Glacial Landscapes and Protohistoric Cultural Heritage of the Mount Bego Region, Southern French Alps

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Abstract

The region of Mount Bego, which is located in the Southern French Alps, is an interesting place to observe scenic inherited landforms as well as cultural remains left by the ancient human societies who lived there. Geomorphology, Archaeology and Anthropology are working jointly to reconstruct the history of landscapes and societies. In particular, the Bronze Age people used the perfect stony tables created by glacial erosion. Indeed, they engraved approximately 40,000 petroglyphs on rocks polished by the ice during the Last Glacial Maximum. At that time, the climate was very cold, corresponding to the full expansion of glaciers. Only the peaks of Mount Grand Capelet and Mount Bego were protruding from the ice. The glacial imprint is widespread in the landscapes of the Mount Bego region, which displays about 40 cirques, abundant moraines and erratic boulders and 30 glacial lakes. Periglacial conditions, which developed after glacier melting, favoured the formation of rock glaciers before the Postglacial warming which induced peat formation. The first traces of the landscape transformation by the human societies date back to the Neolithic, three millennia before the Protohistoric societies left the outstanding petroglyphs of the so-called *Vallée des Merveilles* (Valley of Wonders).

Keywords

Mount Bego • Southern Alps • Glacial geomorphology • Peat bog • Bronze Age petroglyph

21.1 Introduction

Mount Bego, which is surrounded by the Merveilles and Fontanable valleys, is located 30 km from the Mediterranean Sea. This region peaks at altitudes ranging from 2,500 to 3,000 m and displays Last Glacial landforms such as glacially carved valleys and cirques offering a rocky landscape dotted with kettle lakes (Fig. 21.1). This wonderful landscape shaped by the Quaternary glacial actions has been the focus of several geomorphological studies (Faure-Muret 1955; Orengo 1973; Julian 1980). The morphostructural frame inherited from the Alpine movements and Plio-Quaternary evolution has been modified by the installation and the melting of Pleistocene glaciers. The glacial imprint is variable due to the variety of rock types. After the deglaciation, periglacial and temperate conditions continued to reshape the landscapes before human societies added their touch by transforming the vegetation cover and inducing soil erosion. But in the Mount Bego area, around 2000 BC, the Bronze Age people not only left traces of their breeding and agriculture activities; they also left thousands of engravings which provide valuable information about their way of life. They focused most of their rock art on the two largest areas of ice-smoothed rocks (Begin-Ducornet 1991; de Lumley 1995), especially Permian rocks which resist to weathering and have remarkably preserved the petroglyphs (Fig. 21.2).

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Fig. 21.1 The Merveilles Valley landscape with the pyramidal Mount Grand Capelet in the background. The Merveilles Peak in front of it has a large area of ice-smoothed rocks. The Long Inferieur Lake in the foreground is partly filled with a peat bog (Photo J. Magail)

Fig. 21.2 The famous Bronze Age engraving named "the wizard" has been done on an oxidised ice-smoothed outcrop displaying grooves and striations (Photo J. Magail)

21.2 Geological Context

The Merveilles Valley is situated at the transition zone between the middle and the high mountains (2,000–2,500 m), at the eastern end of the Argentera-Mercantour crystallophyllian massif or basement (Fig. 21.3). This NW-SE elongated massif belongs to the external crystalline massifs (like the Mont Blanc and Pelvoux massifs) according to the classic Alpine nomenclature. It is mainly made of metamorphic and granitic rocks above which sedimentary layers ranging from the Carboniferous (300 Ma) to the Pliocene (6 Ma) periods are resting unconformably. These sedimentary sequences present numerous stratigraphic lacunae due to the complexity of the regional tectonic history.

The Argentera-Mercantour crystalline rocks are mainly represented by the Argentera leucocratic intrusive granite (batholith type) and the anatectic granite of Valmasque. They are associated with metamorphic rocks, mainly inherited from the Variscan (Hercynian) period. They include several metamorphic complexes (Faure-Muret 1955) such as the migmatitic Chastillon-Valmasque complex found in the Mesches Lake and the Minière Valley areas (Fig. 21.4).

Sporadic but outstanding detrital Permian series (about 250 Ma) overlie these basement rocks. Classic sedimentary facies have been deposited in basins during the dismantling of the Hercynian chain. They consist of

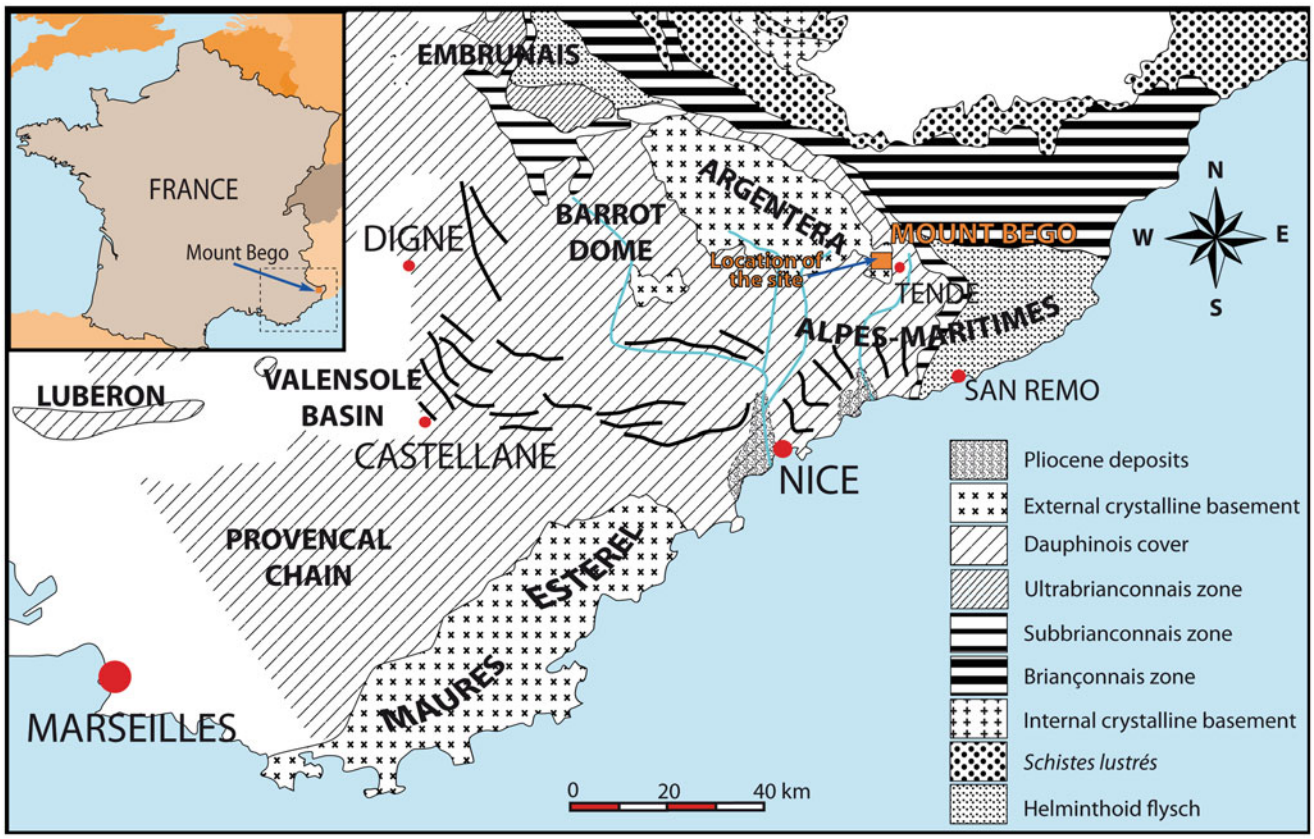

Fig. 21.3 General geologic map of the SE France (After Campredon and Boucarut 1975 – CAD Burle) CAD: Computer Assisted Drawing

conglomerates, sandstones, arkoses and mudstones. Faure-Muret (1955) identified four sets in the area: the Inferno, Meraviglie, Bego and Capeirotto series. These are mainly detrital, either coarse-grained and heterogeneous (Inferno and Bego) or pelitic and mostly homogeneous (Meraviglie and Capeirotto). Volcanism evidences can be found locally such as an interbedded dacite flow and the presence of rhyolite and rhyodacite pebbles. The total thickness of the Permian detrital series reaches about 4,000 m in the Tende province.

The post-Permian sedimentary cover restricted to the southeastern end of the Argentera-Mercantour massif dates back to the Triassic and Jurassic periods. Southwards, in the Nice and Castellane subalpine arcs, sedimentary series display impressive Jurassic limestones and Cretaceous marly limestones. Northwards and eastwards, autochthonous terranes are hidden by the first thrust sheet of the Subbriançonnais and Briançonnais zones (Eocene Helminthoid flysch). The tectonic uplift inherited from the Cenozoic Alpine evolution has been modified by the Pleistocene glaciers, with special reference to the glacial imprint left by the Last Glacial Maximum (OIS 2–20,000 BP).

21.3 The Glacial Imprint on Landscapes

During the Last Glacial Maximum (20,000 BP), the trimline (upper limit of the ice) reached the base of Mount Bego, as indicated by glacial landforms including microscale features (Orengo 1973; Finsinger and Ribolini 2001). The presence of Permian blocks on the Plan Tendasque at an altitude above 2,000 m indicates that the Minière Valley glacier spilled over its left bank and deposited these erratic blocks. The degree of preservation of such glacial imprints depends on the rock hardness and its weathering rate since deglaciation.

21.3.1 The Glacially Carved Valleys and Cirques

The Minière Valley, which extends from the Minière Lake (1,500 m) to the Pas de Colle Rousse (2,200 m), displays a series of three rock basins (*ombilics*) separated by three rock bars and the hilly passage of the Vallon de l'Enfer closed by a cirque (Fig. 21.5). The upstream lacustrine area is located at the confluence of three mountain valleys: the Merveilles, Huile Lake and Muta Lake valleys, characterised by a trough

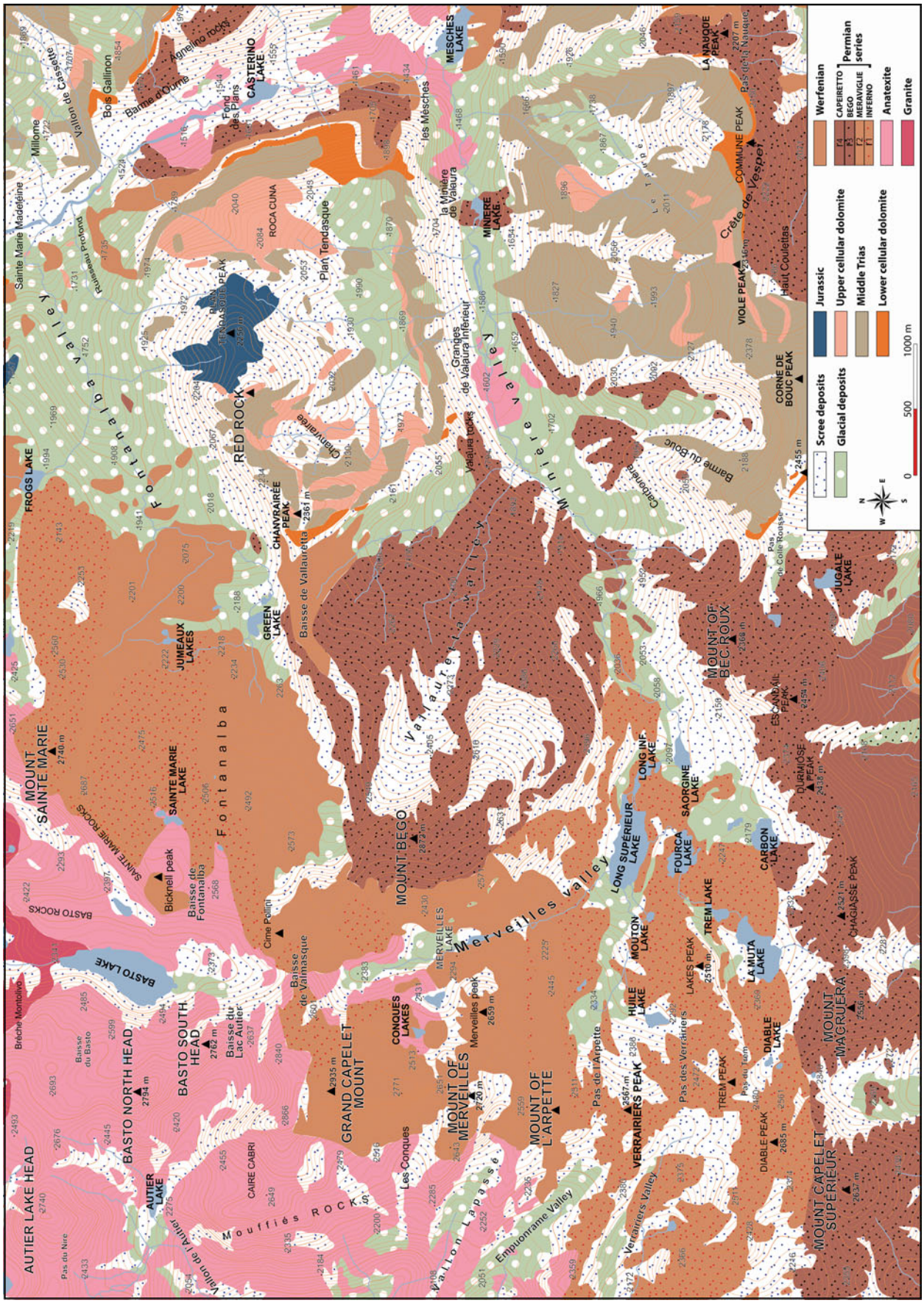

Fig. 21.4 Geologic map of the region of Mount Bego (After Goguel 1967 – CAD Burle) CAD: Computer Assisted Drawing

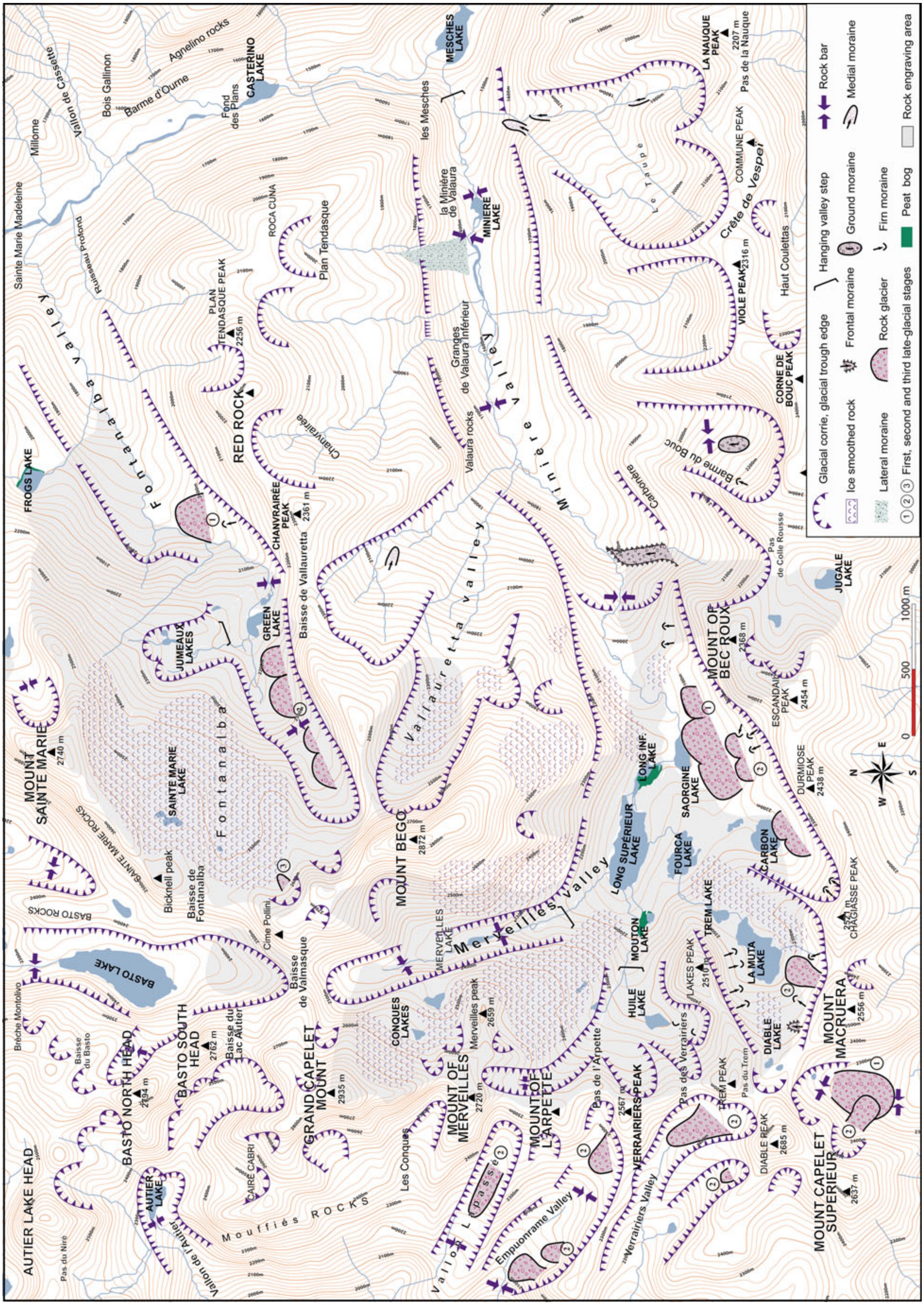

Fig. 21.5 Geomorphological map of the region of Mount Bego (After Orengo 1973 – CAD Burle) CAD: Computer Assisted Drawing

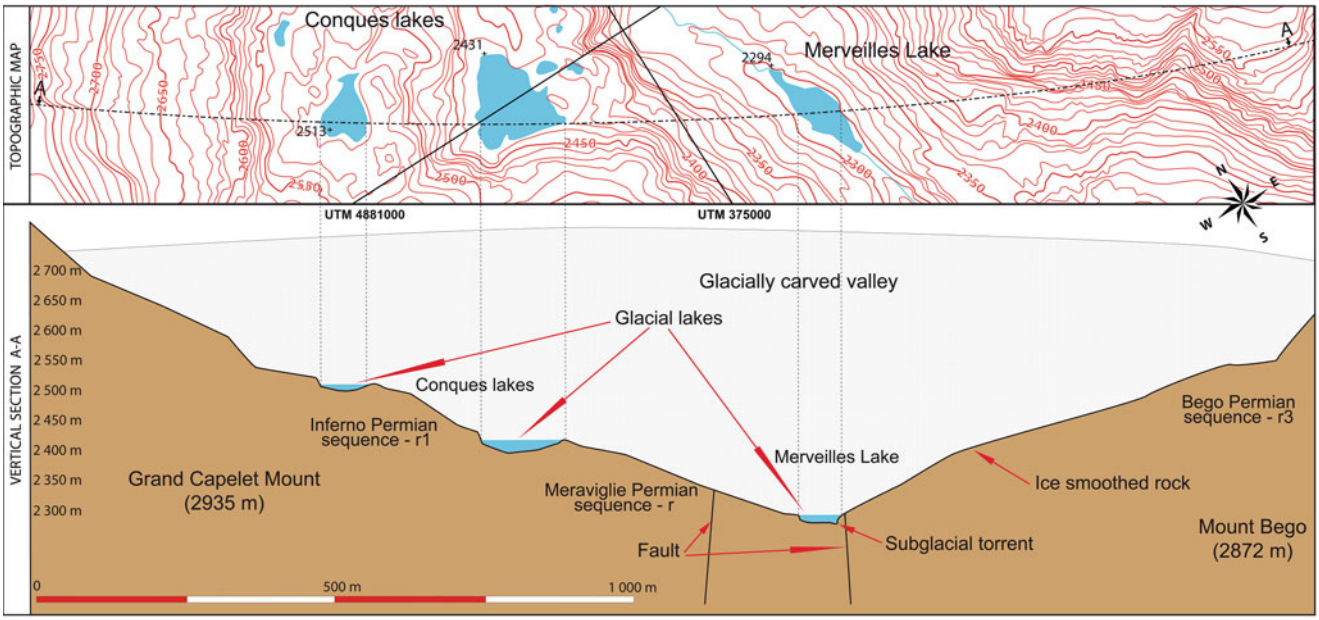

Fig. 21.6 Geomorphological cross-section in the Conques Lake area (Credit Magail – CAD Burle) CAD: Computer Assisted Drawing

profile. The Merveilles Valley is the longest and the narrowest and is dominated by the two highest mountains of the area: Grand Capelet (2,935 m) and Mount Bego (2,872 m).

Over 40 cirques are present in the region of Mount Bego. Mainly located on north-facing shady slopes, the largest are located on the right bank of the Minière Valley and are 2,000 m high. On the left bank, the cirque of Valauretta Valley is carved into the Mount Bego northeastern face. The Plan Tendasque peak area displays much smaller cirques carved in Triassic rocks; this area is characterised both by its glacial and karstic imprints. From the Pas de Colle Rousse to the Nauque peak as well as the Plan Tendasque, some outcrops of Jurassic limestone and mid-Triassic dolomite are prone to karst formation. However, the volumes are too low for large sinkholes to develop. The only karstic evidence is provided by large rock shelters of shallow depth situated in cliffs of mid-Trias in particular near the Pas de Colle Rousse and above the Granges de Valaura. Only one 50 m deep sinkhole was found in the region, namely, the Aven Primard, situated 5 km south of the Minière Valley, in the mid-Trias of Plateau de la Céva.

Other smaller cirques are found in the upper side of the N-S ridge passes across the Head of Basto and Mount Capelet Superieur, some belonging to tributary valleys of the Gordolasque Valley and others to the Minière Valley. The base of the highest cirques is at 2,600 m, as shown by the Conques Lakes (Fig. 21.6).

21.3.2 Scouring and Polishing Effects

The ice-smoothed rocky areas offer numerous examples of glacial scouring and polishing. Those present in the Pic des Merveilles area have particularly striking grooves and ridges, carved into a remarkable Permian eponymous series. The famous engraving known as the *Sorcier* (wizard) has been done on a scoured outcrop displaying large grooves (Fig. 21.4). In other places, grooves are observed, caused by the friction of ice-covered rocks in motion, which are accompanied by real scars left on larger blocks. At places, the ice-smoothed rock surface has been delicately polished. This is the case with pelite outcrops that display large curved or flat surfaces, perfectly smooth.

Current observations of scraping and polishing are possible on the Permian rocks thanks to the quality of this material. By contrast, the glacial polish and striations on Triassic outcrops have been erased by 13,000 years of limestone solution by rain waters. In the Merveilles Valley, there is an outstanding case of glacial polish on a so-called *paroi vitrifiée* (glazed wall). This massive wall in Permian rocks, 10 m high and 25 m long, is a N-S-oriented slickenside (28 °W) linked to a probable strike-slip fault which was active during the late Alpine orogenic phase. Then, a silica film developed on this plane upon pelitic rocks. Its vitrified and shining appearance is probably due to the friction of the silica film by the ice although a listric origin (tectonic polish) cannot be excluded (Fig. 21.7).

Following deglaciation, ice-scoured walls and horizontal surfaces were rapidly in contact with the atmosphere and submitted to iron oxidation inducing a reddish coloration of the surface layer. By hitting the rocks, Bronze Age engravers blew this oxidised film and made the original pelite colour appear at the bottom of their engravings. The bottom of the oldest engravings already displays an oxidised patina (Fig. 21.8).

Fig. 21.7 Remarkable glacial and/or listric polish on the *paroi vitrifiée* (glazed wall) of the "Valley of Wonders" (Photo J. Magail)

Fig. 21.8 Bronze Age engravings on oxidised Permian rocks (Photo J. Magail)

21.3.3 Late-Glacial Moraines and Drift Boulders

During the Late-Glacial period, the glacier that occupied the cirque beneath the Pas de Colle Rousse produced the largest frontal moraine as displayed across the right bank of the Minière Valley. It was deposited while ice was retreating from this valley. This 400 m long moraine is located on a steep slope, starting from 2,000 m altitude and ending near the stream at 1,770 m altitude. It is crossed by the access road to the Merveilles Valley. Located at higher elevations (2,400 m) under the Pas du Diable, another frontal moraine has a much smaller size. Ground moraine occupies the centre of the Barme du Bouc cirque. The Mount Bego also displays traces of glacial transportation during the Late-Glacial period, with drift boulders supplied by the slopes of Mount Bego deposited near the Long Inferieur Lake and Superieur Lake while ice was melting (Fig. 21.9).

21.4 Rock Glaciers and Peat bogs

21.4.1 Rock Glaciers

Periglacial conditions have allowed the formation of rock glaciers which belong to three generations (Orengo 1973; Finsinger and Ribolini 2001). Those of Saorgine Lake, sheepfold of Fontanalba and probably the one of Pas du Diable, were formed during the first phase. Other rock glaciers have been formed after the retreat of the lower part of glaciers. This is during this second phase that a second series of rock glaciers of Saorgine Lake develops itself, like those of Carbon Lake, the ones which lead to the Gordolasque Valley and those located above the Vert Lake of Fontanalba. The third phase of rock glaciers evolution is more discrete. The one located more than 2,500 m above the sea level, north of the summit of Pollini, is an example. Two factors among others (Evin 1985) were favourable to the formation of these rock glaciers: firstly their geographical situation on

Fig. 21.9 Erratic boulder deposited by the glacier at the entrance of the "Valley of Wonders" (Photo J. Magail)

north-facing hillsides where climate is the coldest and secondly the rubble material supplied from the broken Permian walls, above the rim of the cirques.

21.4.2 Peat Bogs

The end of the Late-Glacial period had been already marked by lake filling, peat formation and vegetal colonisation. The cores drilled in the Long Inferieur Lake peat bog of the Merveilles Valley provided enough data to reconstruct the landscape history since the Older Dryas (de Beaulieu 1976; de Beaulieu and Jorda 1977). Pollen analyses show the installation of a first steppe vegetation with a predominance of *Artemisia* pollen, followed by the progression of the tree cover as indicated by *Juniper* and *Pinus* taxa. A marked cold recurrence occurs during the Younger Dryas with a regression of tree pollens. The last phase of the Postglacial period is marked by pastoral activities near Long Inferieur Lake between 3,500 and 3,000 BP. The Subboreal period is characterised by an increased frequency of grasses and plantains (*Plantago* sp.) indicative of agricultural activities. Analyses carried out in the vicinity of Mouton Lake (2,150 m) reveal a larch forest destruction by men at about the end of Subboreal. The Mount Bego population cleared the larch forest in order to cultivate or develop areas of pastures. At the end of the third millennium, pollen analyses detect intense larch deforestation in the valley, followed centuries later by agricultural activity, with cereal and plantain pollens appearing from 1500 BC near Long Inferieur Lake. It is highly probable that groups of people have settled down on the slopes of Mount Bego during the summer season. Rock engravings of ploughs attest their agricultural practices (Fig. 21.10). Recent studies in the Millefont Valley area showed that traces of human activity appeared as early as 4,750 cal. BP, i.e. during the Neolithic period (Brisset et al. 2012).

21.5 Human Activities and Popular Beliefs

Even if the first traces of landscape transformations by human activities date back to the Neolithic, the Mount Bego region seems to have been a place of passage since the disappearance of the glaciers. The Alpine chain is separating several major valleys and men who intend to move from one to another have to cross the passes. At the north lies the plain of Po and at the south, valleys flow into the Mediterranean Sea. People used to reach back valleys and crossed ridges since the end of the Palaeolithic. With the development of pastoral activities at the end of the Neolithic, the region has become the summer meeting place of transhumant shepherds from all neighbouring valleys to the pastures of Mount Bego (Magail and Giaume 2005; Barral and Simone 1990). People have not lived in the winter at high altitudes on the snowy hillsides of these mountains, for we know that thousands of Bronze Age petroglyphs were made between the summer solstice and the mid-September (Magail 2006). The limited iconographic themes (bovines, weapons, fields, etc.) suggest that every year the Bronze Age engravers repeated the same petroglyphs as a rite (Magail 2007). During the last two centuries, the

Fig. 21.10 Detail of an engraving showing two oxen hitched to a swing plough (Photo J. Magail)

shepherds have given a fantastic meaning to this strange landscape shaped by glaciers displaying numerous Protohistoric signs. The name *Vallée des Merveilles* (Valley of Wonders) or *Meraviglia*, which refers to an enchanted or "fairy-like" place, illustrates the special place occupied by the Mount Bego region in the vernacular culture. Similarly, the *Cime du Diable* (Devil's Peak) and the Valmasque Valley names also evoke the supernatural and the evil. These names are associated with popular legends and fairy tales.

21.6 Conclusions

The numerous cirques and lakes scattered around the Mount Bego are indicative of the strong pressure exerted by the glaciers during the Last Glacial optimum period. The huge quantities of water released during deglaciation have caused significant erosion by reshaping lateral moraines and creating alluvial fans. Above 2,000 m, sparse vegetation gave way to a landscape marked by ice-smoothed and polished outcrops. The freshness of small-scale glacial features is amazing. Following deglaciation, this rocky landscape has also changed in colour. Some surfaces are oxidised and this iron oxidation gave a reddish colour to large areas. The entire plateau of the Merveilles Valley and the base of Fontanalba peak are characterised with this bright colour. Although the Mount Bego has been shaped by Quaternary glaciers, its landscape continues to evolve according to the seasons, with alternations of freezing and thawing inducing frost shattering and rainfall episodes responsible for various hydrological phenomena including flooding of the Minière Valley and the formation of potholes in its gorges.

Human activity is also responsible for landscape transformation. People cleared the forests and contributed to soil erosion since the Late Neolithic. The Mount Bego specificity remains the 40,000 engravings inscribed on the rocks around 2000 BC. Between 2,000 and 2,600 m, Bronze Age engravers selected rocks which had been polished by glaciers, especially the Permian rocks including the fine-grained schistose and pelitic rocks which were easy to engrave. The attractiveness of the Mount Bego region lies in a unique combination of scenic glacial landscapes and traces of ancient high-altitude human occupation.

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