

Cold Environments

(Unit F761 AS for OCR)



Shattered boulders on Mont Lozere.

Discover Ltd.
"Timbers",
Oxted Road,
Godstone,
Surrey. RH9 8AD

www.discover.ltd.uk

©Discover Ltd 2009

Teacher's Notes

This half day study will introduce students to periglacial environments around the Eagles Nest field centre on Mont Lozere. It is ideally suited to the last day of your stay, as it involves walking from the centre and discussing and visiting some of the periglacial features found in the locality, with the opportunity for note taking and discussion, field sketching, and making records using GPS and digital photographs of periglacial features.

Key Specification Areas

- The global distribution of cold environments – polar (land and marine based), alpine, glacial and periglacial.
- Periglacial processes – nivation, permafrost formation, frost heave, solifluction. Periglacial landforms – nivation hollows, ice wedges, patterned ground, pingos and solifluction lobes.

Bibliography

Barker, A., Redfern, D. and Skinner, M. (2008) AQA Geography. Phillip Allen updates.

Bishop and Prosser (1997) 'Landform Systems' Collins Educational

Burton, S & Jeanes, A. (1997) 'Central Southern France' Hodder and Stoughton.

Digby, B (Ed.). (1995) 'The Physical Environment' Heinemann

Knill, R. and Smith, J. (2008) AQA Geography. Nelson Thornes.

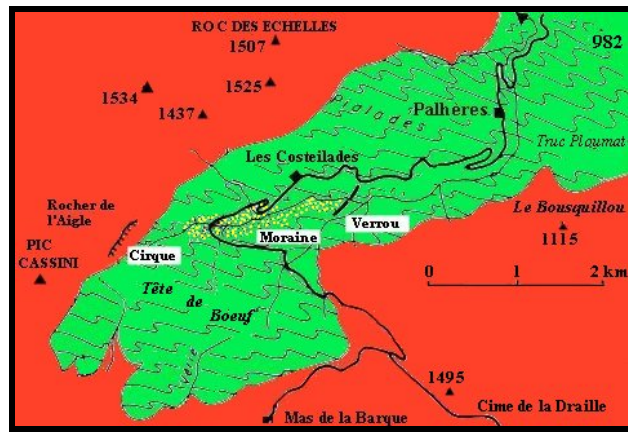
Waugh, D. (1990) 'Geography - An Integrated Approach' Nelson.

Miller G (2000) 'Fieldwork Ideas in action' Hodder and Stoughton

Introduction

Mont Lozere is a large granite upland massif, extending from Villefort in the east to Florac in the west, and Le Bleynard in the north to Pont de Montvert in the south. It's highest point is the summit of Mont Lozere, Pic de Finiels, at 1699m. The area experiences alpine, almost mild periglacial, conditions in the winter months, with in excess of 100 days frost in the average year and heavy snow falls in most winters. Temperatures may drop well below freezing for long periods, the minimum experienced since records began at the Eagles Nest in 1989 has been -26°C (with wind chill -40°C) Summer months are characteristically Mediterranean, with temperatures climbing into the mid-30's and often long periods of drought. During the Pleistocene, the area was covered in permafrost, as evidenced by many periglacial features in the area.

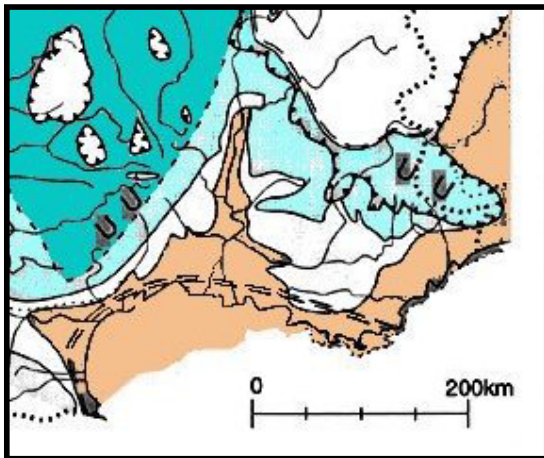
One of the skill skills a geographer develops is landform and landscape interpretation. Looking south from the Eagles Nest, there is no strong physical evidence that the southern slopes of Mont Lozere were a glacial environment during the last glacial advance. There is, however, evidence of the presence of glaciers on the north-east side of the massif, at the cirque de Costeilades, near to Villefort:



The deep cirque which dominates Costeilades constitutes the only recognized glacial site in the area. The site is bounded to the west by more solid granite rocks, being dug into a weaker schist rock intrusion in the granitic mass of Mont Lozere.

Permafrost is permanently frozen ground, where sub-soil temperatures remain below zero for at least two consecutive years. The extent, depth and continuity of permafrost depends on the climatic conditions over a long period of time and fluctuates between summer and winter, when the surface layer may thaw, creating an 'active layer' of up to 4m depth.

During the last ice age, Mont Lozere would have experienced periglacial conditions, with intense frost action and the formation of permafrost:



- Continuous and very deep permafrost
- Continuous permafrost
- Discontinuous permafrost
- Deep seasonal frost
- U Rock glacier

Maximum extent of periglacial conditions in France 20,000 years before present. (Van Vliet Lanoë & Hallégouët, 1998 - Cartographie ANDRA-CNF-INQUA 1999.)

Mont Lozere was not sufficiently high in altitude to have the extensive glacier coverage still seen in the Alps today, nor was it far enough north to have been covered by the advancing arctic ice sheets as experienced in Britain. However, on the summit of Mont Lozere, there is evidence of past periglacial conditions. There are excellent examples of frost shattered boulders and tors; areas where frost heave has formed patterned ground where it is easy to see stone polygons, and stripes on steeper gradients, and nivation hollows, which will be visited, discussed and recorded during your guided walk.

Aims

To visit, discuss and record using a variety of techniques, periglacial features on Mont Lozere, including nivation hollows, stone polygons and stripes, shattered boulders and tors.

Equipment

GPS

Recording sheets

Paper, pencil and clipboard

Digital camera and movie creator

Method and organisation of study

Students will be taken on a walk to visit, discuss and record periglacial landforms by a variety of means. The route taken will depend on the time available, where the group is staying, and any physical limitations the group may have.

Site 1. Granite, frost shattering, felsenmeers and tors.

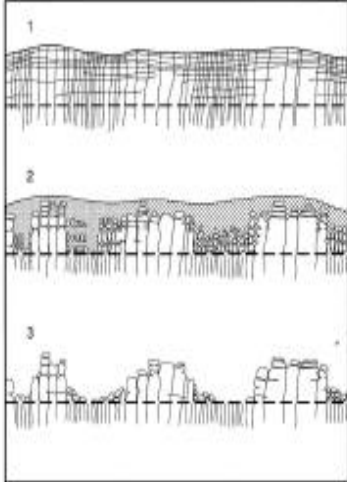
Granite is a coarse-grained intrusive igneous rock. It was formed when magma was intruded into the earth's crust millions of years ago. The granites were intruded in enormous **batholiths**, which cooled slowly allowing large crystals of quartz, feldspar and mica to form. As the granite continued to cool, it contracted and a series of vertical and horizontal cracks (joints) were created. The whole area was pushed upwards over 1,000 metres when the Alps were formed; the overlying rocks were later removed by erosion, exposing the granite at the surface of the Mont Lozère uplands. The most distinctive granite landform is the **tor** – a large granite rock outcrop that often occurs on the summits of hills. These granite blocks are often 5 to 10 metres high, and the rectangular joints give the tors a typical “blocky” appearance. The tors are susceptible to both



chemical and physical weathering, especially along the joints. As water enters the joints they are widened by weathering processes, especially frost shattering, and blocks of granite break off to litter the surrounding slopes with granite boulders. These “fields” of granite blocks surrounding the tors are known as “**felsenmeer**”. Physical weathering was especially active during a former “**periglacial**” climate, and the surrounding granite blocks were moved downslope by **solifluction** (a type of mass movement).

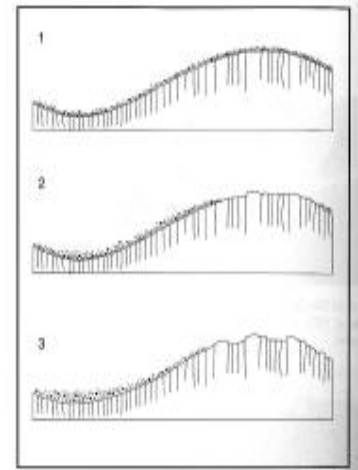
Granite tor. Note rectangular jointing and surrounding felsenmeer

Screes develop on and at the foot of slopes as a result of frost shattering. Blockfields (or felsenmeers) are a common sight on Mont Lozere, and now they are colonised by lichens, have given rise to the name of the local village, Le Pont de Montvert, or ‘the bridge of the green mountain’. There are many tors on the ridges in the valley, which can be visited. Tor formation has several explanations. Initially, it is likely that decomposition of the granite below the ground surface took place primarily by chemical weathering (hydrolysis), during the warmer, wetter Tertiary era. The most rapid weathering took place along the joints, but where these were widely spaced, the rock would be little altered. During the Quaternary periglacial period, the weathered granite was removed (by mass movement) and the unweathered granite was left as tors, with corestones of unaltered granite. During the periglacial period and subsequently during our harsh alpine winters, frost shattering further breaks apart the granite tors and results in sharp edges boulders and scree slopes.



A. Linton (1955): two-stage model, with deep chemical weathering prior to the Ice Age and then removal of the products of weathering by mass movement under periglacial conditions during the Ice Age

B. Palmer and Nielsen (1963): one-stage model, with formation of tors within the Ice Age due to a combination of frost-riving and mass movement under periglacial conditions.



Site 2. Nivation hollow.

Nivation occurs mainly between north and east-facing slopes beneath patches of snow in hollows of bare rock. Frost action beneath the snow, involving cycles of freeze-thaw gradually wears away and shatters the underlying rock. In the spring, melt water lubricates the slope system and carries the resulting ‘head’ deposits of weathered particles down the slope (solifluction). Periodic freeze-thaw results in small hollows called nivation hollows, which in the current inter-glacial often carry snow well into the summer months. Nivation hollows are often the early formation stages of corries.

Site 3. Patterned ground.



When the active layer of permafrost freezes in the winter, ice crystals develop which expand upward at the soil surface. It is possible to see this on very frosty days today, where finer soil particles appear to be perched on top of long, thin ice crystals. Stones within the soil cool faster than the surrounding soil, so ice forms beneath stones more quickly than in the surrounding soil. When this water freezes and expands it pushes the stone upwards bit by bit, until they eventually reach the surface. This is called frost heave, and the soil and stones eventually form small domes. The stones on top of these domes will slowly move down slope by mass movement, forming inter-connecting polygons around the bases of the domes. Where frost heave occurs on gradients above 6°, the stones will move down slope and form elongated polygons, or stone stripes. Freeze-thaw processes under the very cold conditions of a periglacial climate may further modify the felsenmeer. Expansion and contraction causes frost heave, which both lifts and sorts the stones to create “**patterned**”

ground" on the surface. The larger stones move outwards to form well-defined **stone circles**. On gentle slopes the stone circles are elongated by solifluction to create **stone stripes**. These remarkable periglacial stone structures can be clearly seen near the summit of Mont Lozère.

Techniques for data collection:

In addition to visiting each site and taking notes from your leader's explanations, making field sketches and taking digital photographs, you may also consider the following ideas:

- i. Small groups of students can make short, documentary style movies, describing the landforms and how they have come about. These movies can then be uploaded onto the Department/school intranet, or made into short podcasts and put on the internet as a resource for other students;
- ii. Students can take a series of digital photographs of each feature, link them to a GPS position and download the data onto memory map (in all classrooms). It is then possible to examine the location of the different features on the map and draw conclusions about their positions (altitude, aspect, etc.);
- iii. Make a series of annotated field sketches of each feature. After each one, they can be peer-reviewed, with students passing them to their friends for comment. The mark scheme ranges from 1 to 4 as below:

Score	Description	Example
1	Have described or labeled the feature	A big valley
2	Used a geographical term to name the feature and described it	A U-shaped valley, with a flat bottom and steep sides
3	As well as describing and naming the feature, they have explained why it is there	Created by a glacier eroding the rock as it moved north-west
4	Linked the feature to other features	The rock eroded here was carried towards Villefort, and deposited there

- iv. Students develop a self-guided 'Cold environments trail' information leaflet for the Cevennes National Park, which could be distributed from visitors centres. The trail guide would need to include information, sketches/diagrams of features, digital photographs, map references, and detailed descriptions about how the features outlined were formed.

Eagles Nest. Periglacial features recording sheet.

Feature	How formed	Field sketch
1		
2		
3		
4		

