CLASS 9: SEDIMENTARY ROCKS

INTRODUCTION

Last time we described how granite weathers at or near the surface of the earth. The principal weathering products are quartz grains, kaolinite flakes, iron hydroxide stains (goethite, limonite) and dissolved silica and various ions in solution. Mechanical weathering may break the granite into unaltered chunks of granite. Let's follow this material along in the rock cycle.

To visualize these changes we'll consider a desert basin surrounded by granite mountains. In other words a typical geologic setting in the southwestern USA.

SEDIMENTS AND SEDIMENTARY ROCK IN AN ARID REGION

The mountains are mainly dry but receive some moisture in the form of occasional rain storms and snow melt. Thus water is available for the reactions mentioned in the introduction. The granite breaks down both mechanically and chemically to produce sediment. The sediment ranges in size from clay flakes to huge boulders. Many of the boulders are relatively fresh (not chemically weathered). For most of the time sediment piles up on the steep mountain slopes and in the dry stream channels.

During snow melt or sudden thunder storms much of this material is flushed off the slopes and through the valleys. At the foot of the mountains the streams and debris flows slow down and deposit their sedimentary loads. These deposits produce an alluvial fan. Let's look at the material in the fan.

At the mouth of the canyons we'll see material of all sizes: clay to boulders. Many of the clasts (sedimentary particles) are angular; basically unaltered joint blocks. The sands include not only quartz but also less stable minerals such as hornblende, plagioclase and micas.

Farther out on the fan the streams and debris flows are smaller and can't carry big cobbles and boulders and the average particle size is smaller. The clasts are more rounded. Unstable mineral such as hornblende are less common.

Even farther out on the fan we find only small grains: sand, silt and clay. About the only minerals left are quartz, clay (kaolinite) and some muscovite mica. This material is small enough to be moved by the wind. The clay may be blown right out of the basin whereas the sand may be collected to form dunes.

Finally the last flood waters may collect in a saline playa lake. Under the bright desert sky the lake soon evaporates leaving a crust of evaporate minerals such as halite and gypsum.

This finishes our tour of the mountains and the alluvial fan. Now let's look at material sampled by a deep well drilled in the lake. At shallow depths we'll see mainly evaporate minerals interbedded with fine-grained sediment. Maybe we'll see signs of wetter and drier climates. From greater depths we'll collect sand and eventually we'll drill through coarse conglomerate and finally into the granite bedrock.

The well samples will be very similar to the surface samples but with some important differences. The sediments may be chemically more altered from being continually soaked in groundwater. They may be denser from the pressure of the overlying sediments. Finally the sediments may be cemented together with material such as silica that was dissolved in the groundwater. In other words the sediments may have become sedimentary rock.

SIGNIFICANCE OF THE CLASSIFICATION OF SEDIMENTARY ROCK

Sedimentary rocks are classified by texture and composition. Texture includes factors such as size, shape and arrangement of the constituent particles. Composition means what the particles are (quartz grains, coral fragments, etc.). The importance of the normal classification is that it has a strong relationship to origin of the sediment and its environment of deposition (beach, flood plain, deep sea, etc.).

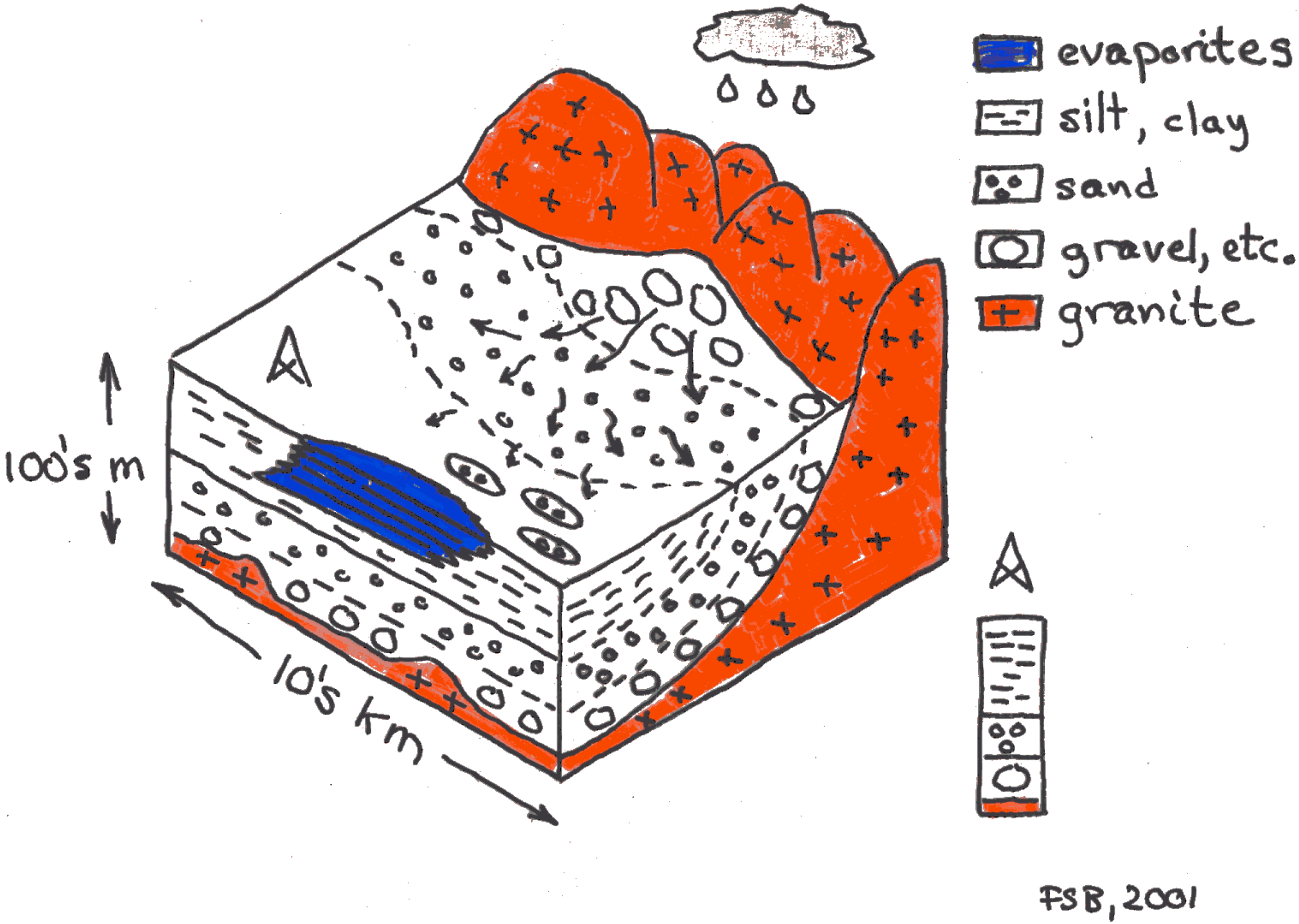
Near the source of the sediment we expect to find steep slopes and coarse clasts of angular rock fragments. Both stable and instable minerals are found. Far from the source the sedimentary particles tend to be small and rounded. Only chemically stable minerals survive the long trip from the source.

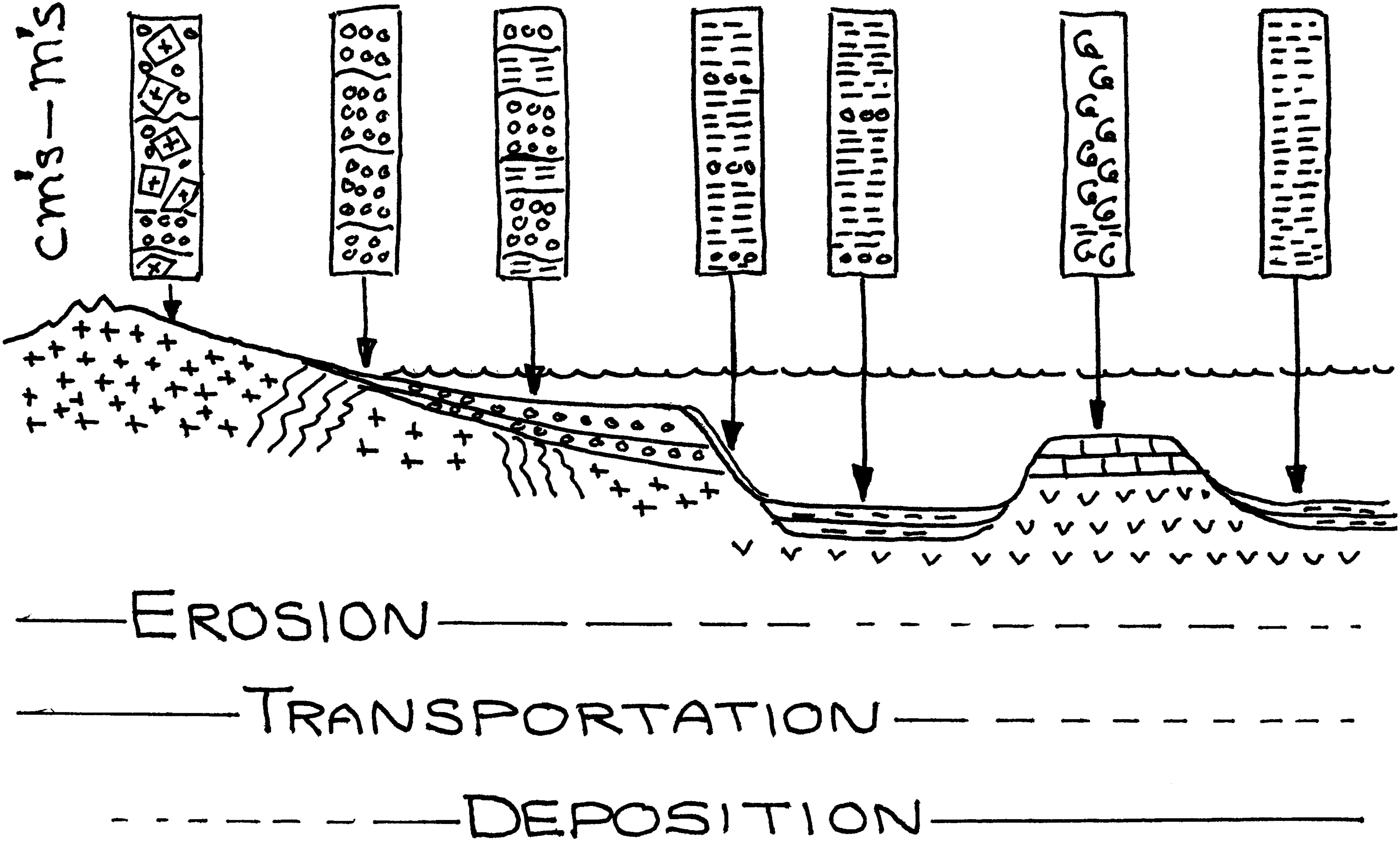
Looking at shallow and deep sediments we also see systematic changes. The surface sediments are low-density and uncompacted. The porosity is high and the sediments are uncemented. The deeper sediments are denser, have lower porosity and are cemented to form sedimentary rock.

BE CAREFUL!!

These generalizations are not natural laws. They are relationships that hold true in many cases but are not universal. For example "beach rock" is made of sand grains cemented in the intertidal zone on tropical beaches. You will note other exceptions throughout the course.

Sedimentary Facies





FSB, 2002

Clastic Sedimentary Rocks

>2 mm	gravel		conglomerate	
$\frac{1}{16}$ - 2 mm	sand		sandstone	
$\frac{1}{256}$ - $\frac{1}{16}$ mm	silt		siltstone	
$<\frac{1}{256}$ mm	clay		shale	

FSB, 2001