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Eastern Korinthia Archaeological Survey

Instructions for Geomorphology Interns

by Lisa E. Wells and Jay S. Noller

Introduction

As geomorphology intern, you will be advising the survey team leader and creating high resolution strip maps of the geomorphology and land cover along the archaeological survey transects. Both of these tasks are essential to the relevancy of the archaeological data and the overall projects goals. This document will explain your anticipated field and office duties while working with EKAS. Please allow for flexibility as we work through the day to day functioning of the survey. We are in the process of creating a new way of collecting archaeological survey data and your help and advice will be essential as we proceed.

First a brief note about the chain of command. Tim Gregory, Daniel Pullen and Fritz Hemans are project directors and oversee the entire survey. Jay Noller and Lisa Wells (not in the field in 2000) are in charge of interfacing geomorphological studies with the archaeological survey. Richard Rothaus is in charge of computing and GIS, with Lee Anderson as Data Manager. Tom Tartarton is field director. You will predominantly be interfacing with Jay, Lee and Tom in your day-to-day work. When Jay is not in the field, Sarah King will serve as the head of the geomorphology team. Please address questions about the geomorphological data collection to Sarah first, and then get in touch with Jay via e-mail if the question remains unresolved. Lee will help you to get your daily printouts of the aerial photographs and orchestrate the entering of the data into the GIS. Tom will work to facilitate the interface between the Geomorph Interns and the survey crews. Tom will assign you to a crew and inform you of your work schedule.

In the field you are in charge of collecting geomorphologic data along your transect lines. The team leader is always in charge of deciding where the survey line will proceed and what fields or units will be surveyed. Your role in making these decisions is as advisor.

Goals of the project

The Eastern Korinthia Archaeological Survey seeks to construct a diachronic history of the cultural and physical landscape of Eastern Korinthia. To this end, an intensive high resolution archaeological survey of the region is planned. Because artifacts on the surface of the earth behave as sediment, to interpret the significance of these artifacts we must first understand what processes are acting upon them. Thus an integral part of the archaeological survey is understanding the geologic context of the archaeological data as it is collected.

We also seek to understand the geological implications of the long history of human land use in this region. The geological survey will provide the stratigraphic context for reconstructing the late Pleistocene history of physical landscape evolution (Fig. 1) that will then be interpreted in light of changing human land use. Artifacts and archaeological features serve as fossils for this part of the study, providing us geochronologic control at a temporal scale rarely available to geologists.

With the two pieces of the puzzle in hand (archaeological history reconstructed in light of landscape evolution and geomorphological history reconstructed in light of changing land use history) we can construct a long-term detailed historical geography of Korinthia. We expect that this history will underline the coevolution of culture and landscape in a way could not be achieved without a highly interdisciplinary study such as this.

First Principle

The EKAS universe is partitioned into landscapes of different temporal, spatial and cultural dimensions. This universe has one common unit for data sharing in its multidimensional array of landscapes—the unit of

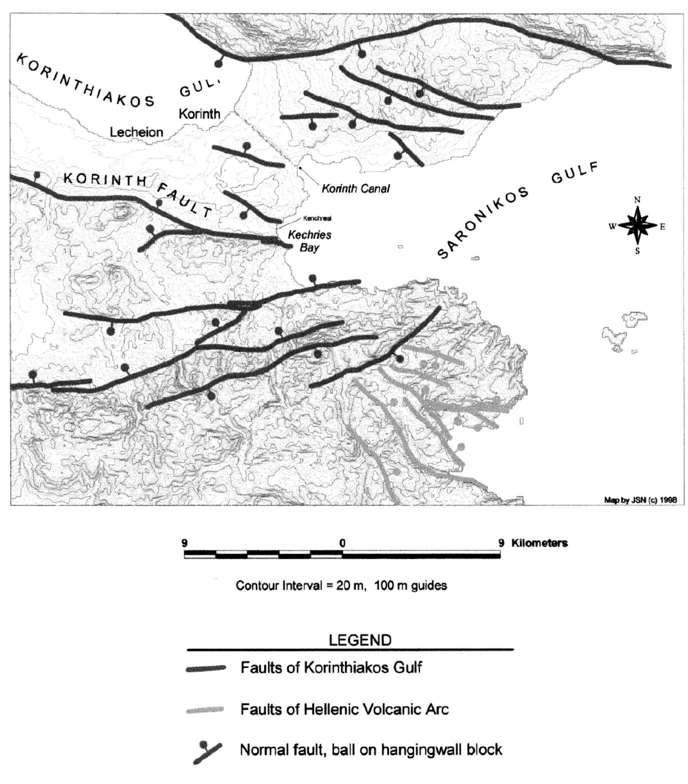

Figure 1. The dominant agency of extra-cultural landscape change is surface deformation associated with tectonic extension of the Korinth Gulf. This is a preliminary map of late Quaternary faults in the region (Noller et al., 1998).

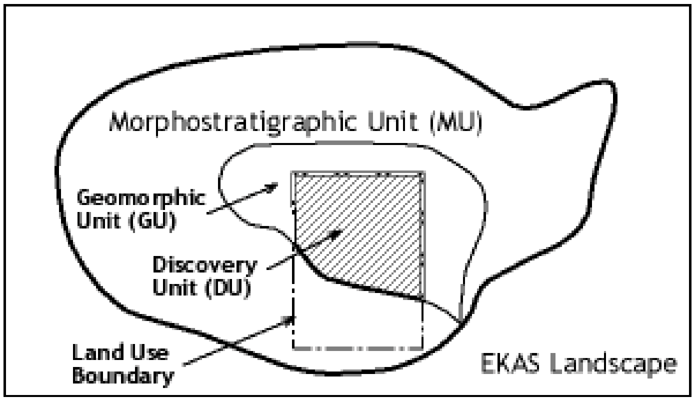

Figure 2. Schematic of the division of the EKAS universe into discrete, yet overlapping, data collection units. The 1:5000 scale geomorphologic map (morphostratigraphic unit shown here) and is a continuous map of the entire region. The archaeological survey units may be discontinuous, will proceed along transects and generally be no larger than a single agricultural field (shown as land unit). Geomorphology strip maps will be continuous along the transect lines, but discontinuous between those lines.

archaeological discovery or DU. As a Geomorph Intern you will be vanguard of the integrity of the DU by abiding by our First Principle of Field Survey:

> ***The field survey unit of archaeological discovery, the DU, is a subdivision of the field survey unit of geomorphological discovery, the GU.***

Yours is a crucially important role in this survey. Without you we will have a severely reduced level of knowledge of the context within which the archaeological record is being read. It might be said that the three most important things for archaeological survey are—*context*, *context* and *context*.

Field Work

We will be collecting data at a variety of scales during this project. Figure 2 provides an illustration of how we expect the relationships of the various spatial data to appear. Your primary mapping will be at the meso-scale, i.e. intermediate to the large scale of the archaeological survey and the small scale of the general geomorphologic maps. Jay has produced a 1:5000 map of morphostratigraphic units (MUs) across the entire survey area and beyond. You should use the 1:5000 map and study the aerial photographs to prepare you for your work each day. The archaeological survey crews will be gathering data at the individual field level (DU), collecting, describing and counting the number of artifacts present in each survey unit. The DUs will predominantly be individual agricultural fields, but when outside tilled land DUs may conform to your GUs. Your GUs will be individual pieces of the landscape that have formed by a single geologic process (e.g. alluvial or colluvial processes) during a discrete period of time. Generally, the MUs will be larger than your GUs, which are greater than or equal in size to the DUs. Ideally, the boundaries of the DUs will not cross the boundaries of GUs.

As geomorphology intern you will walk the landscape with the archaeological survey crews and create the high-resolution strip map of the transect. You will be working with the field crews, but roaming more widely across the landscape for your work. As an analogy, the geomorphologist is like a puppy taken out on a hike, the geomorphologist roams ahead and along side the survey transect, observing the broader region and sniffing out difficulties ahead, but always reporting back with regularity to the survey team leader. Your primary tasks are the following: 1) advise team leader about the surface conditions of the area to be surveyed; 2) create a high-resolution geomorphologic strip map of the survey area; 3) collect descriptions of the surface materials in the mapping units (fill out the geomorphologic unit form and describe details in your notebook); 4) enter the collected geological data into the computer as instructed.

Task 1) <u>Advising the team leader</u>. The geomorphology intern will follow the instruction of the team leader as to what areas to map and when to report back. As you work in the field and create your geomorphology map it is your job to report back to the team leader regularly to discuss data collection strategy in the anticipated survey area. To this end you need to be very aware of noting surface disturbance in the anticipated survey area such that as much as possible the archaeological data collected accurately represents the history of the surfaces studied and not modern redistribution of artifacts (by plowing or bulldozing).

For example, we have observed individual agricultural fields that have a thick layer of imported soil. This imported soil layer was indicated by a small patch of deep red (terra rosa) soil that extended just to the boundaries of the field. Surface survey without geologic information of that field would have been ambiguous at best, and more likely misleading about the land use history of the units as the collected artifacts would represent land use at some unknown distant location. We also anticipate that you will encounter fields that have been cut into bedrock with bulldozers, or that have had their surface materials redistributed by bull dozer activity. All indicators of this kind of recent landscape alteration need to be discussed in detail with the team leader.

You will also want to report back on the nature of erosion or sedimentation in the area. The team leader should be made aware of areas where surface sediments/soils have been stripped or buried during the Holocene. The team leader will then use this information to decide whether or not to proceed with the survey at that location or to adjust the survey collection strategy. As geomorphologist, you will be proceeding ahead of the field crew and noting the unexpected landscape modifications or hazards which may interfer with the survey. You will make the team leader aware of these problems as they arise.

Finally, while you are roaming be sure to make note of interesting cultural features in the surrounding landscape, but do not collect any artifacts. If a particularly rare or important artifact is encountered then you should flag the item with bright colored flagging and mark the location on the aerial photograph. The team leader can then decide what to do with that information.

Task 2) Create a high resolution geomorphologic strip map of the survey area. As you proceed with the survey on the transect you will create a high resolution geomorphologic map of the area. This map will be sketched onto the printouts of the aerial photographs in the field and archived with the EKAS data base. If you need to record point information (GPS coordinant, or sample localities) use a safety pin to poke a hole in the printout and record the information on the back of the printout (e.g. unit 2000; sample 1).

Your mapping units, or polygons, will become a layer in the GIS. Each individual unit must be given a number that you will write directly on the printout. The same number will be recorded on the geomorphologic unit form. The collected data will be entered into the GIS and database for later statistical analysis.

The polygons you draw will be our smallest subset of the morphostratigraphic mapping units. They should represent a single surficial process that acted over a discrete period of time. Typical examples are an alluvial terrace, a talus cone, or a gully. These morphostratigraphic units will generally have a fairly constant slope and the boundaries between different units will commonly occur at breaks in slope angle or aspect. For example, the contact between a colluvial unit and an alluvial unit commonly occurs at a marked decrease in slope (colluvium is generally deposited at a much higher slope than alluvium) and a change in aspect of the surface from a dip parallel to the gravitational gradient – i.e away from a topographic high – to a dip parallel to the hydrologic gradient – i.e. parallel to the average path of the river channel. Use a pencil to sketch in the boundaries between these units and use the shorthand sheet to help you decide how to classify the unit.

For most of the area, your geomorphological units (GUs) will be larger than the archaeological units of discovery (DUs), but this will not always be the case. If geologic conditions are changing at a finer scale than the archaeologists are sampling, record that information on your sheets and in your field notebook. Ideally, GUs and DUs will not cross boundaries. That is, DUs will be confined to a single GU. It is your job (Task 1) to advise the team leader on changing conditions such that these problems may be avoided. However the team leader makes the final decisions as to where the survey units will be collected. The ultimate constraint for the scale and area of your mapping is based on the rate of progress of your survey crew as you must cover more territory than they do. You should also keep a running log of the correspondence between the GU numbers and the DU numbers for cross reference and in case of any problems that might arise when entering the data in the database.

We expect that the most common morphostratigraphic units you encounter will be alluvial, colluvial or littoral landforms. The survey area is characterized by modern streams and hillslopes superposed on a sequence of uplifted and tilted marine platforms with associated sediments. The alluvial deposits commonly form fans as they emerge from the hillsides. You will observe that channels change form along their lengths from being entrenched or incised as they emerge from the mountain front (at the fan head) to being distributary and depositional at the toes of the fans. This results in a morphology typical of desert environments: at the fan head alluvial terraces are steepest and the highest surfaces are the oldest, while on the plains the terraces are buried by younger deposits and the landform is aggradational rather than incising. You will need to to create different polygons for these units as they change character across the landscape.

Collect relative age information and identify sections for further study as you proceed. As part of your geomorphologic mapping you should classify surfaces by relative age, numbering surfaces within a drainage with 1 for the youngest and increasing numbers with increasing relative age. These numbering systems should be coherent for any drainage basin or subdrainage basin and may or may not correlate regionally. All regional correlations will be the responsibility of senior staff, but you should collect any data that seems relavant to that task (soils, weathering characteristics, fossils). Make note on your printouts of the photographs as well as in your notebook of any exposures or stratigraphic sections that would help determine timing and nature of geomorphologic evolution of the region.

In addition to the more common landform types, we have included terrace risers (the steeper slope between terrace treads) as a separate mapping unit. The risers will separate alluvial, colluvial or marine units of different ages. In a marine sequence the riser is the paleoseacliff, in an alluvial environment the riser is is the paleo-cut bank, and in a colluvial environment the riser is the gully wall. These units may be numbered in sequence with the colluvial or alluvial numbering (Qcr_1, Qcr_2… Qcr_{10} youngest to oldest).

The only morphostratigraphic units that will be mapped as lines are faults. Please mark them on your map and in your notebook record the information that led you to classify the lineation as a fault (the nature of the disturbed materials, what units were disturbed, any information on the nature of fault movement). You may give a unit number to a fault if appropriate. Please note if there are exposures of the fault and if so the relative ages of the materials that are displaced.

As you proceed keep a field notebook in which you describe the deposits and units. Provide as broad a description as possible. Provide more detail than average if you are having trouble classifying a unit. For example we expect that there will be difficulty distinguishing between kafkalla (Stage 4+ pedogenic carbonate), Pliocene and Quaternary Marine sediments, and Lower Cenozoic/Mesozoic Limestones. Any time you are having problems classifying materials, then revert to a description classification in your field notebook. With the carbonate rocks/seds/soils you will want to describe nature of the carbonate cement (how are the clasts held together), any lithologic variability or sedimentary structures observed (i.e. the nature and organization of clasts), and fossils observed and their organization within the sediment. This will go a long way in helping us decide a final classification for the unit. Be sure to use the geomorphologic unit numbers to identify the locations described in your field book. Your field book (supplied by EKAS) will be the property of EKAS at the end of the project.

Geological samples should only be taken in rare circumstances. Whenever possible, substitute generous descriptions or photographs for samples. You may sample soil or bedrock where you require advice on unit classification, but please do so sparingly. We do not want to amass a collection of rocks, sediments or soils from the survey units as we have no way of dealing with such materials. Samples you collect will need to be disposed of appropriately, see Tom Tartaron or Jay Noller for advice on this. The senior scientists will be sampling particular sections for specific purposes and you may be involved in this work if time permits. Anytime a geologic sample is collected, make sure to note the unit number (both geologic and archaeological survey unit if appropriate), your name, the date, and a brief description of the locality on the sample bag. Mark the point locality on your printout. Ziplock bags will be available, use a permanent ink pen (Sharpie or the like) to write on the bag.

Task 3) <u>Fill out the EKAS Geomorphology Unit form</u>. For each polygon you draw on your strip map, you will designate a unit number and fill in the requested information. The EKAS Geomorphology Shorthand form gives you the abbreviations and symbols to be used in each of the data fields. You may use commas to separate abbreviated terms if more than one applies (atypical situation). These abbreviations will become simple once you work with them for a while. For each geomorphological unit you will enter the following information:

Geomorphologic Unit number: Numbering system to be established by Tom Tartaron.

Location: A short description of location, e.g., 1 km NW of Isthmia.

Air photo number: The unique identifying number on the aerial photograph.

Bedrock: There are not many different bedrock types here (Pliocene Marine sediments; Lower Cenozoic-Mesozoic Limestones; Metamorphic Basement). If the Quaternary sediments are thick enough that you cannot easily determine what the bedrock type is, then enter unknown in this field.

Morphostrat: This is the primary Quaternary mapping unit. You will need to consider surface form, processes, and lithology to help determine the nature of this unit. This will be the same designation that you made in Task 2, refer above for more information.

Disturbance: This category gives us a classification of modern land disturbance and an assessment of the likelihood that the artifacts are *in situ*. The choices for this category are *scrape* (surface soil or deposits have been removed from site by any process), *dozed* (surface materials redistributed by bull dozer pushing of surface material around unit), *cut* (surface has been cut by machinery into bedrock), *import* (allocthonous soil buries primary surface), *compost* (allocthonous soil amendments plowed into local soil).

Erosion: Description of active erosional landforms affecting surface. *Rills* are defined here as being less than 50 cm deep (measured vertically), *gullies* are deeper than 50 cm. If there are both rills and gullies just write gully as that is the larger, more eroded landform that by definition has rills feeding it. You may write both (i.e., rill/gully) in unusual circumstances, annotate in your field notebook why this was necessary, e.g. the surface had distinctly different erosional characteristics along its length. *Bound* refers to a surface that has active gullies or channels on one or more of its boundaries and that may be eroding from the sides. *Absent* for a surface without active rills or gullies, and ND for no data.

Stability: This classification will give us a measure of how much surface soil has been lost at any given site. You will need to estimate how much of the A horizon is present on the surface, if 70% or more of the surface has intact A horizon then classify the surface as *stable*. If over 30% of the A horizon has been removed then classify the surface as *unstable*. If the A horizon has been removed and subsurface soil horizons are exposed at the surface, then classify the surface as *erode*d. If all suface soil and sediment has been removed and bedrock is exposed, then classify the surface as *strip*ped. Surfaces that are actively depositional (e.g. lakebeds, deltas, floodplains) receive the classification *dep*. Human made surfaces are *cons*tructed. And finally, if the stability varies greatly over a very fine scale you may use the classification *mix*, however it is preferable to break your units into smaller homogenous units rather than use this final classification.

Soil Color: Use the Munsell color chart and take an average color for the exposed soil at the surface.

Soil Texture: Use the USDA texture class triangle at the bottom of your shorthand sheet.

Soil Carbonate: Follow the classification in Table 1. Review Birkeland for descriptions, as soil carbonate accumulations are very important indicators of relative age of a surface. The problem in Korinthia is that lithified bedrock may look like an old carbonate soil horizon. You may amend a question mark (to this or other designations as well) if you are unsure of your classification. Please take adequate notes on why you were unsure of your classification.

Land use: This data will be used to create a separate GIS layer of land use/land cover. The descriptors are largely botanical and self explanatory with the addition of built or industrial areas.

Sample: Note if samples were taken and a brief description of the sample. Make sure to record the unit number, your name, date of collection, and brief description of locality on the bag.

Afternoon/Evening Office Work

Task 1) GIS Inputs. As mentioned above you will be expected to have printed out the copies of the relevant aerial photographs in the evenings and reviewed the stereophotos and map of the area to come. As we will have only one stereoscope, you will need to coordinate your time with the other geomorphology interns. Work with the survey team leader in printing and choosing photographs for the next day.

Task 2) Enter the collected geological data into the computer as instructed. Richard, with Lee, will coordinate computing and GIS work for EKAS. They will instruct you as to your responsibilities for data entering and management.

TABLE 1. MORPHOLOGICAL CLASSIFICATION OF SOIL CARBONATE FOR EKAS GEOMORPHOLOGY.

Stage	Gravelly Parent Material	Non Gravelly Parent Material
Ka	No pedogenic carbonate	No pedogenic carbonate
K1	Thin to many clast coatings, filaments, and calcareous matrix next to stones	Few to common filaments and grain coatings.
K2	Continuous clast coatings, local cementation of clasts, matrix is loose but slightly whitened by carbonate.	Few to common carbonate nodules and vein lets, matrix between nodules is whitened by carbonate.
K3	Carbonate forms a nearly continuous medium and coastal all clasts thickly. Color is mostly white and carbonate rich layers are present.	Many nodules and carbonate coasts many grains, 90% of horizon is white. Most grains are coated by carbonate.
K4+	[Both parent material types] Upper part of horizon is pure cemented carbonate with weak to strong platy structure and laminar deposition of carbonate. The soil may have lost its surface horizons as the K horizon forms a burial to infiltration and surface flow is enhanced.	
Ku	Unknown at geomorphologic unit	Unknown at geomorphologic unit