Chapter 6 Fence Diagrams

"Complicated systems produce unexpected outcomes."

Alternative Formulation of the Generalized Uncertainty Principle

INTRODUCTION

In Chapter 2 we developed the principles of correlation and in Chapter 5 we applied the nomenclature of sedimentary rocks and structures to drafted graphic measured sections to produce simple two-dimensional correlations. However, the ultimate correlation diagram is the fence or panel diagram. This graphic illustration allows one to visualize the changes in rock units both vertically and laterally in three dimensions. Fence diagrams are constructed in a format that gives a three dimensional view but still allows measurements to be made from the diagram. Two scales are utilized in the construction of the fence diagram: 1) a horizontal scale from measured sections or drill hole data plotted to scale on a base map; and, 2) a vertical scale, equal for all sections, to be chosen with discretion by the stratigrapher. The horizontal scale is usually much smaller than the vertical or section scale. This is best demonstrated by a simple example of a hypothetical fence diagram constructed for central Montana (Fig. 6.1).

Assume that three drill holes recovered the three sections illustrated in Figure 6.1, from the sites indicated on the small inset map. If trenches were dug between the three sites, and the walls of the trenches carefully photographed and described, a detailed and accurate picture of the lateral and vertical stratigraphic variation of the region could be constructed. In reality, such a trench would be much too costly and environmentally disruptive (if not technologically impossible!), so the diagram must be constructed from drill hole data only. As we stated in the correlation chapter, such an interpretation depends on the type of deposits and the geologist constructing the diagram. Even a simple diagram demands careful attention to detailed correlation. We will present those techniques in this chapter. The construction of fence diagrams is essentially the same as correlating between to columns, except that the three-dimensional aspects of the stratigraphic framework must be considered.

PRINCIPLES AND METHODS

Construction of fence diagrams incorporates few new ideas from correlation other than three

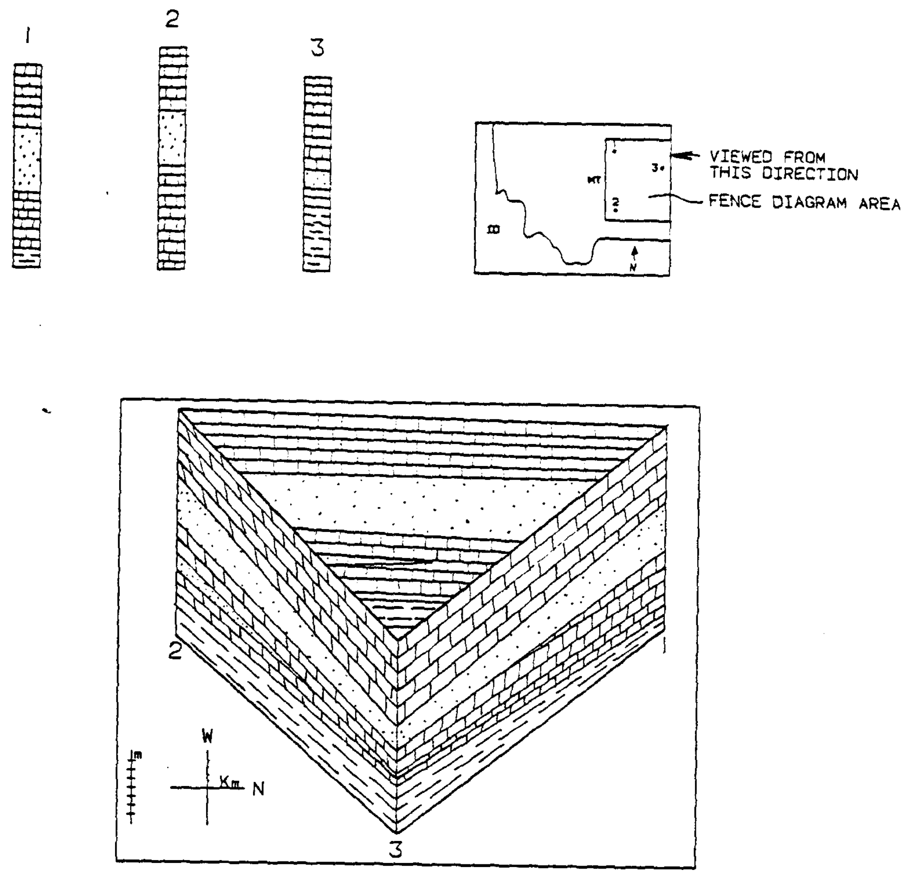


Figure 6.1. Example of a simple fence diagram from central Montana.

dimensionality. To construct a fence diagram first lay out a map covering the area of the stratigraphic survey. Then choose a scale to accommodate space for the columns. Next plot locations of stratigraphic sections as points on the map. Sections measured in the field should be labelled with township, range and section, or latitude and longitude, or by reference to a standard grid as appropriate for the field area. These points will act as the bases to the posts of the fences.

After you have plotted the points, it is time to decide what perspective to give the reader when looking at the fence. Imagine a map where many of the section locations roughly line up in a north-south direction. If you constructed the fence with a northward viewing perspective, chances are many of the fence posts would block each other and many of the fence panels would be sitting at too high an angle to be seen. In such a case, it would be better to construct the fence with an eastward or westward facing perspective to show a maximum amount of stratigraphy.

The next step is to decide which posts should be connected to form fences and which should not. In cases where there are many posts, it would be too confusing to connect all of them. Thus, the best strategy is to choose the minimum number of fences that show the maximum amount of stratigraphic detail, fences that show important lateral relations over ones that duplicate information shown on other fences. Also, remember that fences in the front of the diagram will obscure the ones behind them. In practice, there is usually a short period of trial and error that precedes final plotting of the fences.

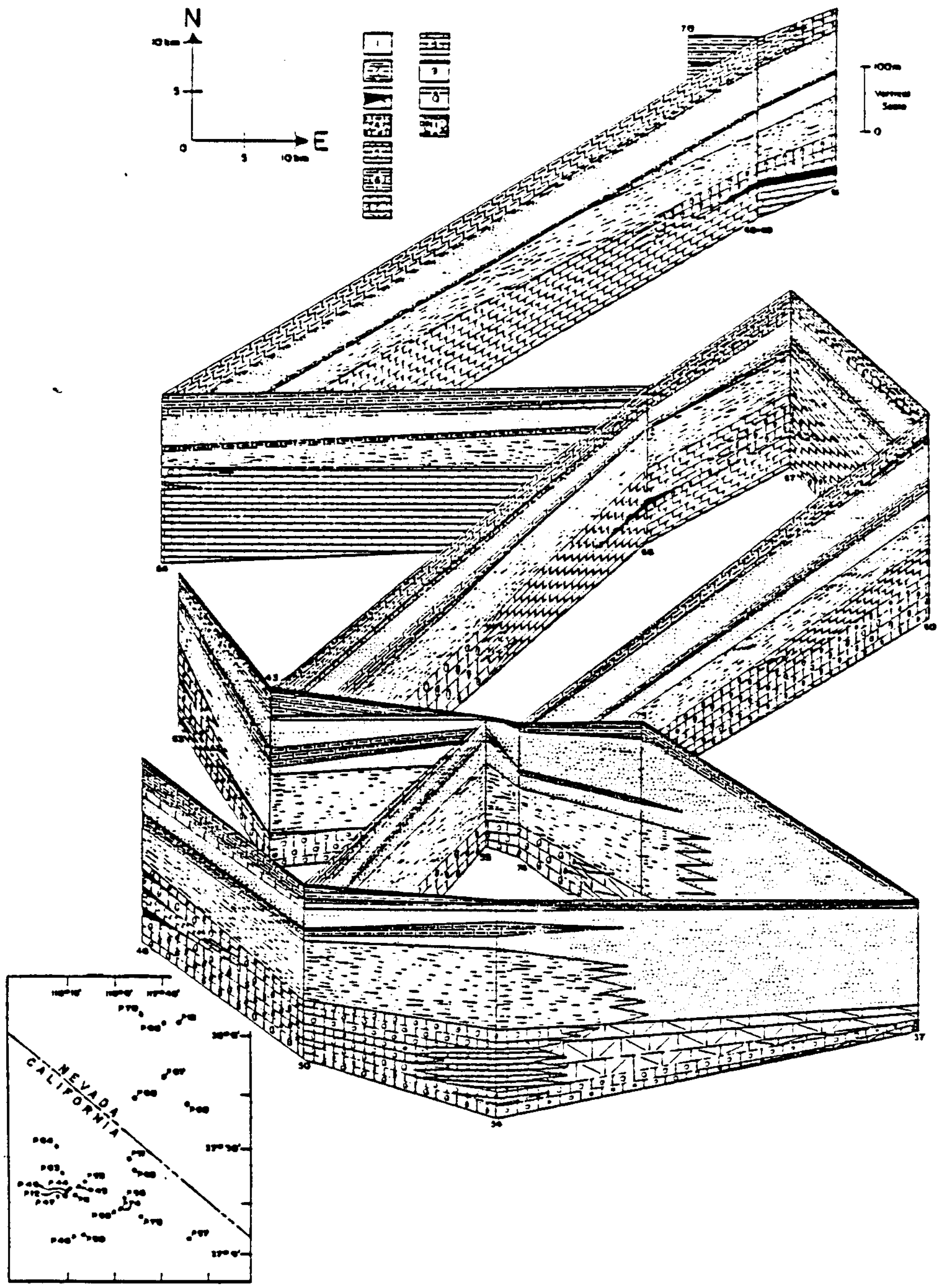


Figure 6.2. Fence diagram from the Lower Cambrian of the Great Basin.

After all this preparation, it should be time for filling in the chosen fences. It is usually easiest to draw in the fence boundaries (top and bottom) before filling in the walls with the detailed stratigraphy. When the walls are outlined with stratigraphic boundaries, you should pencil in the individual posts. It often saves time to treat each wall on its own, perhaps by sketching them individually on scratch paper. This way, you can get a better view of problem areas where correlation decisions are needed. Most of the graphic and mechanical techniques described in the correlation chapters (Chapters 2 and 5) also apply to fences.

Due to the three dimensionality of fence diagrams, certain problems can arise. One of the more common of these errors committed during fence correlation is when a unit, let's call it sandstone #3, is correlated all the way around the fence until it arrives back where it started, but ends up connecting with a different sandstone! We could liken this to a painter who is painting brown and white stripes around a house and who winds up back where he started, but three feet higher up. There is a system of checks and balances on a fence diagram that does not exist on any given two dimensional wall of that fence. Beds must eventually connect with themselves if they are correctly correlated around the fence. This principle applies to biostratigraphic, time-stratigraphic and all other stratigraphic units as well as lithostratigraphic units.

Another problem arises when the stratigrapher inadvertently hides too much information behind the concealed area of a fence wall. Look back to Figure 6.1. Notice that on the back fence panel there is a thin tongue of sandstone pinching out from left to right. Now, if the stratigrapher did not show that, the reader may assume that it pinched out somewhere near post #2. But, as described in Chapter 2, in cases where details of true lateral relationships are unknown, it is best to arbitrarily locate the pinchout, or zone of interfingering, in the middle of a fence or correlation panel.

Figure 6.1. shows a simple example of a simple fence diagram, and Figure 6.2 an example of a fence diagram from data measured in the lower Cambrain of the Great Basin. With biostratigraphic and other types of correlation superimposed on such lithostratigraphic correlations, fence diagrams become excellent frameworks from which to construct paleofacies or paleogeographic maps, the end products of many stratigraphic studies.

Exercises in the following section are designed to allow you to practice the techniques of constructing and interpreting fence diagrams. To keep things from getting too complicated, the position of the sections are already located on fence diagram base maps. However, notice that each contains three scales, one for the vertical columns and two different scales for east-west and north-south directions. The two different map scales are necessary to provide the proper perspective for the diagram. Imagine flying in an airplane directly over a series of fences and looking straight down. You would not be able to see the sides of the fences and the fence would appear only as a line. To see the side of a fence from the air, you would have too look from an oblique angle, thus fore-shortening the straight-on look dimension. This same effect can be achieved when transferring points from a base map to a base for a fence diagram. When making this transfer, the vertical scale should be only about three fourths that of the horizontal scale used. This will give the diagram the illusion of looking from an oblique angle. Remember that we have already done this for all maps in this section and you only need to understand this concept if you plan to measure sections in the field and produce your own fence.

OUTSIDE READING

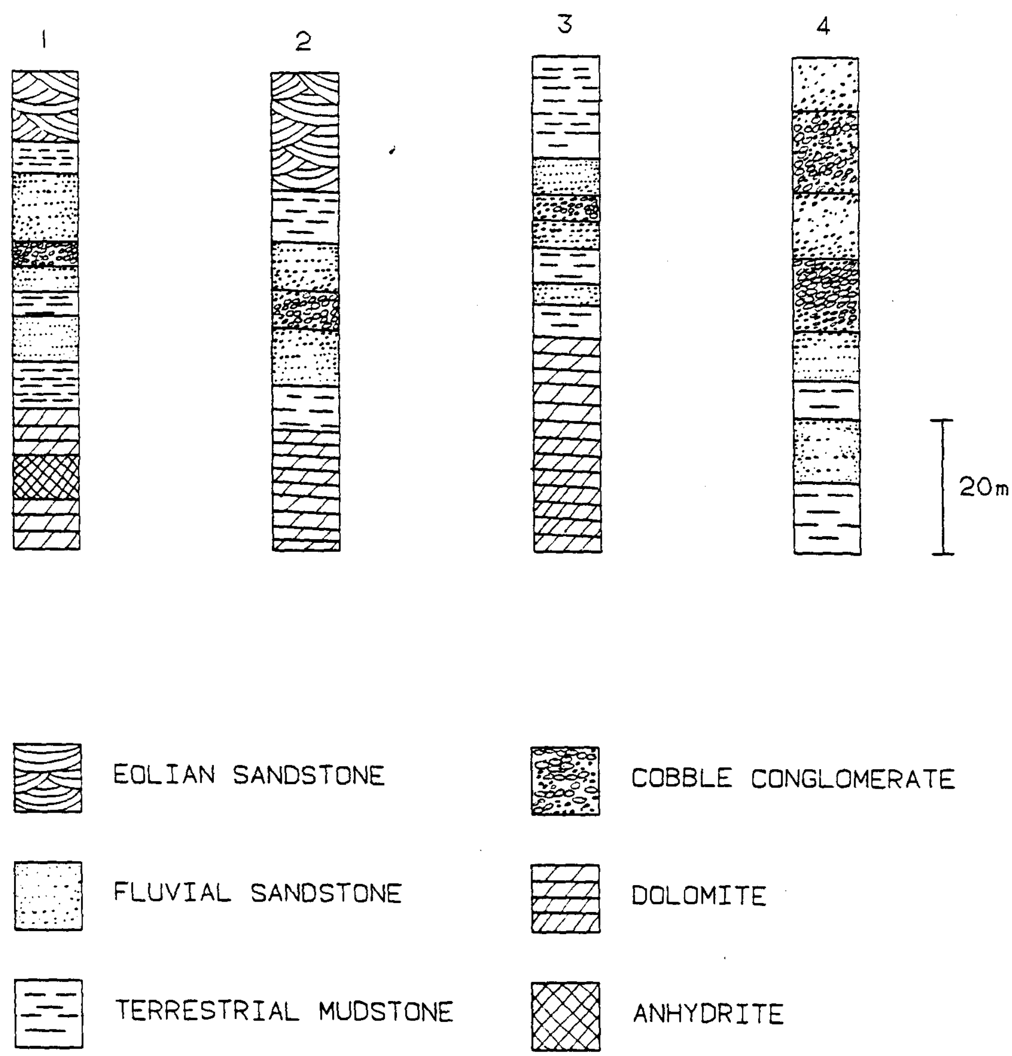
Krumbein and Sloss (1963); LeRoy and Low (1954)

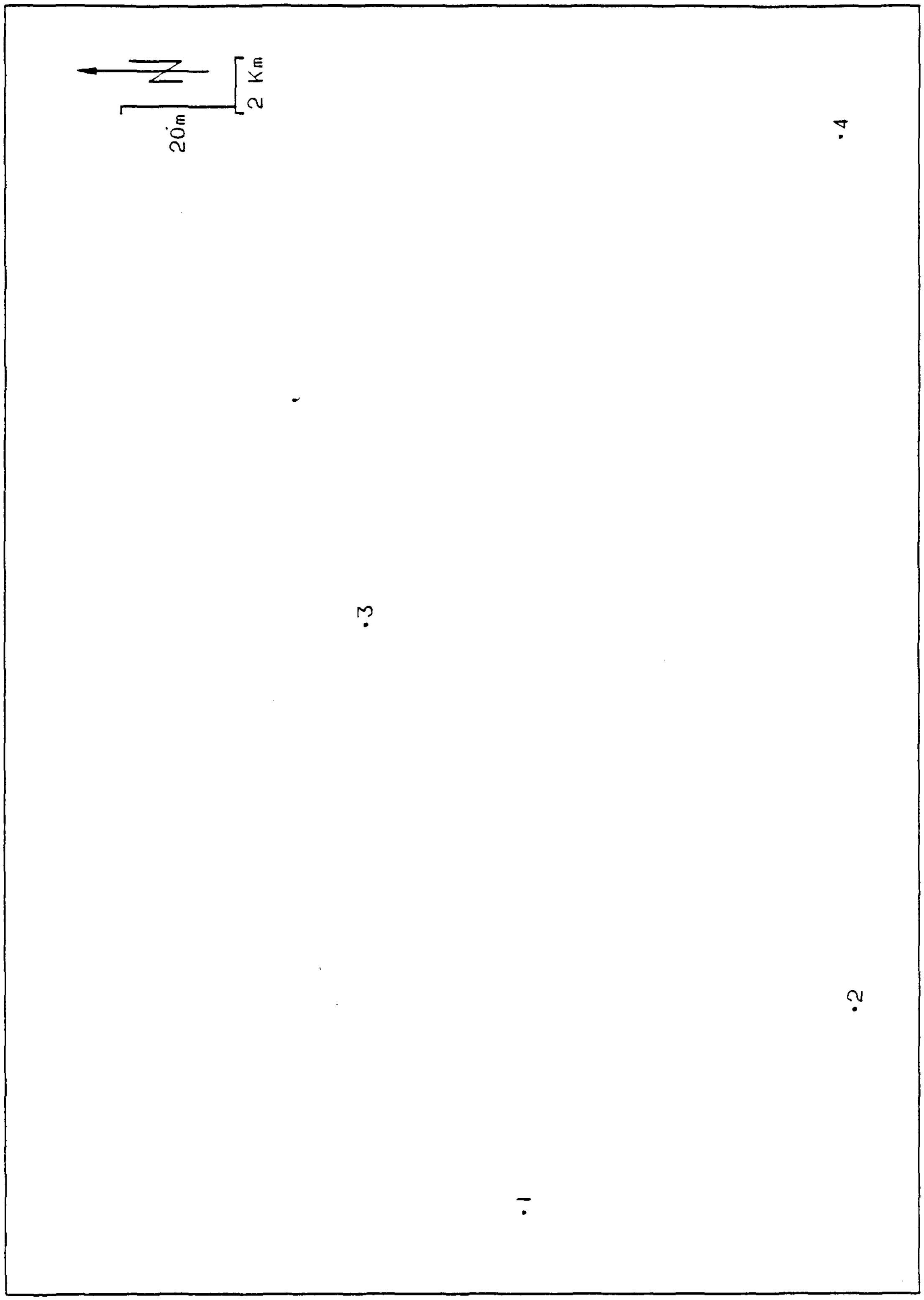
EXERCISES FOR CHAPTER 6

This set of exercises will further your correlation skills in the construction of fence diagrams. Stratigraphic columns from the correlation exercises in Chapter 2 are supplemented with additional columns to correlate and use in the construction of your fence diagrams. Construct your fence diagram on the base map which follows each problem set. Remember that these diagrams may be constructed with perspectives other than viewing from the north. You may wish to construct additional diagrams from a different perspective. You should answer the questions which accompany each set of columns after the fence is constructed, but it may help to keep them in mind during the exercise.

Exercise 6.1

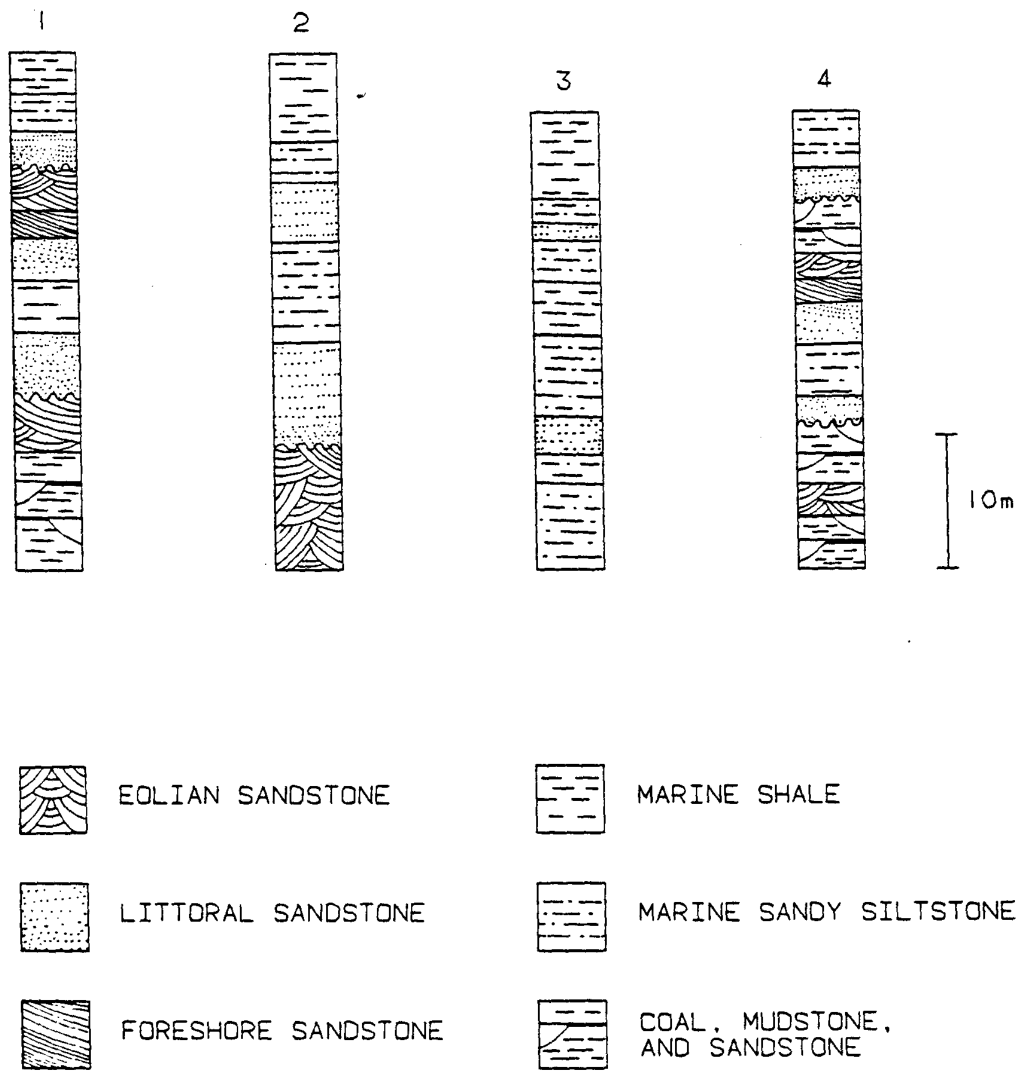
Construct a fence diagram from the following columns. Does your three-dimensional correlation allow you to more accurately locate the source of coarse clastic sediment than did your two-dimensional correlation from Chapter 2 (Exercise 2.2)? What apparent direction is this source material derived from? Where is the playa located in this "basin"? Where were the dunes forming with respect to the other depositional environments?

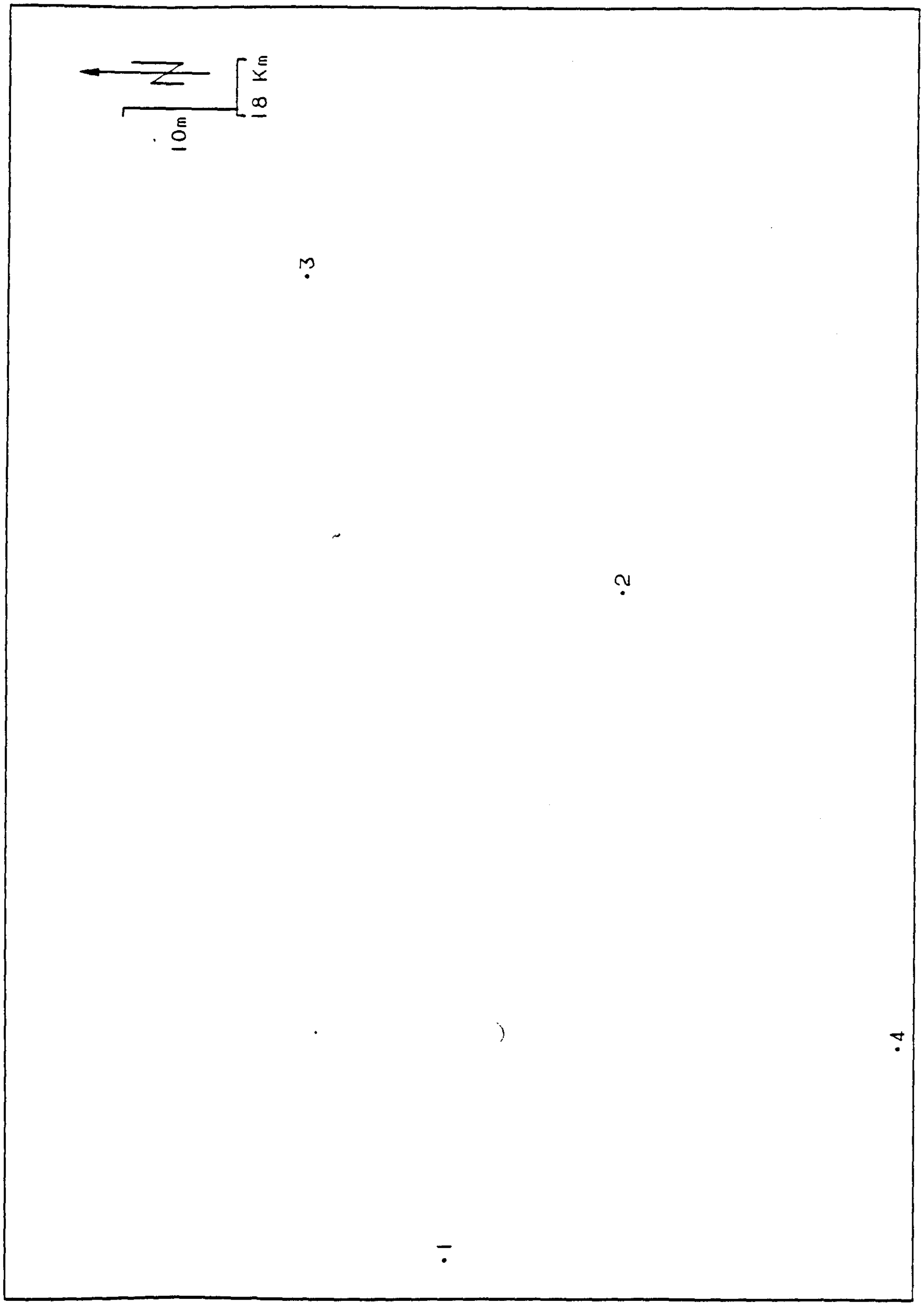



N
2 Km
20m
4
3
2
1

Exercise 6.2

Give an approximate orientation for the barrier islands responsible for deposition of part of this sequence? Which direction is offshore? Onshore? Why are there no unconformities present at locality #3? Which locality best illustrates a classical coastal progradational sequence? After recognizing the locality, where in the sedimentary section does it occur?




18 Km
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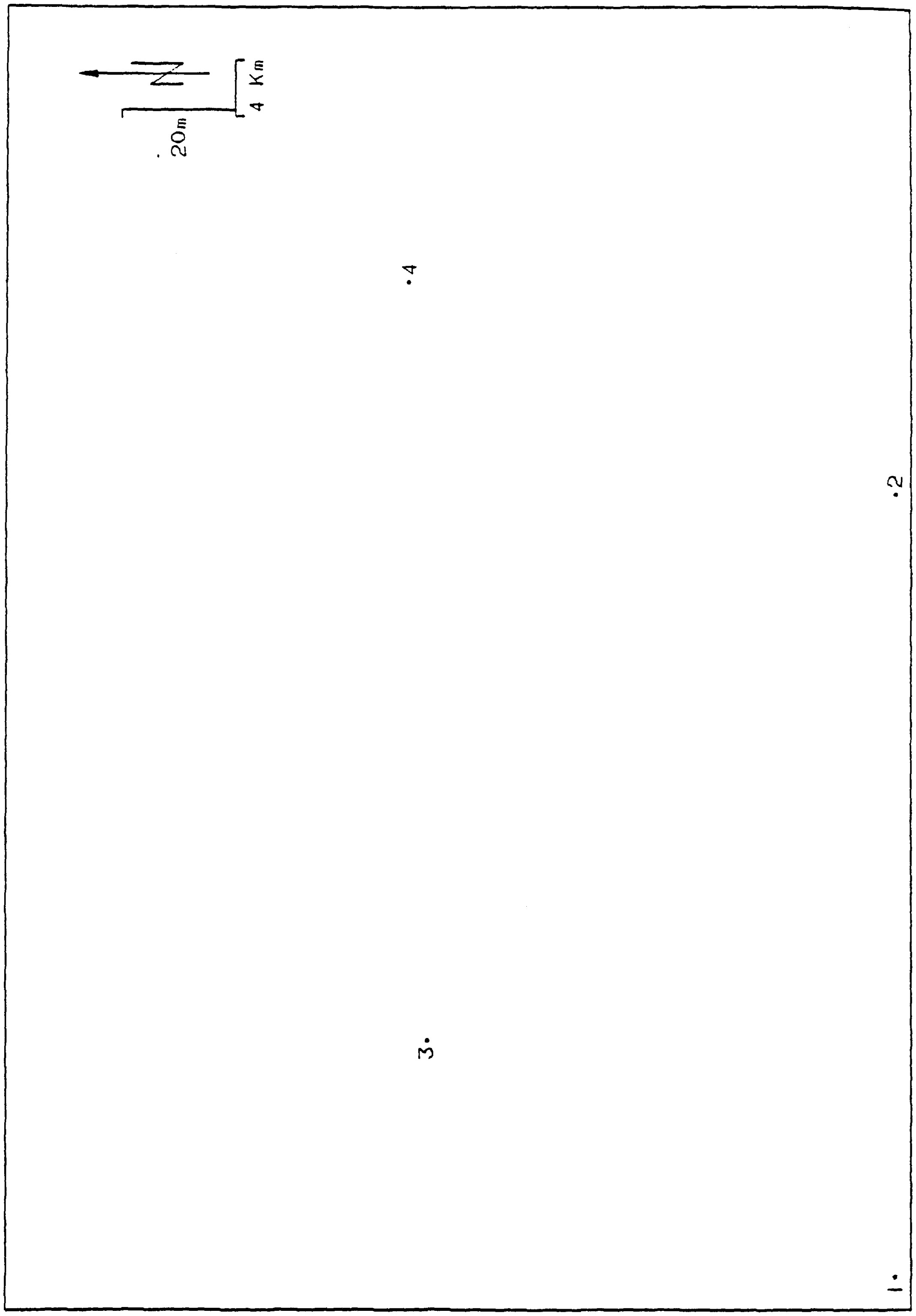
Exercise 6.3

Would growth and retreat of ice lobes more likely be recorded in Section 2 or Section 4? Would rises and falls in the lake level more likely be recorded in Section 3 or Section 4? Explain.


N
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