

# **Geoscience writing**

## ***Suggested activities for developing key writing skills in geoscience students***

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### **Activities**

1. Report sections
2. Finding cross-references
3. Ordering sections
4. Audience for science
5. Geology writing is peculiar!
6. From log to report or paper
7. Where to make an argument

### **Tips and advice on creating structure and sections**

### **Ways of making an argument in Geology**

These activities were part of a project funded by the GEES Subject Centre, 2004. The article describing the project was published in Planet, No 15, December 2005. [www.gees.ac.uk/planet/](http://www.gees.ac.uk/planet/)

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## Activity 1. Report sections

*In your groups:*

- Sketch out what sections need to go in a geology report
- Put these in what you think is the 'correct order'

*For each section write down two sentences that explain:*

- Why the section is needed
- Why you placed it at that point in the order

*Please hand in your sketch and notes after the activity*

## Activity 2. Finding cross references

*Please read the geology paper provided and do the following:*

*Mark or highlight in different colours*

- All cross references to other sections, tables, diagrams etc.
- Draw lines from the cross reference to the section, table, diagram etc.
- All signposting for the reader

*Write notes on how effective you found the cross-referencing and signposting*

*Would you have added more/taken some away?*

*Mark up implicit cross-referencing*

- Try to mark up sections whose content or argument is dependent on something presented in an earlier (or later!) section

## Activity 3. Ordering sections

*Open the "Report Structure" Envelope and put the cut up sections into an order you think would make a well structured geology report. Use the glue to stick it to the paper.*

*Write a few notes below about why you put the sections as you did! This should be very easy!*

*Please hand in your sketch and notes after the activity*

### Example report structure

This example report structure below is taken from a good quality student dissertation. It is therefore an example of what students in final year UG should be aiming for. The contents list was 'cut up' for the Activity 3 above.

Abstract  
Key words

- X Introduction
- X.X Aim and scope of the report
- X.X Location
  - X.X.1 Physical location
  - X.X.2 Geological location
- X Stratigraphy
  - X.X Description of mapped units
    - X.X.X Sedimentary units
      - X.X.X.1 Fountains Conglomerate Formation
      - X.X.X.2 Lyons Aeolian Sandstone Formation
      - X.X.X.3 Lykins Mudstone Formation
      - X.X.X.4 Morrison Lime-mudstone Formation
      - X.X.X.5 Dakota Ridge Sandstone Formation
      - X.X.X.6 Dakota Ridge Mudstone Formation
    - X.X.X Igneous and metamorphic units
      - X.X.X.1 Boulder Creek Granodiorite
      - X.X.X.2 Flagstaff Rhyolitic Intrusion
- X Structure
  - X.X Description of fold structures
    - X.X.1 “Dakota Ridge” monocline
  - X.X Description of faults and fractures
    - X.X.1 Fractures
    - X.X.2 Fault systems
  - X.X Description of shear structures
    - X.X.1 Shear fracture zones in the basement rocks
    - X.X.2 Shear-fracture zones in the sedimentary Formations
    - X.X.3 Variations in sense of motion between basement and sedimentary shears
  - X.X Overall structure
- X Geological history
  - X.X Depositional history
    - X.X.1 Arid uplift margin sequence
    - X.X.2 Coastal sabkha sequence
    - X.X.3 Fluvial-coastal sequence
- X.X Deformation history
  - X.X.1 Deformation in the basement rocks
  - X.X.2 Deformation in the sedimentary rocks
  - X.X.3 Deformation within shear fracture zones
- X Conclusion
- X References

## Activity 4. Audience for science

- Look at the 'Mantle Plumes' readings
- There are three different texts all on the same topic
- Read some of each
  - Not all of all 3! There is not enough time!
- In your groups discuss and write down how the three texts differ
- How does this difference relate to the audience for the text?

Please hand in your notes at the end of the activity

The following 3 texts were used for this activity:

- Extracts from the 'great plumes debate' on the Geological Society of London web site
- Foulger, G.R., Du, Z., Julian, B.R., 2003, "Icelandic-type crust", *Geophysical Journal International*, 155(2): 567-590
- Jones, N., 2003, "Volcanic bombshell", *New Scientist*, March 8<sup>th</sup>, Issue 2385

## Activity 5. Geology writing is peculiar!

- Look at the questions below
- In your groups discuss and write a few sentences in answer to each of the questions

Please hand in your notes at the end of the activity

Questions:

Why do you not use personal pronouns (e.g. I observed that the rock was basalt) in geology reports?

Why do you use the present tense when describing observations of rocks (e.g. the unit is pink in colour and contains well rounded and sorted clasts; the bed dips at 20 degrees) in geology reports?

Where and how often should you use 'attenuated assertions' (it might be, it could be, a possible interpretation is) in a geology report?

## Activity 6 From log to report or paper

*For this activity you have a field log of a type section of a formation taken from a student dissertation  
Your group needs to do two tasks*

- Using the coloured slips fill in the process, interpretation and environment sections missing from the log (stick the slips to the sheet)
- Using the slips in the 'Write up envelope' create what you think is a good description of the Formation (stick the slips to the sheet)

*Write any notes about your reasoning for your decisions on the sheets*

*Please hand in your sheets at the end of the activity*

### Example formation description

The following formation description from a student report was used for Activity 6. The description was cut up for both parts of the activity. For the first part specific sentences were chosen. For the second part all elements of the description were included.

### Fountains Conglomerate Formation

Poorly sorted pebble-grade lithoclastic silicate-conglomerate

This Formation outcrops across the whole of the mapped area and appears broadly 'brick' red. On a scale of a few metres the Formation shows variation in colour from white to very dark red with variation within as well as between beds.

The formation sits unconformably on the Boulder Creek Granodiorite basement rock (See Section x and y).

The Formation consists of a clast-supported conglomerate with the clasts ranging in size from fine (0.125 mm) grains to very large pebbles (3-5cm).

All the clasts are sub-rounded to sub-angular in form. The majority of the smaller clasts are quartz whereas the larger clasts and pebbles range in composition from quartz, to lithic clasts of granite, granodiorite, schist and gneiss.

The Formation shows considerable variation in both apparent and actual thickness throughout the mapped area. This is viewed as the product of the initial topographic relief upon which the formation was deposited and the effects of structural deformations (See Section z).

For a detailed log of a representative section of the Formation see Figure 5.1. Overall the Formation consists of repeated fining up sequences (0.5-2m thick) with horizons or inclusions of very large pebbles. These are repeatedly overlain by thinner (10-30 cm thick) structure-less or laminated (<1mm) beds of fine sandstone.

Where the surface of these deposits is visible they show sets of polygonal fractures. The fining up sequences commonly show erosive bases and cross-stratification in the upper section. Fining up sequences can include clasts of finer darker silt/sandstone.

The Formation appears to have been formed from repeated gravity driven catastrophic debris flows. Following Nemec and Steel (1984) the Formation is viewed as consisting of repeated sub-aerial mass flow deposits, ranging from 'turbulent stream flood' deposits through to debris flows topped by stream deposits.

The fine sandstones are likely to be over-bank deposits. The sub-rounded/sub-angular clasts and lack of sorting all indicate that the formation was deposited proximal to its provenance region.

The polygonal cracks in the over-bank deposit indicate desiccation of the mud through drying out. This is taken as an indication that the Formation was deposited in a hot arid climate.

## **Activity 7 Where to make an argument**

- In your group look at the 'typical structure' of a geology report and try to decide where you would use each of the 4 types of 'argument'

*Write your decisions and any thoughts on the sheet*

*Please hand in your sheets at the end of the activity*

## Tips and advice on creating structure and sections

Because a geology dissertation/report is big, possibly the longest thing you will ever have written, it requires some techniques you won't have applied in previous essays or reports. So as you are working, make sure:

- all ideas you put forward relate to the field work, descriptions, analyses and interpretations you are reporting on
- you avoid 'interesting' but peripheral information
- you create links across and within major sections
  - end each major section with a brief summary of what has been covered
  - start major sections with a short description of what they will contain
- link new ideas and information clearly to ideas and information already presented, using cross-references and signposts where appropriate
- let readers know where they are in the development of the report
- use graphics and tables as relevant to present and summarize data
- use visual elements to help the reader navigate (e.g. different typography for headings, indented paragraphs or different typography for certain types of information)

Geology dissertations/reports are best written in stages. Create a draft of each section shortly after you've completed the relevant analysis or collation of data – you might even think about making notes on these things in your field notebook as you complete your field work. When all stages have been completed, redraft all the chapters so that they better fit together, making sense in respect of each other and with good cross linkage. **Write any geological history or conclusion last!!** Then write the *Introduction* - make sure it highlights the issues and topics that you know are going to be addressed by the main sections. Finally, write the Abstract or Summary.

### Using references

When you are reading the work of others, whether it is with a specific purpose in mind (e.g. preparing for an essay) or more generally (e.g. background 'reading around' a topic), you should be doing more than simply trying to understand and assimilate the information in front of you. Everything you read, or come across, that might be relevant to your project, needs to be treated as potential source material. A good discipline is to keep notes on everything you read and all potential sources with each item annotated with full bibliographical information. You could do this in your field notebook or in a separate notebook. A good way to do this is to put at the top of the page a complete and correct bibliographical reference for the source. This can be helpful to you in several ways:

- It gives good practice in creating and completing bibliographical references
- It gives you a detailed and concrete heading for your notes for when you return to them in the distant future, making them easy to find and easier to remember

So you'll be a better notetaker, a better writer and less annoyed by the bibliographical aspects of writing, if you keep full bibliographical information with your actual notes on sources. This need not be difficult to compile, either, as a photocopy of the title page of your source can often give you all the information you need; and you can always annotate it with additional information if it does not quite contain all the detail you need.

References within other people's writing can have several uses for you, so don't ignore them. For a start, they can be helpful examples of how referencing can be done, and how it can be used to support writing. More helpfully, the list of references in a text, and the associated bibliography can be a chain of evidence leading you deeper into the understanding of your subject. There's a long list of potential uses of references. Here are a few of the most common uses:

- *To lead you to other sources of information.* By locating one central (key, seminal) text, and using that as a starting point (working through the most used references, checking out the most interesting items in the bibliography) you can locate sources which are most focused on your specific topic.

- *To verify and assess the quality of the information you have discovered.* By following up references you can test how adequate the source is, checking that it has used its information in an appropriate way. You can get some understanding of the worth of the argument, or potential holes in it. You can assess the extent to which the piece is original or derivative.
- *To 'cross-validate' information.* This is a researcher's term: it means 'to check one source of information against another'. By chasing up the references in your reading, you can see if the sources they are based on are actually saying the same thing, or perhaps in conflict in some sense.
- *To understand, and to evaluate, the strength of an argument,* the validity of a point of view, the relevance of a judgement, the quality of an interpretation. Often you will find in the pieces you read statements like 'x argues that' or 'y seems to suggest' or 'the data in z study clearly indicates...' These are all interpretative statements, interpretations of other sources. How do you know if these interpretations are reasonable ones? Well, you can either take the statements on trust, or you can check the sources.

You will need to use references yourself in your own writing. When you do, bear all the above points in mind, from your reader's point of view.

### **How do I write references and bibliographies?**

All academic writing, and much report writing, requires clear and complete references. A good researcher develops skills in attaching complete source information to any notes. A good academic writer annotates her or his writing with that source information.

### **Why use references?**

The key reason for including references in your work is so that people can know where the information you are reporting came from. However, they may want to know this for many different reasons. They may want to be able to:

- distinguish between your own, original work, and work you have drawn on from elsewhere
- decide which is primary data (i.e. raw, real, first hand information) and which is secondary data (i.e. information which has been assembled, processed or otherwise mediated by someone else)
- be assured that the bulk of the work is your own
- check the original sources, to make sure you have cited them or used them appropriately
- follow up on the information or ideas you report, so they can pursue it in more detail
- judge how much research you've actually done as part of your work (e.g. as an indicator of how much work you have actually done)
- judge the nature and quality of the research that underlies your reporting (e.g. as one indicator of your academic credibility)
- judge how appropriately you've selected and critiqued available information from all possible sources (e.g. have you simply relied on one main source; have you merely reproduced other people's ideas, or put them in a critical context; have you used up to date information, or relied on out of date sources; have you looked at all competing ideas in the topic area)
- find an entry point for their own research in a related area
- find a basis for constructing their own critique of your presentation (e.g. if they find themselves disagreeing with your conclusions, they might want to know if that's because of the way you have argued, or because of the use of information in your sources)
- be assured that no parts of the work have been copied, plagiarized or adapted from other sources

Some of these reasons are standard reasons for all practicing academics. Others are more to do with student work, which is being assessed (in part) for its application of academic practices.

## How to use references in your own work

In your own work, you must offer references to the reader to serve their needs. Much of a geology report is based on your own observations and interpretations and so does not need referencing. Having said this, your work may be re-assessing existing field work or your interpretations may rely on arguments and claims made by others. You may also need to address some existing literature in the introduction and conclusions. As a student, in particular, your tutors will be judging the quality of your work, and the adequacy of its referencing is a good indicator of the degree of scholarliness. So, at any point in your work where you think one or more of the criteria described above apply, you should make sure you give as many good and suitable references as are appropriate to the task.

- Give all references completely, in a perfectly consistent way, using an accepted academic convention.

There are many different conventions used for giving references in texts. Most boil down to two elements: complete information and clear cross-reference. 'Complete' means that every reference cited in the text must give all the information that the reader is likely to need, which usually means all the information the reader would need in order to look up the exact source of your information without difficulty. 'Clear cross-reference' means that the reader can see easily and without ambiguity which citation relates to which part of your text, which in turn means that all citations should have exactly the same format and conventions, so the reader can quickly learn how to read your citations. If you have any doubt about which convention to use on any occasion, the key advice is to choose one of the most generally accepted and stick to it. Probably the most widely used convention is the 'Harvard convention', but even this has different forms. Using this convention you cite a particular text in the following way in your writing:

'Texttexttexttext' (Williams 1999)

i.e. you give the quotation or make your statement derived from the text and then give a short form of the author's name and the date of publication. In your Bibliography or list of references you arrange items alphabetically by authors' surname, with the data following, like this:

Widdowson, A. ed (2001) *Everyday Life and Everyday things*, Hodgart Press.

Williams, N. (1999) 'All you never wanted to know about Communication', in *The Answer to Everything*, Routledge.

Williams, N. (2000) 'All you ever wanted to know about Culture', in *Other Answers to Everything*, Routledge.

Xavier, P. and Butler, K. (1983) 'Culture is Communication', *Journal of International Communication*, vol 2, issue 3, pp.34-67.

Arranging the list alphabetically means that the reader can easily move from your text to the appropriate reference without ambiguity, but you need the date immediately after the name in order to make it clear which actual text by the author you are citing. If you use more than one text by the same author, it's conventional to distinguish them by letters (e.g. 'Williams 2000a'). Note also here various other conventions:

- Titles of books and journals are given in italics (or underlined if italics are not available), but titles of articles or chapters are given in inverted commas. This is because your source, in the case of a journal article, has two titles: the title of the actual article and the title of the journal it appears in. Both need to be given, so the reader needs to be clear which is which.
- Publishers are also included for books, but not usually for journals. Sometimes place of publication is also included, though this seems to be used less frequently these days (probably because of an increase in international publications).
- For a journal, the reader needs to know exactly which issue the article appeared in, so volume and issue number are given. It's also quite common to give page numbers as well, so the article can be easily retrieved. In some circumstances you might give similar information for a book. For example, if a book was published in several volumes, and has many chapters, you might give volume number and page numbers of the chapter you had cited.
- Where there is more than one author, you cite them in the order they are given in the text itself (which may not be alphabetical order), and in your own text cite them by the same

order (e.g. Xavier and Butler 1833). However, where there are three or more authors, although you list all the authors in your bibliography, the normal form of citation in the text would be 'Williams *et al* 1987'

- If the originator is not the author of the text, but its editor (quite normal for collections of articles on a particular subject, for example) your reference should have the abbreviation 'ed' or 'eds' within it.

In many instances you may also want to refer in your text to the precise page that you are citing (e.g. if you've given a particular quotation), such as 'Williams 2000a p.37'

## Ways of making an argument in Geology

Approach	Uses
General to particular	This is described within rhetoric as the <i>deductive</i> approach to an argument. You start from generic principles, such as a theory in geophysics (e.g. mantle plumes), and show how particular detailed consequences follow from it (e.g. the geology of Hawai'i)
Particular to general	This is described within rhetoric as the <i>inductive</i> approach to an argument. It is what Sherlock Holmes does (though confusingly Conan Doyle who wrote the books has Sherlock Holmes call it deduction!). You start from particular observed details, such as observations or data, and show how a general truth follows from them. This approach is the corner stone of geology field work! You gather lots of specific bits of information from observations and build these into an account, a history, of the geology you have observed.
Spatial	Your document follows the same structure as the geography or spatial layout of the area under discussion. This is obviously most useful when, for example, describing a place but also where you need to summarize and explain the relations across a mapped space. For example providing an overview of the main types of geology in a region.
Historical or narrative	Whilst 'history' and 'story' are not quite the same thing, the basic idea is the same, as far as geology report writing goes. Detail what happened in the order it happened. Be careful, however, not to choose this approach simply because it is easiest. Be careful not to describe observations and data as a story of 'what you did'. Observation and interpretation require an inductive approach. You use an historical argument where you have <i>causal</i> explanation of some kind. So your narrative will need to answer the question <i>why</i> something happened, as well as merely reporting <i>what</i> happened.

### When to use the methods to structure your writing

- When testing theory (i.e. confirming a geophysics or seismic model) – Use a Deductive argument
- When describing and interpreting rock units, facies and sequences from field data – Use an Inductive argument
- When describing location context and spatial relations – Use a spatial argument
- When describing geological histories and sequential geological processes – Use an Historical argument.