Field courses in sedimentology; how to improve students logging and sketching skills

Sten-Andreas Grundvåg. Department of Arctic Geology, University Centre in Svalbard

E-mail: Steng@unis.no

Introduction:

In the field of sedimentology, it is of great importance to be able to illustrate what you see in the rock record through field sketches and making sedimentary logs (sometimes referred to as stratigraphic columns or measured sections). The latter method, which is referred to as logging, results in a graphic visualization (i.e. a sedimentary log) of the outcrop (i.e. the actual rock face) or well core, and record amongst others grain-size variations, bed thicknesses, sedimentary structures and fossil contents. The method is one of the most important tools of a sedimentologist as it enables us to interpret sedimentary processes and depositional environments which further allow us to reconstruct the palaeo-landscape and its evolution. The palaeo-landscape reconstructions are important when exploration geologists try to predict the presence of reservoir sands in a given sedimentary basin.

The problem:

From my experience in teaching field-based courses, I know that most sedimentology students have problems with drawing nice-looking and understandable sketches and sedimentary logs. In this modern day digital world, students don't get much training in doing so. This is mostly because many universities can't afford field courses and excursions for the students, and that is a tendency for many universities to focus more on computer-based education where students get experts in a certain type of software that are used in the petroleum industry. It is, of course, not the students' fault that the universities can't afford field courses or give them appropriate training, so we really can't blame them for the general decrease in sketching and drawing skills. Some people though, will tell you that the students in the past had much better skills in both observing and sketching than those of today. And very often they blame the digital camera for this, as many students nowadays just take a photo of a geological feature instead of sketching it, in which would have given them more time to reflect upon what they actually see. This may hold true. However, we must assume that if the students get assignments where they are forced to observe and sketch out in the field, their skills will eventually increase.

The poor skills in drawing sedimentary logs typically become evident when students present their logs in post field-work presentations. Logs are typically drawn using a ruler, and layers and beds are visualized as square boxes which don't reflect the actual geometry of the deposits. In the end, the final logs lack so much information that they are difficult to understand and use for process and environment interpretations. For teachers this is sometimes surprising, since the students are regularly exposed to nicely drawn logs through lectures, exercises and the papers they are assigned to read. But then again, is it possible to gain a practical skill without relevant practice? The answer is obviously no.

What causes the problem?

There may be various reasons to why so many students have poor skills in constructing sedimentary logs, and below I have listed some of them:

- Students don't find those particular skills important and actually don't bother to learn them.
- Students don't understand the concept.
- Students are not exposed to real rocks.
- Teachers don't explain the concept well enough.
- Students don't get relevant exercises.
- Teachers can also be bad in drawing and may find it hard to teach those skills to the students.
- Some people just can't draw.

Apart from the first and the last points, most of these reasons are easy to do something with. A concept can easily be explained better, and sedimentology students can, and should, be exposed to real rocks and practical exercises as often as possible (here economy can be a major limitation). Teachers that can't draw may seek help from guest lecturers or colleagues. Although drawing skills may improve by practice, the last bullet point is actually harder to do anything about as some humans are less talented in certain skills than others.

The first bullet point, that students don't finding logging skills important to learn may hold true for some. These may be the ones that don't have the right background, and just sign up for a course in need of the ECTS points. However, most students that sign up for a course in sedimentology at master's level do it from their free will and are generally highly motivated students that want to learn more. Actually, in one of my sedimentology courses, I asked the students to write down on a piece of paper what they wanted to learn during the course and what expectations they had. About 70% of the students had listed that they wanted to learn how to log better and how to make better looking logs. But even so, with highly motivated students, and sometimes also experienced students, the problem with the logs still persists. So there must be other reasons, or bottlenecks, apart from the ones listed above that makes it difficult for the students.

Identifying the bottlenecks:

In order to find the unknown problem, I decided to do an informal test of the students. First, they were divided into groups of three where each group had at least one member with some experience in doing field work. Each group where then assigned to log an outcrop section which they were to present later in the week. They also got a three hour deadline to finish their section. I observed the groups as they worked their way through the outcrop section, and it became evident to me that the students often have good eyes for details. They spend too much time discussing small things that are off less or even no importance when it comes to interpreting sedimentary processes and depositional environments. The result is that they end up using most of the time on 1/3 of the section while the remaining 2/3rds are given very little time at the end of the assignment. However, this is a matter of experience, and most students will learn how to adjust their level of detail to the amount of meters to log and the time available. Nonetheless, the students spent a lot of time discussing where to put boundaries between successive beds, and how to draw bed geometries. For an experienced sedimentologist these decisions are normally an easy task that he or she won't spend much time on.

In addition, students spend a lot of time drawing the layers and beds as accurate as possible on millimeter papers, with the result that they become too confined by the square and strict gridlines on the logging sheet. When the students presented their logs later in the week, the result was as I expected; most beds were drawn as square boxes even though they actually showed lenticular geometries and fining upward trends in the outcrop. Furthermore, most of the groups had too little time to finish the upper part of their sections, and those who actually managed to get through their section showed few or no details in the logs. In the classroom, I kindly asked each group to share with the rest what they thought had been the most difficult part of making their logs.

The students identified a lot of problems, for instance the lack of experience, bad group dynamics, poor outcrop quality, bad weather, cold fingers etc. I explained to the students that these are problems you often will encounter in other stages of your working career. Some of these problems are hard to do anything about (e.g. bad weather), whereas others you just have to deal with (e.g. cold fingers and poor outcrop quality). However, I asked them to explain in more detail what they meant with the lack of experience, and they listed amongst others: that it is hard to see sedimentary structures when you have not seen any before, it's hard to decide where to put bed boundaries, it's difficult to decide on how to draw the observed geometries, and it's difficult to decide on the level of detail.

To sum up, it seems to me that the students have seen too little sedimentary rocks during their undergraduate studies, and more importantly in my opinion, is that they have problems to make decisions because they are afraid of doing mistakes. And I think the latter is the main problem. The students are too confined by the gridlines on their logging sheets, which prevent them from being a bit artistic when they make a sketch. They tend to avoid drawing inclined or wedge-shaped beds even though that is how it appears in the outcrop. They are afraid of putting the bed boundaries in the wrong places. However, if you log a hundred meter long section, an error of some few centimeters or even decimeters here and there is acceptable. Thus, the main bottlenecks the students need help to overcome are: see enough rock (this reflects the old geology saying that the best geologist is the one that have seen most rocks), decision making (where to put boundaries and how to draw), be more artistic (draw what you actually see), and don't be afraid of doing mistakes (it's better to try and fail than not trying at all).

How to overcome the bottlenecks:

One obvious solution on how to overcome the bottle necks is to expose the students to as many outcrops as possible and give them deadlines so that they have to make quick decisions. But from my experience, it is a high probability that they use their time in the wrong way as already stated previously. So I decided that the students were going to work with decision making for a whole week. The idea was to work with similar deposits the whole week, but do it in three different ways. The first day of this project, the students were as usual assigned to log an outcrop having in mind that they were allowed to be more artistic when they made the logs. The logs definitely improved from the week before, although it was still room for major improvements. The students again pointed out that it was difficult to make decisions about bed boundaries. The next day, the students were assigned to characterize a whole outcrop, not only vertically but also laterally. In this exercise they had to make a sketch of the entire outcrop (not only take a photo) and mark on the sketch all the important bed boundaries they could observe. In addition, they had to make two logs, one in each end of the

outcrop so that they could do a lateral correlation. The logs were only going to be sketch logs drawn on the same sheet as their outcrop sketch. This was to prevent them from being confined to the rigid gridline regime of their standard logging sheet. Together these two tasks forced the students to think and to make decisions on bed boundaries laterally along the outcrop, and the results were positive. The students loved the exercise, and the sketches they showed in their presentation later that week were of superb quality. For the third and last day of that particular field week, the students were assigned to log a well core. A well core has the advantage that it displays sedimentary structures at a level of detail that is not achievable in outcrops. There are no screen covers, no cold weather to distract your mind since you do this core logging inside, and bed boundaries are superbly exposed.

The limitation of a well core is that is only 5 cm wide, so lateral variations and bed geometries are impossible to grasp. I did not know what to expect, since they only had been logging outcrops. I was expecting square boxes in the logs, but to my big surprise they constructed fantastic looking logs and they all finished in time without missing any important details. The question of why arose in my mind. The answer from the students was that they had by now seen these deposits in the field many times and they had been forced to make decisions under various weather conditions and with variable outcrop quality. Together, this had, according to the students, made decision making in the core much easier.

Outcomes:

I noted that the student's observation and data recording skills increased during the field course. This was reflected through better looking and more informative logs and sketches. In addition, the students became more or less self-sustained after the week with logging exercises. They rarely needed help to solve problems in the field and acted very independent. However, apart from noticing this improvement during field work and post-fieldwork presentations, I found it hard to measure the improvement quantitatively. I tried to construct an exam where it was stated from the start that drawing/sketching was positively assessed. When I got the exams back for grading, I realized that most students wrote a lot of text in their answers as they do in most other written exams. The majority of the students had only made sketches were it was explicitly stated to do so. Whether this is a result of old habits or by the fact that the students are afraid of making bad sketches is hard to tell. So all in all, I was a bit disappointed. However, in the time following the course, I got to see the course evaluation made by the students. Here, the majority (80%) was very satisfied with the course outcome. The only thing they actually complained about was that the extensive reading list. There was however no specific points related to the logging exercises in the evaluation form. So in the end I did not know what the students felt about the logging exercises. Did the students find it useful? Did they learn anything from my exercises? Will they be able to apply their skills in the future? I had many questions, but no answers. However, in some time following my course, I got some positive oral feedback. Several of the students were supposed to do their own fieldwork related to their theses after the course. These students told me later that they would have no clue on how to collect data and create proper logs without the training they received in my course. Also later in the semester, in a course where I'm a teaching assistant, I was happy to see that some students from my course actually applied their new knowledge and skills. And not only did they apply it themselves, but I also observed that some of them gave tips on how to do it to their fellow students. Taking this into account, I feel that my little project was a success regardless of the lack of

any measurable or quantifiable results. In the end, maybe some skills that are important to learn are hard or impossible to assess with grades.

Discussion and concluding remarks:

For my next course in sedimentology, I will try to organize my approach and use it more extensively (this time I just experimented as the course went on). In the following discussion I will suggest a five step way of making the students overcome their issues with decision making and their fear of drawing things wrong. The overall aim is that each group (or student) presents all their logs at the end of the week so they can see their own improvement.

1) Introduce the students to an outcrop without any knowledge on how to log and collect data. Here the students are just told to log their given section without any proper background information or training. This enables both me and the students to pin point the bottle necks. After this session, the students should draw their presentation log on a large piece of paper (A2/A3 format).
2) Before the next logging session there should be a small workshop on how to recognize and how to draw various sedimentary structures and bed relations. This workshop should be arranged as a group work facilitated by the teacher, where the aim is for the students to come up with common symbols or common ways on how to draw things in their logs. Here, there will hopefully be many creative suggestions which will make the students be a bit more reflective on how to draw and sketch sedimentary features. In addition the students should try to pin point the bottle necks they experienced the day before.
3) In the next logging session, the students are told to be more artistic, and to not be afraid of drawing things just as they look in the outcrop. This process can be facilitated by making the students draw their logs on sheets without any gridlines. In addition, the students should apply the knowledge they gained from the workshop the day before. Again their presentation log should be drawn on a large sheet before the next logging session.
4) In the next exercise the students are told to make a sketch of the whole outcrop and trace bed boundaries laterally before they make their logs. In this way they are forced to decide where the bed boundaries are. If they in addition are given a deadline, they will have to make quick decisions. Again their presentation log with an accompanying outcrop sketch should be drawn on a large sheet before the next logging session.
5) The last exercise should be to log a well core of similar deposits as they worked with in the field. Here the students will have to practice decision-making on the level of detail and not bed boundaries (bed boundaries are well exposed in a core and the core show much more delicate details than the outcrops). Also this log should be presented on a large sheet. At the end of the logging session, each group will have to put up their four logs side by side so that it is possible to see their development throughout the week. Hopefully, the student's skills have improved day by day throughout the week. At this stage the students can discuss or reflect on what of the logs they like the most, what were the main bottle necks, and did they find or learn techniques on how to overcome these issues. This will be a positive experience for the students as they compare their first poor attempts to their close-to professional end result. Having this positive experience in their minds, I think these students for the future will tend to reflect more on how to illustrate and visualize things they observe in the field.