Field sketching in geology: time to think

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Field sketching is something that many geology students dread, at least those whose departments still take them outside to see rocks in their natural habitat.

"What am I supposed to draw?"
"I cannot draw"
"I have an iPhone so why do I need to draw?"

Part of this reticence is a fear of what our colleagues will think when they see what we have drawn. And certainly, the sketching of some of our past MSc's, who will remain nameless, has erred towards the surrealist movement more than one might hope. But this belies the fundamental reason for sketching in geology. The aim is not to create a Rembrandt. If it were, we would be issuing oils and watercolor paints (tempting for next year). The objective is to help us to observe, to think and to understand what we are looking at. That is also why the iPhone, brilliant that it is (and it is certainly part of my workflow as you will see), does not make sketching redundant.

So out with the sketchbook and pencils.

Figure 1. The view east from near Aren, central Pyrenees (Locality 1.4. on the Leeds MSc course). So much to take in so where do we start?

Why sketch?

Geology is a highly visual subject and a very diverse one. Like all science, it is grounded in primary observations.

But the diversity of what we need to consider for us to understand those observations gives us a problem. There is so much to take in.

Where do we start? In Spain, the first thing we get our MSc students to do when they look at an outcrop is to draw a sketch.

But why?

For me there are three principal reasons for starting with a sketch:

- **A sketch helps you observe**
- **A sketch provides you with a physical context for recording measurements, notes, and hypotheses to test**
- **A sketch gives you time to think**

A workflow for sketching

This is how I go about a sketch. This is not the only way, and others will have their own, preferred methods. My background (in the very distant past) was art, which may bias my approach. I have included links to some other resources at the end of this article.

1. Decide on how much of the view you need to capture.

The first question is how much of the view to capture. This depends on the focus of your study. In the example used in this blog from the central Pyrenees, the focus of this outcrop is the seismic-scale stratigraphic relationships and what they tell us about the evolution of the underlying structure, and what that structure might be.

Figure 2. The first step is to identify what part of the view you need to sketch. This will depend on the scientific subject you are investigating.

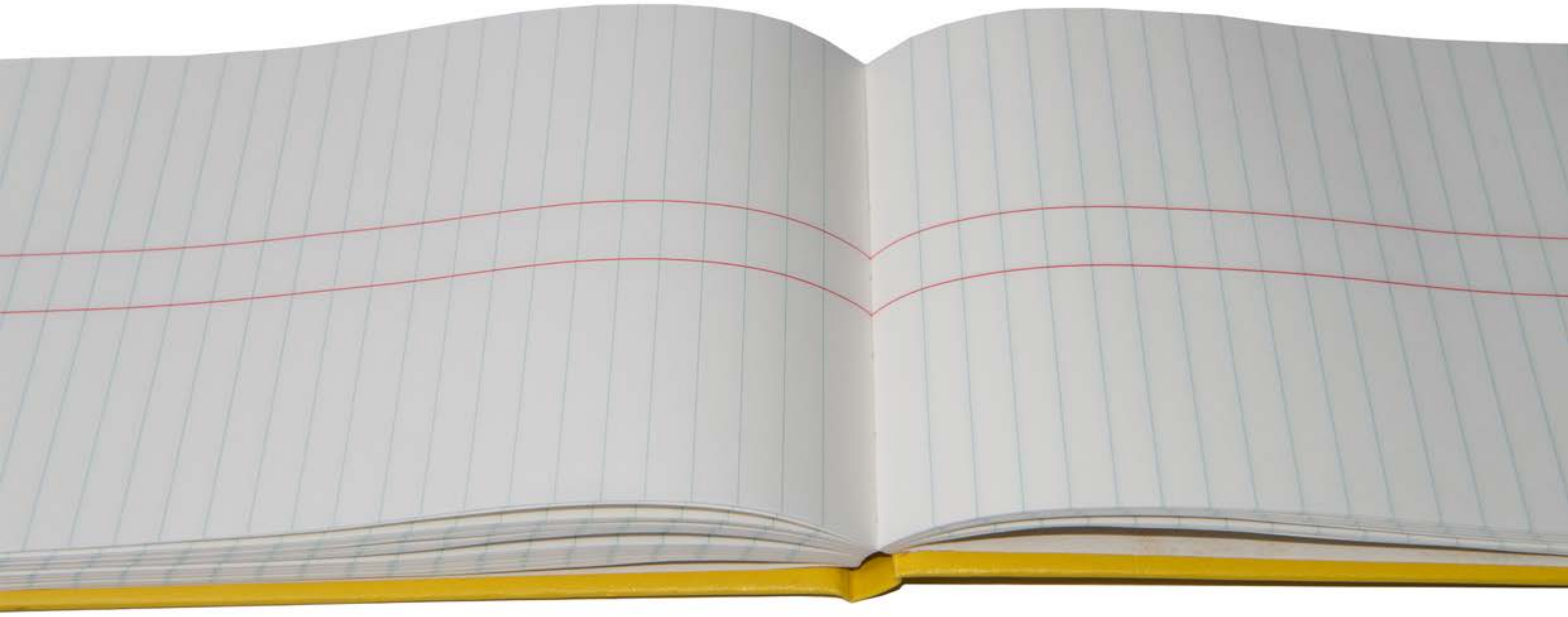

Figure 3. Use a notebook that you can place into landscape orientation.

2. Use the full extent of your notebook or input device

For sketches of large outcrops, especially if, as in this example here, you are capturing seismic-scale features, use the full extent of your notebook page. Ideally, use your notebook in landscape orientation across two pages. This gives you more space to add notes.

3. Identify the central vertical and the edges of the view you intend to draw.

Again, using your notebook in landscape orientation can help, with the central vertical being the spine of the book. Mark in the left and right limiting verticals and keep to these extents.

4. Identify key reference points and mark 3-4 of these on your page (useful as a guide especially if you are not confident in your sketching)

If you have a field notebook with ruled feint lines and other lines (or a square grid) then these provide you with a very useful guide that can be lined up with key points in the landscape.

5. Draw in the horizon

Drawing the horizon and foreground limits will define the extent of the sketch. These are the first lines I draw. I tend to draw from left to right in one go, but sometimes it can be useful to draw away from the edges and center references points.

Use your pencils held at arm's length to get a sense of scale and perspective.

By constraining the extent from the outset, you can avoid running out of space. There is nothing worse than starting a 'great' sketch and finding that all the action is off the page.

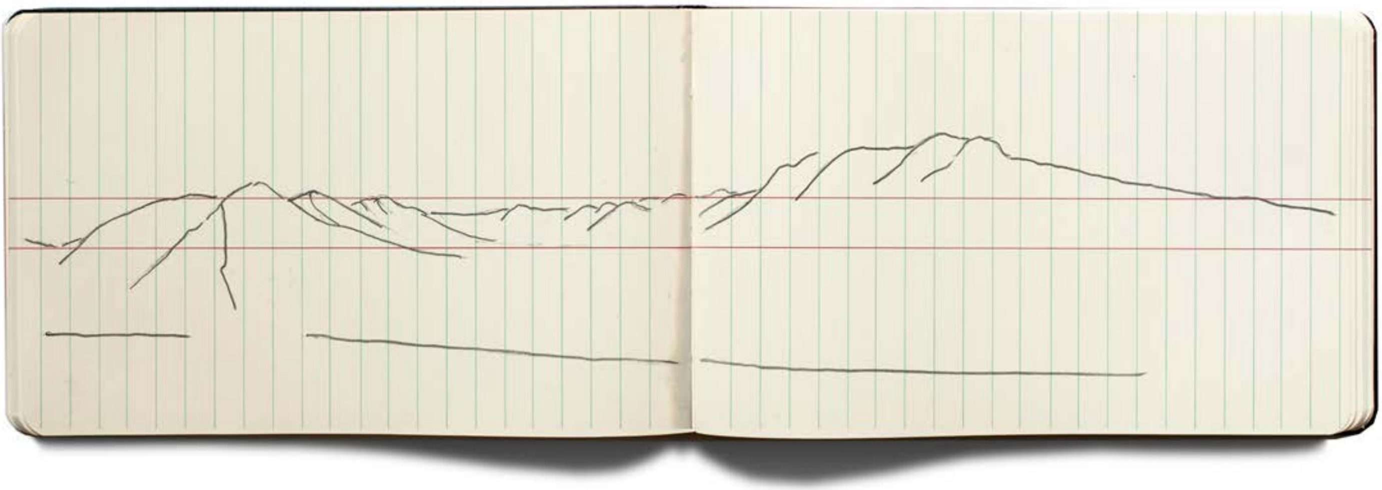

Figure 4. The first lines on the map are the horizon and foreground limits that help define the extent of the sketch.

6. Add location information and azimuths

Add the locality number and other spatial information. This should include the date and weather conditions. The latter is useful for understanding what you can and cannot see.

Use your compass to identify the azimuth of your key verticals on the page and write this information as a 3-digit number at the top of the page in line with each vertical. Add north, south, east, and west as appropriate.

In the past, I have put this locality information on the page first, but having run into space problems I now generally do this after I have drawn the horizon and baseline, so I at least know what space I have. Note that in this example the vertical axis of the sketch is exaggerated with respect to the original photograph. This means that I can record more information.

This is also the point when you can add distances and other measurements. This is always less easy that one would think. In this example, the distance along the foreground from north to south is about 2-3 km. It looks less in the photo! As for the distance to the far hills? We can estimate this, but there are better ways available. Maps and Google Maps! So, the advice is to pencil in estimates but to then revisit your sketch once you are back at your computer.

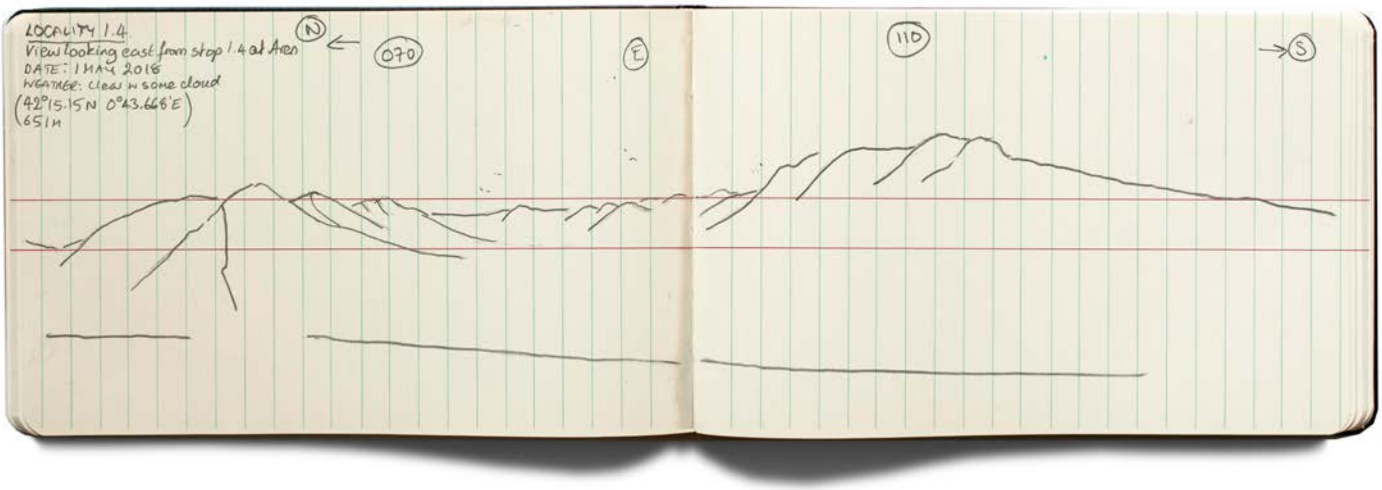

Figure 5. Add annotation, including details of the locality and geographic orientation (azimuths). You can add the locality information first, but doing so after you have identified the best use of the page for your sketch extent means that you can place the data where you have space.

7. Draw in the middle ground

The aim of this is to further constrain geometric relationships and distances on your sketch. Follow plateau tops or hill slopes into the valleys. This gives you more of a framework for understanding the geology.

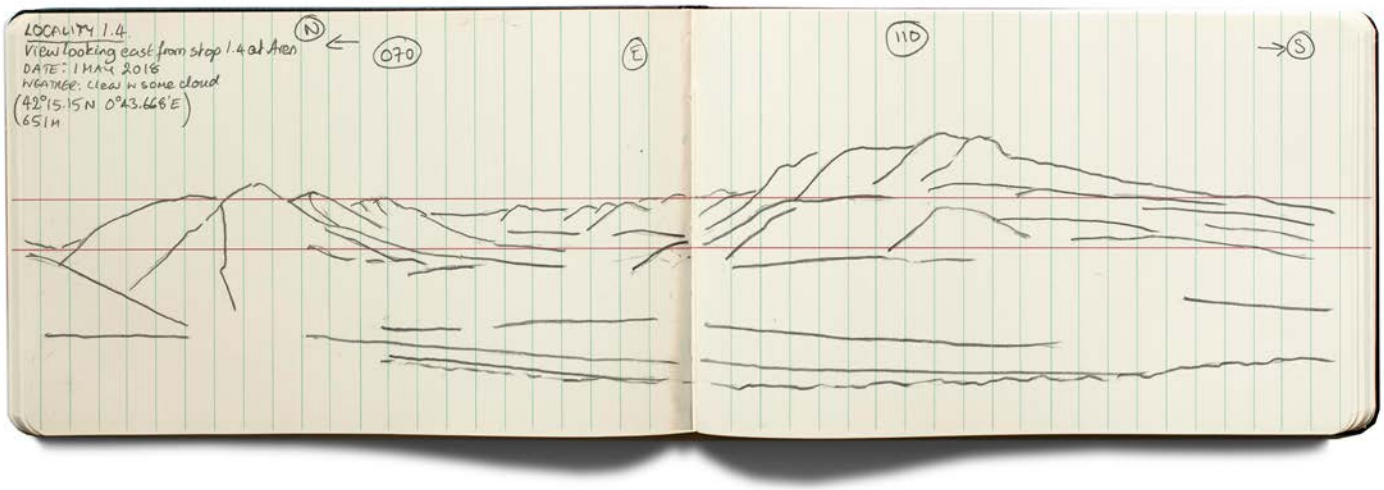

Figure 6. The middle ground provides the rest of the framework of the landscape you are capturing. Follow slopes down into the valley, cliffs and tree lines. This will help tie your sketch together.

8. Draw in trees

Why draw in trees and vegetation? I find that adding landscape features such as trees can help me better remember the landscape and, more importantly, provide reference points and guides to scale that I can then see in related photographs. The vegetation also reminds me of the extent of the visible geology.

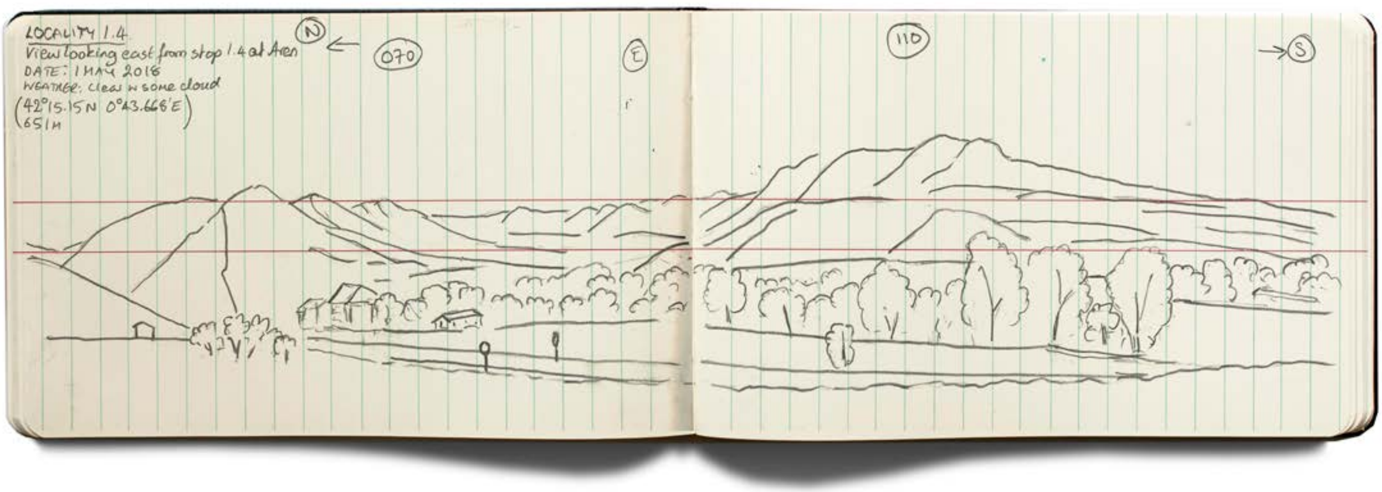

Figure 7. Adding trees and buildings provide indications of scale. They also provide reference points for locating where you are.

9. Locate and capture key geological features

This includes features such as bedding or unconformities that you want to draw attention to.

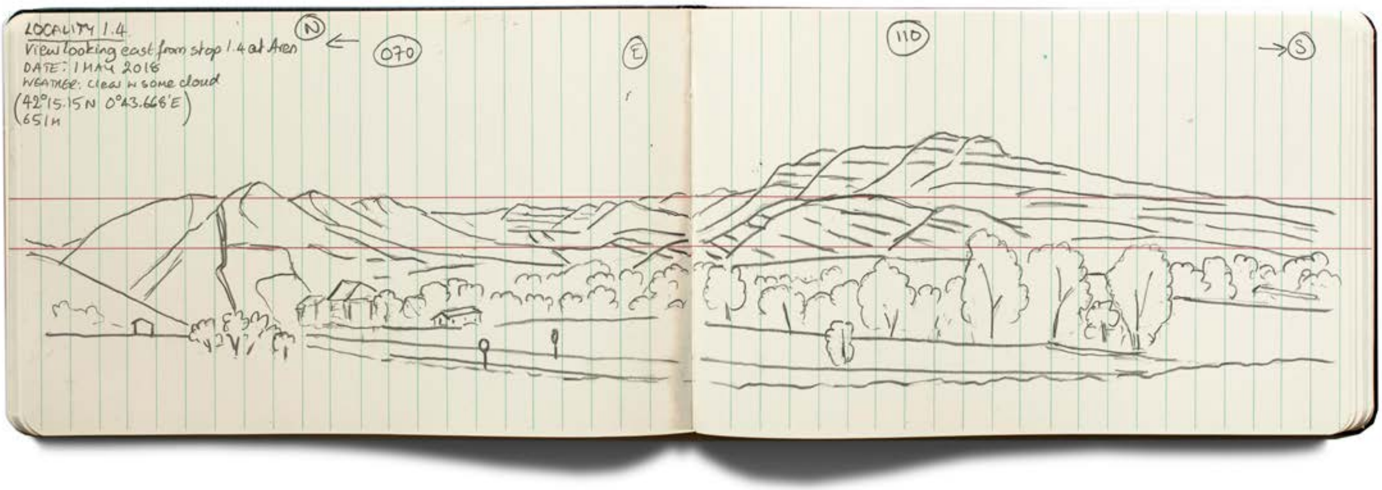

Figure 8. The final drawing stage is to add bedding and other key geological features that have not already been represented by the previous stages.

10. Annotate geological features.

Include any information on bedding geometry, apparent and real dip, major color changes. Any relationships between the landscape geomorphology and underlying geology. Include notes to any scaling issues resulting from your sketch (this is ad to memory for comparing with the photographs you take).

Include notes of any uncertainties about interpretations or things that you want/need to investigate further.

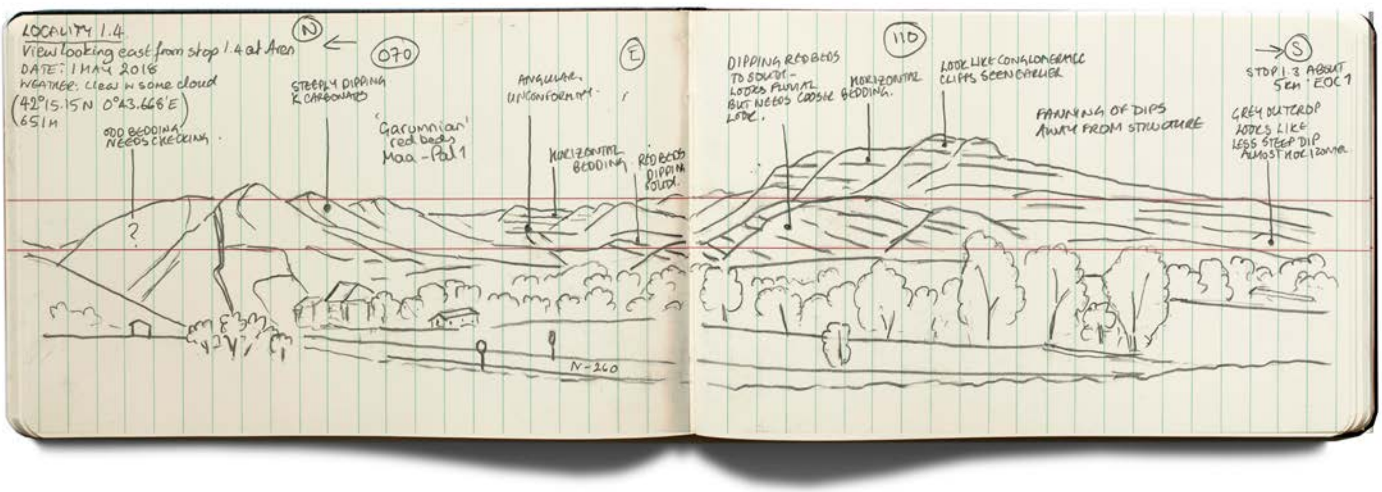

Figure 9. The final stage is to add geological annotation, dips, notes, ideas, hypotheses to test.

11. Color

Whether or not you should add color to your sketch is highly contentious (*Hi Amicia*). An advantage of keeping your sketch in black and white is that you can then scan or photograph it and add color in Microsoft Powerpoint, Apple Keynote or other graphics software (see below). However, I have found over the years that color helps me remember what I am looking at. In figure 10, I have colored the trees because they are not the geology, but they do help bring out the depth of the landscape and what parts are exposed. I have also colored the red-beds because of their importance as a marker unit.

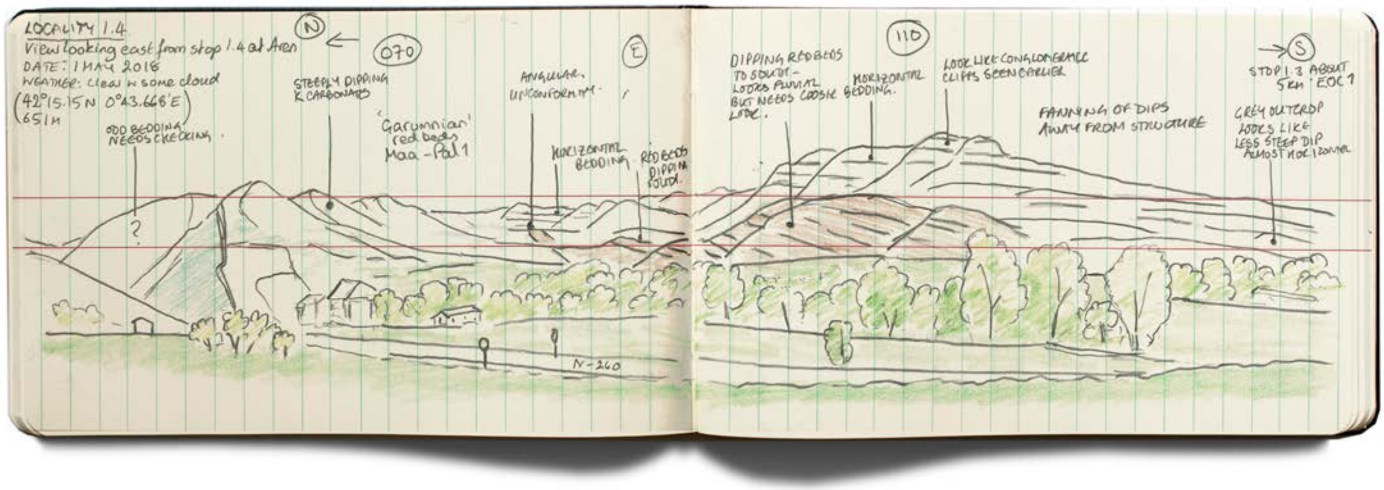

Figure 10. Adding color is highly contentious as I found out last year when one of our Ph.D. students posted a questionnaire and competition on Twitter Amicia won... black and white came top. But sometimes color can help you remember the landscape. This is less of an issue when the sketch is supported by digital photographs. Here I have colored the trees which provide information on what geology is exposed and what is not. I have also colored the red-beds as a key marker unit.

12. Photograph your sketch

Just in case you drop your notebook in a puddle, you leave it in the coffee shop or at the outcrop, or it is stolen and eaten by goats. Yup, it happens...

13. A sketch is never finished

Earlier, I left open the question of dimensions, the height of the mountains, distance to the background hills. Traditionally, and even today, it is good practice to estimate these in the field (your estimates will get better the more you do this), but today we have other tools to help us in addition to checking a physical map on our return. The easiest of these is Google Maps.

I touched on the use of Google Maps in my Field Photography blog last year

You can use Google Maps to look at relationships that were not clear to you in field and also to measure distances if you don't have a physical map available. Do be careful about using the 3D perspective view (as picked here) for absolute dip measurements. My advice, is don't. But the overall stratal geometries will usually be fine.

There is another important lesson here: your sketch is never finished.

As a student, or indeed any field geologist, do not draw your sketch and then walk away. By checking your observations back at base (hotel, office or tent) you can better enhance your understanding.

Use all the tools available to you.

Figure 11. The Google Map view of the locality in this field sketching exercise. Immediately you get much more information on relationships, the fanning of dips and especially the sub-Late Eocene unconformity. Information that you can add to your sketch. Note that the lithological variations in the Paleocene-Eocene section become much clearer too, with the limestone unit (the Alveolinid Limestone) is a much more prominent feature. This was discussed in my blog last year on field photographs.

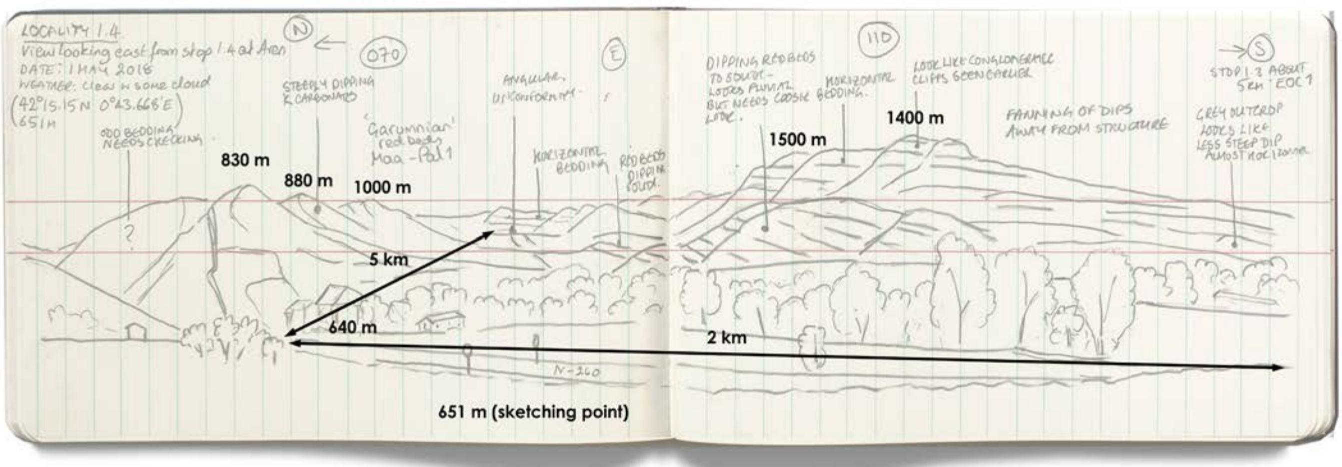

Figure 12. The addition of distances and elevations (in black) read from either Google Maps or a printed map, depending on which is available. Using simple geometry, you can then start to estimate unit thicknesses.

14. Post-production

With access to the internet and maps back at your office or hotel you can manipulate your field sketch in a graphics package to extract more information. Using maps and publications you can test out some of your hypotheses, answer questions that you wrote to yourself on the sketch, and see what others have made of the outcrop. This might mean that you have to return to an outcrop (if that option is available) as you revise your hypotheses and ideas.

The aim here is, as much as anything, to help enhance your understanding of the outcrop.

In this example, I have used Microsoft Powerpoint because I always have Microsoft Office on the laptop I take into the field. This means that I can simultaneously build any presentations that I might be asked to give.

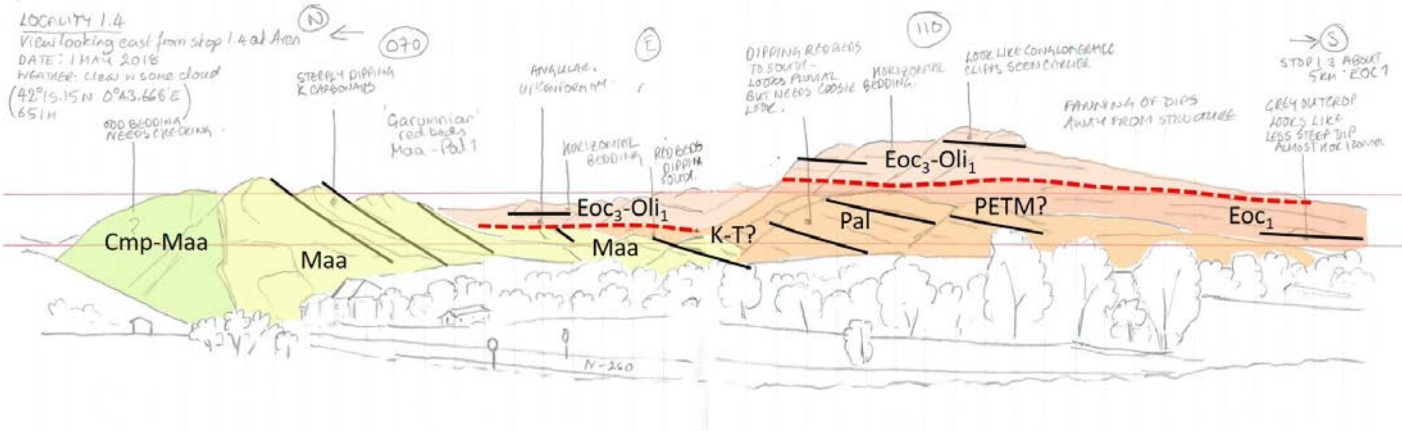

Figure 13. An advantage of keeping your sketch uncolored is that you can add color later to a digital version as here. This example was constructed in Microsoft Powerpoint with the sketch first lightened and then polygons drawn to represent unit age. This can then be added to a presentation if you are asked to give one.

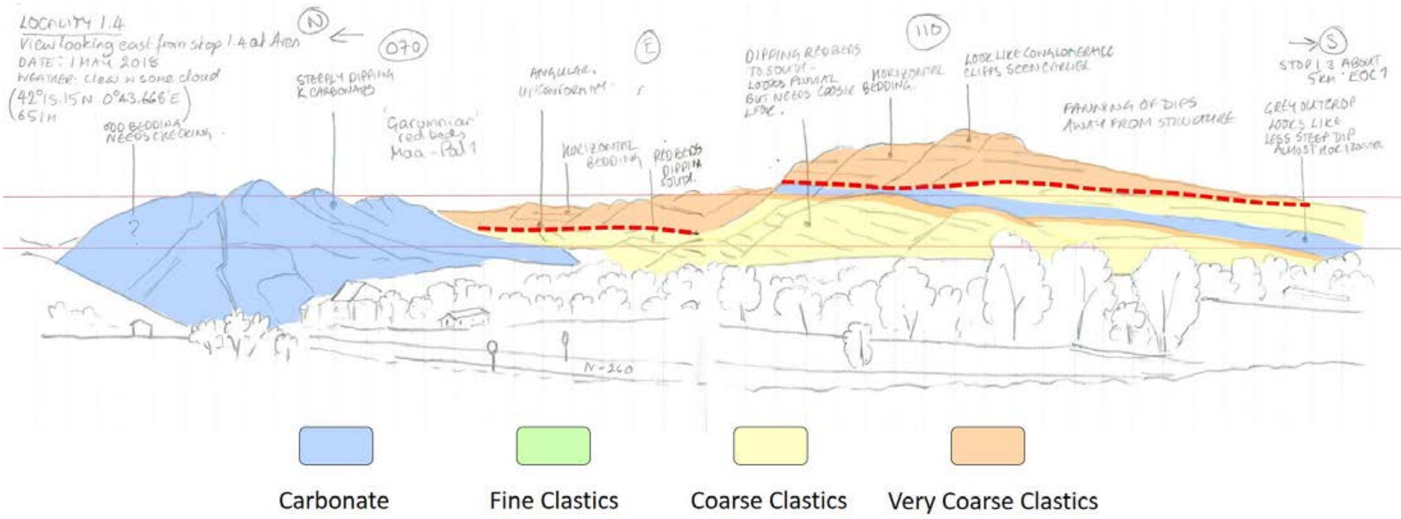

Figure 14. In this example, the units are colored according to the dominant lithology identified in the sketch and from the related geology map.

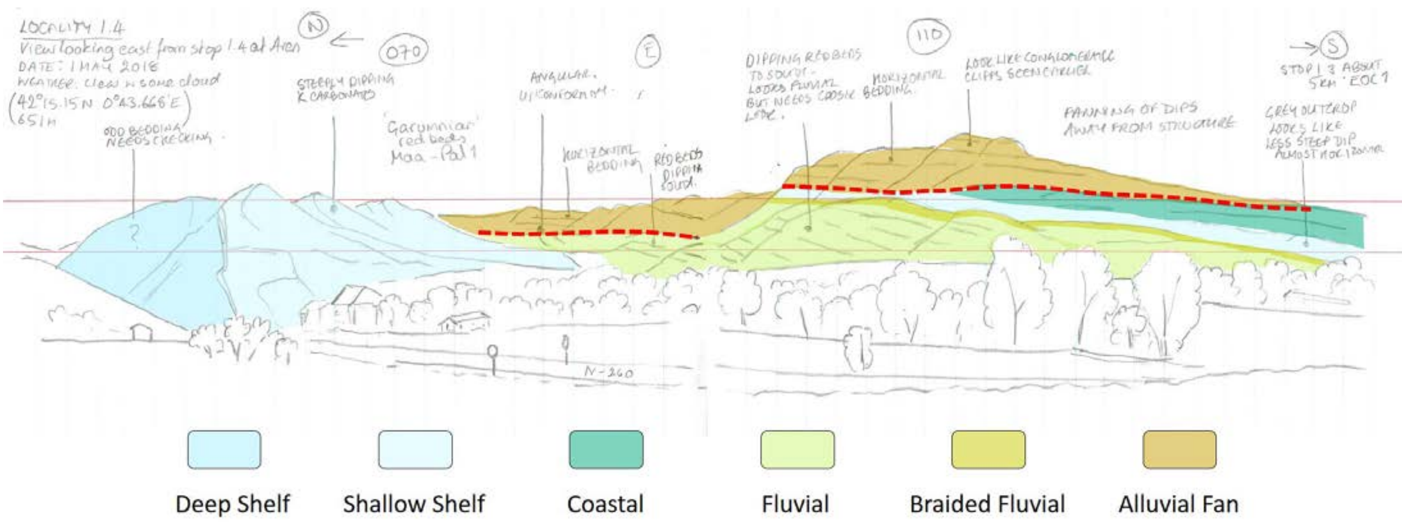

Figure 15. This example shows the same sketch now colored according to the dominant depositional environment.

This is where the black and white versions of the sketch give you the most flexibility and where you can add color to pick out key geological features you want to draw attention to.

In the examples here I have colored the sketch to bring out the age of units and bedding, dominant grain size and depositional environment (part of my input for a paleogeographic map).

15. And the answer is?

At the beginning of this blog, I said that the aim of this outcrop was to identify and investigate the stratal relationships and from this interpret the nature and evolution of the structure that caused them. As in all good Agatha Christie novels, I have left answering this to the very end.

This is best examined by constructing cross-sections using high-resolution geological maps (available from the excellent ICGC and IGME websites) or even better, seismic. Here let us look at this as a quick back of the envelope interpretation using the sketch.

As drawn, the dips decrease to the south. This 'fanning of dips' is consistent with a growing structure to the north, conveniently just off picture. We are seeing the steep southern limb of the resulting anticline. The fanning appears to start with the Maastrictian-Paleocene red-beds, which indicates that this is a growing, positive topographic feature at the time. This is why this unit is such an important marker bed in this sketch.

The question is what is the vergence of this structure? Here I show one interpretation.

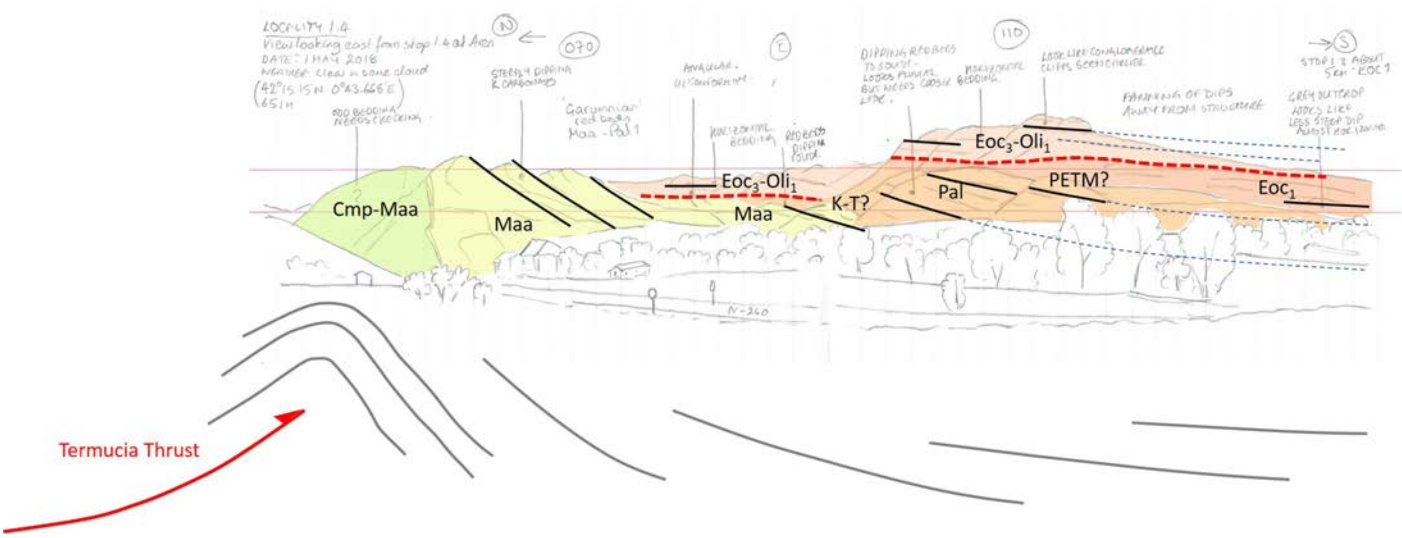

Figure 16. A back-of-the-envelope structural interpretation based on a first look at the stratal architecture. This does not immediately answer the question about vergence of the underlying structure (although we do know this from other sources) but does give us an age for the activity which is Maastrichtian – Paleocene.

Which kit?

The general guidance is to use a pencil in the field and to then generate an inked-in version each evening. This has the benefit of ensuring you have two copies of your notes.

Notebooks

My personal preference is the Chartwell 2006Z top opening survey book. Although this lacks the waterproofing and very useful look-up information contained at the back of the Rite in the Rain Geological Notebooks, which are great, I do like the fact that I can open up the Chartwell notebook in landscape orientation which gives me two pages for sketches. It also has two parallel lines which provide great reference lines for sketching and also for logging when in portrait view.

Pencils and Pens

Mechanical or regular pencils are a matter of personal choice. In the past I used Staedtler HB pencils with an eraser, but then I make sure that I have at least 6 with me each day, and 2 pencil sharpeners. But two years ago I tried out the Pentel Graphgear 1000 mechanical pencils [LINK], after reading numerous reviews, and I have to say they are impressive (all my nieces and nephews got them for Christmas! Lucky them...).

To keep my pencils organized I use a Derwent Canvas Pencil Wrap. It takes up limited space and unrolls to give you easy access to pencils, pens, crayons and pencil sharpeners.

Figure 17. A sketching kit. The key elements are a notebook that can be used in landscape orientation and a good pencil.

Colored Pencils

There are so many different colored pencil crayon brands on the market and you will probably have your favorites. I tend to pay a little bit more for my pencils to minimize broke leads - there is nothing worse than finding that the pencil leads are broken throughout the pencil – you pay for what you get!

Brands like Derwent and Faber-Castell are very good. I can recommend the Faber-Castell's GRIP pencils which are very good quality for the price with a good range of useful colors. I currently use a set of Faber-Castell Polychromos Colour pencils. They are great pencils, but probably more than needed for field sketching or seismic - I use them because I enjoy more artistic sketching as well as field sketching.

This is all very much a personal and budget choice.

Waterproof Clipboards

There are a range of good A4 and A3 Waterproof clipboards on the market. Check out Amazon or your local art or hobby store (viz., Hobbycraft in the UK, Michaels in the US)

Cameras and Phones

Most of us still take large digital SLR cameras into the field. But the cameras on phones are now so good that in most circumstances these will meet your needs and certainly be ideal for capturing your field sketches. The panorama mode on the iPhone is especially useful for capturing big picture landscapes such as the example in this blog.

Please remember to save your photos to the cloud or to your computer. I use Dropbox or iCloud as further backup insurance.

Further Information

Maggie Williams (University of Liverpool). "Field sketches and how to draw them" http://pcwww.liv.ac.uk/geo-oer/index_htm_files/Field%20sketches%20&%20how%20to%20draw%20them.pdf

Geobus (2016). "How to draw a field sketch". https://www.youtube.com/watch?v=3pkNsDcC61Y

Linescapes "*How to draw a Landscape Section*": https://www.youtube.com/watch?v=asHra1Ekseo and "How to draw analytically" https://www.youtube.com/watch?v=6JhPsZPcT0Y

ICGC (geology maps for study area) https://www.icgc.cat/en/Downloads/Geological-and-geothematic-cartography

IGME (geology maps for study area) http://info.igme.es/cartografiadigital/geologica/geo50.aspx

Figure 18. Field sketching, what could possibly go wrong?

About the author

Paul is CEO of Knowing Earth Limited, as well as a Visiting Lecturer at the University of Leeds and Visiting Research Fellow at the University of Bristol. He graduated from St. Edmund Hall, Oxford University in 1987 and received his Ph.D. from The University of Chicago in 1996.

He worked for two years at BP's Research Centre in Sunbury-on-Thames before moving to Chicago, where Paul studied with Professor Fred Zeigler's oil industry-sponsored Paleogeographic Atlas Project. This was followed by a post-doctorate at the University of Reading researching the exploration significance of the paleoclimatic and drainage evolution of southern Africa using computer-based climate models with Professor Paul Valdes. He then moved to Robertson Research International Limited, now part of CGG, as a Staff Petroleum Geologist, where he developed global predictive models of source and reservoir facies. In 2004 Paul moved to Getech Group plc, to set-up the Petroleum Systems Evaluation Group with Dr. John Jacques. From 2006 to 2017 Paul served on the Getech board overseeing the strategic technical direction, which saw the business transition and grow from an academic research group to a multi-million-pound company with four offices, 120 staff and an international client base.

His active research interests include global tectonics, palaeogeography, palaeoclimatology, the history of geology and depositional modelling. Paul is the author of over 100 published scientific papers and articles.

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