POLAR TREC
Learning Resources

Details


Completion Time: About a week

Permission: Download, Share, and Remix

Create a Topographic Profile of Beacon Valley

Overview
Beacon Valley is recognized by scientists as one of the most Mars-like environments on Earth. This lesson plan was created so that students could have the opportunity to examine the same landforms that scientists use to study the processes that operate in both of these extreme environments. There are two parts to this lesson. Teachers may choose to use one part or the entire lesson depending on the grade level.

Objectives
The goal of this lesson is two-fold: (1) to construct a topographic profile and identify the glacial landforms using the landscape of Beacon Valley, Antarctica; and (2) compare those landforms with similar landforms on Mars.

At the end of this lesson students will be able to:
• Construct and interpret a topographic profile.
• Identify glacial landforms in Beacon Valley;
• Compare and contrast glacial landforms in Beacon Valley with those on Mars.

Lesson Preparation
Before assigning this lesson, the following content should be covered.

For students:
Students should read science/geology textbooks for a discussion on polygon formation before completing this lesson. This discussion is typically found in chapters on glaciers and may be discussed under "patterned ground."

For students and teachers:
Both students and teachers should read the following pages in Jackie Hams' journals on the PolarTREC website at: www.polartrec.com

Materials

- High speed computers to access websites and download images.
- 3-D glasses
- Stereoscopes (optional, depending on grade level)
- Images & Files (Download with lesson, see Resources section for others)

Learning Resources

• 30 November 2008 "A Tale of Two Planets"
http://www.polartrec.com/node/7801
• 22 November 2008 "Return to Mac Town"
http://www.polartrec.com/node/7383
• "Ask the Team" section of Jackie's expedition page - Post on polygons
http://www.polartrec.com/node/7609

For teachers:
Teachers should lecture on polygon formation before assigning this lesson to students.

The lesson plan consists of Parts I and II. The content of Parts I and II is as follows:

I. Students will construct a topographic profile across Beacon Valley, Antarctica and label the glacial features on the profile.

II. Students will examine groups of photographs of glacial features taken in Beacon Valley and compare them with the images obtained of the same features on Mars and answer questions provided by the teacher.

Procedure
Part I. Create a Topographic Map Profile
1. Two topographic maps have been provided for the students.
Print out the Beacon Valley topographic map and the Beacon Valley topographic map with profile line (attached). The minimum paper size that should be used to print the maps is the legal size (81/2 x 14). 11 x 14 paper can be used if available.

Option: Depending on the grade level, students can create their own topographic maps and print them directly from the NASA Lima website at http://lima.nasa.gov/. Teachers can use the help menu for instructions. Note that the site is fluid and image menus and instructions are periodically updated.

2. Print out copies of the BlankTopoProfile.pdf. The profile can be printed on 8 ½ x 11 paper in landscape view or on legal sized paper 8 ½ x 14.

3. Label the topographic end points on your blank profile (A, A' and A''). The end points on the blank profile should match up with the end points on the map when you overlay the blank profile. Endpoint A has been added to the blank profile as a guide.

4. Complete the topographic profile along the section line and label the following features:
- Mullins Glacier
- Bigfoot
- Mullins Valley
- Beacon Valley

- Profile Bluff
- Polygons in Beacon Valley (the valley floor is covered with polygons).

Students can use the LIMA site to zoom in and identify features. The site works best with Firefox. To view the map features do the following:

- Go to http://lima.nasa.gov
- Select "Find Antarctic Feature"
- Select "Try it now"
- Type Beacon Valley in the box labeled "Feature Name"
- Select Beacon Valley
- Select "View Feature in LIMA" on right

You can zoom in on Beacon Valley and read the names of the features using the magnifying glass under the "Tools" menu. You can also change views by using selecting "Orthoimagery" on the right to view the topographic maps. Selecting "Satellite Imagery" will provide an aerial photograph of Beacon Valley. You can use the transparency tool to overlay the topographic map on the aerial photograph.

Note: Teachers can contact me for a completed topographic profile to use as an answer key at hamsje@lavc.edu.

Part II Photograph Interpretation
Background reading:
Textbook reading on polygons or patterned ground in the chapters on glaciers.

Websites:
http://lima.nasa.gov/ (Faces of Antarctica)
http://hirise.lpl.arizona.edu/katalogos.php (Mars High Resolution Imaging Science Experiment)
http://polartrec.com/ancient-buried-ice-in-antarctica
http://www.pnas.org/content/105/36/13258 - article on Formation of gullies on Mars

There are two groups of photographs below. Students should review the group photographs and answer the questions provided for each group. Note: Students can access the photographs via the HiRISE website by typing the photograph number in the Observation ID box under the search menu. Photos are also found in the PowerPoint available with this lesson.

Group 1 Photographs: Polygons
a. Photograph of polygons in Beacon Valley
b. Photograph of polygons on Mars (Photograph SP_007372_2475PolygonsMars).
c. Close-up photograph of polygons on Mars that includes a scale (PSP_007372_2475).

Learning Resources

Questions
1. Describe the process of polygon formation in Beacon Valley.
2. What is the approximate diameter of the polygons in the Beacon Valley photograph?
3. Can you estimate the approximate diameter of the polygons in the Mars photo?

Group 2 Photographs: Holes, Holes, and more Holes
a. Photograph of Bigfoot in Beacon Valley
b. Photograph of beheaded glaciers on Mars. (PSP_001842_1395BigfootMars.
Teachers and students should read the article on "Formation of gullies on Mars at:
http://www.pnas.org/content/105/36/13258
c. Photograph of scallops on Mars (PSP _002070_2250). Students will need the red and green 3-D glasses to see the scallops in 3-D. Option: Depending on the grade level, teachers may wish to print out stereo pairs instead of using 3-D glasses. Go to the HiRISE site and search for the observation ID (PSP _002070_2250) to obtain the original image. On the main page of the image, you will find a link on the right to print out stereo pairs.

Questions
1. Describe how "bigfoot" is formed in Beacon Valley.
2. Highlight/outline the beheaded glaciers in the Mars photograph.
3. How are beheaded glaciers on Mars formed?
4. How are the scalloped depressions on Mars formed?
5. What process is instrumental in the formation of these "holes" in Beacon Valley and Antarctica?

Extension
Extension Questions for further research
1. Since polygons on earth are cemented by ice, what does that tell you about polygons on Mars?
2. What is the significance of water related features on Mars?
3. What type of life forms would you expect to find on Mars?

Resources
PowerPoint with images (attached)
Note: Students can access the Mars photographs directly and obtain detailed information on the images by going to the HiRISE site at http://hirise.lpl.arizona.edu/katalogos.php. Select the search feature at the top of the screen and type the PSP number in the observation ID box.

Other Resources:
http://lima.nasa.gov/ (Faces of Antarctica)
http://hirise.lpl.arizona.edu/katalogos.php (Mars High Resolution Imaging Science Experiment)
Video on overview page of journal titled "Dr. Marchant explains the significance of sampling

in Beacon Valley in this video".
http://polartrec.com/ancient-buried-ice-in-antarctica
Read the article "Formation of gullies on Mars: Link to recent climate history and insolation microenvironments implicate surface water flow origin", Proceedings of the National Academy of Science (PNAS) http://www.pnas.org/content/105/36/13258

Assessment
See attached Rubric.

Credits
This lesson plan was created by Jacquelyn Hams, hamsje@lavc.edu. Please credit photographs and images where appropriate.

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National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard D: Earth and Space Science
a. Structure of the earth system
b. Earth's history
c. Earth in the solar system

Content Standard E: Science and Technology
a. Abilities of technological design
b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives
e. Science and technology in society

Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of science

Content Standards, Grades 9-12

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard E: Science and Technology
a. Abilities of technological design
b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives
f. Science and technology in local, national, and global challenges

Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of scientific knowledge

Other Standards:
California State Standards: Grades 9-12 Earth Science Content Standards

Learning Resources

Investigation and Experimentation
ESIE1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three reporting clusters, students should develop their own questions and perform investigations. Students will:

ESIE1. d. Formulate explanations by using logic and evidence.

ESIE1.h. Read and interpret topographic and geologic maps.

ESIE1. i. Analyze the locations, sequences, or intervals that are characteristic of natural phenomena (e.g. relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

Earth's Place in the Universe
ES1. Astronomy and planetary exploration reveal the structure, scale, and change of the solar system over time.

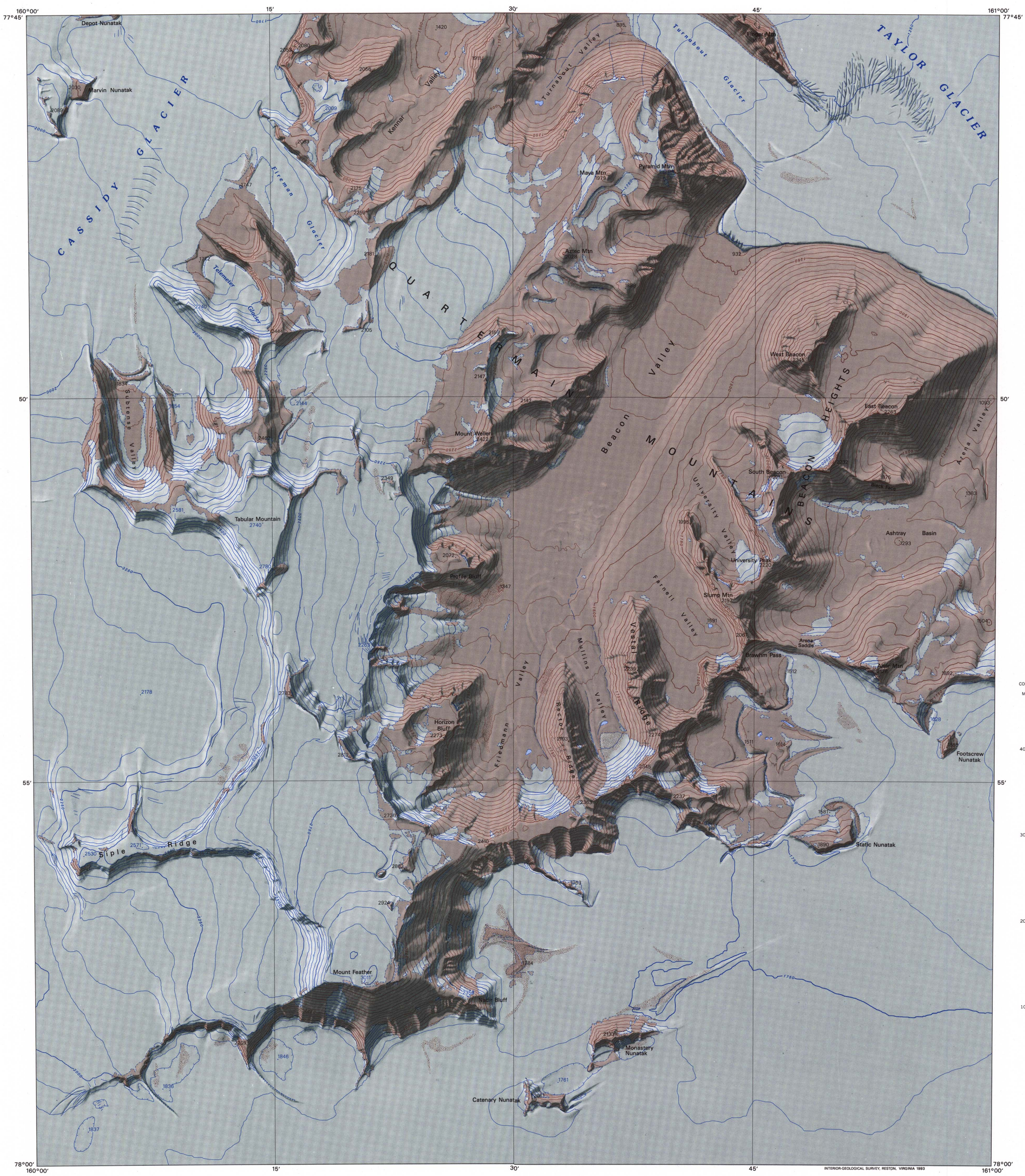
Structure and Composition of the Atmosphere
ES8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

DEPARTMENT OF SURVEY AND LAND INFORMATION
NEW ZEALAND

BEACON VALLEY, ANTARCTICA

1:50 000-SERIES (TOPOGRAPHIC)



CONVERSION SCALE

Metres	Feet
4000	15000
	14000
	13000
	12000
	11000
3000	10000
	9000
	8000
	7000
2000	6000
	5000
	4000
1000	3000
	2000
	1000
0	0

Produced by the U.S. Geological Survey and the New Zealand Department of Survey and Land Information in cooperation with the U.S. National Science Foundation

Control by U.S. Geological Survey and New Zealand Department of Survey and Land Information

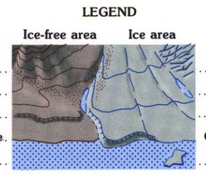
Compilation by photogrammetric methods by New Zealand Department of Survey and Land Information from aerial photographs taken by U.S. Navy 1983

Map edited 1992

Names approved by the U.S. Board on Geographic Names and New Zealand Geographic Board

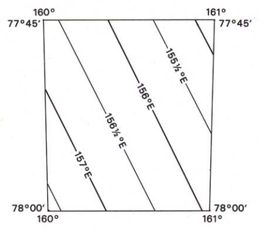
Absence of crevasse symbol does not neccessarily indicate a crevasse-free area

LEGEND



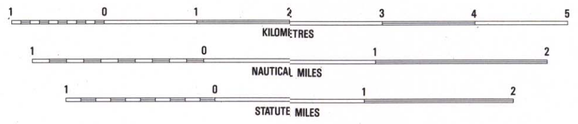
Moraine
Contour lines
Escarpment
Ice-free coastline
Fast or bay ice
Crevasses
Meltwater lake
Melt stream
Coastline under ice
Iceberg

DECLINATION DIAGRAM



Isogonic lines compiled from DMA Chart WOBCZ-43, 1985

SCALE 1:50 000

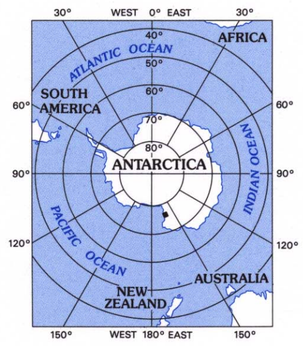


CONTOUR INTERVAL 50 METRES WITH SUPPLEMENTARY CONTOURS AT 25 METRE INTERVALS
ELEVATIONS SHOWN TO THE NEAREST METRE
DATUM IS MEAN SEA LEVEL

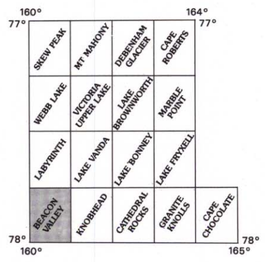
LAMBERT CONFORMAL CONIC PROJECTION - STANDARD PARALLELS 76°40′ and 79°20′
WORLD GEODETIC SYSTEM 1972

FOR SALE BY U.S GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR RESTON VIRGINIA 22092 AND NEW ZEALAND DEPARTMENT OF SURVEY AND LAND INFORMATION, WELLINGTON, NEW ZEALAND

LOCATION DIAGRAM



INDEX TO ADJOINING MAPS



BEACON VALLEY
ANTARCTICA

77199-Y1-TM-050
1993

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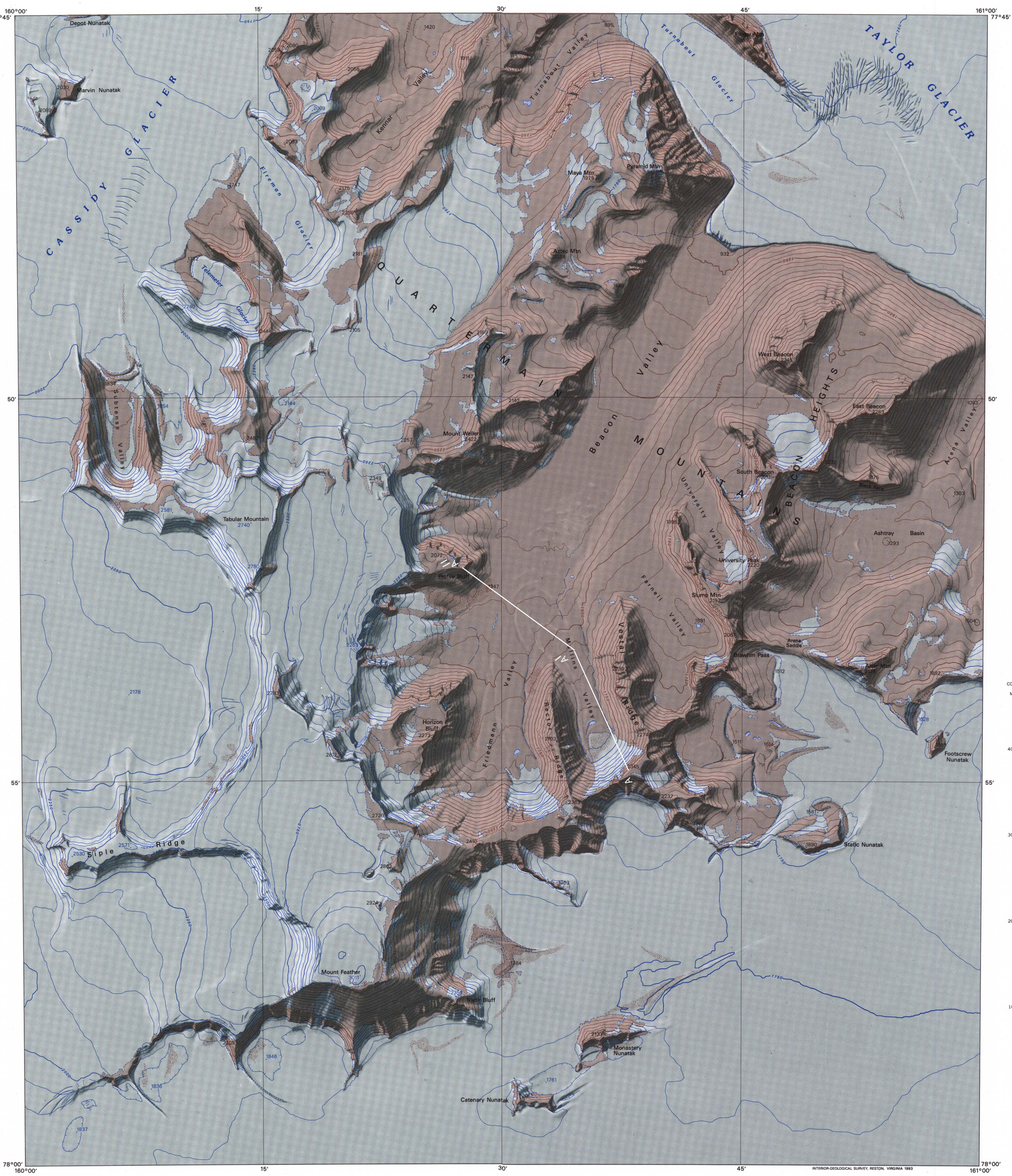

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INTERIOR-GEOLOGICAL SURVEY, RESTON, VIRGINIA 1993

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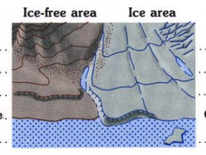

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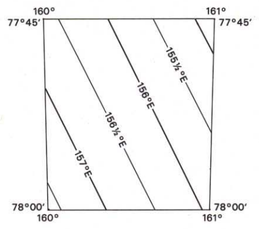

Isogonic lines compiled from DMA Chart WOBCZ-43, 1985

SCALE 1:50 000

KILOMETRES 1 0 1 2 3 4 5

NAUTICAL MILES 1 0 1 2

STATUTE MILES 1 0 1 2

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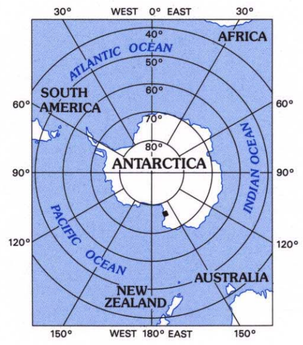

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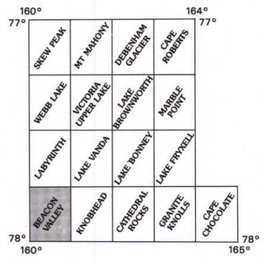

BEACON VALLEY
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Topographic Profile Part I Rubric

This rubric is designed for the topographic profile in Part I of the lesson plan.

Advanced Proficient	• Topographic profile is well constructed and neatly labeled. • All contour lines and profile end points are correctly marked in the appropriate intervals on the topographic profile. • All glacial features are clearly and neatly labeled in the correct location. • There are no errors in the topographic profile construction or labeled features.
Proficient	• Topographic profile is well constructed and neatly labeled. • Contour lines and profile end points are correctly marked in the appropriate intervals on the topographic profile. • Glacial features are clearly and neatly labeled in the correct location. • There are minor errors in the topographic profile construction or labeled features.
Partially Proficient	• Topographic profile is constructed and labeled. • Contour lines and profile end points are marked in intervals on the topographic profile. • Glacial features are labeled. • There are errors in the topographic profile construction or labeled features.
Not Proficient	• Topographic profile is poorly constructed and improperly labeled. • Contour lines and profile end points are incorrectly marked on the topographic profile. • Glacial features are incorrectly labeled. • There are major errors in the topographic profile construction or labeled features.

Topographic Profile Part II Rubric

This rubric is designed for the questions in Part II of the lesson plan.

Advanced Proficient	● Complete and correct responses to all questions. ● Appropriate scientific terminology is used correctly in all answers. ● The correct mathematical and numerical units are used and numerical values are correct. ● In-depth understanding of the scientific concepts applicable to the questions is demonstrated. ● Thorough understanding of the connection between glaciation on Earth and Mars is demonstrated. ● Correct use of English and grammar in all answers.
Proficient	● Complete and correct response to most questions. ● Appropriate scientific terminology is used in answers. There are minor omissions/errors that do not detract from the overall answer. ● The correct mathematical and numerical units are used and numerical values are correct. There are minor omissions/errors that do not detract from the overall answer. ● Understanding of the scientific concepts applicable to the questions is demonstrated. There are minor omissions/errors that do not detract from the overall answer. ● Understanding of the connection between glaciation on Earth and Mars is demonstrated. ● Correct use of English and grammar in the answers. There are minor omissions/errors that do not detract from the overall answer.
Partially Proficient	● Complete and correct response to at least 4 questions. ● Scientific terminology is used in answers, but there are major omissions/errors. ● The mathematical and numerical units used are partially correct. Numerical values are partially correct and there are major omissions and errors. ● Limited understanding of the scientific concepts applicable to the questions is demonstrated. ● Limited understanding of the connection between glaciation on Earth and Mars is demonstrated, ● Partially correct use of English and grammar in the answers.
Not Proficient	● Incomplete and incorrect response to 4 questions or less. ● Scientific terminology is missing or incorrect. ● The mathematical and numerical units used are incorrect. Numerical values are incorrect. ● Explanation shows no understanding of the scientific concepts. ● Explanation shows no understanding of the connection between glaciation on Earth and Mars. ● Responses contain major English and grammar errors.