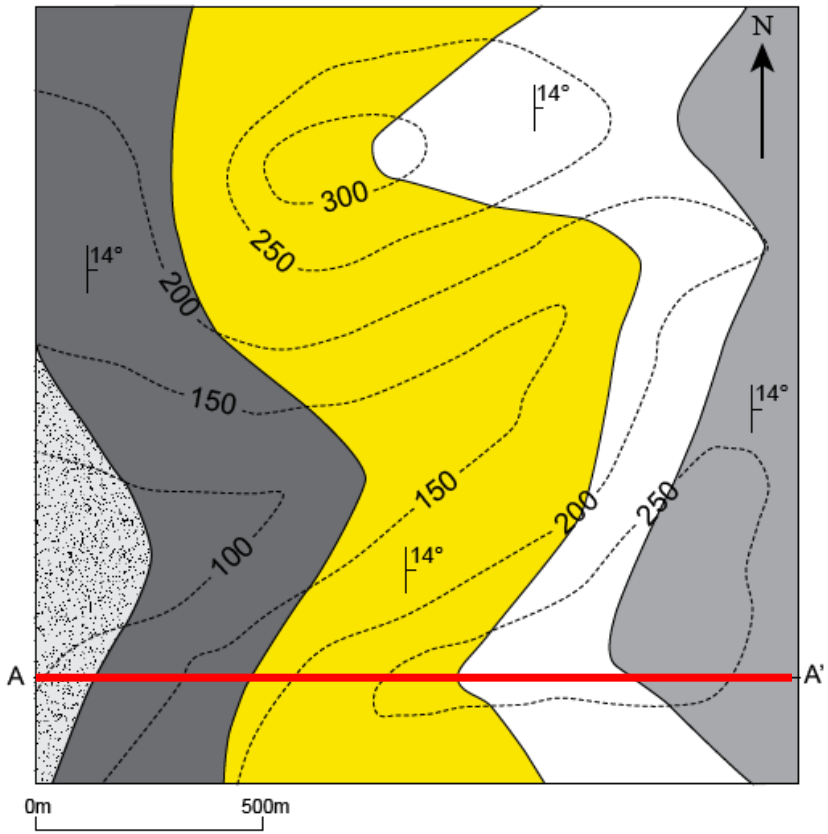
It is an approximate model of the real distribution of the rocks in depth, consistent with the information available on the surface and the subsurface.

Step 1:
Determine the line along which to draw the section.

The line of section should be representative of the study area:

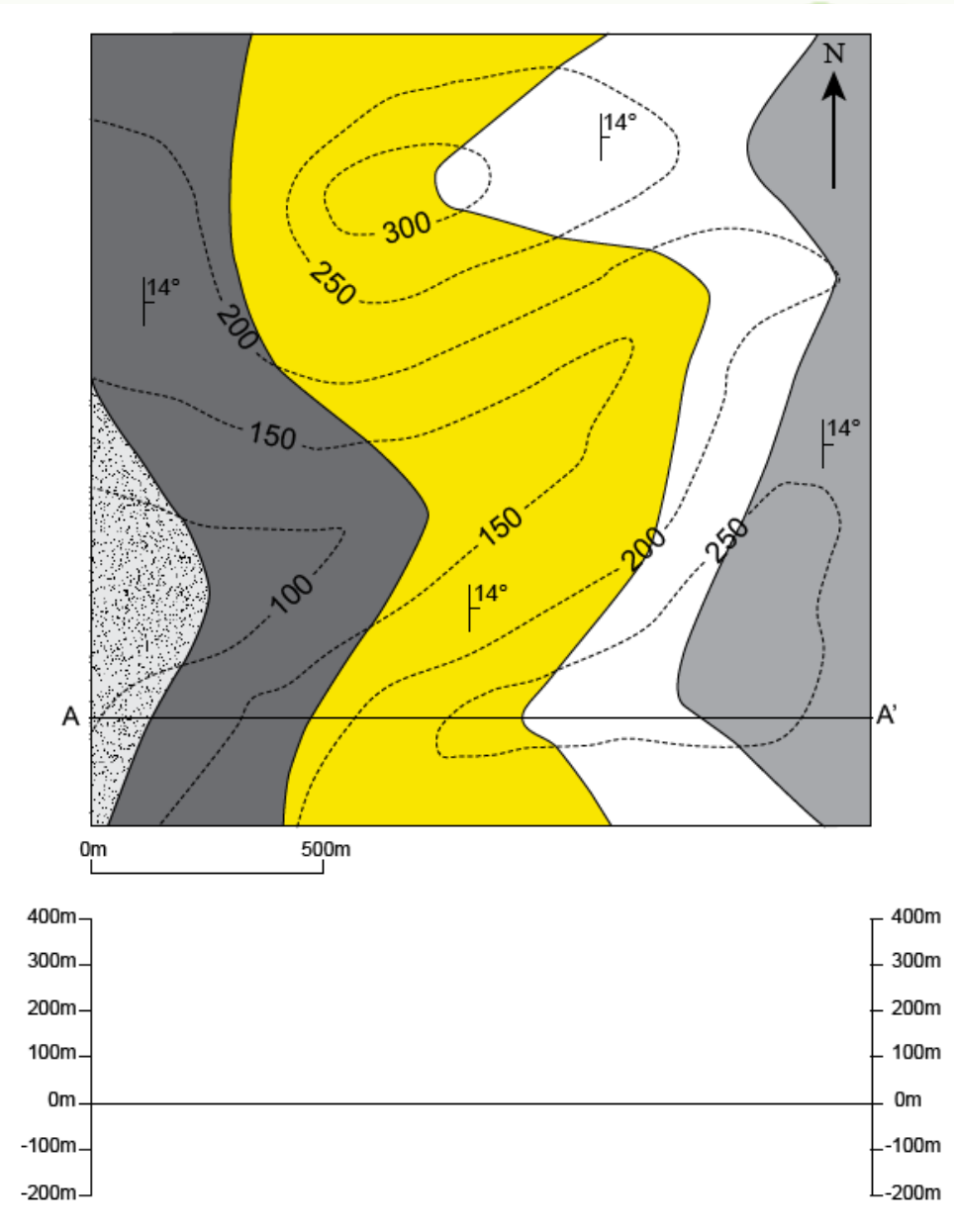
•be perpendicular to the major structural feature of the area (e.g. large scale folds or faults)

•cross as many structural features as possible.

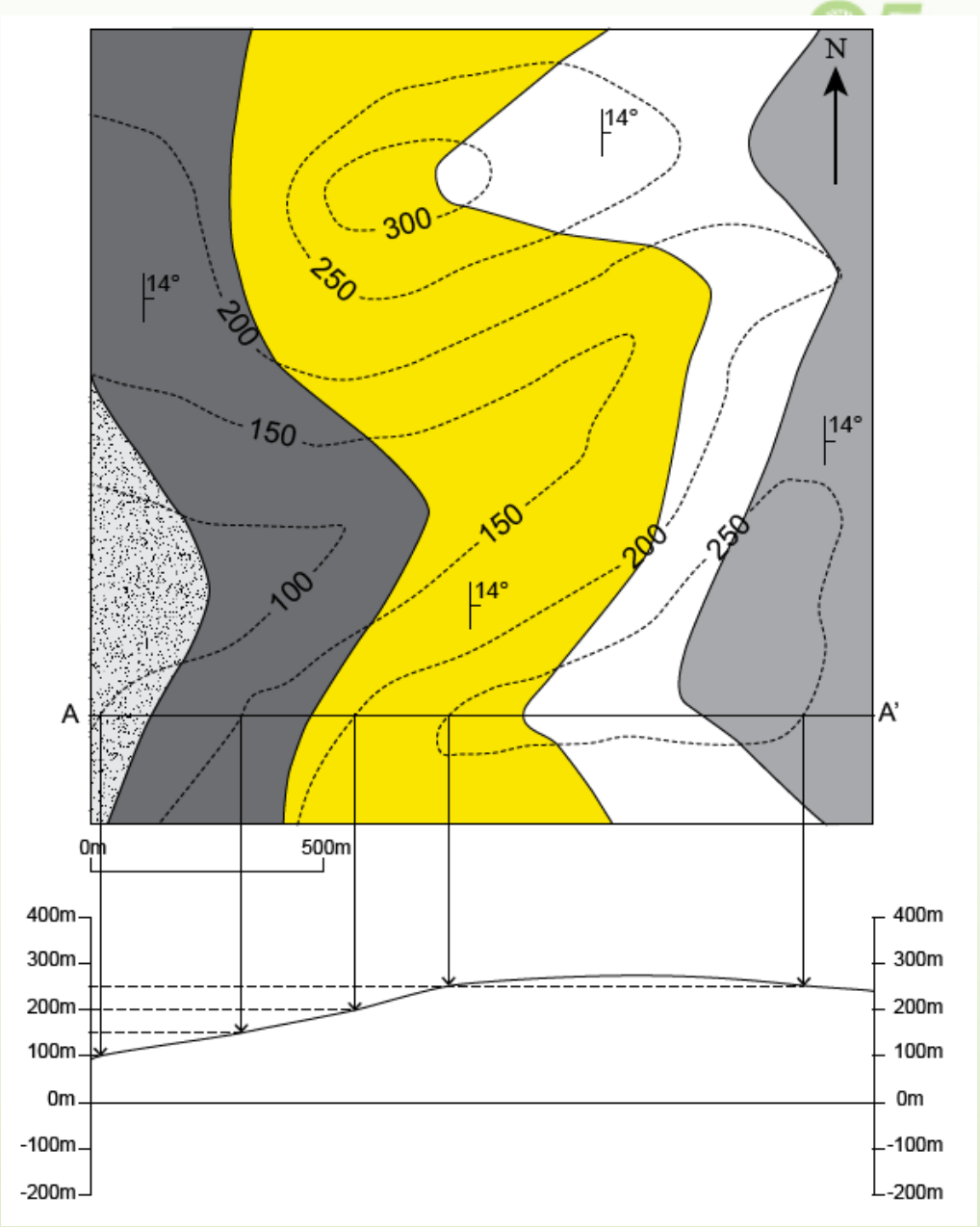


Step 2:
Draw axes of an appropriate scale with the topographic values.

Unless there is a reason to do otherwise, draw a true-scale section.



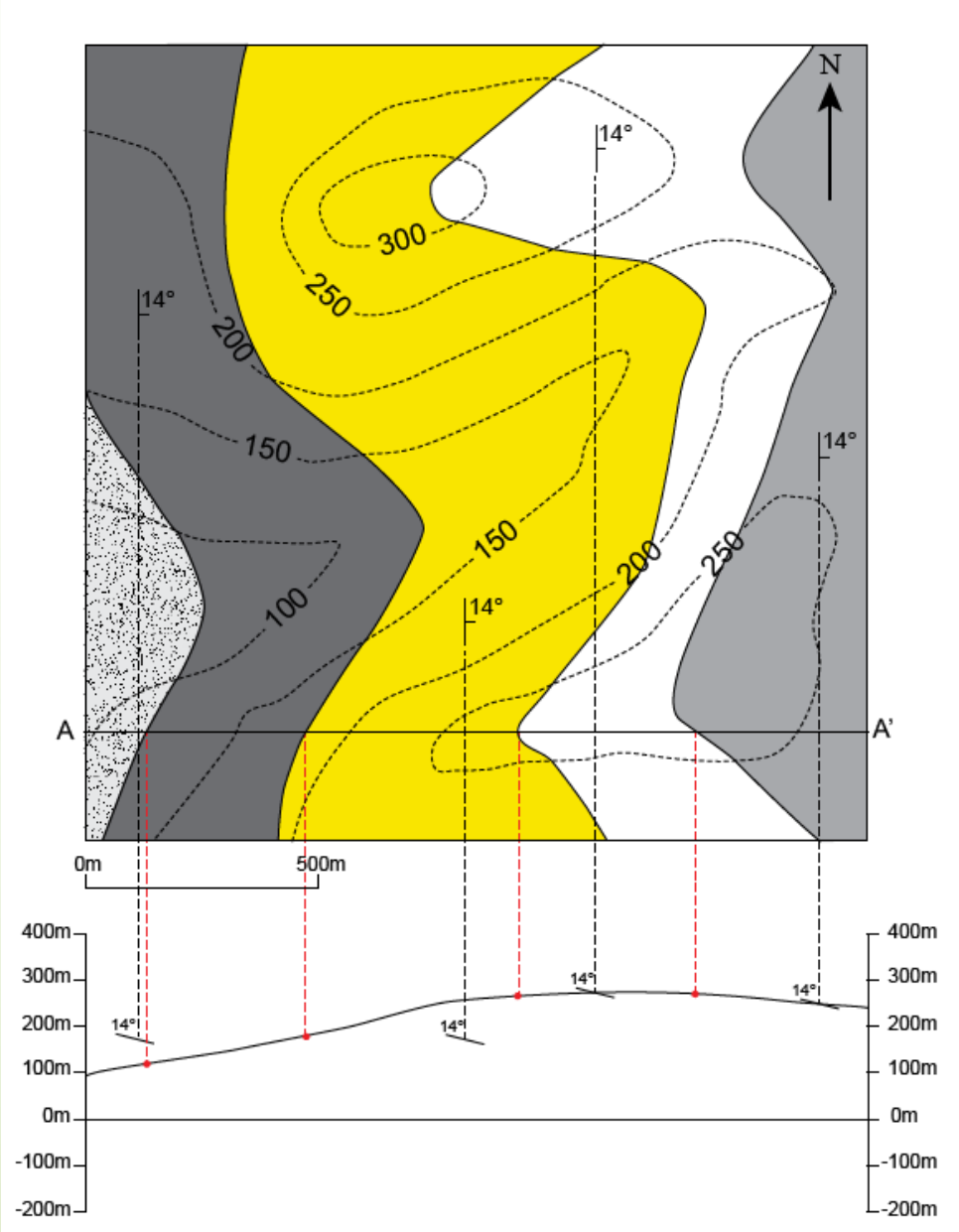
Step 3:
Transfer the topographic information from the map to the section. Project the height of each topographic contour, where it crosses the line of section, on to the section and draw in the topography.



Step 4:
Transfer the lithological boundaries, faults etc on to the cross section in the same way.

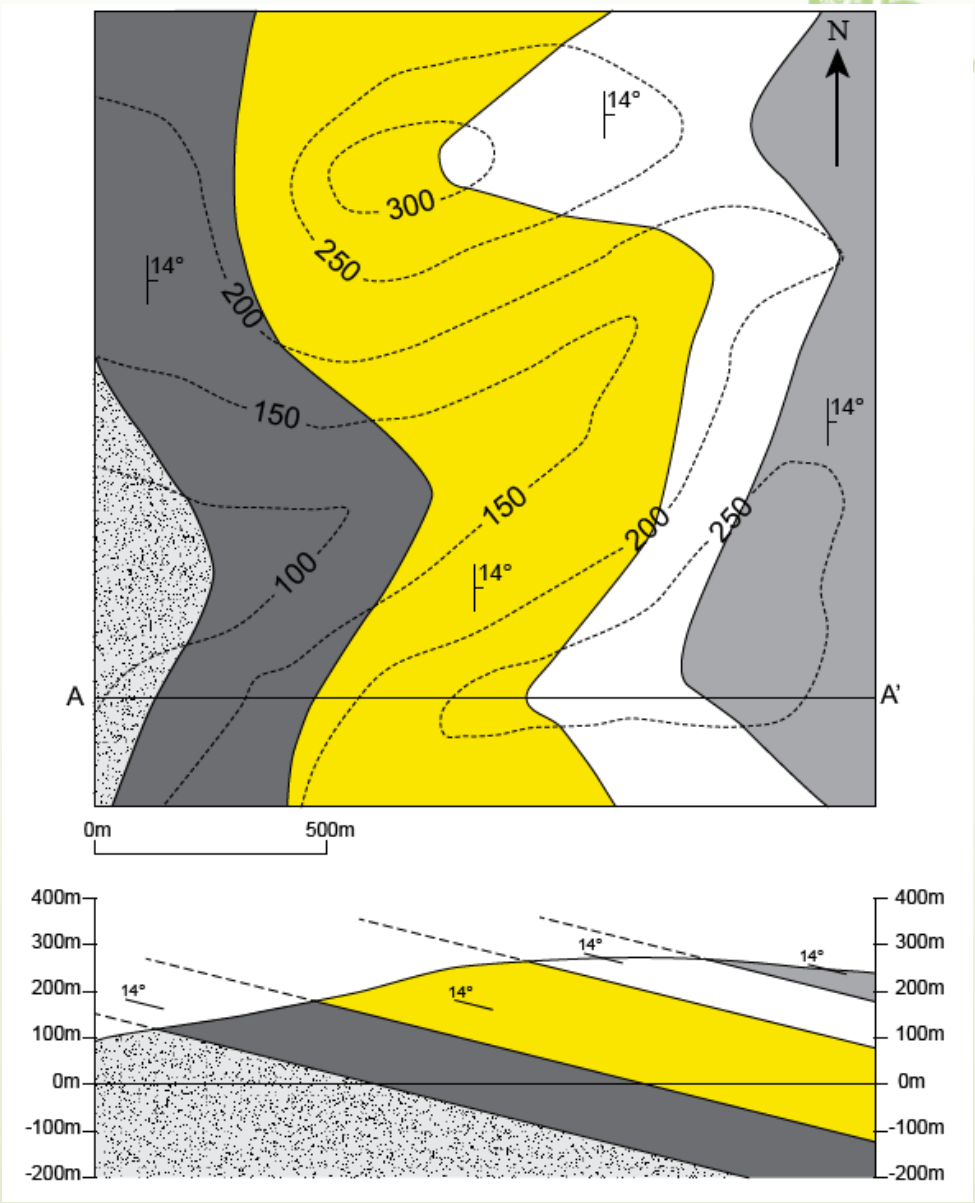
Step 5:
Transfer bedding readings on to the section, correcting for apparent dip if necessary. Plot the readings at the height at which they occur, so where a reading is extrapolated from a greater or lesser height than the topography of the cross section plot it above or below the

topography as appropriate.



Step 6:
Using the bedding readings as a guide, draw in the lithological boundaries both above and below the surface.

Geology extended above the topography is shown by dashed lines. When drawing the section always consider what is geologically reasonable behaviour for the layers e.g. sudden changes in a unit's thickness or dip should be justifiable.



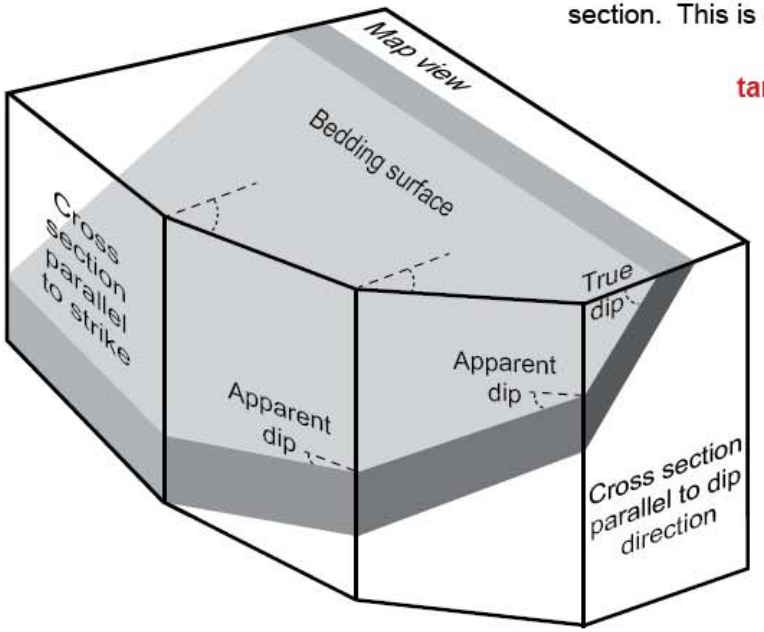
When the line of section is perpendicular to the strike, the plane of the cross section lies in the plane containing the true dip of the beds

If the line of the section is not perpendicular to the strike, the apparent dip of the contact in the cross section must be determined.

The apparent dip of the contact is the angle that the contact appears to dip in any given plane.

The closer that plane comes to being perpendicular to strike, the closer the apparent dip is to the true dip.

Apparent dip:
Where a sequence of rocks are cut by a section which is not parallel to the maximum dip of the beds, then the amount of dip will appear to be less.



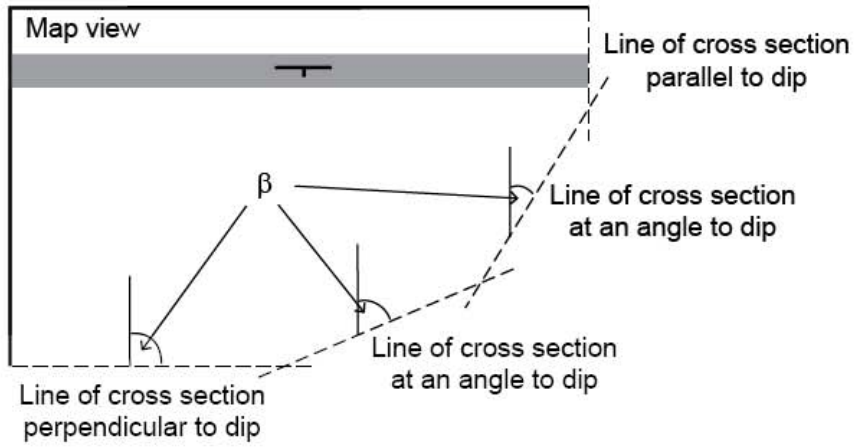
This is known as the apparent dip and it is always less than true maximum dip

So to draw an accurate cross section it is necessary to calculate the apparent dip of the beds that do not strike perpendicular to the section. This is done using the equation:

$$\tan \alpha' = \tan \alpha \cos \beta$$

where β is the angle between the dip direction and the cross section; α is the angle of dip and α' is the apparent dip.

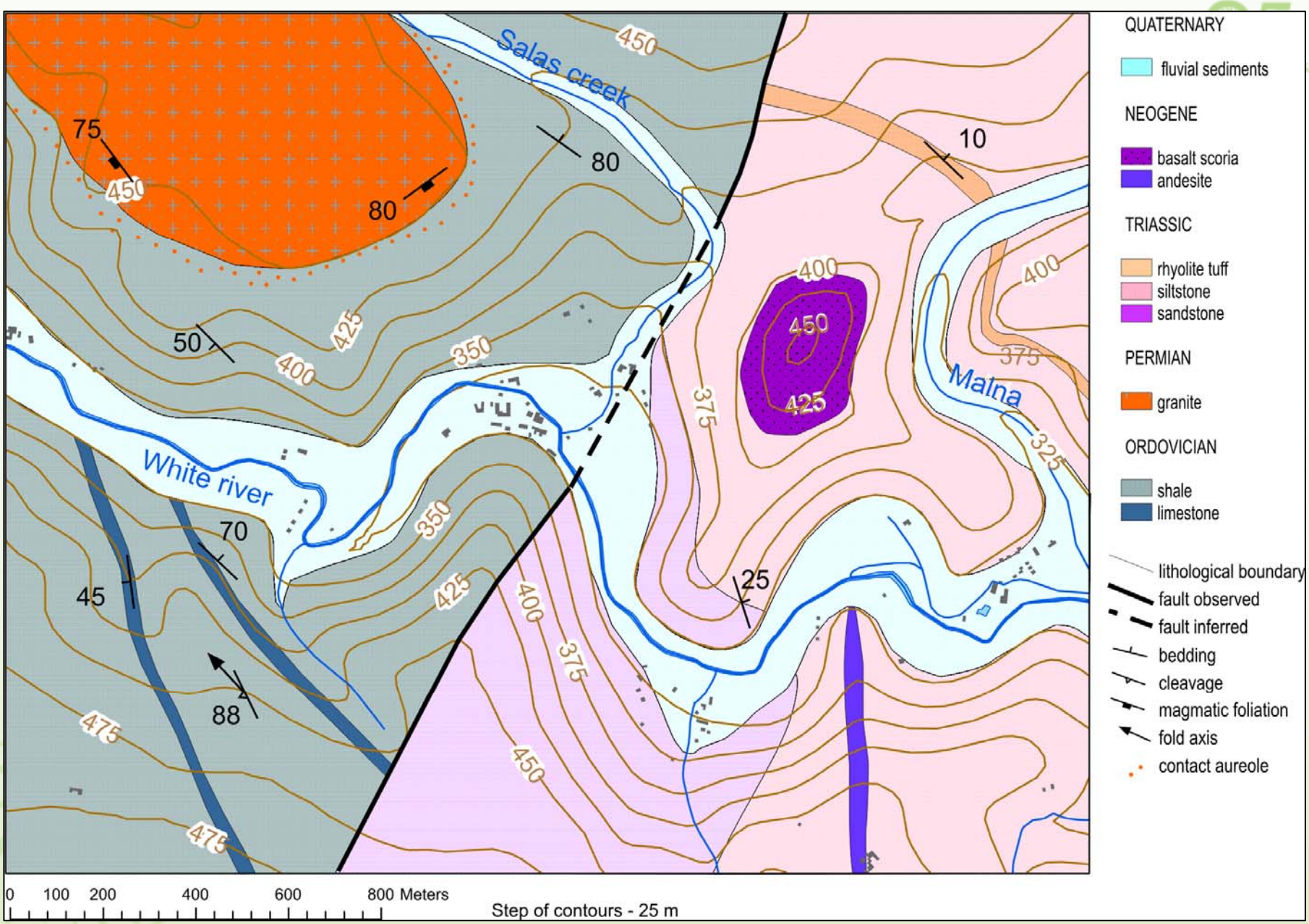
As the section becomes more and more oblique to the maximum dip the apparent dip will become less and less until, where the cross section is parallel to strike the beds, it will be zero and the beds will appear horizontal regardless of their true dip.



True dip	Angle between strike and direction of section															
	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°
	Apparent dip															
10°	10°	10°	9°	9°	9°	8°	8°	7°	6°	6°	5°	4°	3°	3°	2°	1°
15°	15°	14°	14°	14°	13°	12°	12°	10°	10°	9°	8°	6°	5°	4°	3°	1°
20°	20°	19°	19°	18°	18°	17°	16°	14°	13°	12°	10°	9°	7°	5°	4°	2°
25°	25°	24°	24°	23°	22°	21°	20°	18°	17°	15°	13°	11°	9°	7°	5°	2°
30°	30°	29°	28°	28°	27°	25°	24°	22°	20°	18°	16°	14°	11°	9°	6°	3°
35°	35°	34°	33°	32°	31°	30°	28°	26°	24°	22°	19°	16°	13°	10°	7°	4°
40°	40°	39°	38°	37°	36°	35°	33°	31°	28°	26°	23°	20°	16°	12°	8°	4°
45°	45°	44°	43°	42°	41°	39°	37°	35°	33°	30°	27°	23°	19°	15°	10°	5°
50°	50°	49°	48°	47°	46°	44°	42°	40°	37°	34°	31°	27°	22°	17°	12°	6°
55°	55°	54°	53°	52°	51°	49°	48°	45°	43°	39°	36°	31°	26°	20°	14°	7°
60°	60°	59°	58°	58°	56°	55°	53°	51°	48°	45°	41°	36°	30°	24°	17°	9°
65°	65°	64°	64°	63°	62°	60°	59°	57°	54°	51°	46°	42°	36°	29°	20°	11°
70°	70°	69°	69°	69°	68°	67°	65°	63°	60°	58°	54°	49°	43°	35°	25°	13°
75°	75°	74°	74°	74°	73°	72°	71°	69°	67°	65°	62°	58°	52°	44°	33°	18°
80°	80°	80°	79°	79°	78°	78°	77°	76°	75°	73°	71°	67°	63°	56°	45°	26°
85°	85°	85°	85°	84°	84°	84°	83°	83°	82°	81°	80°	78°	76°	71°	63°	45°

Values for true dip, etc. not stated above may be calculated from:

$$\tan(\text{apparent dip}) = \tan(\text{true dip} \times \sin(\text{angle between strike and direction of section}))$$


Salas creek
White river
Malna
75
80
80
10
50
70
45
88
25
450
425
400
375
350
325
475
QUATERNARY
fluvial sediments
NEOGENE
basalt scoria
andesite
TRIASSIC
rhyolite tuff
siltstone
sandstone
PERMIAN
granite
ORDOVICIAN
shale
limestone
lithological boundary
fault observed
fault inferred
bedding
cleavage
magmatic foliation
fold axis
contact aureole
0 100 200 400 600 800 Meters
Step of contours - 25 m

Questions ?