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## STRUCTURAL ANALYSIS OF ROCHES MOUTONNÉES IN WESTERN OROBIC ALPS (LOMBARDIA)

**ABSTRACT:** GHISELLI A., BINI A. & ZUCALI M., *Structural analysis of roches moutonnées in Western Orobic Alps (Lombardia).* (IT ISSN 1724-4757, 2005).

The structural characters of the *roches moutonnées* have been studied within four cirques of the Western Orobic Alps, for the purpose of identifying the relationship between structures and observed morphologies. The meso-structural analysis of the area has led to the identification and the chronological ordering of six deformation phases (three pre-Alpine and three Alpine) represented by many different structures both ductile (folds and foliations) and brittle (faults and cataclasites). Each exposed surface of the *roches moutonnées* has been analysed on the base of this structural model and the correspondence between morphological and structural characters has been evident. The investigated cases demonstrate that the exposed surfaces of the *roches moutonnées* are, in reality, structural surfaces. Therefore, it would seem that their *moutonné* appearance is not of glacial origin alone. The glacial action is likely to be limited to the removal of the higher rock portion weathered during interglacial periods.

**KEY WORDS:** *Roches moutonnées*, Structural analysis, Western Orobic Alps, Glacial morphology.

**RIASSUNTO:** GHISELLI A., BINI A. & ZUCALI M., *Analisi strutturale di rocce montonate nelle Alpi Orobiche Occidentali (Lombardia).* (IT ISSN 1724-4757, 2005).

Nelle Alpi Orobiche Occidentali sono state studiate le caratteristiche strutturali delle rocce montonate affioranti all'interno di quattro circhi, allo scopo di indagare la relazione tra le strutture presenti e le morfologie osservate. L'analisi mesostrutturale dell'area ha permesso di individuare e ordinare cronologicamente sei fasi deformative (tre prealpine e tre alpine) rappresentate da numerose strutture sia di tipo duttile (pieghe e foliazioni) sia fragile (faglie e cataclasiti). L'esame della superficie esposta di ciascun dosso motonato, sulla base di tale modello strutturale, ha messo chiaramente in evidenza la corrispondenza tra i caratteri morfologici e quelli strutturali. I casi studiati dimostrano che le superfici esposte delle rocce mtonate sono, in realtà, superfici strutturali. Perciò sembrerebbe che il loro aspetto mtonato non sia solo di origine glaciale. L'azione dei

ghiacciai potrebbe, quindi, essere limitata alla semplice rimozione della porzione superiore della roccia precedentemente alterata durante i periodi interglaciali.

**TERMINI CHIAVE:** Rocce mtonate, Analisi strutturale, Alpi Orobiche Occidentali, Morfologia glaciale.

### INTRODUCTION

Twelve glacial cirques in the Western Orobic Alps have been studied in order to compare the influence of glacial action and of structural actions control on the present-day morphologies.

A geological, geomorphologic and structural detailed mapping (scale 1:5,000) has been carried out and the structural field data have been elaborated. It is on this structural analysis that the observed shapes have been interpreted both on macro and meso scales.

Particular attention has been paid to the analysis of the *roches moutonnées* surfacing the cirque bottoms and close to their thresholds. Of the twelve cirques under examination only four are characterized by rock knolls that are likely to be defined *roches moutonnées* of glacial origin. These four are discussed in greater detail below.

### GEOGRAPHIC AND GEOLOGICAL SETTING

The area stretches along the main ridge of the Western Orobic Alps, which constitutes the central part of the Southern Alps. The four cirques being analysed develop from 1,800 to 2,350 m a.s.l. and occupy the valley heads of Valle del Salmurano (Circo del Salmurano) on the southern side, Valle del Bitto di Albaredo (Circo di Passo San Marco) and Valle del Bitto di Gerola (Circo del

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