SUNSET BAY GEOMORPHIC MAPPING PROJECT
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INTRODUCTION

Geologic mapping has a long tradition in the United States, dating to the western expeditions of Powell in the late 1800's (Powell, 1882; 1888). The National Geologic Mapping Act of 1992 recognized the importance of geologic mapping as a tool for resource evaluation, environmental protection, and natural hazards assessment. As a cartographic subset, surficial maps provide representation of the critical links between bedrock geology, climate, tectonics, vegetation, and surficial processes.

The purpose of this field-based exercise is to gain an understanding of mapping concepts as they are applied to the surficial deposits and landforms manifested at the Earth's surface. This exercise focuses on landforms and processes in the vicinity of Sunset Bay, Coos County, Oregon.

SURFICIAL MAPPING APPROACH

Surficial mapping will employ a four-fold scheme in which units are delineated on the basis of age, origin (process), landform, and material (texture). The technique emphasizes the link between landforms, materials, and processes in a landscape dominated by tectonic uplift, hillslopes, mass wasting, and fluvial/coastal erosion.

Large-scale landform units are classified into hillslope and valley-bottom features. Hillslope landforms are subdivided into ridges and side slopes. Valley-bottoms are subdivided into channels, floodplains, terraces, and fans. Hillslope deposits include residuum and colluvial diamicton. Fluvial deposits are typically clast supported, moderately sorted, and imbricated due to deposition by turbulent streamflow. Debris flows result in poorly-sorted diamictons with crude internal stratification. Dating of surficial deposits is problematic, hence traditional stratigraphy-based techniques are largely not applicable. The four-fold mapping protocol circumvents the need for formal stratigraphic nomenclature.

SOIL SURVEYS AS A REFERENCE FOR LANDSCAPE ANALYSIS

Soils represent the weathered mantle of unconsolidated surficial material that covers land surfaces. They are comprised of a mixture of mineral and organic matter derived from the physical, chemical, and biologic weathering of bedrock. The Natural Resource Conservation Service (NRCS) is the federal agency that is primarily responsible for the analysis and preservation of this valuable resource. As a result, county soil surveys and soil maps have been prepared for most regions of the U.S. These surveys provide an important data set for geomorphic analysis of landforms and surficial materials.

The main controlling factors that contribute to soil formation are: 1) climate, 2) organic activity (animals / plants), 3) relief / topography, 4) parent material, and 5) time (CLORPT). Climate refers to amount of rainfall and temperature. Organic activity refers to style of plant growth, microbial activity, and burrowing organisms. Relief / topography refers to the steepness of slope. Parent material refers to the source of weathered material upon which the soils are formed (e.g. bedrock = igneous, sedimentary, metamorphic; surficial regolith = colluvium). Time refers to the residence time of the soil material, essentially the length of time that the soil has been forming without physical interruption. All of these factors contribute to soil characteristics.

Soil surveys are conducted by using topographic maps, air photos, ground surveys, soils excavations, and geologic maps. Soil map units are delineated primarily on the basis of material composition (i.e. texture of the soil) and topographic configuration (steepness of slope, flood-prone areas, etc.). Other parameters include color and soil chemistry. Soil maps are typically published on air photos and created for individual counties and conservation districts. A brief comparison of soils and topographic maps suggests that soils are not randomly distributed, but are intimately related to topography and geomorphic setting. Landforms and geomorphic processes often influence the physical and chemical properties of soils. Hence, if we know the soil and its characteristics we may be able to begin to understand the geomorphic system.

PROCEDURES AND TASKS

Part 1. Geomorphic Mapping

(1) Drive to Sunset Bay, Coos County, Oregon… or take a class field trip as the case may be.
(2) We will spend the afternoon at Sunset Bay. The following resources are available to support your observations: (a) topographic map of Cape Arago-Sunset Bay area, (2) 10-m hillshade model, (3) slope model, and (4) relevant excerpts from the NRCS Coos County Soil Survey.

(3) The first step is to orient yourself to the area, examine all available maps and directly observe the landscape around you, answer the following questions:

   a. List and describe the upland (ridge, hillslopes) and lowland (valley bottoms, beaches) landforms that you observe.

   b. List and describe the dominant erosional processes evident in the area. Think of all the agents of erosion, and how they are working at this site.

   c. List and describe the range of surficial deposits ("regolith") that occur in this area. In your description include texture (grain size) and sorting of surficial material). Make observations of material color as well.

(4) Examine the topographic and slope maps. Using the topographic map as a base, use colored pencils to shade landform elements based on slope. Use the following color code and slope classes:

a.	0 to 10 degrees	Yellow
b.	10 to 20 degrees	Green
c.	20 to 30 degrees	Blue
d.	> 30 degrees	Red

(5) Once you've color-shaded your map, use a heavy pencil or pen to draw "contacts" or black line land-unit boundaries between your shaded areas.
(6) Compare your color-coded topographic slope map to the Coos County soil survey for the area. Fill in the following table combining observations from these two data sources:

A. Yellow Land-Unit Zone (0-10 degrees)

Soil Unit Code (number + name)	Landforms	Materials (texture, sorting)	Processes (transport agent)	Age

B. Green Land-Unit Zone (10-20 degrees)

Soil Unit Code (number + name)	Landforms	Materials (texture, sorting)	Processes (transport agent)	Age

C. Blue Land-Unit Zone (20-30 degrees)

Soil Unit Code (number + name)	Landforms	Materials (texture, sorting)	Processes (transport agent)	Age

D. Red Land-Unit Zone (>30 degrees)

Soil Unit Code (number + name)	Landforms	Materials (texture, sorting)	Processes (transport agent)	Age

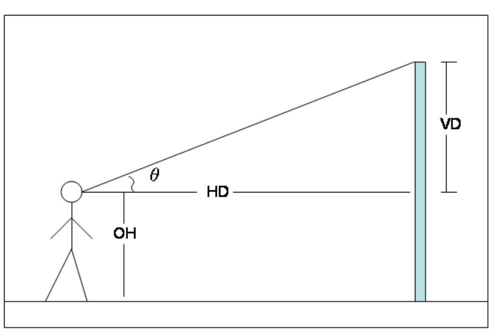
(7) Complete your draft geomorphic map by combining slope observations with soil-landform-material observations. Using a marker or dark pencil, refine your color-shaded areas to include subdivisions based on the soils-landform-process observations. Subdivide color zones with heavy dashed-lines, and label your geomorphic units within each color zone with one of the following designations:

Qr – residuum, Quaternary in age, undifferentiated (ridge tops, in-place regolith)
Qc - colluvium, Quaternary in age, undifferentiated (hillslopes and footslopes)
Qal - alluvium, Quaternary in age, undifferentiated (river deposits, valleys, channels, floodplains)
Qt – marine terrace, Quaternary in age, undifferentiated (abandoned, elevated beach zones)
Hb – beach zone, Holocene in age (present day beach zones)
Qd – dune deposits, Quaternary in age, undifferentiated (wind-blown, sand dunes)

Part 2 - Landform and Soil Sampling Exercise – North End of Sunset Bay

A. At the north end of Sunset Bay, there is an elevated upland bench that bounds the beach. Examine the area on the topographic map, on your geomorphic map, and on the slope-hillshade-soils maps. Working in teams, conduct the following tasks.

B. At the beach level, using a Brunton compass-pace-tape, and trigonometric techniques, determine the approximate height of the upland bench above active beach level **in meters and feet**. Refer to the figure below for a guide on how to complete this calculation.



OH = ocular height, VD = vertical distance from eyes to top of object, HD = horizontal distance from eyes to object, θ = angle of inclination between eyes and top of object:

$\tan\theta = VD / HD$ Total Height of Object = OH + VD

Ocular Height __________
HD __________
θ _________ Total Height (ft) _________
VD ____________ Total Height (m)____________

C. Hike up to the top of the bench, at the north end of Sunset Bay. Using the soil auger, collect a series of samples at about 20 to 25 cm increments, to a total depth of approximately 150 centimeters. See how far you can drive the auger into the regolith materials. Carefully empty the bucket auger samples out on the ground in organized, linear fashion, from top to bottom for observation. Keep track of the depth increments of each extraction using a meter stick and the sample rod.

Once we make field observations, we will ziplock-bag and label the samples for transport back to the Geology Lab. Depending on time, in the field, or follow-up in the lab, use your soil observation skills / tools to describe the soil samples for each increment. Refer to the soil-observation reference materials provided in the field guide. Fill in the table below.

Depth Interval (cm)	Color (moist)	Consistency (moist)	Texture	Other Observations

D. Soil Interpretation

Question 1: Table 2 below is a summary of soils data collected for marine surfaces throughout the southern Oregon region. By comparing your soils observations to Table 2, what is your best approximation of soil development stage for the Sunset Bay surface soil?

Question 2: Based on your geomorphic mapping, soil sampling, and review of the Coos County Soil Survey, what is the type of landform that you sampled at the north end of Sunset Bay?

Question 3: Explain how this surface formed? How old is this surface, i.e. the time since it was eroded and formed at sea level?

Question 4: Using your surface height calculation in 8 B above and age estimate, calculate rate of surface elevation change in mm/yr. Calculate again in meters / thousand years. Show all of your work.

Question 5: Is the Oregon coast at Sunset Bay uplifting or subsiding over time? What forces may be driving this phenomena?

Question 6: How does the Quaternary tectonic setting of the Oregon Coast relate to that manifested in the Tertiary bedrock outcrops and structured exposed on the beach at Sunset Bay? Are similar processes operating today as they did in the Eocene or Oligocene? What is your evidence one way or another?