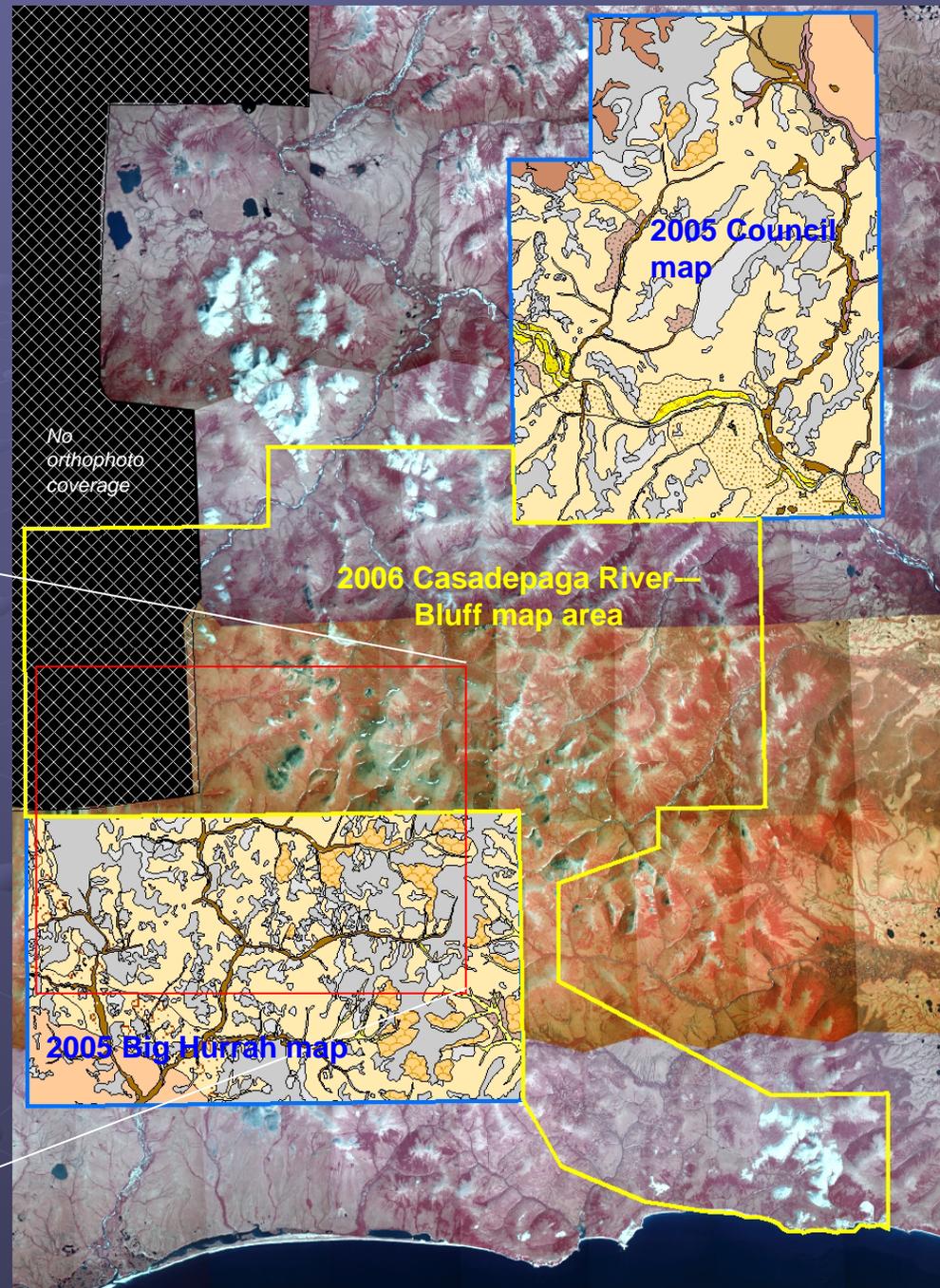
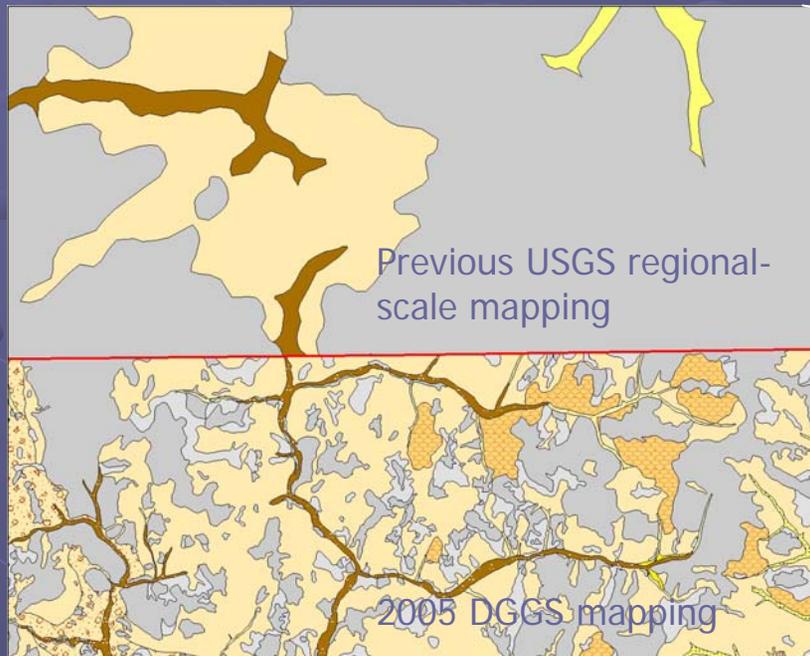
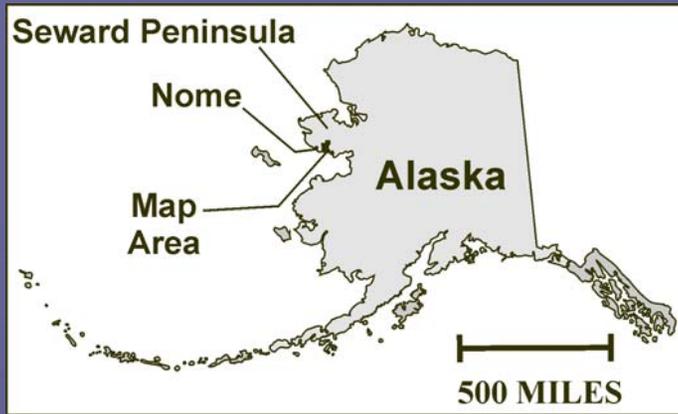


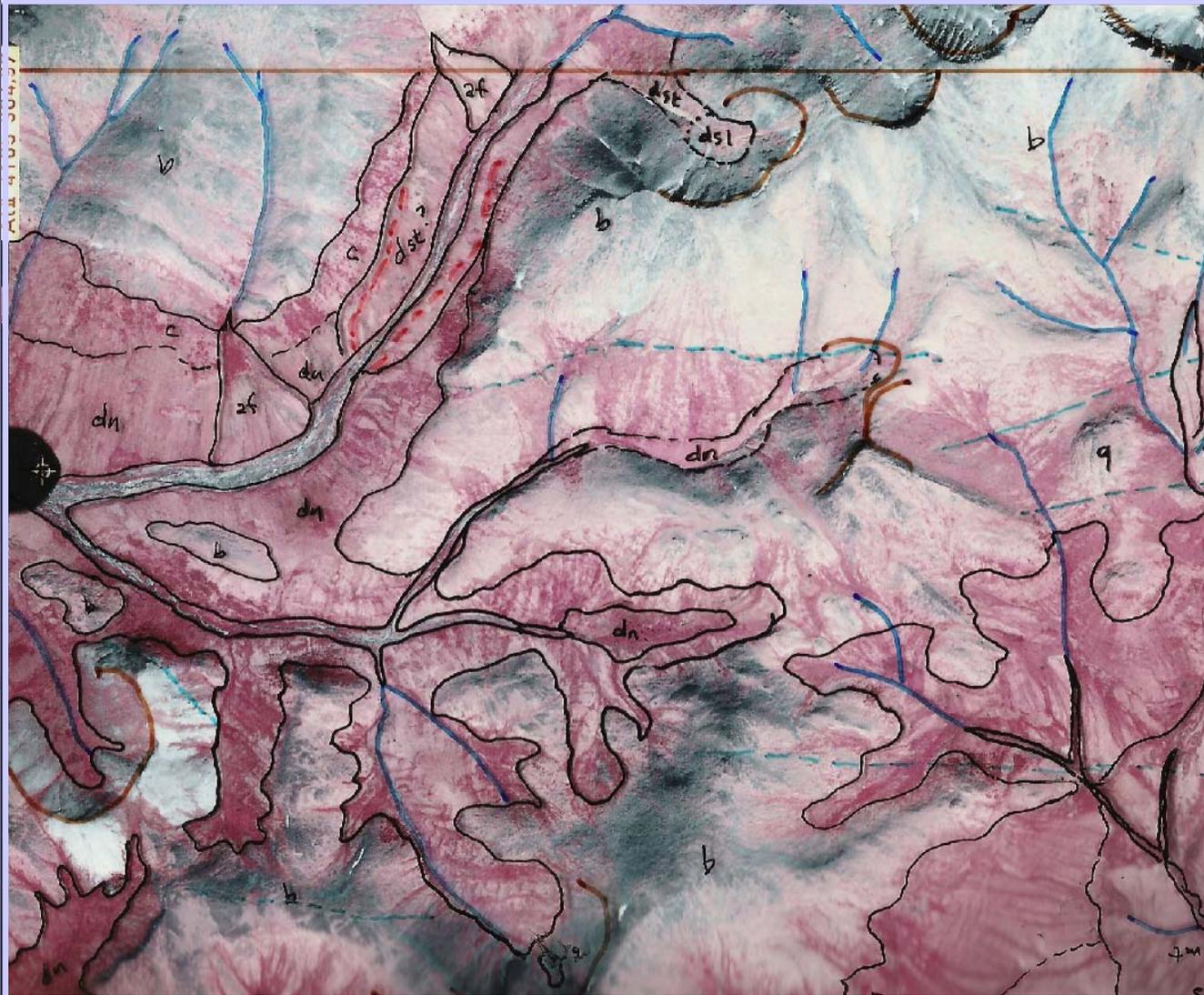
# Softcopy Photogrammetry: Assessment for GIS-based Geologic Mapping Applications

De Anne S.P. Stevens



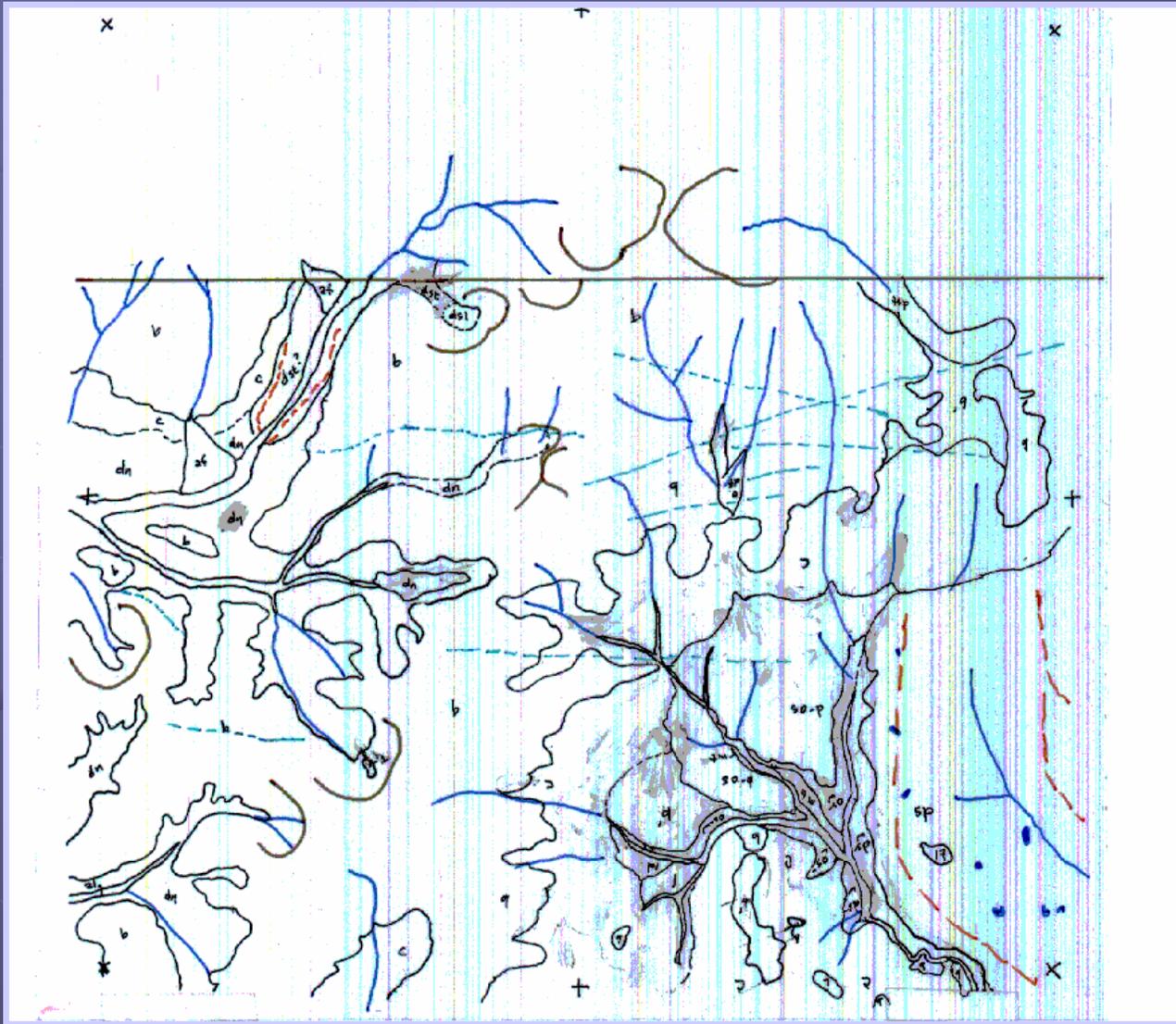


# My Workhorse: Air Photo Interpretation of Stereopairs



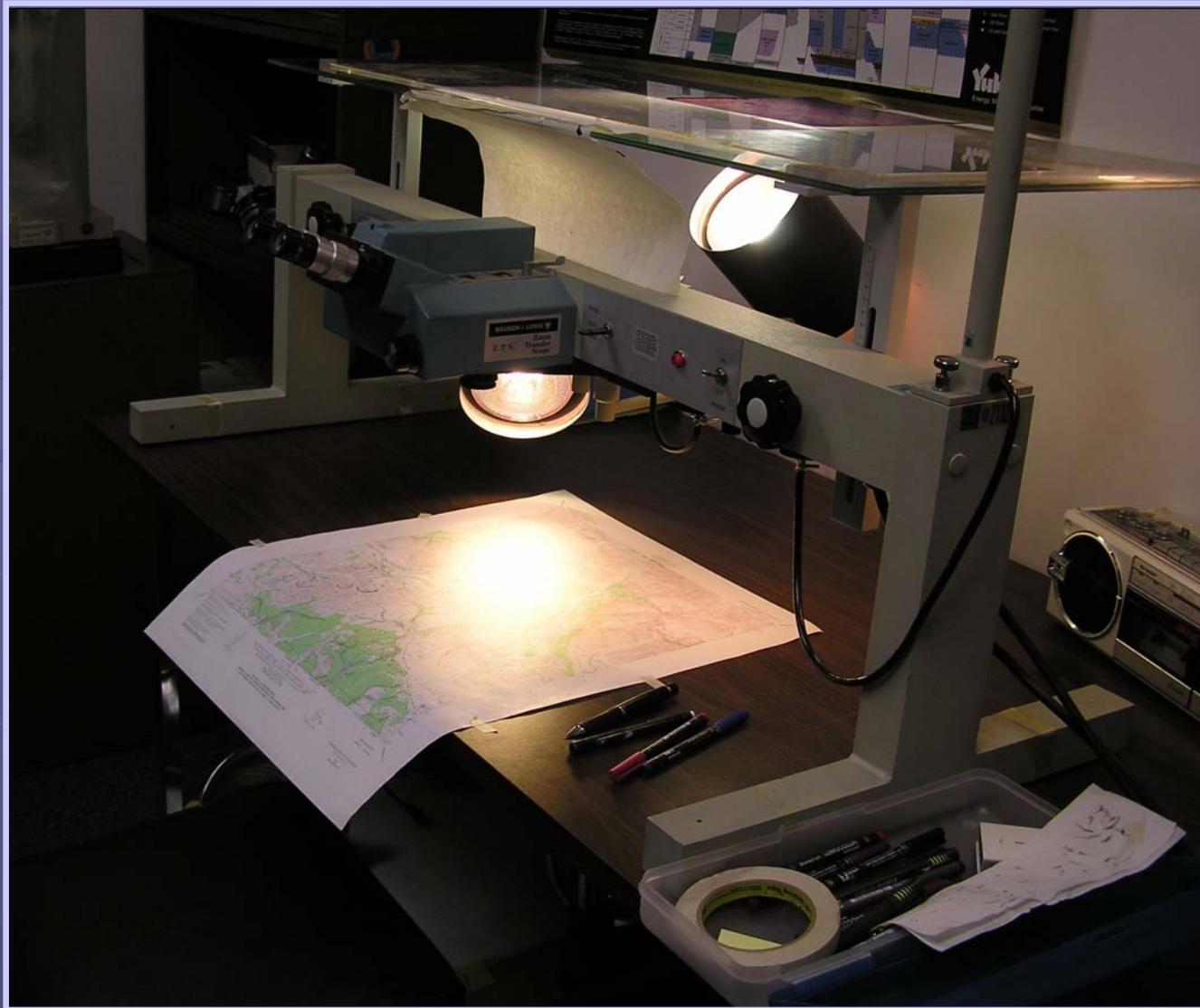
- Cheap
- Available
- Appropriate scale
- CIR
- Stereo

# Photointerpretation Overlay



How do we get to a GIS map from here?

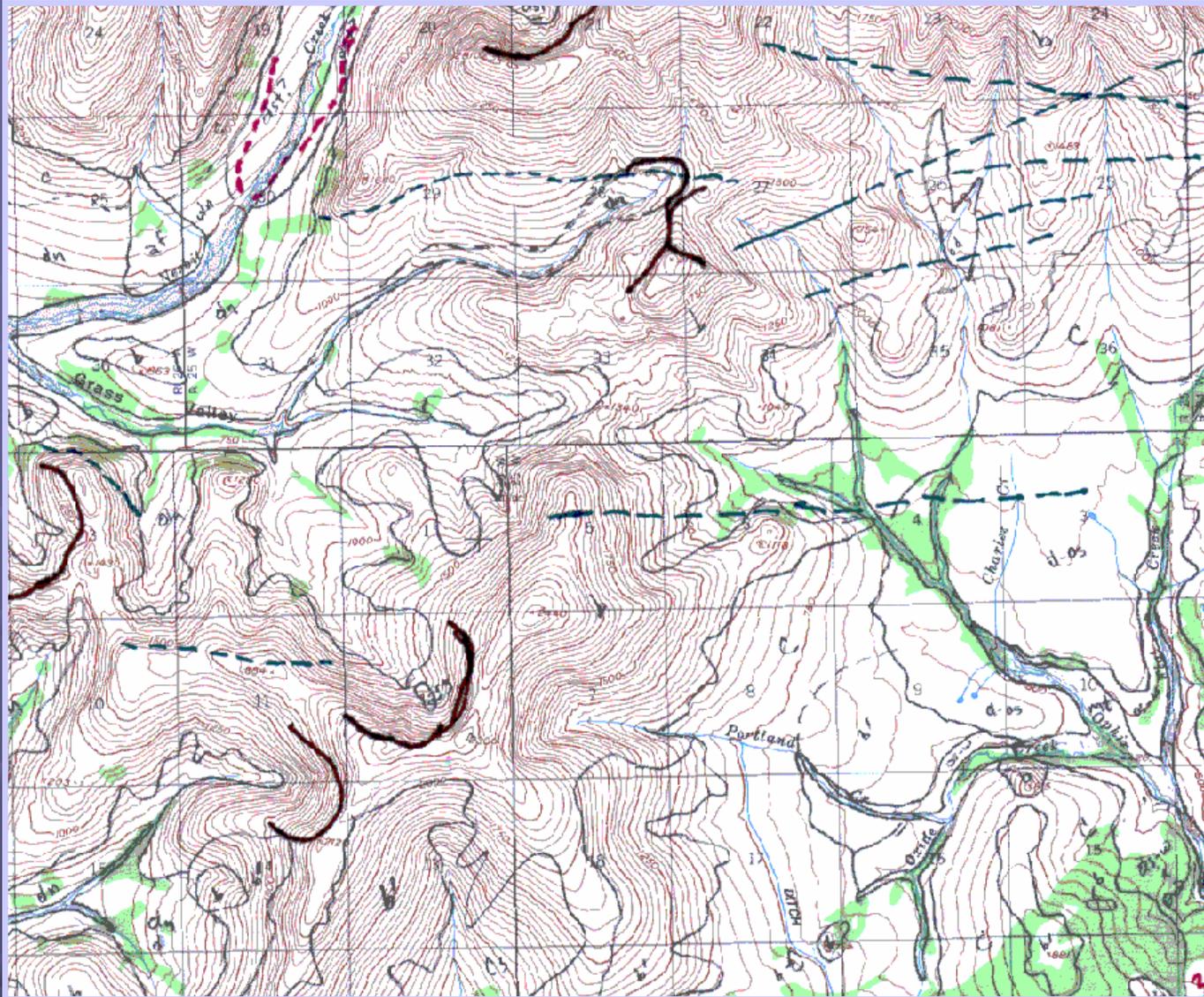
# Bausch & Lomb Z.T.S. 2006!



“Nearing”  
extinction...

# Zoom Transferred Contacts

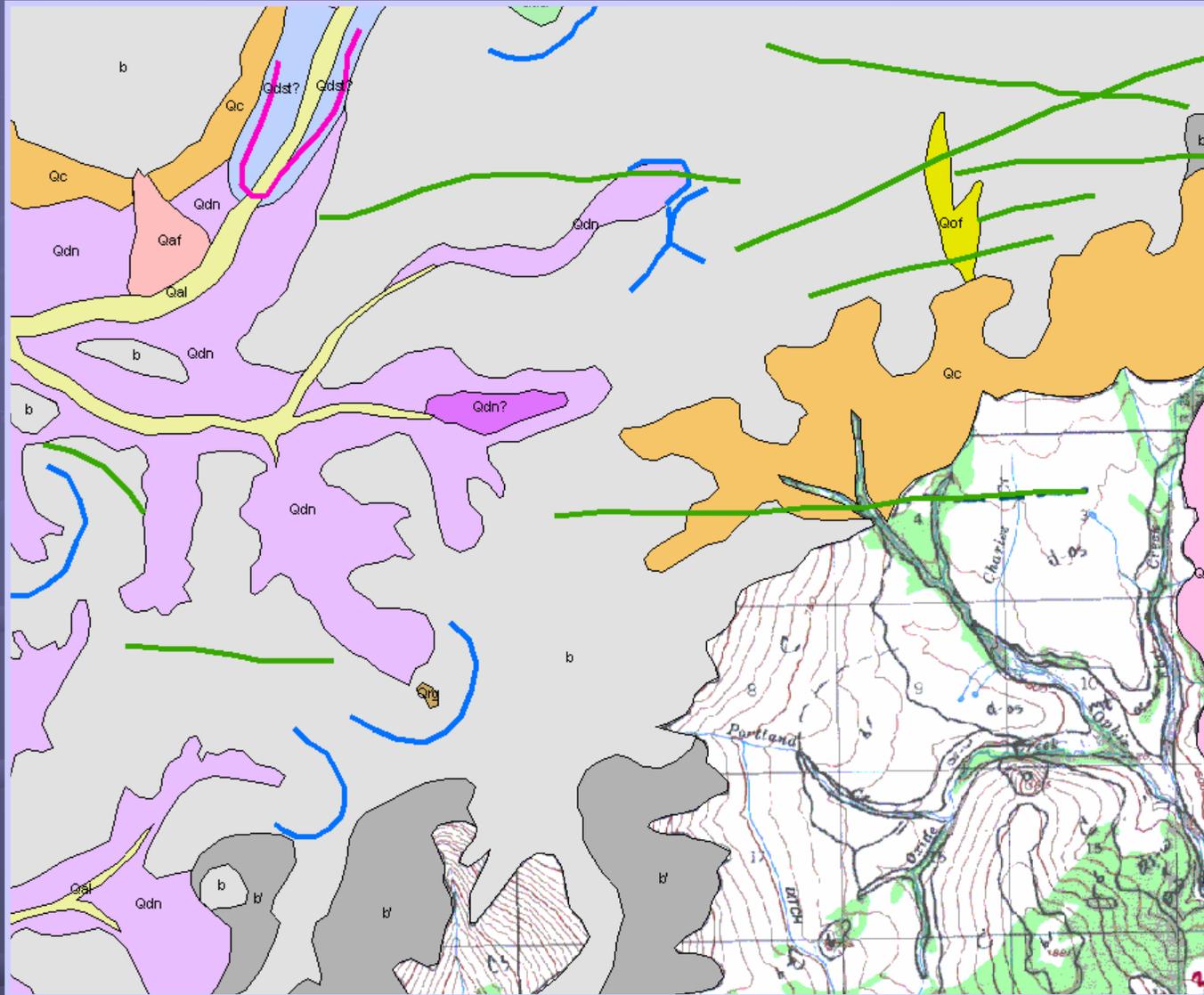
*(on paper map)*



Retrace...

# Digitized Geology

(digitizing table or scan/register/heads-up)

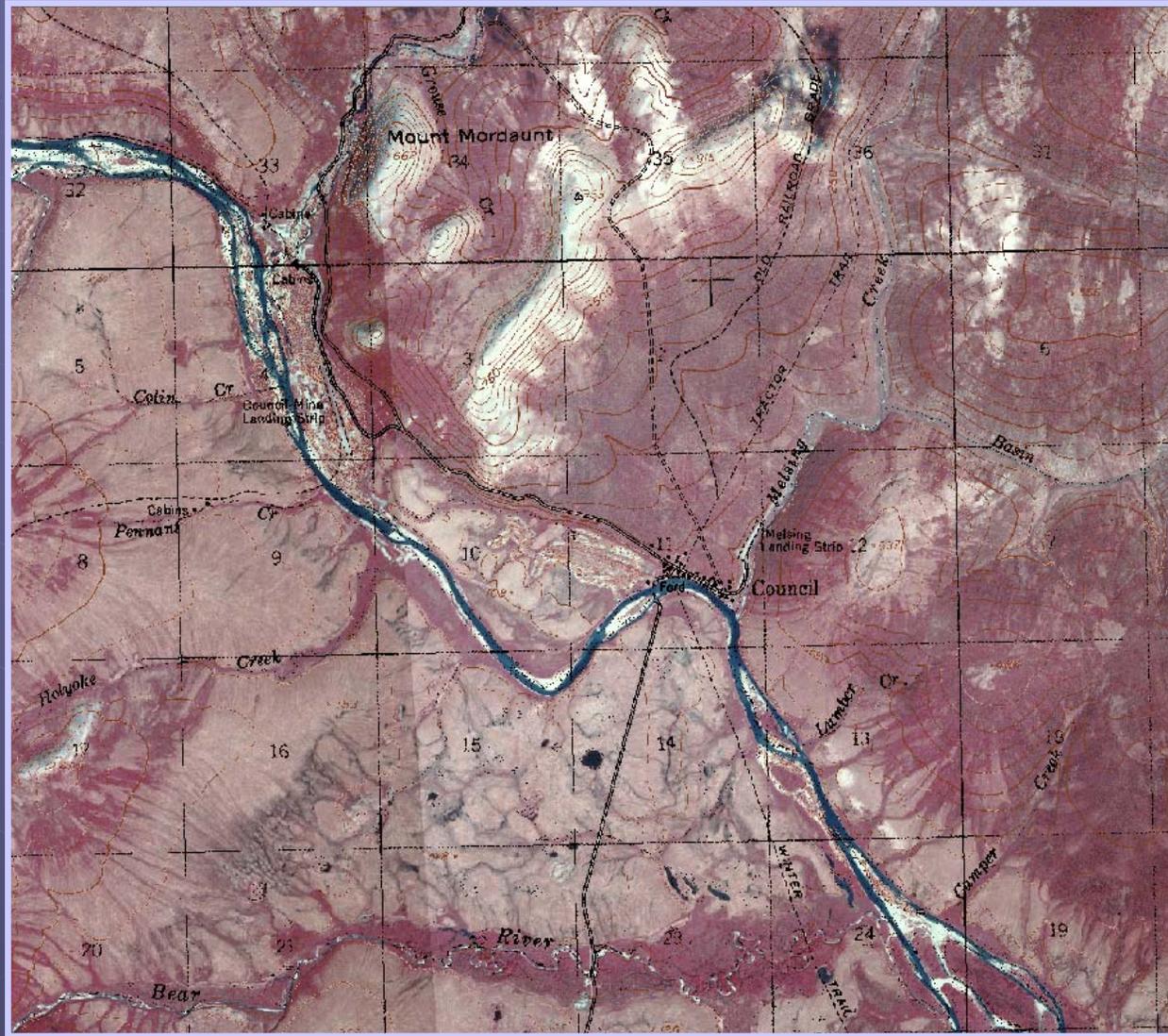


Retrace  
again!

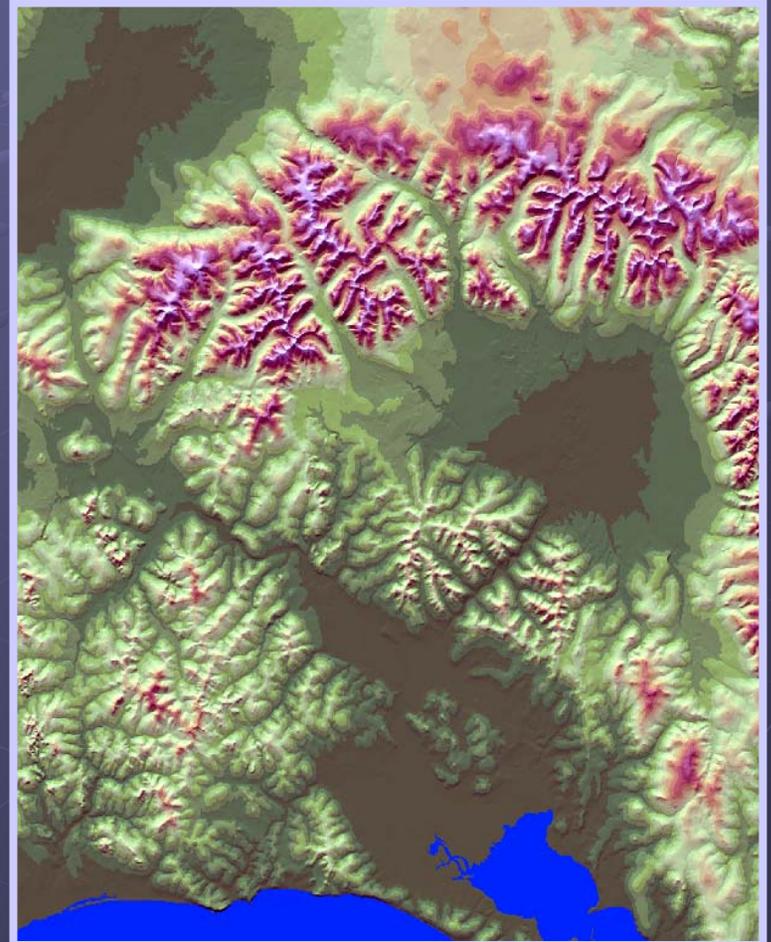
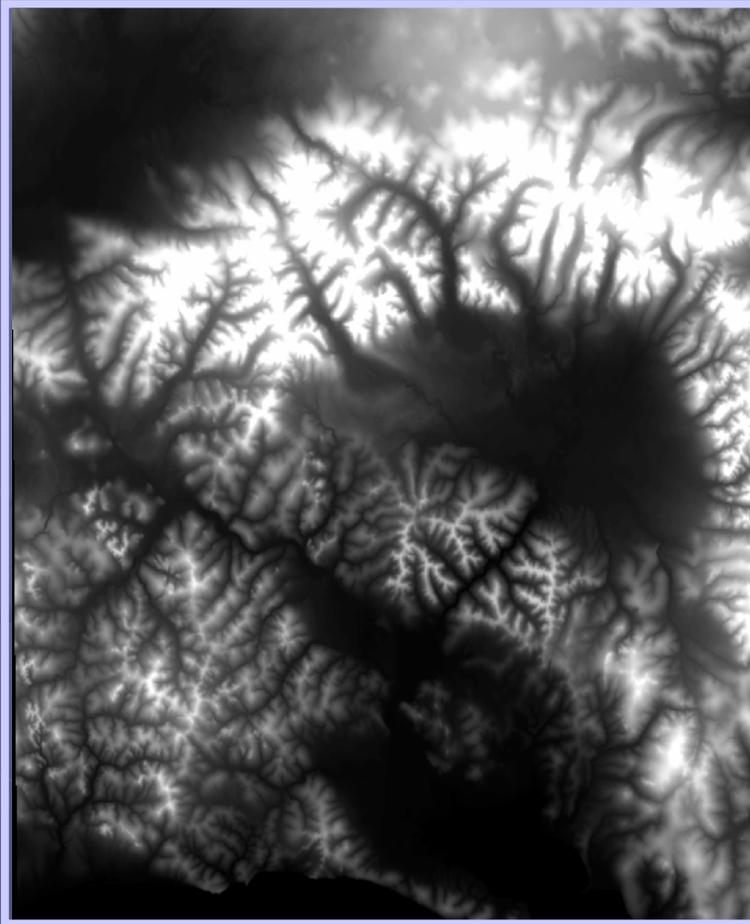
# Digital Photogrammetric Methods



# The Key: Digital Orthophotos (distortions are corrected)



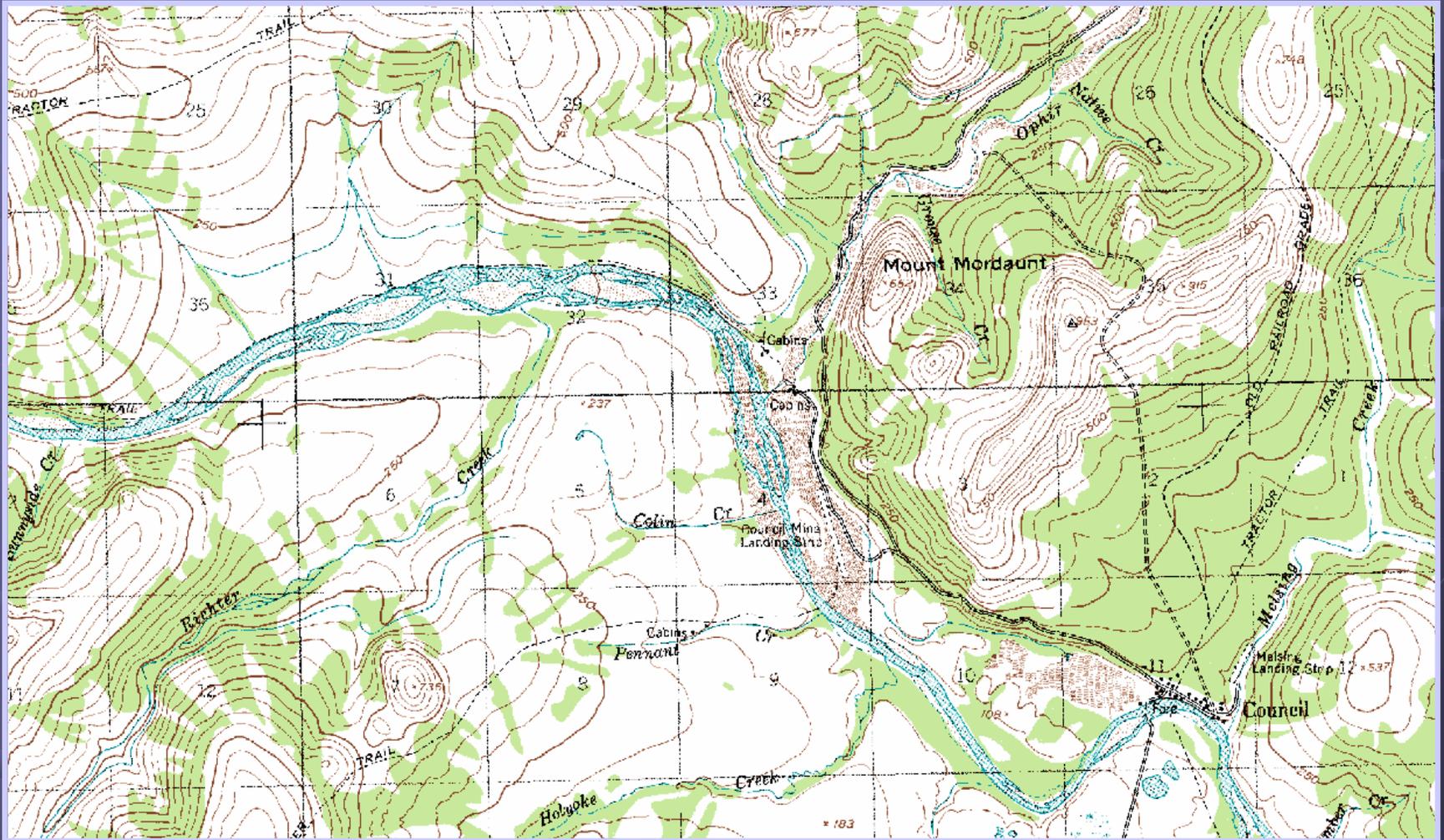
# Need: DEMs



USGS National Elevation Database (NED)

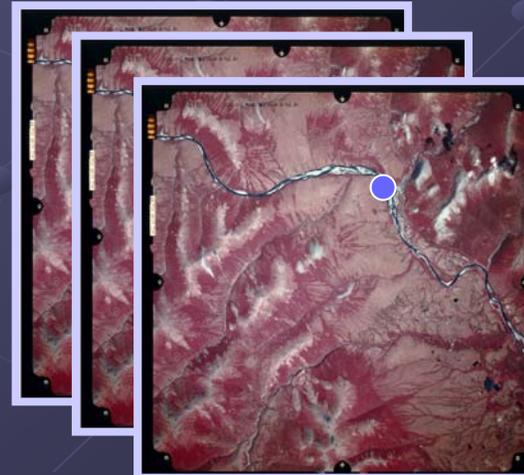
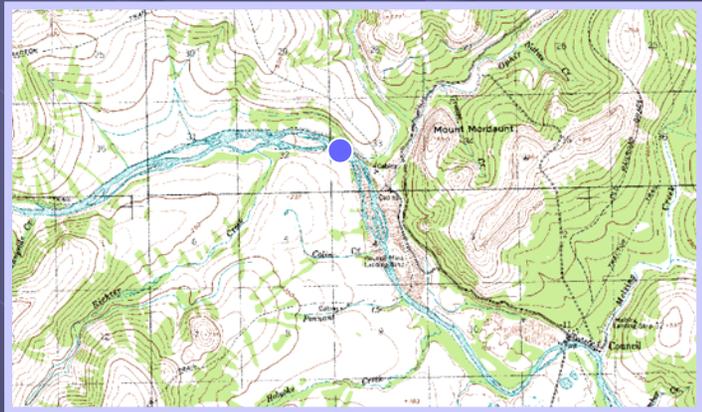
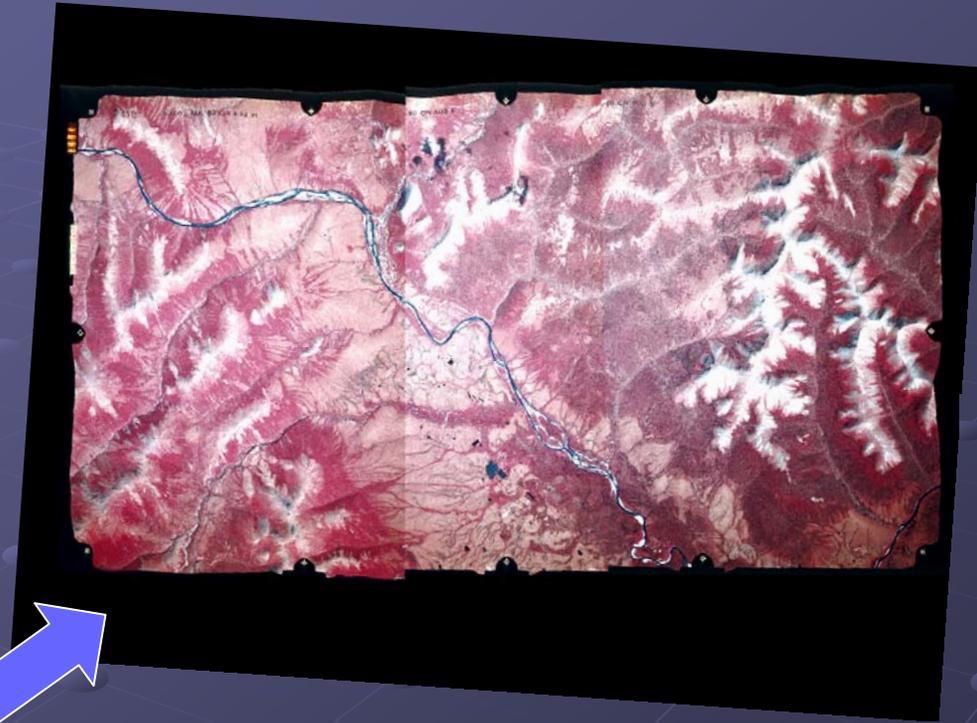
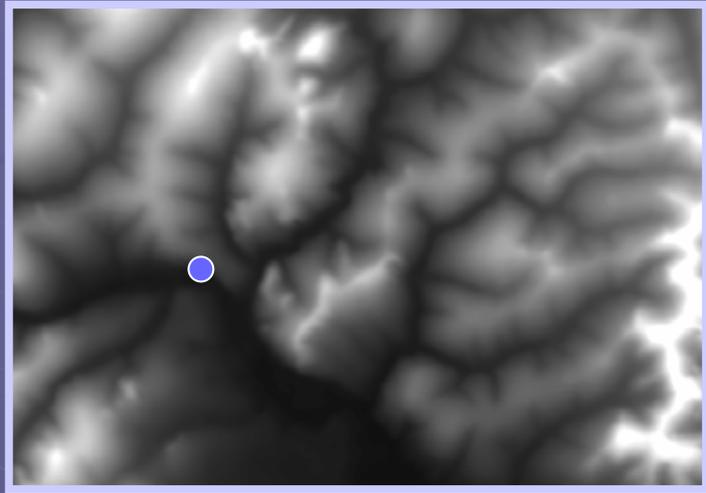
- 60 meter resolution

# Need: Georeferenced Digital Topographic Base Map (DRG)

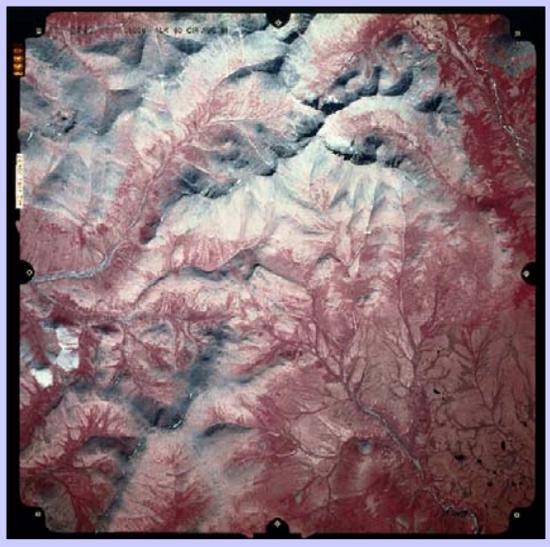


(in the absence of existing orthophotos or other digital image base)

# Digital Orthophoto Process

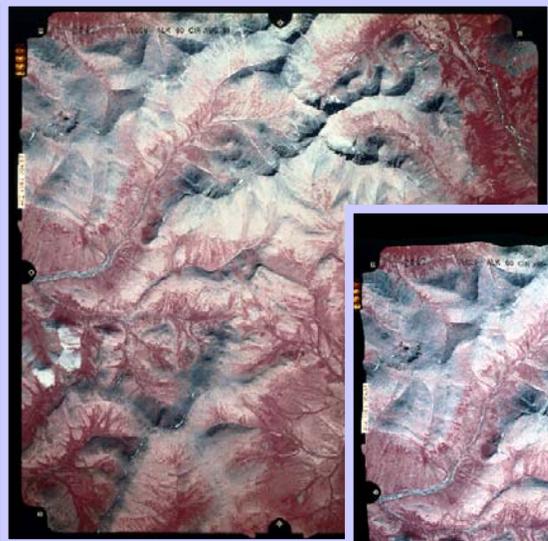


# The Connection: Co-Rectified Overlays for GIS

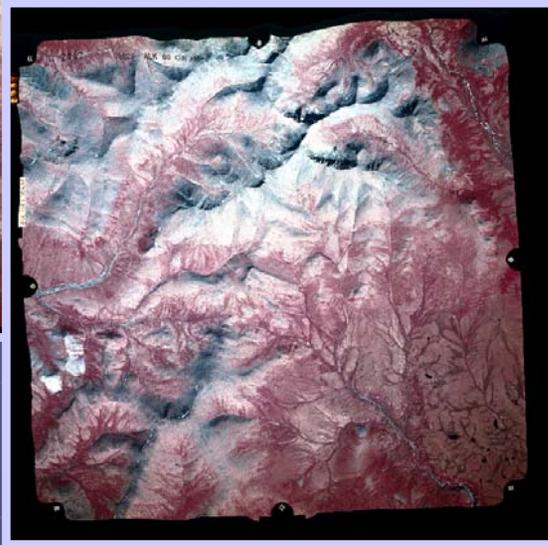


Original photo

# The Connection: Co-Rectified Overlays for GIS

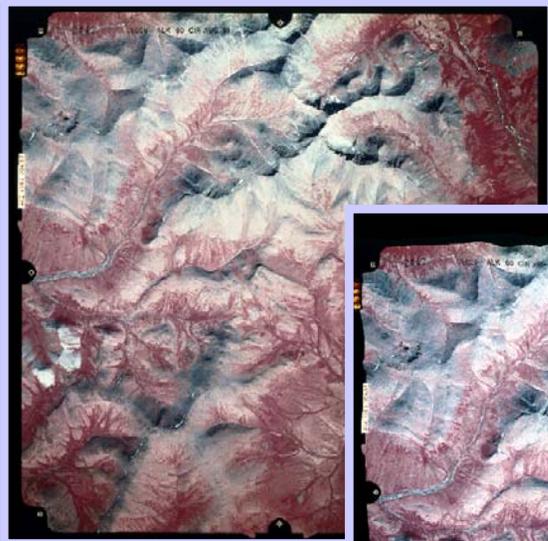


Original photo

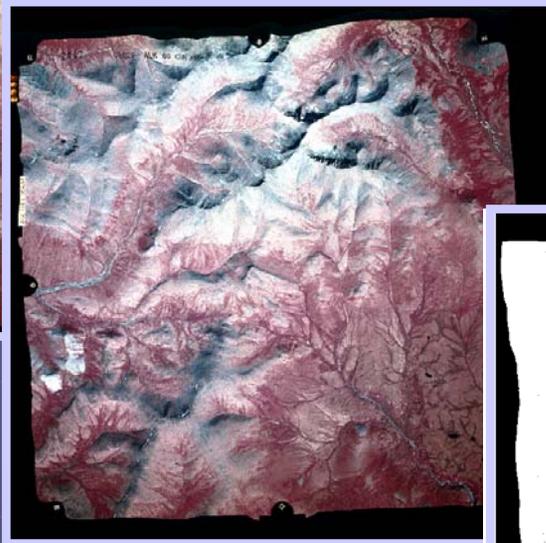


Orthorectified photo

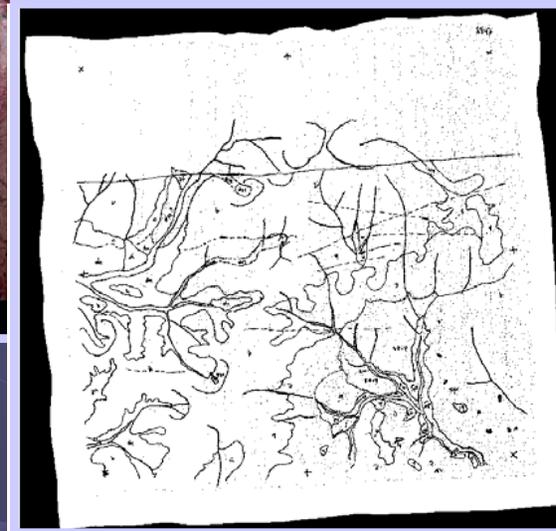
# The Connection: Co-Rectified Overlays for GIS



Original photo

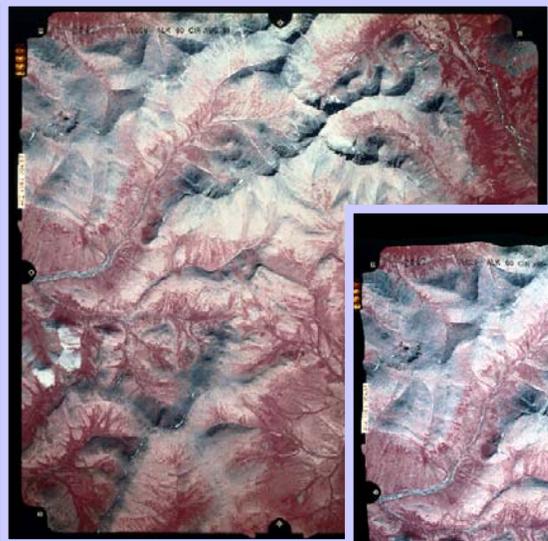


Orthorectified photo

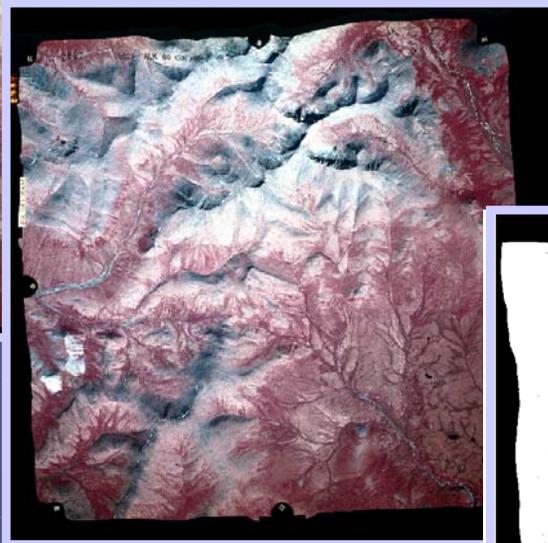


Co-rectified overlay

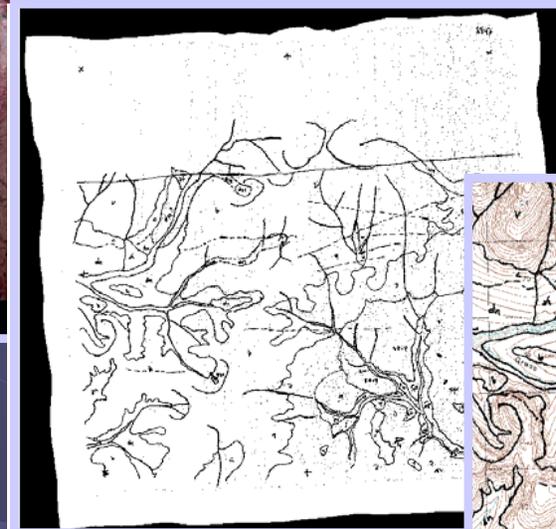
# The Connection: Co-Rectified Overlays for GIS



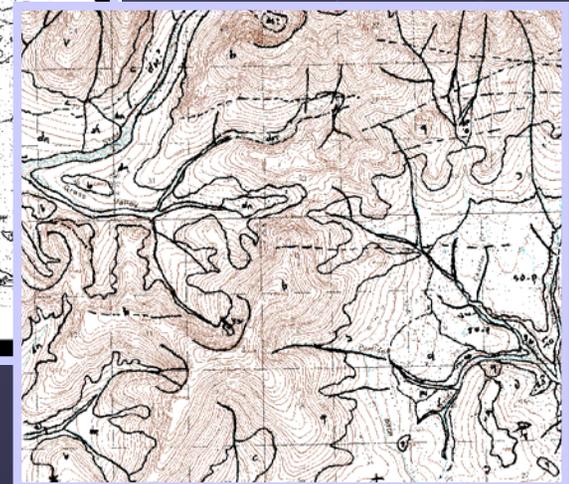
Original photo



Orthorectified photo



Co-rectified overlay



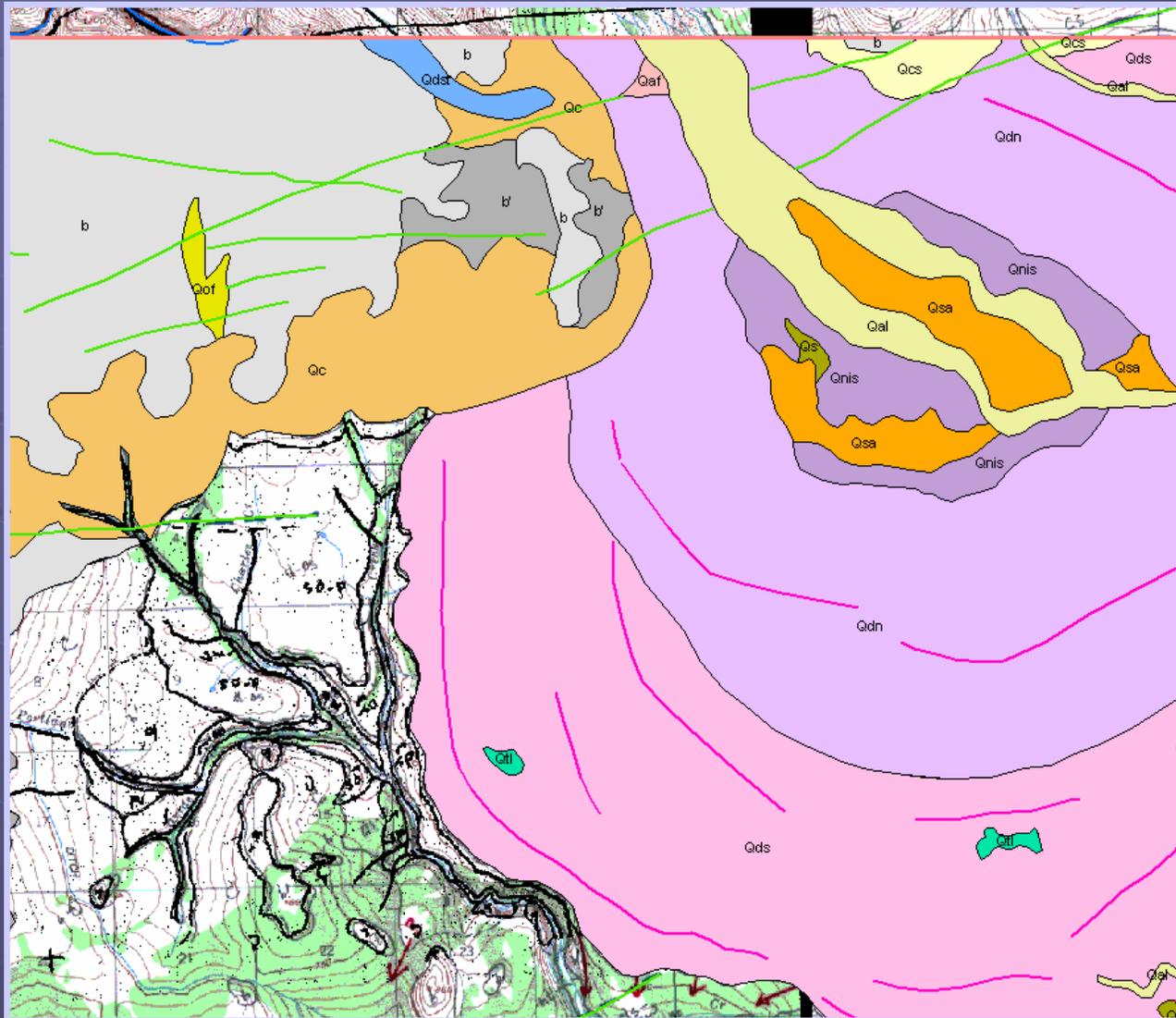
Overlay on topographic base



# Orthorectified Overlay



# Digitizing: Orthorectified Overlay



Only one  
retrace!



Results

Efficiency

	<b>Time (hours)</b>
<b>Zoom Transfer Method</b>	
Zoom transfer	5.0
Scan transferred maps (4 sheets)	1.0
Georeference scanned maps (4 sheets)	2.0
<i><b>Total for entire area</b></i>	<i><b>8.0</b></i>
<b>Digital Photogrammetry Method</b>	
Scan overlays (5 total) and transfer files	0.5
Set up directory and file structure for projects	0.5
Interior orientation (14 photos)	2.0
Orthorectify overlay	1.0
Resample photo, crop overlay, convert file formats	0.5
Generate single orthophoto and rectified overlay	0.1
<i><b>Total for entire area</b></i>	<i><b>5.0</b></i>

*Times required to transform photointerpreted geologic data hand-drawn on acetate overlays to digitizing-ready digital format.*

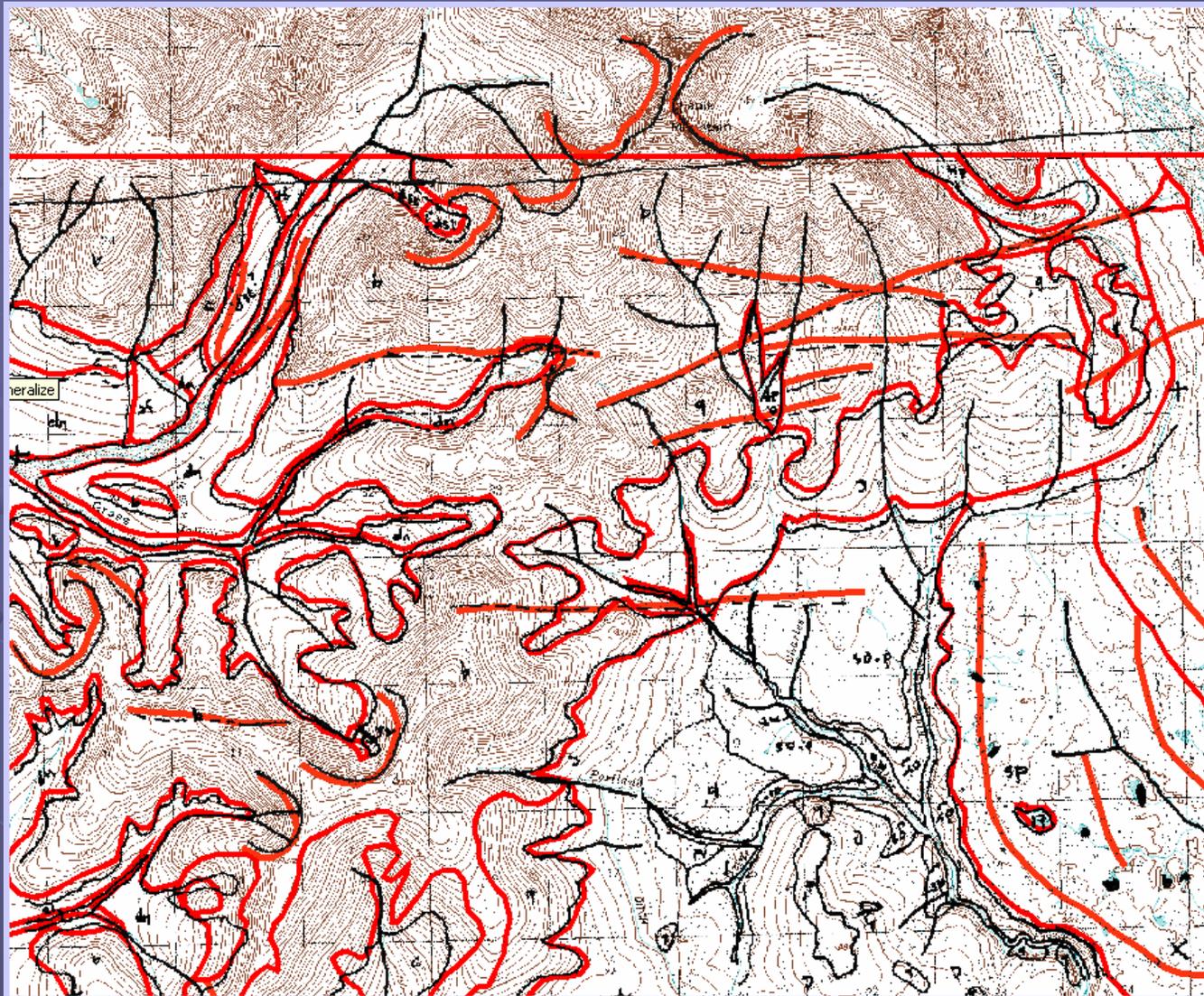
*Time includes man-hours only, not computer processing time.*

*Digital photogrammetric method drops one iteration of line tracing.*

# Results

Accuracy

# Z.T.S. vs. Ortho-overlay

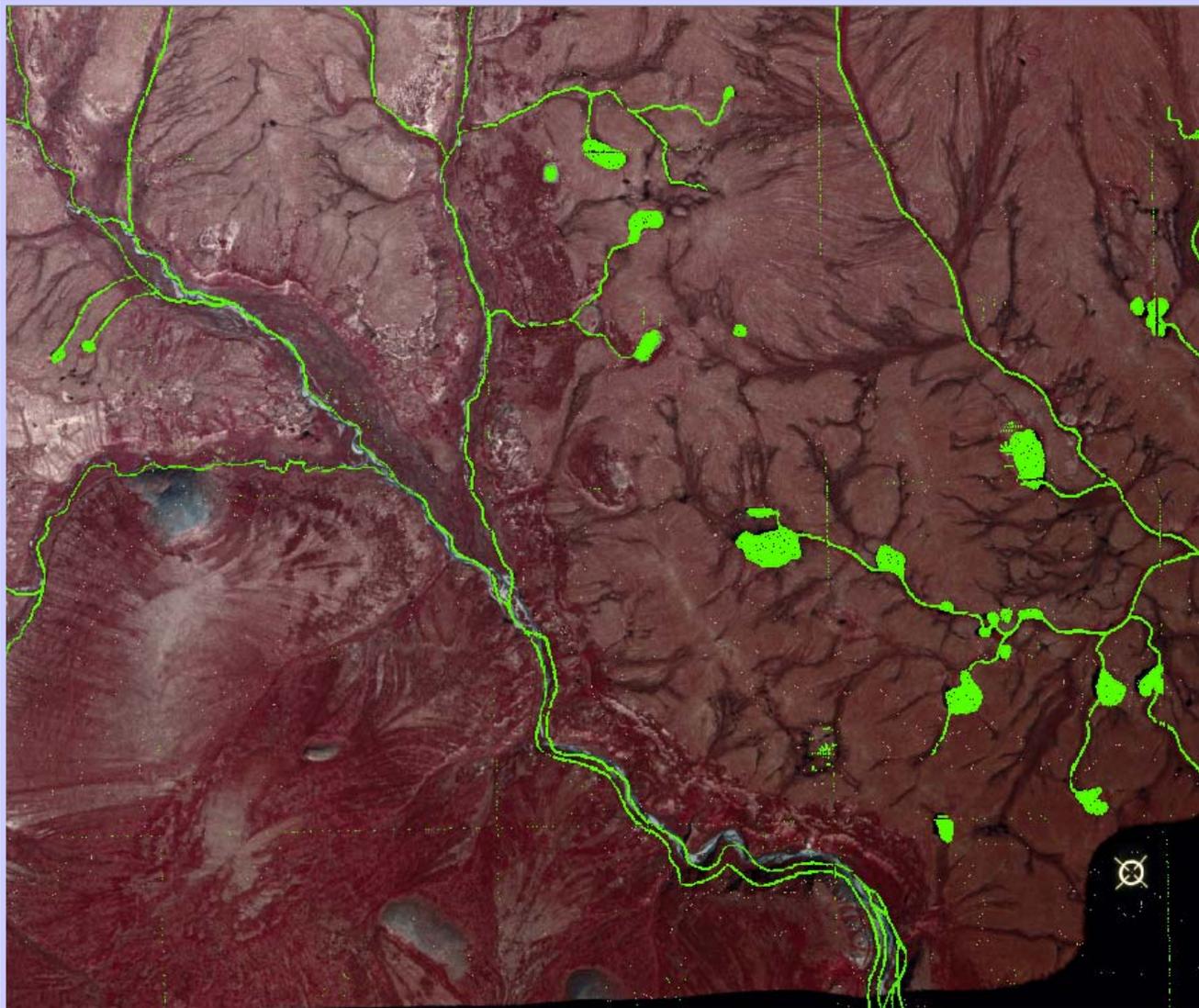


Red – zoom transfer  
linework

Black – ortho-overlay  
linework

Measurements taken  
using GIS tools show that  
some of the offsets are  
as great as 175 meters  
on the ground.

# Orthophoto and DRG



Green – hydrography  
from topographic DRG

Lakes generally line up  
quite well.

Many of the streams also  
line up well, but others  
are significantly  
mismatched.

Ophir Creek is  
particularly mismatched  
in the lower quarter of  
this orthophoto where it  
enters a canyon.  
Mapping that is digitized  
exclusively from the  
orthorectified overlay  
would be unacceptable in  
this area.

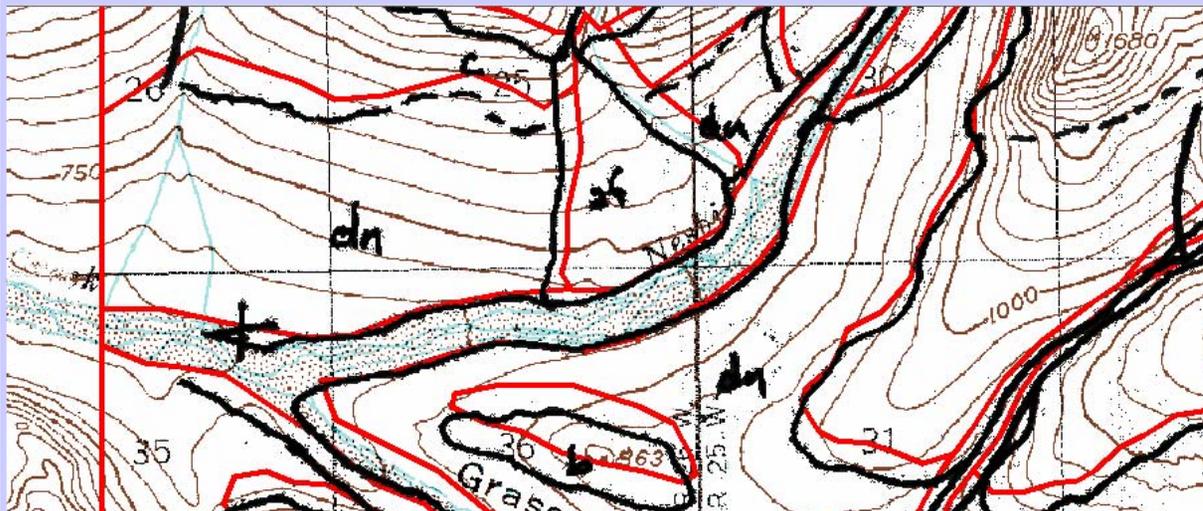
# Z.T.S. vs. Ortho-overlay



Red - zoom transfer features in bottom panel - contacts match the river channel very closely

Black - orthophoto overlay in bottom panel - significant offset on the southern channel

Note alluvial fan on north side of Nesbitt Creek, the eastern margin of which is closely defined by a stream - zoom transfer map shows significant offset



Note bedrock knob across the river - similarly shows that the orthorectified overlay gives a better match to the topographic base map

*Trade-offs, but on average the overall accuracies are approximately equivalent*

# Summary of Results

- Softcopy photogrammetric software shows great potential as a viable means of producing geologic maps from interpreted aerial photographs
- Non-digital zoom transfer technology is obsolete, and the high costs of digital zoom transfer systems have precluded its availability to many organizations
- Advantages of the traditional zoom transfer method include:
  - operator can perform adjustments and corrections on the fly as the geologic features are traced onto the topographic base map, allowing one to automatically mosaic the overlay geology during the process of zoom transferring
  - this may lead to a more consistent map at an earlier stage and allows more flexibility by making early revisions outside the digital environment
- Disadvantages of the traditional zoom transfer method include:
  - a large investment of time (in this study, up to double the amount of time compared to photogrammetric methods)
  - a skilled operator is necessary for good results
  - necessity of retracing the geologic features prior to digitizing
  - difficulty of obtaining good alignment of anchor features in steep terrain where there are many shadows
  - eye strain is a significant factor

# Summary of Results

- Photogrammetric methods using single orthophotos took about half the time of the zoom transfer process, as calculated for a 14-photo/5-overlay block
- The overall relative accuracy of softcopy photogrammetric methods is comparable to the traditional methods
- At the standard mapping scale of 1:63,360 that is used by the Alaska Division of Geological & Geophysical Surveys, the offsets of features between the zoom transfer method and the orthorectified overlay method is on the order of 1/8 inch; this is deemed acceptable at this scale, especially given that the accuracy with respect to the digital topographic base map appears to be at least as good as the traditional methods that have been in use for decades
- The photogrammetric accuracy would likely be better if a bundle adjustment were executed upon the data
- Heads-up digitizing of the overlay geology with the master topographic base and orthophotos as background layers in the GIS allows some of the same on-the-fly corrections as we find in zoom transfer methods

***ADGGS geologic mapping from air photos is now all accomplished using digital photogrammetric methods that generate co-rectified overlays for heads-up digitizing in a GIS environment***



# Questions

## OrthoMapper - **Now Available!**

If you just need to create an orthophoto from a DEM and a photo, this is for you. With this you orient your images, create your orthophoto and even extract features. The whole process is straight forward and fast. Download PDF document about [OrthoMapper](#) (requires Adobe Acrobat Reader) - (Size 20 MB)

[|| OVERVIEW](#) | [FEATURES](#) | [PROCESS](#) | [REQUIREMENTS](#) | [MANUALS](#) ||

## OrthoMapper™

Simply the easiest and least expensive way to make and update orthophotos from aerial images.

For the GIS and Natural Resources Professional



From:  
**Image Processing Software, Inc.**  
6409 Appalachian Way  
PO Box 5016  
Madison, WI 53705

Phone: (608) 233-5033  
Fax: (608) 238-7086

Web Site: [www.orthomapper.com](http://www.orthomapper.com)